3900 and Infoprint 4000

Theory of Operations

First Edition (December 1999)

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Chapter 1. Overview

Infoprint 4000 and 3900 Wide Advanced Function Printers are:

- All-points-addressable
- Continuous forms
- Host computer system attached via Parallel Channel, ESCON Channel, Token Ring TCP/IP, Ethernet TCP/IP or FDDI TCP/IP features
- nonimpact

These printers are available in two types: a simplex printer system (one printer engine and one host-system-attached control unit) and a duplex printing system (two printer engines each attached to a cross-coupled control unit, one of which is host-system-attached).

The Infoprint 4000 and 3900 Wide Advanced Function Printers print only on continuous forms. The print line is 8 to 17 inches on forms 9 to 18 inches wide. The print line is 11 to 17 inches on forms 12 inches to 18 inches wide.

The stacker can stack forms that are 7 to 14 inches long. The printer can print on forms longer than 14 inches, such as A3 size forms, but a postprocessor is required for longer forms. The printer uses forms in the ranges shown in Table 2 on page 14 and also can print on many special-purpose materials, such as preprinted forms and adhesive labels.

Printer Speed

Supply Yields Affected by Printer Speed

Two printer supplies are affected by printer speed: Developer Mix and the Oiler Belt

Developer Mix: The Developer Mix reference settings stored in the printer's memory translate to:
- 1.2 Mft. at 310 ppm and 324 ppm
- 1.4 Mft. at 229 ppm
- 1.0 Mft. at 150 ppm

Whether a printer is running at 324, 310, 229, or 150 ppm, when the Developer Mix threshold is reached, the code will display the **Change Developer Mix** message and remember that this limit has been reached. The code will then only allow 50,000 additional feet of forms to be processed, before **requiring** the Developer Mix to be changed.

If the printer has the 229 ppm Feature (DW1/DW2 Only) installed, a speed-select switch integral within this feature allows the customer to select either 150 ppm or 229 ppm operating speed in either duplex or dual-simplex modes. The customer may be required to change the Developer Mix immediately if the speed is changed. For example, the printer is running at 229 ppm and then changed to 150 ppm. If more than 1.0 Mft. of forms have been processed when the speed is changed, the customer is required to change the Developer Mix immediately because the 150 ppm limit of 1.0 Mft. has been exceeded.

Oiler Belt: The Oiler Belt reference settings that are stored in the printer memory addresses translate to:
- 1.7 Mft. at 310 ppm and 324 ppm
- 1.5 Mft. at 229 ppm
- 1.3 Mft. at 150 ppm

Whether a printer is running at 324, 310, 229, or 150 ppm, when the Oiler Belt reference setting is reached, the code will display the **Change Oiler Belt** message and remember that this limit has been reached. The code will then only allow 10,000 additional feet of forms to be processed, before **requiring** the Oiler Belt to be changed.

Other Printer Elements Affected by Printer Speed

The mag brush bias and the drum surface voltage are controlled to different values depending on the printer speed. In addition, some components change speeds when printing at the different speeds. See Table 1

Table 1. Component Speeds in Revolutions-Per-Minute (RPM)

Component	RPM at 150 ppm	RPM at 229 ppm	RPM at 310 ppm	RPM at 324 ppm
Drum Motor	639	975	1320	1380
Paper Feed Motor	639	975	1320	1380
Hot Roll Motor	639	975	1320	1380

Speed-Select Switch

A Speed-Select Switch is available only as part of the 229 ppm Feature (DW1/DW2 Only).

With the 229 ppm Feature installed, the customer has the choice of running at either 150 ppm or 229 ppm in both duplex and dual-simplex.

Each duplex printing system control unit has a Speed-Select Switch mounted on the pre/postprocessor tailgate.

Attention: The printer must be properly shutdown and powered off before the position of the switch is changed

After the printer speed is changed, the prints may be darker or lighter than prints at the previous speed. This condition is normal. Prints may become lighter during the first 20 minutes of printing at the new speed while the toner concentration is stabilizing.

After the printer speed is changed from 229 ppm to 150 ppm and the printer is powered back on, the preheat platen on DW2 will need to cool down from 100°C to 45°C. The message will read “Fuser Warming” during this cool down time which may last up to 30 minutes.

The following table summarizes printer specifications:

Table 2. Infoprint 4000 and 3900 Printer Specification Summary

Model	Mode	Resolution (PEL)	Print Speed (IPM)	Basic Paper Weights		Forms Width		Forms Length Stacking	
				gm/m^2	lbs.	Min. mm (in.)	Max. mm (in.)	Min. mm (in.)	Max. mm (in.)
OW1	Simplex	240	229/354[1]	60-160	16-42	229 (9)	457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)
OW1 w/310 IPM Feature	Simplex	240	310/480[1]	60-105	16-28	229 (9)	457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)
OW3	Simplex	240	150/232[1]	60-160	16-42	229 (9)	457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)
D01/D02[2]	Duplex[6] Dual Simplex[7] Dual Simplex[8]	240 240 240	300/464[1] 150 232	68-105 60-160 60-160	18-28[10] 16-42 16-42	229 (9) 165 (6.5) 165 (6.5)	406 (16) 406 (16) 406 (16)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)
D01/D02[3]	Duplex[6] Dual Simplex[7] Dual Simplex[8]	240 240 240	300/464[1] 229 354	68-105 60-160 60-160	18-28[10] 16-42 16-42	229 (9) 165 (6.5) 165 (6.5)	406 (16) 406 (16) 406 (16)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)
DW1/DW2[4]	Duplex[6] Dual Simplex[7] Dual Simplex[8]	240 240 240	300/464[1] 150 232	68-105 60-160 60-160	18-28[10] 16-42 16-42	305 (12) 229 (9) 229 (12)	457 (18) 457 (18) 457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)
DW1/DW2[5]	Duplex[6] Dual Simplex[7] Dual Simplex[8]	240 240 240	458/708[1] 229 354	68-105 60-160 60-160	18-28[10] 16-42 16-42	305 (12) 229 (9)[9] 229 (12)[9]	457 (18) 457 (18) 457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)
DR1/DR2	Duplex[6]	600	300/464[1]	68-105	18-28	305 (12)	457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)[11]

Table 2. Infoprint 4000 and 3900 Printer Specification Summary (continued)

Model	Mode	Resolution (PEL)	Print Speed (IPM)	Basic Paper Weights		Forms Width		Forms Length Stacking	
				gm/m^2	lbs.	Min. mm (in.)	Max. mm (in.)	Min. mm (in.)	Max. mm (in.)
IS1	Simplex	240/300	229/354[1]	60-160	16-42	204 (8)	457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)[11]
IS2	Simplex	240	310/480[1]	60-105	16-28[10]	204 (8)	457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)[11]
IS2 with Feature 9324	Simplex	240/300	325/501[1]	60-105	16-28[10]	204 (8)	457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)[11]
ID1/ID2	Duplex[6] Dual Simplex[7]	240/300 240/300	458/708[1] 229/354[1]	68-105 60-160	18-28[10] 16-42	229 (9) 204 (8)	457 (18) 457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)[11]
ID3/ID4	Duplex[6] Dual Simplex[7]	240/300 240/300	648/1002[1] 324/501[1]	68-105 60-160	18-28[10] 16-42	229 (9) 204 (8)	457 (18) 457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)[11]
IR1/IR2	Duplex[6] Dual Simplex[7]	480/600 480/600	300/464[1] 150/232[1]	68-105 60-160	18-28 16-42	305 (12) 305 (12)	457 (18) 457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)[11]
IR3/IR4	Duplex[6] Dual Simplex[7]	480/600 480/600	458/708[1] 229/354[1]	60-105 60-105	16-28 16-28	305 (12) 305 (12)	457 (18) 457 (18)	76.2±0.3 (3.0±0.013)	356±0.3 (14.0±0.013)[11]

Notes:

1. Print Speed stated in 1–up mode/2–up mode. (See notes 7 and 8 for more information.)
2. Without Dual Simplex Speed Switch feature or with feature set at 150 IPM.
3. With Dual Simplex Speed Switch feature set to 229 IPM.
4. Without High Speed (458 IPM) Duplex feature or with feature set at 150 IPM.

5. With 458 IPM Duplex feature set at 229 IPM.
6. The Print speed for Duplex is the total system speed (2 printers). The Print speed for dual simplex lists individual printer speed (either Printer 1 or Printer 2).
7. 1–up mode (assuming an 8.5 inch length page, measured in the forms process direction).
8. 2–up mode (assuming an 11 inch length page, measured in the forms process direction).
9. When using the High Speed (458 IPM) feature in simplex DW1 forms width is 229 (9) to 457 (18) and DW2 forms width is 305 (12) to 457 (18).
10. The maximum paper weight for duplex printers running in simplex mode should be 105 g/m^2 (28 lb) on Printer 2 and 160 g/m^2 (42 lb) on Printer 1.
11. Maximum form length is 635 ± 0.3 mm (25 ± 0.013 in.) or by enabling RPQ on Operator Console it is 711 ± 0.3 mm (28 ± 0.013 in.) when used with preprocessing and postprocessing devices.

Electrophotography

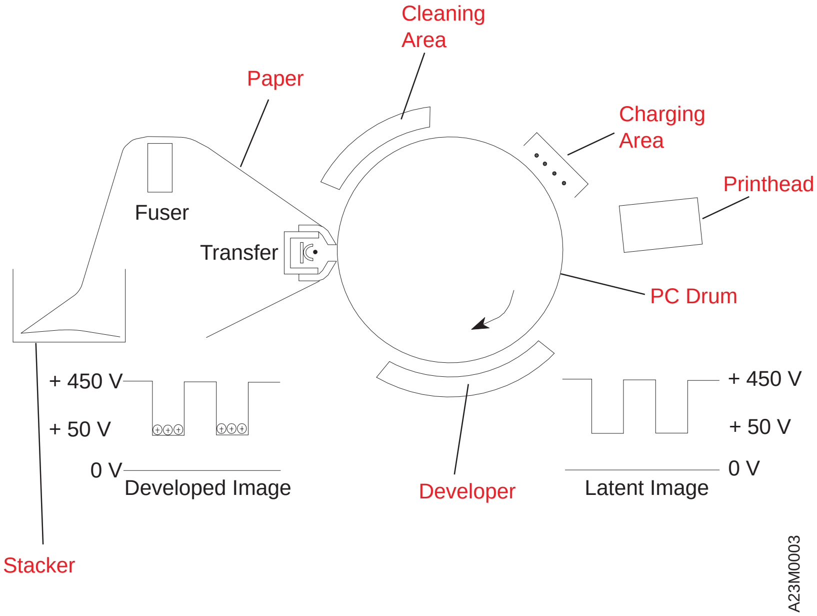


Figure 1. Principles of Electrophotographic Process

The principle of electrophotographic (EP) printing is shown in Figure 1. The electrophotographic print process requires six basic steps:

1. Charging

High-voltage is supplied to the charging area to provide an even, positive electrostatic charge on the surface of the photoconductor drum. The coating on the surface of the drum is a photoconductor (PC). The charge ranges between 480 and 800 volts, as required by the usage of the developer mix and the desired contrast.

2. Exposing

The printhead exposes the PC drum to light in the areas in which printing is desired. The printhead produces the light as pulses to form exposed areas on the PC. The length of the pulses (the time the light is on) is determined by the number of consecutive picture elements that must be printed.

At each point where the light from the print head strikes the PC surface, the electrostatic charge on the PC discharges, and a latent electrostatic image forms, such as light produces a latent image on photographic film. The voltage at each of the exposed areas in the latent image is discharged to about 50 Volts.

3. Developing

As the drum rotates, it passes the developer mechanism, which deposits toner on the areas of the PC that have been exposed to light.

Developer mix is brought into contact with the PC by a rotating magnetic roller called a mag brush. Positively charged toner is attracted to the sections of the PC that are discharged during the exposure process. The latent electrostatic image becomes visible on the PC and is called the developed image.

4. Transferring

At the transfer station, a high voltage transfers the toner to the paper.

The transfer station places a negative charge on the back of the forms. The positively charged toner transfers from the PC to the forms.

5. Fusing

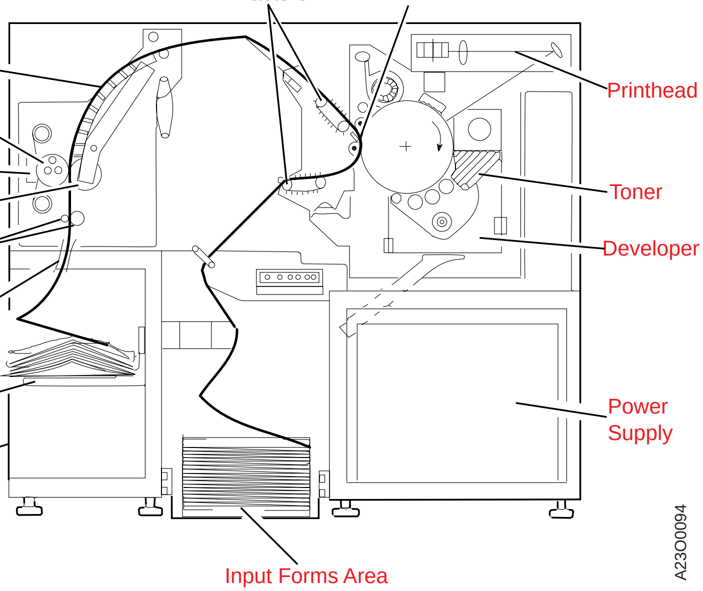
After the toner transfers to the paper, the paper goes to the fuser. The fuser preheats the paper, then applies heat and pressure to melt the toner and press it into the fibers of the paper. After the toner is fused to the paper, the paper is directed into a stacker to be stacked.

6. Cleaning

About 80% of the toner in the developed image is transferred to the paper. The rest remains on the PC drum. The drum passes under the cleaning area. The charge on the untransferred toner is neutralized by alternating current (ac) voltage. The toner is mechanically removed from the drum by a cleaner brush. An erase lamp before the cleaner station discharges the PC to a uniform condition.

Forms Drive

Table 3. Elements in the Forms Path



The forms are lifted and driven through the transfer station by the tractors.

During the transfer operation, the retractors **(9)** and **(10)** see Table 37 on page 133 are extended so that the forms come in contact with the toner on the PC drum . The tension arm applies tension to the forms between the tractors and the fuser.

The forms travel over the preheat platen and into the fuser. The hot roll is driven and pulls the forms coming from the upper tractors.

During the fusing process, the backup roll is lifted against the hot roll on the steering arms. The forms are steered by changing the pressure at either end of the backup roll through the steering arms.

The scuff rolls feed the forms to the stacker and pull the forms when the backup roll is unloaded.

The pendulum in the upper part of the stacker refolds the fused forms. The stacker table slowly lowers during printing to keep the top of the stack in the same place.

Page Synchronization and Customer Billing

Page synchronization in a duplex printing system is kept by printing exactly a known number of print cycles. To achieve this, many “nonprint” operations are performed by actually printing blank pages. This causes the billing meters of both machines to be incremented. Any NPRO, thread, or single-form advance operation causes the billing meters of both machines to run. This is true only while the machine is in duplex mode.

In operation of the Infoprint 4000 or the 3900, during non-printing operations the retractors move the forms away from the PC drum, and the billing meter is not incremented.

When the printer is in simplex mode, the billing meter increments only when the printer is actually printing. It does not increment during NPRO or forms-advance operations.

The form advance push-buttons on the printer control panel do not cause billing meters to increment. If they are pressed after the duplex printing system has been threaded, page synchronization may be lost.

The operator can check page synchronization by printing verification marks on the carrier strip on both sides of the forms. The marks include a number that the operator can read. If the number printed on side 1 matches the number printed on side 2, page synchronization is correct. Printing of these verification marks can be set off or on in **Configure Printer**.

Side 1/Side 2 Verification

The verification system is designed to verify the proper alignment and synchronization of Side 1 and Side 2 of a document as it is printed on the Infoprint 4000 or 3900 duplex printing system. The verification system will determine if the pages printed on Printer 1 and Printer 2 are out of synchronization by 4.2 mm (1/6 inch) or more for several prints. If the Side 1/Side 2 Verification fails, an error code is displayed.

The verification system consists of both hardware and microcode. Verification marks are printed on the front edge of the forms on both Side 1 and Side 2. An optical sensor on the verification sensor card, located in Printer 2, reads the marks that were printed on Printer 1. Data is sent to the MIC via the Side 1/Side 2 Verification Control Card.

The verification system must be enabled before it will operate. Functional microcode v8.4 and higher posts an error message whenever this function is initially disabled and at every power-on with Side 2 Verify disabled..

Side2Verify appears in the detailed status pop-up window of the printer status screen, and □1 = □2 is displayed on the Operator Panel, located on the left front side of the printer, when the Side 1/Side 2 Verification function is enabled.

Under Functional microcode v8.2 and higher, the verification page numbers may be printed on the front and back of forms by setting the **Verification marks** option to **Yes**. This option is located under the **Configure\Configure Printer...** menus, and is operable even when the Side 1/Side 2 Verification hardware is not installed or is not enabled. When the Side 2 Verify is enabled, however, the verification page numbers and marks are always printed, regardless of the setting of the **Verification marks** option.

Because the location of the marks is checked, the registration in both the scan and process directions must be accurate. See “Registration” under the Printhead section of *CARR*.

Printing Process

The RS/6000 controller communicates with the attached host to receive the data, fonts, images, and overlays needed for printing. Internally, the controller uses memory (DRAM) and the SCSI internal disk drive to hold information in buffers. All incoming information is stored temporarily in buffers.

The RS/6000 controller reads information from the input buffer to generate raster pages of each complete page to be printed. The raster pages are stored in the output buffer until they are printed. The amount of memory allocated to the input and output buffers may be configured to achieve optimum performance (continuous running of customer jobs).

Pages with very high print coverage may need more space in the output buffer. Configuring buffer sizes for “HIGH” usage will use more of the RS/6000 memory, and could adversely affect performance of the system. Adding additional memory features to the RS/6000 controller causes buffers to increase in size, but without having to reallocate memory from other areas in the RS/6000 controller.

As pages are placed in the output buffer, the RS/6000 controller communicates to the Mechanism Interface Card (MIC) to activate the printer. The controller sends complete pages from the output buffer to the MIC to be printed. While the controller is sending pages from the output buffer, it continues to receive information from the host and build more pages for placement in the output buffer. If the output buffer runs out of pages or is not large enough, the controller communicates with the MIC to stop printing until more pages or memory become available.

To print:

- The controller is placed on-line to the host and is made ready.
- The host sends the information necessary to print to the RS/6000 controller.
- The information is used to construct a complete raster page to be printed, which is then placed in the output buffer.
- The controller signals the MIC to activate the printer.
- The MIC issues the ACTIVATE command to the printer to start the PC drum turning. After about 5 to 10 seconds, the printer is ready to print (if the fuser is warm).
- The controller then begins to transfer raster page data to the MIC. The control unit receives a signal from the printhead when the beam-detect card detects the beam and interprets the beginning of the scan.
- The MIC distributes the page data scan line data for each beam of the printhead, and passes the data into the Print Quality Enhancement (PQE) Card.
- To begin printing at the top of the page, the MIC issues the PAPER FEED command to the printer in synchronization with the first CVD signal to modulate the laser beam. The synchronization time is adjusted via the process and scan factory adjust settings in Configure Printer.
- As the page image that is generated by the CVD signal approaches the transfer station, the printer begins to move the form and retractors move the paper into contact with the PC drum. By the time the first print position on the drum has reached the transfer position, the forms are up to speed and the transfer corona is powered to transfer the image to the forms. The backup roll closes to pull the forms and cause fusing.
- The process of sending pels to the printhead and transferring the image, and fusing the image continues as long as the control unit can process the print data in time to send it to the printer. If the control unit cannot complete processing a page before the forms will pass the transfer unit, it drops the PAPER FEED command until the image is ready to transfer.
- The forms continue to move without stopping as long as the controller continues to send raster pages to the MIC.
- When no more data is available for printing, the MIC drops the PAPER FEED command and stops raster page transfer to the printhead.

Chapter 2. Control Unit

Controller

The controller, or Advanced Function Common Control Unit (AFCCU), is located in the host-system-attached control unit. It is an IBM RS/6000 POWERstation computer, and is either a Type 7012 Model 370, Type 7012 Model 390, Type 7009 Model C10, Type 7009 Mode C20, Type 7013 Model 591, Type 7013 Model 595, Type 7025 Model F50, or Type 7043 Model 43P-140.

7012 - 370 Unique Components

The Model 370 uses a 62.5 MHz microprocessor chip set and has standard 32MB of random access memory (RAM) when used in a Wide Simplex Printer or 64MB of RAM when used in a Wide Duplex Printer System. A memory upgrade can add 32MB or 64MB of RAM to a simplex printer or 64MB of RAM to a duplex printing system.

The 7012-370 has a 1.44MB internal diskette drive and a 540MB internal disk drive. It also has an integrated Ethernet interface adaptor that can be used for thick/thin or twisted pair network connections.

Four Micro Channel card slots are available on the 7012–370:

- Slot 1 – SCSI I/O card
- Slot 2 – Second host attachment card, if required
- Slot 3 – Display Card
- Slot 4 – First host attachment card

7012 - 390 Unique Components

The Model 390 uses a 67 MHz microprocessor chip set and has standard 32MB of random access memory (RAM) when used in a Wide Simplex Printer or 64MB of RAM when used in a Wide Duplex Printer System. A memory upgrade can add 32MB or 64MB of RAM to a simplex printer or 64MB of RAM to a duplex printing system.

The 7012-390 has a 1.44MB internal diskette drive and a 600MB internal CD-ROM drive, and a 1GB internal disk drive. It also has an integrated Ethernet interface adaptor that can be used for thick/thin or twisted pair network connections.

Four Micro Channel card slots are available on the 7012–390:
- Slot 1 – SCSI I/O card
- Slot 2 – Second host attachment card, if required
- Slot 3 – Display Card
- Slot 4 – First host attachment card

7009 - C10 and C20 Unique Components

The Model C10 uses an 80 MHz PowerPC 601 microprocessor and the C20 uses a 120 MHz PowerPC 604 microprocessor. Both models have 32MB of random access memory (RAM) (64MB RAM for IS1/IS2) as standard when used in a Wide Simplex Printer or 64MB of RAM (128MB RAM for ID1/ID2) when used in a Wide Duplex Printing System. A memory upgrade can add 32MB or 64MB or RAM to a simplex printer or 64MB of RAM to a duplex printing system (64 or 128MB option for ID1/ID2.)

The 7009-C10 and C20 have a 2.88 MB internal diskette drive, a 600MB internal CD-ROM drive, and a 1GB internal disk drive.

Four Micro Channel card slots are available on the 7009–C10 & C20:
- Slot 1 – SCSI I/O card
- Slot 2 – Second host attachment card, if required
- Slot 3 – Display Card
- Slot 4 – First host attachment card

7013 - 591 Unique Components

The Model 591 uses a 77 MHz microprocessor chip set and has 256 MB of random access memory (RAM) as standard when used in a Wide Duplex Printer.

The 7013-591 has a 1.44MB 3.5 inch internal diskette drive, four 2.2 GB internal disk drives, and a 4X, 680 MB internal CD-ROM drive.

Eight Micro Channel card slots are available on the 7013–591:
- Slot 1 – Not used
- Slot 2 – Not used
- Slot 3 – Not used
- Slot 4 – Not used
- Slot 5 – Token Ring
- Slot 6 – SCSI Adapter
- Slot 7 – Display card
- Slot 8 – SCSI Adapter

7013 - 595 Unique Components

The Model 595 uses a 133 MHz microprocessor chip set and has 128MB of random access memory (RAM) as standard when used in a Wide Duplex Printer.

The 7013-595 has a 1.44MB 3.5 inch internal diskette drive, one 2.2 GB internal disk drive, and an 8X, 680 MB internal CD-ROM drive.

Eight Micro Channel card slots are available on the 7013–595:

- Slot 1/1 – Not used
- Slot 1/2 – Not used
- Slot 1/3 – Not used
- Slot 1/4 – SCSI Adapter
- Slot 0/1 – SCSI Adapter
- Slot 0/2 – Host attachment card
- Slot 0/3 – Display card
- Slot 0/4 – Host attachment card

7025 - F50 Unique Components for IR1/IR2

The Model F50 uses a 77 MHz microprocessor chip set and has 256MB of random access memory (RAM) as standard when used in a Wide Duplex Printer.

The 7025-F50 has a 1.44MB 3.5 inch internal diskette drive, four 3.5GB internal disk drives, and an 8X, 680MB internal CD-ROM drive.

Nine PCI card slots are available on the 7025-F50:

- Slot 1 – SCSI Adapter (IR1/IR2)
- Slot 2 – Not used (IR1/IR2)
- Slot 3 – Display Card
- Slot 4 – Not used
- Slot 5 – Not used
- Slot 6 – First host attachment card
- Slot 7 – Not used
- Slot 8 – Second host attachment card (if required)
- Slot 9 – SCSI Adapter (IR1/IR2)

7025 - F50 Unique Components for IR3/IR4

The Model F50 uses a 332 MHz microprocessor chip set and has 1MB of random access memory (RAM) as standard.

The 7025-F50 has a 1.44MB 3.5 inch internal diskette drive, one 3.5GB internal SCSI disk drive, four 4.5GB internal SCSI SSA disk drives, and an 8X, internal CD-ROM drive.

Nine PCI card slots are available on the 7025-F50:

- Slot 1 – SSA Adapter (IR3/IR4)
- Slot 2 – Not used
- Slot 3 – Display Card
- Slot 4 – SSA Adapter (IR3/IR4)
- Slot 5 – Not used
- Slot 6 – First host attachment card
- Slot 7 – Not used
- Slot 8 – Second host attachment card (if required)
- Slot 9 – SSA Adapter (IR3/IR4)

7043 43P–140 Unique Components

The Model 43P-140 uses a 233 MHz microprocessor chip and has 128 MB of random access memory (RAM) as standard.

The 7043 43P-140 has a 1.44MB 3.5 inch internal diskette drive, a 4.5 GB internal SCSI disk drive, and a 12X – 20X internal CD-ROM drive.

Five PCI card slots are available on the 7043 43P-140:

- Slot 1 – Display Card
- Slot 2 – Second host attachment card (if required)
- Slot 3 – SCSI Adapter
- Slot 4 – First host attachment card
- Slot 5 – Not used

Components Common to All RS/6000 Models

The internal disk drive is loaded with AIX (Version 3.2.5, 4.1, 4.2, or higher) and a compatible set of printer control microcode.

With the appropriate host attachment card, the RS/6000 controller can support Parallel channel, ESCON channel, Token-Ring, Ethernet, and FDDI attachments.

The RS/6000 includes an integrated Ethernet interface adapter that can be used for thick/thin coax or twisted pair network connections.

Extra memory is required for complex applications. Complex applications may print several combinations of fonts, images, page segments, or overlays on each page. The RS/6000 controller must have enough storage available to accommodate all the fonts and images appearing on a page.

After power on, the RS/6000 controller automatically runs self-diagnostic tests before the AIX operating system is loaded. (These tests also run when the RS/6000 controller is reset via a Restart procedure).

The first test to run is the built-in self-test (BIST) programs. These programs test the 32-bit processor and memory addressing.

Next, the power-on self-test (POST) programs load from read-only memory (ROM) and check the devices needed to accomplish an initial program load (IPL). The POST programs also check the memory, the common interrupt handler, and the direct memory access (DMA) handler.

Following the POST programs, the configuration program determines what features, cards, and devices are on the system. It also builds a configuration list that is used by the diagnostic programs to control which tests are run during system checkout.

Note: The 7013–591 RS/6000 controller does not support Parallel Channel or ESCON Channel.

Note: On the 7012–370 and 7012–390, Ethernet uses an integrated interface card, not one of the four Micro Channel card slots.

Display/Touch Screen

The Display/Touch Screen is an IBM Color Display. It operates as a normal display when it is not being used with touch-screen applications.

The display receives video signals from the display card in the controller (slot 3) via a 15-pin D-shell connector cable. The display card addresses 1024 pixels x 768 pixels.

Image size, shape, position, color, and brightness can be adjusted with front-mounted digital controls. Operator settings can be stored, or factory settings can be used.

The capacitive interactive touch screen is factory installed and fully integrated. Touch-screen signals are sent from the Display/Touch Screen to Serial Port 2 of the controller via a 9-pin RS232 connector cable.

Mechanism Interface Card (MIC)

The mechanism interface card (MIC) is the hardware that connects the controller to the printer. The MIC is attached via a small computer system interface (SCSI) or a Serial Storage Architecture (SSA) interface to the controller. All commands and data for the printer must come through this interface.

The MIC provides the data and control lines required by the printer. The interface is specific to the printer, and may vary from one printer model to another. Figure 2 shows the relationship between the MIC and the rest of a simplex printer system.

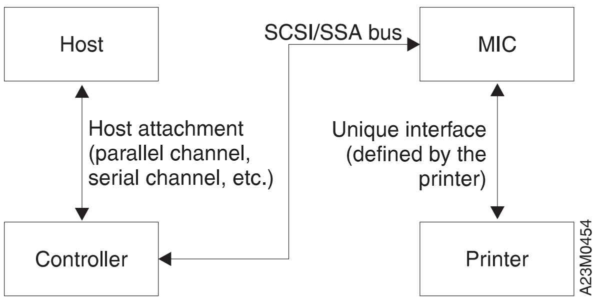


Figure 2. System Block Diagram - Simplex Printer System

More than one MIC may be on the SCSI/SSA buss. If so, each MIC must have a different address to allow the controller to communicate individually with each printer.

MIC Hardware

Intel 80960 Processor

The MIC card is controlled by an Intel 80960 (i960) processor. This processor incorporates many aspects of RS/6000 technology. It is a 32-bit processor, capable of addressing up to 4GB of memory.

EPROM/FLASH

The MIC uses EPROM or FLASH to hold the start-up program. The actual run-time program is downloaded from the controller. The EPROM/FLASH program runs power-on diagnostics on the card and download path, then waits for a command to download the run-time program into the DRAM.

The routines to handle catastrophic errors also reside in EPROM/FLASH. This kind of error is so severe that data cannot be sent to the Display/Touch Screen using the SCSI path, so it must be shown on the 7-segment LED display. During normal operation, the EPROM/FLASH program should never be referenced.

Note: Older models use EPROM; newer models use FLASH.

SCSI/SSA Controller

SCSI communication is handled by a controller chip. This 720 chip is an intelligent, high performance, programmable controller.

Note: Older models use SCSI; newer models use SSA.

DRAM

Dynamic RAM is provided by the MIC. This memory is used for:

- Program memory for the i960 processor
- Program memory to hold instructions for the SCSI/SSA processor
- Memory buffers for data received from the SCSI/SSA path.

7-Segment LED Display

A single digit 7-segment display is provided on the MIC for error and status reporting. This display is used to convey the results of diagnostic and program check errors if the communication path through the SCSI/SSA to the controller has been compromised. This display is also used to show printer status and status during phase transitions and download diagnostics.

Other MIC LED Displays

Other MIC LED status indicators:

- 0 – Printing
- 2 – Normal (Ready to print)
- 3 – Engine cycling up, or out of supplies condition
- 6 – Waiting for fuser temperature
- 8 – SCSI/SSA hang
- 9 – Memory test failure
- = – Waiting for RS/6000 memory download (may indicate time-out)
- L – SSA Link(s) are not on-line between MIC and RS/6000 controller

Start-up

The MIC is designed so that its normal operating program is downloaded from the controller. Because of this, the MIC does not power up in a “ready to run” state. Following is a description of the MIC function at power-on.

1. Whenever the i960 processor is reset (such as at first power-on), it automatically runs its built-in self test (BIST). If errors are found, the processor asserts an error pin and halts. The error pin is connected to an LED (the decimal point in the 7-segment display) on the MIC.
2. After a successful self-test, the i960 processor loads setup information from memory (EPROM) and verifies the EPROM/FLASH checksum.
3. Next, the DRAM memory is tested, and a few verification checks are performed on the SCSI/SSA chip.
4. All hardware that is needed to download programs is initialized, and a Reset_State status message is sent to the controller, which indicates that the MIC is in the reset state (with no errors).
5. The MIC waits to receive the run-time program from the controller. The controller may send programs to run more diagnostics or to run the printer.

Error Reporting

MIC errors can be grouped into hardware and software categories; each of these is subdivided into various types. The MIC has three means of reporting errors:

- The decimal point in the 7-segment display is used solely to report that the i960 processor failed its built-in self-test. (There is no microcode involvement in this test; it runs automatically at every power-on.)
- The full 7-segment LED display is used to report catastrophic errors. Multiple-digit messages are displayed by presenting each digit sequentially and blanking the display briefly between digits. When the end of a message is reached, there is a long pause, and then the message repeats. This is continued until the next power-on.
- Less severe errors are transmitted in a status message through the SCSI/SSA to the controller, where they are logged and handled like other controller errors.

Host System Attachment Options

Parallel Channel Attachment

The parallel channel attachment is a customer-selected feature on an Infoprint 4000 or 3900 Wide Advanced Function Printer.

The printer is connected to a S/370 or S/390 host channel through the standard I/O interface via the parallel channel adapter (PCA), which is contained in the host-system-attached RS/6000 controller.

The control unit can be attached via a single-byte-wide block multiplex S/370, S/370-XA, ESA/370, or ESA/390 channel, and it can connect up to two channel interfaces. It adheres to IBM specifications S/360 and S/370 I/O Interface Channel to Control Unit OEMI, GA22-6974-10, and ESA/390 Common I/O Device Commands, SA22-7204-1.

The printer can be located at a maximum distance of 122 m (400 ft) from the channel if it is the only control unit on the interface. For each additional control unit (up to a maximum of 8 control units) the distance is reduced by 4.6 m (3.27 ft).

The printer may also be attached to the remote end of an IBM 9034 ESCON converter or IBM 3044-II fiber optic channel extender, which can be used to extend the standard channel interface by up to 3 km.

The 9034 can also be used with the IBM 9032/9033 ESCON director to further extend the interface to a total of 6 km with one director in static connection mode (or 9 km with two directors both in static connection mode).

Another enhancement to the distance is using the extended distance feature (XDF) on the 9032 or 9033. With XDF on one director, the total distance becomes 23 km with an RPQ (with XDF on two directors, the total distance can be a maximum of 32 km with an RPQ). For more information, consult the 9034, 3044, and 9032/9033 product publications.

Also supported is the remote power control facility, which complies with the IBM specification GA22-6906, S/360 and S/370 Power-Control Interface OEMI.

The control unit also supports the remote ENABLE/DISABLE feature.

The data received for printing is in the form of the IPDS, which is described in the *Intelligent Printer Data Stream Reference*, S544-3417.

ESCON Channel Attachment

The ESCON channel attachment is a customer-selected feature on the Infoprint 4000 or 3900 Wide Advanced Function Printer, and is the strategic replacement for the S/370 or S/390 parallel channel. It provides improvements in data rate, physical path length, space requirements, and overall system connectivity. ESCON channels use a fiber optic transmission media, allowing for full duplex communication.

Data is transmitted and received in a serial-by-bit fashion at a raw bit rate of 200Mbps using a light emitting diode driver and pin-diode receiver. Eight-bit bytes are encoded into 10-bit characters resulting in a raw burst rate of 20MB/s.

The attachment is a combination of hardware and microcode; it provides the capability to attach the control unit to 370XA, ESA/370, and ESA/390 ESCON channels. It adheres to IBM specifications ESA/390 ESCON I/O Interface, SA22-7202-2, and the ESA/390 Common I/O Device Commands, SA22-7204-1.

The printer can be located at a maximum distance of 3 km from the channel.

The IBM 9032/9033 ESCON director can be used not only to provide connectivity to additional hosts, but to further extend the interface. The interface is extended to a total distance of 6 km with one director (or 9 km with two directors). Another enhancement to the distance is using the extended distance feature (XDF) on the 9032 or 9033. With XDF on one director, the total distance becomes 23 km (with XDF on two directors, the total distance becomes 43 km). For more information, consult the 9032 and 9033 product publications.

To extend the interface across common carrier fiber optic connections, the IBM 9036 ESCON remote channel extender can be used. One, two, or three 9036 extenders can be used, keeping the total distance under 43 km.

Also supported is dynamic path-finding. This allows the control unit to choose any established path within a path group to reconnect to the system that started the I/O operation. This results in improved throughput and improved availability.

Also supported is the remote power control facility, which complies with the IBM specification GA22-6906, S/360 and S/370 Power Control Interface OEMI.

The data received for printing is in the form of the IPDS, which is described in the *Intelligent Printer Data Stream Reference*, S544-3417.

Token Ring Attachment

The Token Ring attachment is a customer-selected feature on the Infoprint 4000 or 3900 Wide Advanced Function Printer. The attachment connects a host Token Ring through the IBM Token Ring cabling via the Token Ring high-performance adapter installed in the RS/6000 controller.

The controller can be attached to either a 16 mega bits per second (Mbps) or a 4 Mbps Token Ring local area network (LAN).

The attachment adheres to the IBM Token Ring Network OEMI. The following documents together describe the IBM Token Ring Network Other Equipment Manufacture Interface:

- IBM Cabling System Technical Interface Specification, GA27-3773
- IBM Local Area Network Technical Reference, SC30-3383
- IBM Token Ring Area Network Architecture Reference, SC30-3374 (6165877)
- Token Ring Access Method and Physical Layer Specification, IEEE Standard 802.5-1989

The printer may be located at a maximum distance of 100 meters from the 8228 multistation access unit or the 8230 controlled access unit. For more information, consult the 8228 and 8230 Product Publications.

The distance between 8228 multistation access units can be increased with either the 8220 or 8219 optical fiber repeater. For more information, consult the 8220 and 8219 product publications.

The data received for printing is in the form of the IPDS, which is described in the *Intelligent Printer Data Stream Reference*, S544-3417.

Ethernet Attachment

The Ethernet attachment is a customer-selected feature on the Infoprint 4000 or 3900 Wide Advanced Function Printer; it provides an interface from the RS/6000 controller Micro Channel to an Ethernet Local Area Network (LAN) through an Ethernet adapter installed in the RS/6000 controller. The adapter, whether a standard integrated adapter in the 7012, 7025 or 7043 controllers, a plug-in adaptor in a 7009 Micro Channel card slot, or a plug-in adapter in a PCI card slot, is IEEE 802.3 and ISO 8802/3 compatible and attaches to a 10-megabit Carrier Sense Multiple Access with Collision Detection (CSMA/CD) LAN. The micro channel interface is a 32-bit buss master for data. The interface supports data and address parity but does not support streaming data protocol.

The integrated Ethernet adapter in the controllers is composed of several functional blocks. The control module and Ethernet controller reside on the system planar, while the serial and analog portion reside on the riser card.

Ethernet adapter cards that support 10/100 Mb/sec data rates are available to install into the PCI slots in the 7025 and 7043. Installation of this Ethernet card prevents the use of the integrated Ethernet adapter.

The thick/thin adapter card provides a 15-pin DIX connector for the thick function and a BNC connector for the thin function. Both connectors are IEEE 802.3 compatible.

An Ethernet twisted pair can be connected to the thick/thin card by using an external transceiver that is plugged into the DIX connector.

The data received for printing is in the form of the IPDS, which is described in the *Intelligent Printer Data Stream Reference*, S544-3417.

Fiber Distributed Data Interface (FDDI) Attachment

The Fiber Distributed Data Interface (FDDI) is a Local Area Network (LAN) attachment that is a customer-selected feature on some Infoprint 4000 printers. For more information on FDDI attachments, see the *Infoprint 4000 and 3900 Wide Advanced Function Printers Introduction and Planning Guide*, G544–5427.

The attachment connects directly to an RS/6000 processor or to an 8260 Multiprotocol Intelligent Switching Hub that is attached to an RS/6000 processor. The attachment complies with the following:

- Fiber Network Interface specification of ANSI X3T9.5 and X3T9.12
- FDDI Station Management SMT 7.3 from the ANSI X3T9 technical committee.

When using a FDDI attachment, the printer can be located a maximum distance of 2 kilometers from the 8260 Multiprotocol Intelligent Switching Hub or RS/6000 processor using 62.5/125 micron multimode fiber. For more information, refer to the 8260 publications.

The FDDI adapter cable, PN 19G4867 (20 meters in length), is included with the printer. This 62.5/125 multimode fiber cable has a Subscriber Connector (also referred to as an SC connector) on each end. There are similar cables with other part numbers that can be ordered in addition to the one that is shipped with the machine. These cables have lengths of 2, 4, 6, 10 meters, and custom lengths. They can be ordered by calling 1-800-388-7080 (U.S. only) or by using the internet: `http://www.direct.ibm.com/parts`.

Pre/Postprocessing Interfaces

Coupled Interface Signals (4710 interface only)

Table 4 describes the signals used in the pre/postprocessing coupled interface (but not the Advanced Function Postprocessing Interface). The names shown are consistent with those used on the pre/postprocessing interface test card.

Table 4. Coupled Interface Signals

Signal	Description
DEVICE READY (YES position)	Indicates that the device is powered on and ready. The display shows: `Pre/postprocessor Ready`.
DEVICE READY (NO position)	Simulates a jam or hard stop at the device. The display shows: `Pre/postprocessor Stopped`.
S SHEET ADV	Causes the printer to advance one page of forms.
NPRO	Causes the printer to fuse the forms already between the transfer station and the fuser, and feed them into the stacker. The display shows: `Pre/postprocessor NPRO`.
OPER READY	Resets the OPER STOP condition.
OPER STOP	Simulates the action of a stop key on the pre/postprocessor, a soft stop, a recoverable error, or a pause. The display shows: `Pre/postprocessor Operator Stop`.
3835 STOP (0 position)	Simulates the action of a stop key on the pre/postprocessor, a soft stop, a recoverable error, or a pause. The display shows: `Pre/postprocessor Stopped`.
3835 STOP (1 position)	Normal position.
3835 EOF (0 position)	Simulates an end-of-forms signal from the pre/postprocessor. The display shows: `End of Forms`.
3835 EOF (1 position)	Normal position.
6 PPI SYNC	Test point for ac voltage measurement.
OFFSET	Test point for dc voltage measurement.

Table 4. Coupled Interface Signals (continued)

Signal	Description
RUN CFS/BTS	Test point for dc voltage measurement.
GND	Ground point for voltage measurements.
POWER OK	Lights when the interface test card is installed and powered, and checks the voltage regulator on the isolation card.

Intelligent Interface Signals (4720 interface only)

Table 5 describes the signals used in the Advanced Function Postprocessing (Intelligent) Interface.

Table 5. Post Device Isolation Card Signals

Signal	Description
INBOUND	
READY	This signal indicates the ready state of the postprocessor. When it is activated, this signal indicates that all internal conditions for operation are met, and that the postprocessor is ready for operation.
PAUSE	This signal is activated when the postprocessor requires a limited amount of time before starting or continuing an operation. An example is a short delay or interruption that is required to allow the postprocessor to get up to speed or to get ahead. PAUSE can be activated only for conditions that are short term and self-clearing (no operator intervention is required).
STOP	This signal from the postprocessor indicates that any operation in process is to stop and new operations are not to be initiated. When READY is also deactivated, it indicates that an unusual condition exists, such as a paper jam, and operator intervention is required at the postprocessor.
PAPER ADVANCE	This signal is used to move one or more sheets of paper within the printing subsystem. Whenever this signal is activated, the printer advances one sheet of paper. Additional sheets can be advanced by activating this signal again. To execute this function, the printer must be Ready and the postprocessor must be Not Ready.
POSTPROCESSOR COMMUNICATION LINE READY	This signal is used to inform the printer that the postprocessor is ready to receive data.
OUTBOUND	
CYCLE UP	This signal provides a warning in advance of paper motion. It remains activated while paper is moving and when paper motion can resume in a short time.
SENT	This signal indicates that a sheet has been imaged by the printer. It is activated one time for each sheet and is generated whether the sheet has been printed correctly, with an error, or with a blank.

Table 5. Post Device Isolation Card Signals (continued)

Signal	Description
EJECT	This signal indicates that normal processing for this sheet is not to be done, and that the sheet needs to be ejected from the completed job output stack. EJECT is activated for sheets delivered by the printer as a result of an “Eject to Front Facing” IPDS command or a non-process runout (NPRO).
PAPER POSITION PULSE	This signal is generated whenever there is paper motion. The period of this signal represents a fixed distance of paper motion.
PRINTER COMMUNICATION LINE READY	This signal informs the postprocessor that the printer is ready to receive data.
RECEIVE DATA	This signal is used to receive serial data from the postprocessor.
TRANSMIT DATA	This signal is used to transmit serial data to the postprocessor.

Signal Timings

There are no fixed timings between any signals in this interface. However, all postprocessor tag responses to outbound tags must be completed within 1 second.

Power Input/Power Return

The postprocessor must supply power for the interface logic. Because of the potential distances involved, +5 volts cannot be transmitted within tolerance to the interface logic by the postprocessor. Therefore, a voltage regulator on the interface logic board is used to supply power for the interface logic. The postprocessor must supply power for the voltage regulator.

The voltage, as measured at the input to the interface logic board, must be equal to or less than +28 volts and greater than +9.5 volts. There is a POWER INPUT (HIGH) that handles voltages between +28 and +18 volts and a POWER INPUT (LOW) that handles inputs between +18 and +9.5 volts, and a POWER RETURN for each input. The postprocessor may use either POWER INPUT (HIGH) or POWER INPUT (LOW), but not both.

Transmission Protocol

The transmission of information is accomplished using two serial lines: TRANSMIT DATA and RECEIVE DATA.

The basic component of transfer is a byte, with 6 or more bytes composing a frame. Outbound frames are referred to as commands, and inbound frames are called requests.

Power

Electrical voltages in the control unit are controlled by two units:

- AC control box
- Low-voltage dc power supply

AC Control Box

This unit controls power sequencing to the control unit and its attached printer. The ac circuits in the control unit are protected by the main power disconnect switch in the printer.

Low-Voltage DC Power Supply

This unit provides the following dc voltages:

Voltage	Regulation Under Load
+12	+11.7 to +12.5
−12	−12.7 to −11.5
+5	+4.9 to +5.2
−5	−5.3 to −5.0

If the load is removed, the voltage may be slightly higher.

An internal failure or a short circuit in any dc voltage circuit electronically switches off all the dc circuits. Therefore, fuses are not needed in dc circuits.

Unit Emergency Switch

The unit emergency switch has two settings: Power Off and Power Enable.

In the Power Off position, all voltage is removed from the control unit and the printer, except voltages to the ac control box.

In the Power Enable position, secondary voltage is supplied to the power-on switch. However, power is not distributed to the printer until the **Power On** switch is pressed or by the remote power sequencing if in Remote.

Power On Switch

Both the control unit and its attached printer have a Power On switch. Each switch is active only if its associated Local/Remote Switch is set to Local, the Unit Emergency Switch is in the Power Enable position, and the printer circuit breakers (see “Power Switches” on page 172) are ON. With the Control Unit Local/Remote switch set to Local and the associated Printer Local/Remote switch set to Remote, pressing the Control Unit Power On switch supplies line voltages to the transformer and begins the initialization process (see Chapter 3. Initialization and Sequencing).

In duplex printing systems, with the Control Unit Local/Remote switch of Printer 2 set to Local, the Control Unit Local/Remote switch of Printer 1 set to Remote, and both Printer Local/Remote switches set to Remote, pressing the Control Unit Power On switch of Printer 2, powers on the entire printing system.

Power Off Switch

Both the control unit and its attached printer have a **Power Off If In Local** switch. Each switch is active only if its associated Local/Remote Switch is set to Local.

With the Control Unit Local/Remote switch set to Local and the associated Printer Local/Remote switch set to Remote, pressing the Control Unit **Power Off If In Local** switch removes all dc voltages from the printer (except 24 V dc to the Printer Power On switch) and removes ac voltages from the transformer. All power is removed from the printer except the 3-phase input power to the primary connectors, line noise filter, and circuit breakers in the printer ac control box.

Operator Alert Assembly

The operator alert assembly, located on top of the control unit, alerts the operator when an intervention has occurred. It does this with a light (flashing or always on) and an alarm with adjustable volume. If the customer prefers that printer-attention-alerts be relayed to a remote operator's terminal, contacts are provided to connect to an external device.

Note: The customer is responsible for supplying power to run any external device used.

Operator Panel

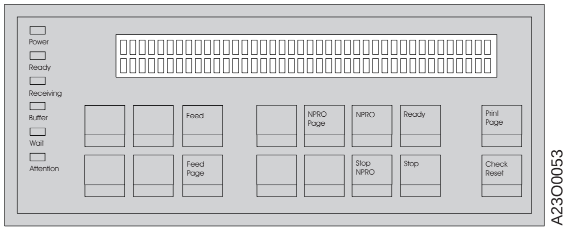


Figure 3. Operator Panel

The operator panel is on the left front cover of the printer where it serves as an auxiliary control unit to perform some printer tasks more conveniently than from the display/touch screen.

The panel also has a liquid crystal display (LCD) to provide status information, error conditions, and other messages in readable form rather than coded form. The LCD displays alphabetic characters in the language in which the printer is set, numeric characters, and special characters as required.

Chapter 3. Initialization and Sequencing

In the course of transferring information to paper, there are numerous steps. Some of the actions are determined by the control unit and some by the printer.

Printer – Control Unit Interaction

Printer Functions

- Manage all temperatures, processes, speeds, supplies levels, and errors
- Report readiness, heating (waiting), error status, and memory contents.

Printer States

The printer can be put into any of the following states by the control unit:

- PRINT – Ready or actively printing
- COOL – Heating the hot roll or preheat platens
- WAIT – Intervention condition present
- DORMANT – Inactive between print jobs

  The drum is stopped and the fuser is hot.
- FUSER OFF – Inactive during long periods between print jobs

  The drum is stopped and the fuser is cool.

Control Unit Functions

- Build page images from the channel data and serialize them for the printhead
- Read, display, and log errors from itself or the printer
- Control the state of the printer (but not the status of any individual motor, switch, or lamp).

Control Unit Commands

The control unit issues the following commands to the printer:

- ACTIVATE – Prepare for printing
- DORMANT – Go to the DORMANT state
- PAPER FEED – Move the forms with full process on
- NPRO – Move the forms without printing them
- CHECK RESET – Clear any error or intervention
- REQUEST – Send status or memory contents
- FUSER OFF – Go to the FUSER OFF state.

Initialization

Initialization occurs when power is turned on to the printer. Initialization prepares the printer to receive data from the host and print it on forms. Initialization occurs in two stages: **power sequencing** and **printer sequencing.**

Power Sequencing

Before power is applied to the system, the printer switches should be in the following positions:

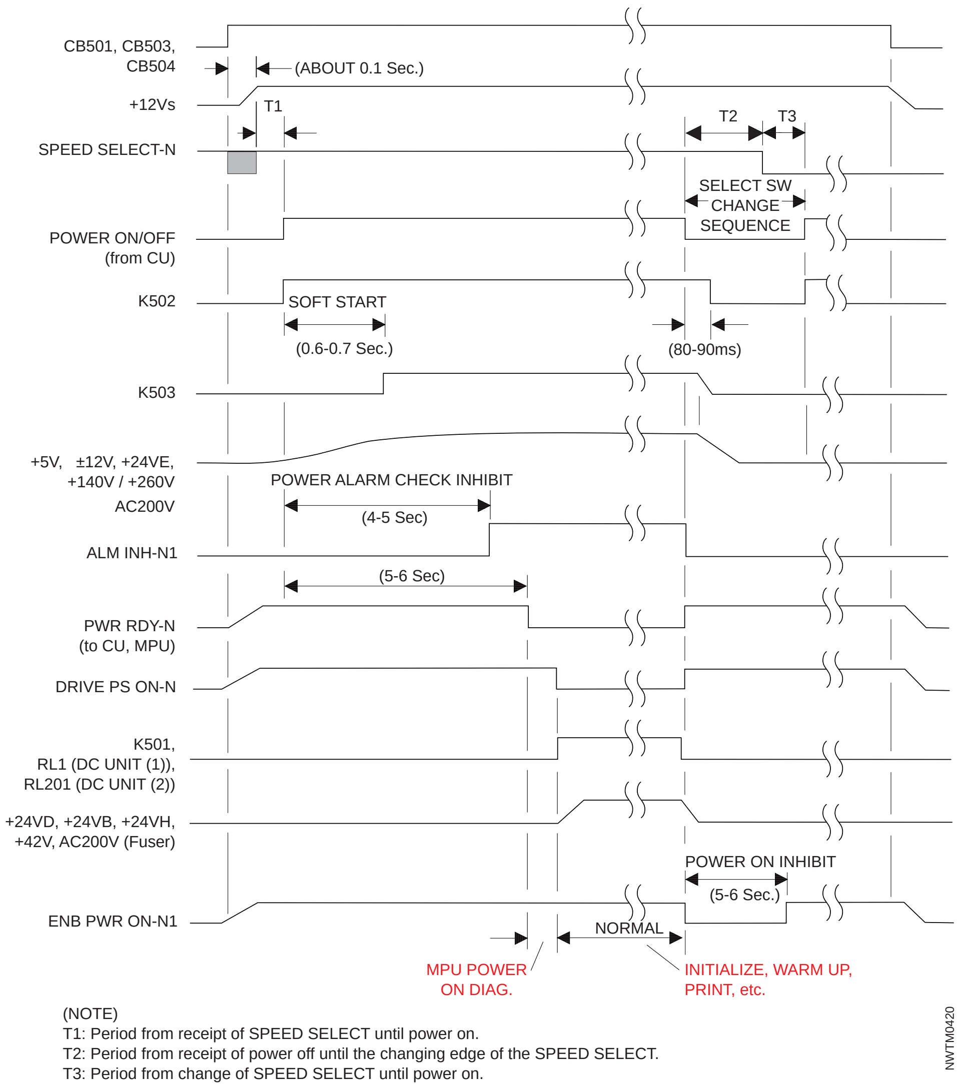
Table 6. Switch Positions For The Simplex Printer

Switch Name	Set To
CB501, CB503, CB504	ON
Control unit CP1	ON
Unit Emergency	1
CU Local/Remote	Local
Printer Local/Remote	Remote
CU Service Disconnect	Normal
Printer Service Disconnect	Normal
RS/6000 controller power switch	ON
Display/Touch Screen power switch	ON

Table 7. Switch Positions for a Duplex System

Switch Name	Printer	Set To
CB501, CB503, CB504	1	ON
Control unit CP1	1	ON
Unit Emergency	1	1
CU Local/Remote	1	Remote
Printer Local/Remote	1	Remote
CU Service Disconnect	1	Normal
Printer Service Disconnect	1	Normal
CB501, CB503, CB504	2	ON
Control unit CP2	2	ON
Unit Emergency	2	1
CU Local/Remote	2	Local
Printer Local/Remote	2	Remote
CU Service Disconnect	2	Normal
Printer Service Disconnect	2	Normal
RS/6000 controller power switch	1	ON
Display/Touch Screen power switch	1	ON

Table 8. Printer Power Sequencing Timing Chart



When the printer power-on switch is pressed, the following occurs:

1. AC voltage comes into the printer primary connectors, line noise filter, and CB501. When CB501, CB503, and CB504 are ON, voltage is supplied to transformer T503.
2. The secondary of T503 supplies 18 V ac to the SQ081/SQ082 card where 12 V dc (12VS) is generated and where the AC IN LED indicator is lighted. This indicates that ac voltage is being supplied to the printer.
3. With CB501 and CB503 ON, ac voltage is always present in the control unit. This voltage goes to the ac control box where 24 V dc is generated for use in power sequencing. The 24 V dc goes to the power-on switch located on the control unit power panel.

Infoprint 4000 and 3900 Wide Advanced Function Printers Control Unit

The RS/6000 controller for the Infoprint 4000 and 3900 Wide Advanced Function Printers is located in the control unit. The RS/6000 controller for the duplex systems is located in the Printer 2 control unit. When the control unit power-on switch is pressed, the following occurs:

1. In the control unit, relays K1 and K2 in the ac control box pick.

   Relay K2 contacts provide ac power to the RS/6000 controller and the Display/Touch Screen at connectors PJA05 and PJA06.

   Relay K1-1 contact holds K1 and K2 and also starts a time-delay sequence.
2. After the delay, relays K21, K22, and K3 in the ac control box pick.
3. Relay K3-2 contact supplies 24 V dc to the SQ081/SQ082 card in the printer through PJA07-1 to start the printer power-on sequence. Go to Printer Power-On Sequence for details about the printer power-on sequence.
4. After a second delay, K23 picks. The ac control box supplies 24 V dc to the printer tailgate through PJA09.

Infoprint 4000 and 3900 Wide Advanced Function Printer 1 Control Unit

A cable from the Printer 2 control unit tailgate is connected to the Printer 1 control unit remote host connection.

1. The power pick and power hold lines from the remote host connection pick and hold relays K1 and K2 in the Printer 1 ac control box.

   Relay K1-1 contact holds K1 and K2, and also starts a time-delay sequence.
2. After the delay, relays K21, K22, and K3 in the ac control box pick.
3. Relay K3-2 contact supplies 24 V dc to Printer 1 through PJA07-1 to start the Printer 1 power-on sequence. Go to Printer Power-On Sequence for details about the printer power-on sequence.

Printer Power-On Sequence

When 24 V dc is supplied to a printer power-on line (PJ205-1; WD-25/A2), the following sequence occurs:

Note: The unit emergency switch in its normal position connects PJ205-6 and PJ205-8.

1. In the printer, the SQ081/SQ082 card creates the following time-delayed outputs:
   - PWR ON (PJ511-3)
   - SOFT START (PJ511-2)
   - HTR PS ON (PJ511-1)
   - CLNR DRV (PJ511–10)

These outputs go to the SR081 card (WD-17/A2) and pick ac heavy-duty relays K501, K502, K503, and K505.

2. K501 provides ac power to the preheat platen and fuser hot roll.
3. K502 provides ac power to the DC1 and DC2 low-voltage power supplies, K502 also provides soft-start ac power to:
   - Low-voltage power supply in the control unit
   - Laser power supply (via T502)
   - Fans and Motors (via T501)
4. K503 bypasses the soft-start resistors and provides full ac power to the items in step 3.
5. K505 provides ac power to the cyclone blower.

The power-on sequence is complete.

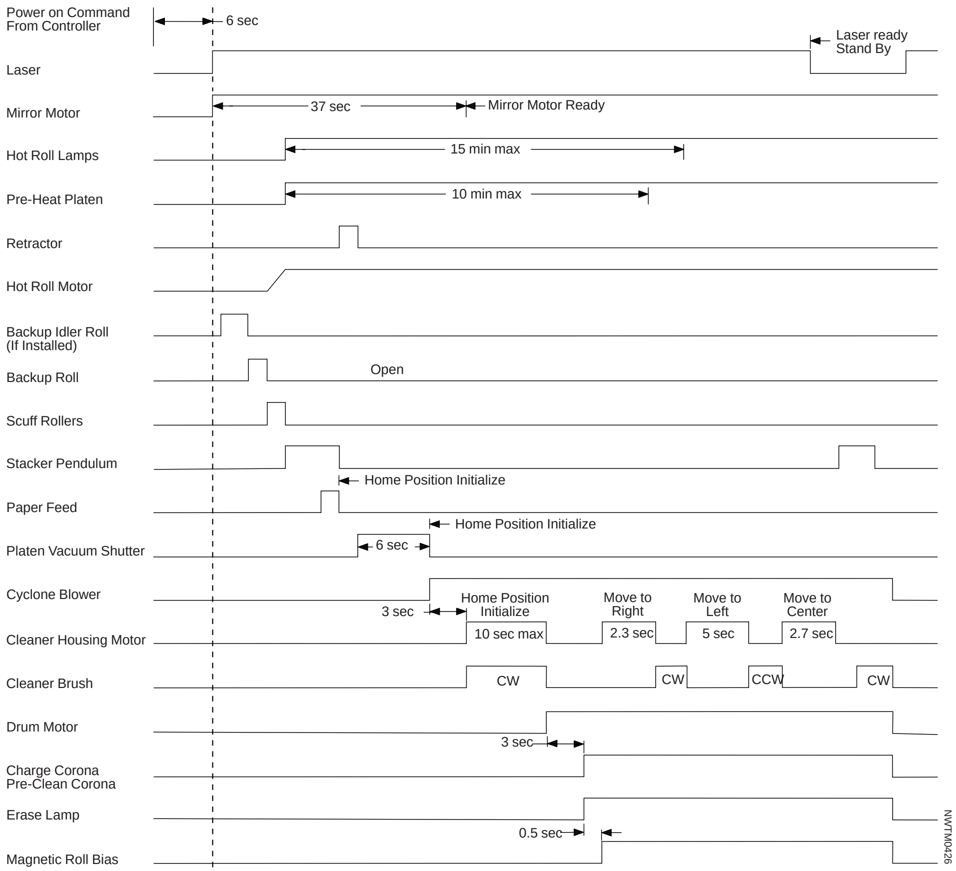
Printer Sequencing

After the power-on sequence, the printer begins its initialization. The steps in the initialization are:

- When the printer is powered on, it begins in the cool status.
- When the printer is powered on or the reset switch on the B1J11 Card is operated, the microprogram executes processing from address 0. In the initial stage, a test program executes for about 6 seconds to diagnose the logical circuits in the printer. After execution of the test program, execution of the main program begins.
- The resolution switching lens cycles and moves to its correct resolution position.
- The mirror motor is driven to the specified speed for the type of printer being run.
- Power is applied to the preheat platens and the hot roll lamps. To reduce the effect of the surge current, the power is applied to the hot roll lamps through soft-start resistors for about 4 seconds.
- These mechanisms cycle and move to their home positions:
  - Retractor
  - Backup roll open/close mechanism
  - Backup idler roll (not in all printers)
  - Paper feed motor
  - Vacuum Shutter
  - Pendulum
  - Scuff rolls.
- The photoconductor drum begins to rotate; 3 seconds later the coronas, erase lamps, and magnet roll motor are turned on; and the developer run operation is performed. Meanwhile, the cleaner housing swings right and left, and the cleaning brush turns clockwise and counterclockwise to automatically clean the inside of the cleaner housing.
- The rotation of the photoconductor drum continues for approximately 2 minutes. After about 10 minutes (maximum 15 minutes), the preheat platens and hot roll reach their specified temperatures. At that time, the status of the printer changes from cool to dormant.

Printer Sequencing Power Problems

Table 9. Printer Power-On Sequencing Timing Chart



The printer may power up normally. However, during the sequencing stage, voltages are applied to the various components in the printer system (drum motor, cleaner housing, backup roll, and other functional areas). If there is a short circuit in one of these areas, a circuit breaker trips. These problems are the most difficult to diagnose. To help isolate these failures, it is important to understand the timing relationship between the various printer components; that is, to know what device was sequencing when the circuit breaker tripped.

This timing chart shows the sequencing of the printer components. For example, if a circuit breaker tripped 3 seconds after the cyclone blower started, the problem might be a short circuit in either the cleaner housing motor or the cleaner brush, because the cleaner housing motor and the cleaner brush *both* come on approximately 3 seconds after the cyclone blower starts.

RS/6000 Controller Sequencing

Following any system power-on sequence or a Restart procedure, the RS/6000 controller runs internal diagnostics. When successfully completed, an initial microcode load (IML) from the disk is performed and additional diagnostics are run.

Until the fuser reaches the temperature required to operate the printer, the Display/Touch Screen shows **Warming Up**. If no error is sensed by the diagnostics, the Display/Touch Screen shows **Not Ready** if attachments are enabled or if there are no attachments. Printing is started when the **Ready** button is pressed. If attachments are not enabled, the display shows that the attachment(s) is disabled and printing cannot be started.

If the **Auto Start** configuration item is set to "Yes", all current attachment interface status (enabled/disabled) is saved during a **Shutdown** procedure and automatically restored at the next power on of the system. Simplex and dual-simplex printers are also automatically made Ready at the completion of the power on sequence, unless there is an error. The Thread/Align forms procedure must be performed on duplex printers before the system can be made ready.

Auto Load Sequencing

Pressing the load key in the autoload area of the printer control panel starts the autoload operation:

1. The capstan pinch rolls close, and the premeasure shaft moves away from the lower forms guide.
2. The tension arm moves to a horizontal position.
3. The bridge rises
4. The bridge feed belts and rollers and the capstan roll begin to rotate.
5. The vacuum is released.
6. The tractor motor starts and the tractors advance the forms installed in the lower tractors by the operator.

   When the forms begin moving, a timer starts. The distance between the lower and upper tractor jam sensors is 20 in. If the forms do not pass over the upper tractor jam sensor before the timer times out, a jam is reported.
7. The lower tractors push the forms against the deflector plate to wrap them around the transfer station.
8. The upper forms guide guides the forms into the capstan rolls and onto the upper tractors.

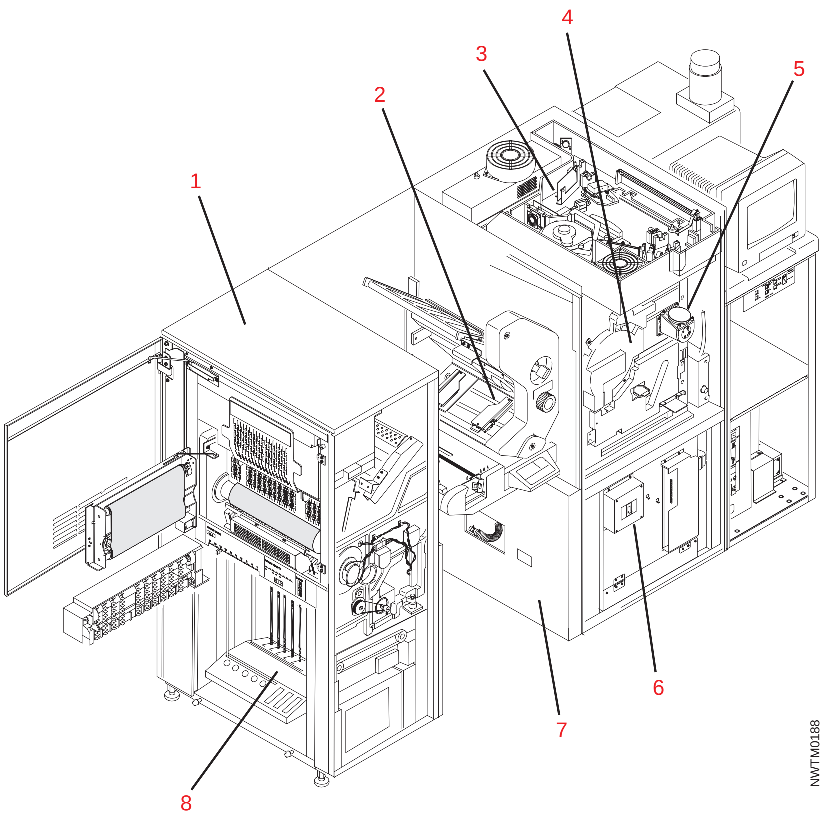
   When the forms pass over the upper tractor jam sensor, a second timer is started. The distance between the upper tractor jam sensor and the pendulum jam sensor is 54.5 in. If the forms do not reach the pendulum jam sensor before the timer times out, a jam is reported.
9. The tractors push the forms until they reach the bridge. Rubber belts on the bridge feed the forms into the bridge feed pressure rolls.
10. The forms follow the preheat platen down into the fuser area.
11. The paper passes between the hot roll and the backup roll, which is left open during auto loading, and into the scuff rolls.
12. The scuff rolls drive the forms down into the pendulum.
13. The pendulum jam sensor checks that the forms have not jammed in the upper fuser.
14. The pendulum has been correctly timed with the forms first passing over the upper tractor jam sensor. The first perforation is assumed to be an upward perforation.
15. Several sheets are fed into the stacker.
16. The pinch rolls in the fuser and transfer station open.
17. The bridge goes down and the tension arm goes up.
18. The tractors run momentarily to place the tension arm and the perforation in the correct position.

Chapter 4. Subsystems

Subsystems are the units of the printer that do some major part of the operations of the printer, such as moving paper, transferring the latent image, developing the latent image, and fusing the image to the paper.

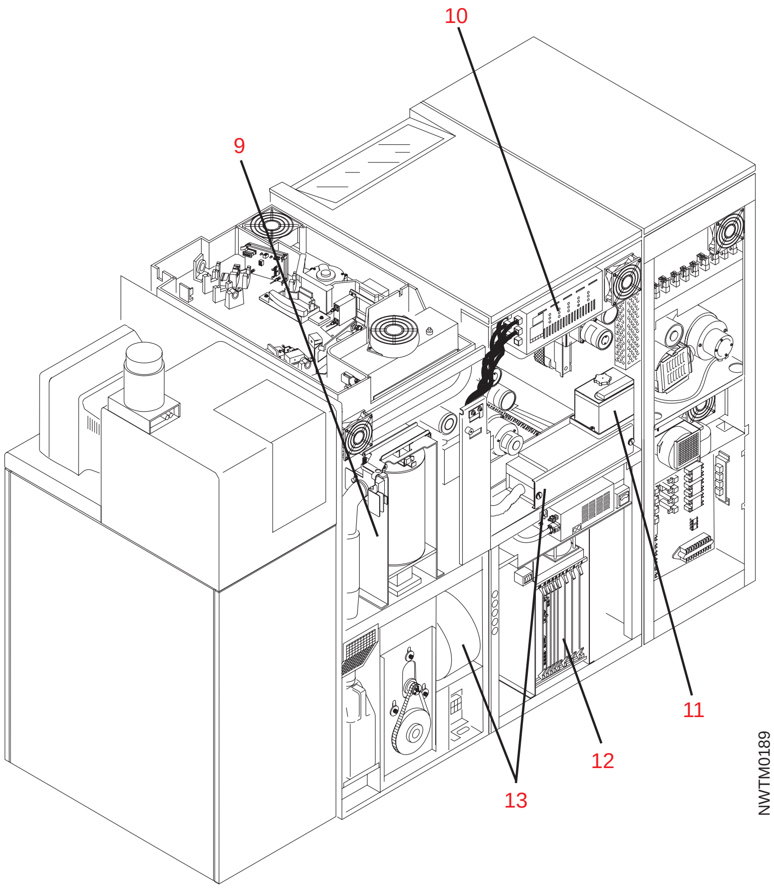
Table 10 shows the front view of a Infoprint 4000 or 3900 Wide Advanced Function Printer with subsystems labeled. See Chapter 2. Control Unit, for subsystems of the control unit. Table 11 shows the rear view of the printer with subsystems labeled.

Table 10. Front View of Infoprint 4000 or 3900 Wide Advanced Function Printer Showing Subsystems



- **(1)** – Fuser station
- **(2)** – Transfer station
- **(3)** – Printhead
- **(4)** – Photoconductor drum
- **(5)** – Developer
- **(6)** – Power supplies, ac and dc
- **(7)** – Input station
- **(8)** – Stacker

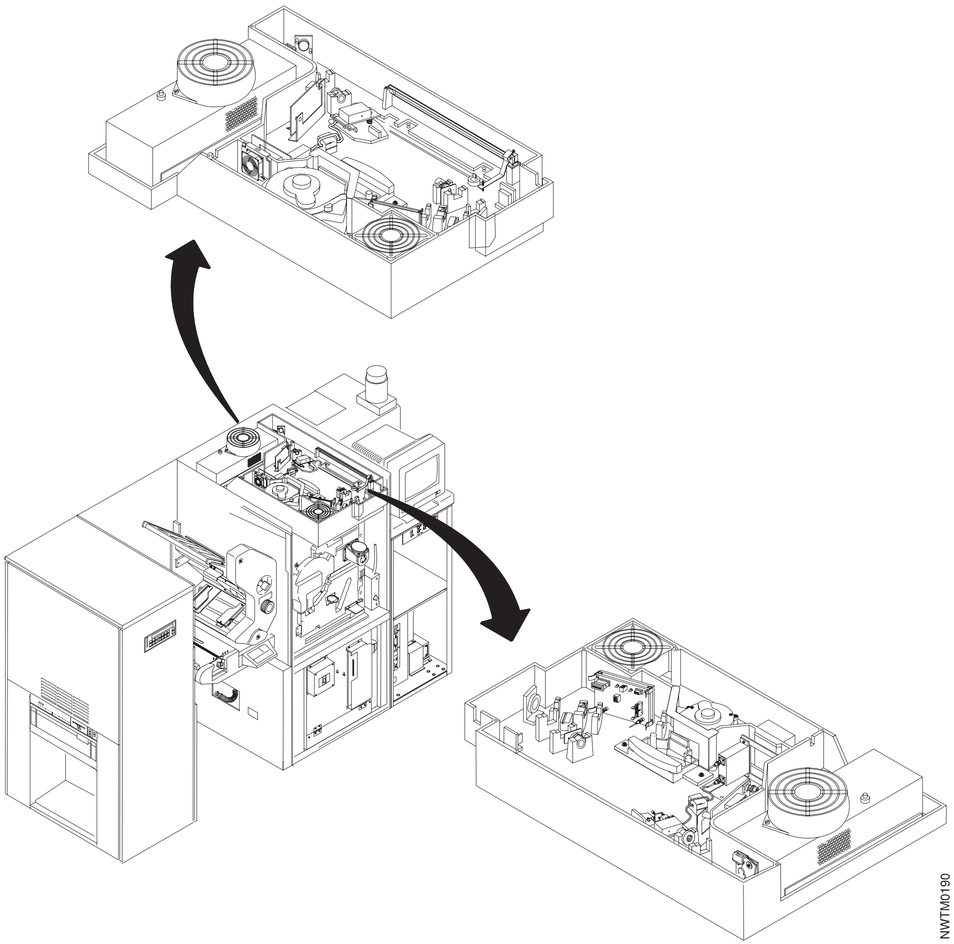
Table 11. Rear View of Infoprint 4000 and 3900 Wide Advanced Function Printer Showing Subsystems



- **(9)** – Cleaner system
- **(10)** – High-voltage power supply
- **(11)** – Fuser oil tank
- **(12)** – Electronics
- **(13)** – Vacuum system

Printhead (Single Beam)

Table 12. Printhead (Single Beam)

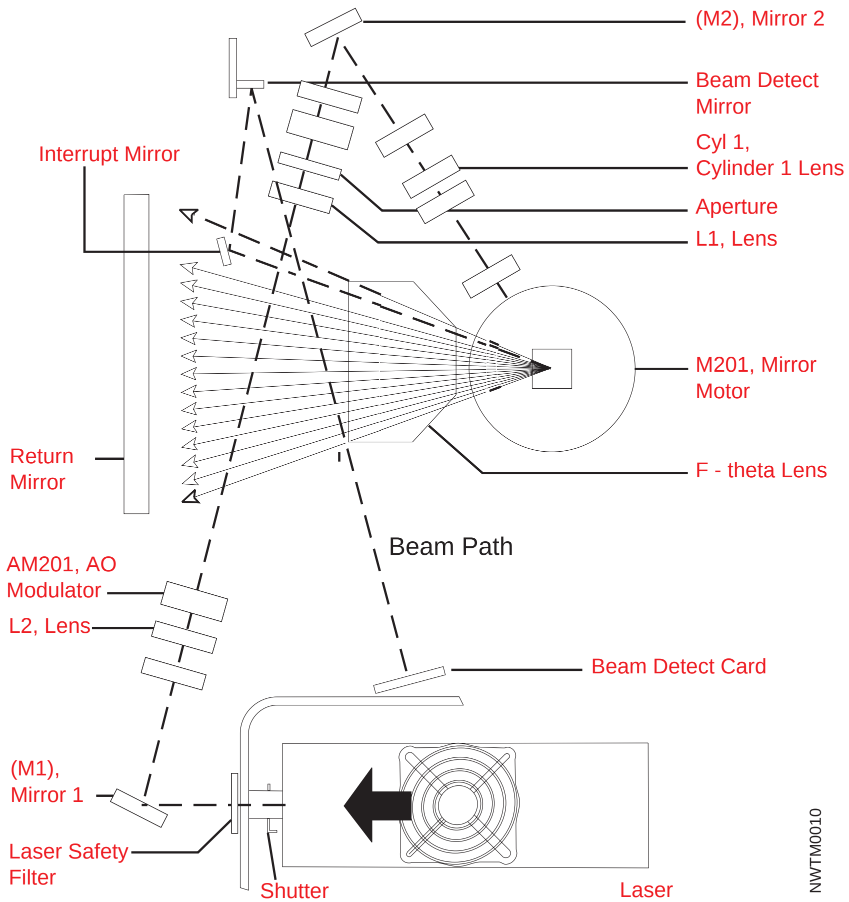


The single beam (240 DPI only) printhead is used in some printer models that operate at 150 ppm or 229 ppm.

The printhead creates a beam of light that discharges the charged PC drum to write the latent image. To generate the beam and write a series of dots on the drum, the printhead uses a laser, mirrors, lenses, a modulator, and aperture, and a beam-detect card. A multifaceted rotating mirror scans the beam along the axis of the rotating drum.

Table 12 shows two views of the printhead exploded from the printer.Table 13 on page 67 shows how the beam is generated and passes through the various elements of the printhead.

Table 13. Elements in the Single-Beam Path



You can compare the drawings in Table 12 on page 66 and Table 13 to orient yourself with regard to the position of the elements in the beam path. Refer to Table 13 as you read the descriptions that follow. In describing the condition of the laser beam, these terms are used:

Focus
: The rays of the beam are converging toward a point; that is, the diameter of the beam is becoming smaller.

Diverging or expanding
: The rays of the beam are spreading; that is, the diameter of the beam is becoming larger.

Parallel
: The rays of the beam are neither diverging or converging; that is, the diameter of the beam is not changing.

Laser

The argon gas laser provides a beam of visible blue light. The beam is produced at a power of 15.5 to 16.5 mW and a wavelength of 488 nm. The beam diameter is 0.65mm. The laser power supply controls the output power of the laser.

The laser turns on during initialization process when power is applied to the printer and normally remains on as long as the printer is on. However, the laser can be off when printer power is on. The laser is off momentarily when the printer is powered on and can be turned off in diagnostic mode.

Laser Power Supply

The laser is current-controlled by the laser power supply to one of two possible states: full printing power and standby power.

The power output of the laser is constantly controlled during printing from 15.5 to 16.5mW by varying the current as necessary. The end of life of the laser occurs when it requires more current than the supply can provide.

Standby power is used to prolong the life of the laser by reducing the output power from 0 to 3 mW. A timer causes the supply to drop to standby power after a few minutes of inactivity. The laser power can rise to full operating power within a few seconds.

Shutter

The shutter is a sliding mechanism that allows the laser beam to pass through when it is open and blocks the laser beam when it is closed. You use the shutter to block the beam if you must work on the printhead with power on.

Band Pass Filter

The band pass filter filters out extraneous side bands of light that could cause ghost images when printing at slower speeds.

Safety Filter

The operating power of the laser can damage the eyes. A filter is mounted between the laser and mirror M1 to reduce the operating power to a safe level for maintenance. The safety filter consists of an attenuating lens mounted in a filter mechanism which is spring loaded so that it automatically moves into place when the printhead cover is removed.

After the beam passes through the safety filter, it goes to mirror M1 and on through the rest of the beam path.

Mirror M1

As the beam leaves the shutter area, it strikes mirror M1. Mirror M1 turns the beam and directs it to the L2 lens.

Lens L2

Lens L2 focuses the beam on the entry hole in the AO modulator.

AO Modulator

The laser beam must be turned off and on very quickly to write the desired image. Because it is not possible to cycle a gas laser at that rate, a beam-splitting device called an acousto-optic (AO) modulator is used.

The AO modulator is a transparent crystal that allows the laser beam to pass through it. When the crystal is driven, the laser beam is split into four beams that emerge at predictable angles from the input beam. One of these beams, called the *primary beam*, is used to write the image on the drum.

Placing a piece of white paper between the AO modulator and Lens L1, displays the beam as it leaves the AO modulator. When the AO modulator is not driven, only the input, or zero beam, is present. The zero beam always passes through the AO modulator in a straight line, whether or not the modulator is driven. The beam as it leaves the modulator appears as shown in Figure 4 on page 70.

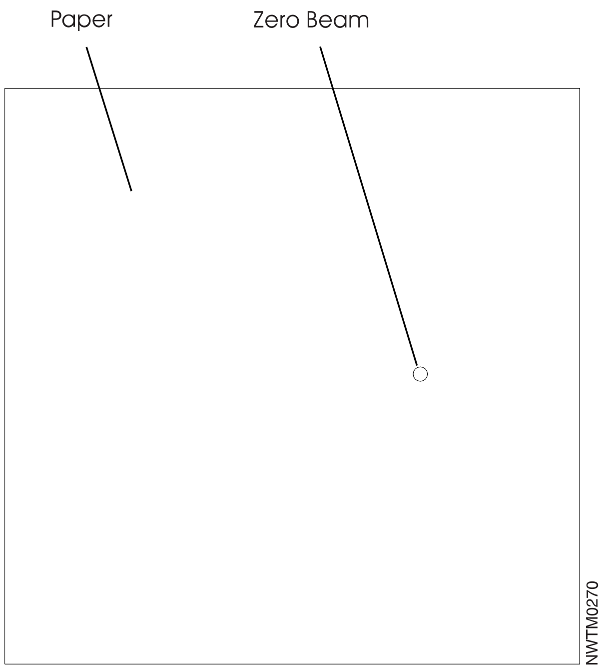


Figure 4. Unmodulated Beam from AO Modulator

With the paper still in place and with the modulator driven, the beam as it leaves the modulator appears as shown in Figure 5 on page 71.

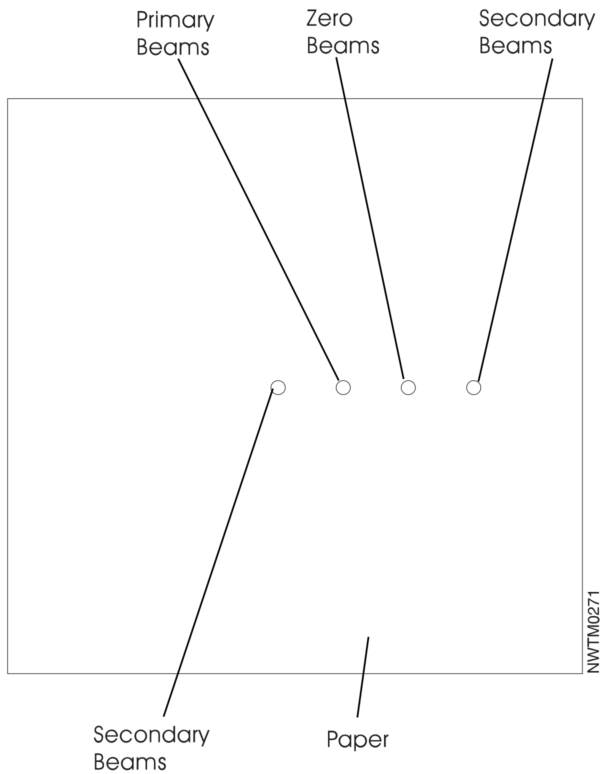


Figure 5. Modulated Beam from AO Modulator

The power is not the same in the four output beams of the AO modulator. The beam power can be greatly varied by changing the angle at which the beam strikes the crystal. For this reason, the AO modulator is mounted on a fixture that permits rotation in two directions. When the AO modulator is correctly adjusted, about 65% of the input beam power can be directed into the writing, or primary beam. Even a very small movement of the AO modulator can have a large effect on the beam power. For this reason, shaking of the printhead, which may occur in shipping, can cause a maladjustment of the AO modulator.

AO Driver and Video Data

The AO driver (not shown) converts the on/off logic signal from the control unit to a driving signal for the AO modulator. It can be adjusted to give more or less beam power at the AO modulator.

The on/off signal is called video data, or CVD. It is a high-frequency signal that is carried by coaxial cables for noise immunity.

Lens L1

The beam that leaves the modulator is diverging from it's focused condition. Lens L1 modifies the shape of the beam and transmits it to the cylinder 1 lens. The beam that leaves lens L1 is circular and parallel.

Aperture

The zero beam always passes through the AO modulator and Lens L1. If it were allowed to reach the PC drum, it would write a totally black page for every page. The aperture is a hole in a metal fixture used to pass the writing, or primary beam, and to absorb the idle, or zero beam, to prevent it from reaching the PC drum surface.

Mirror M2

Mirror M2 turns the beam and directs it to the cylinder 1 lens.

Cylinder 1 Lens

The cylinder 1 lens focuses the shaped and aligned light beam onto the mirror surfaces of the rotating scanning mirror. The cylinder 1 lens focuses the beam only in the vertical direction. The result is that the beam that strikes the rotating mirror (scanning mirror) is a line rather than a circular spot.

Scanning Mirror

For the beam to be able to write on all printable positions of the PC drum, it must move across the drum and down the page area of the drum. Because the PC drum is turning, the beam moves down. The scanning mirror moves the beam across the PC drum.

The scanning mirror is a 12-faceted mirror that is mounted on high-quality air bearing and turns at 25546 RPM at 150 ppm, and 39000 RPM at 229 ppm.

The mirror is driven by a three-phase synchronous motor. The high quality of the air bearing allows the mirror to spin for minutes after the motor has been turned off. The rotational speed of the mirror is checked internally by an LED light source and phototransistor receiver.

The scanning mirror is positioned just above the mirror motor as shown in Table 13 on page 67. As the mirror rotates, the beam strikes the facet at a different angle, causing the beam to be reflected toward a different entry point on the F-Theta lens.

The motor is driven by it’s own control board, called the Mirror Motor Driver Board (MD141).

F-Theta Lens

A sweeping beam across the flat return mirror has the effect of having a greater velocity at the ends than in the middle. This would produce a longer spot on the ends of the PC drum than in the middle.

The F-Theta lens corrects this problem with it’s curved surface. It also provides the correct magnification of the image.

Interrupt Mirror

At the beginning of each scan line the beam from the F-Theta lens strikes the interrupt mirror. The interrupt mirror reflects the beam toward the beam-detect mirror. After the beam strikes the interrupt mirror, the rotation of the scanning mirror sends the beam from the F-Theta lens to the return mirror.

Return Mirror

When the beam strikes the return mirror, it is reflected down toward the PC drum, writing the latent image. The return mirror can be adjusted to control where the first line appears on the page.

Beam-Detect Mirror

The beam-detect mirror receives the beam from the interrupt mirror and reflects it to the beam-detect card.

Beam-Detect Card

The beam-detect card creates a short electrical pulse when the laser beam is scanned across it. This pulse is used by the MIC card to determine when to turn on the laser for each scan line on the page.

The electronics on the B1J11 Card and the factory adjust print function in the control unit allow you to change the start-of-scan position. This is done by changing the delay time between when the beam-detect pulse is sensed and when printing begins.

The beam-detect card requires that the beam be correctly aligned on it’s sensor and that the beam have enough power. Because this is the only sensor beyond the laser itself, it detects most of the problems in the printhead.

Fan

Three fans provide air to the printhead. One fan is mounted on the laser to provide cooling to the interior of the laser mechanism. A second fan mounted behind the mirror motor (viewed from the front of the printhead) cools the mirror motor. The third fan, mounted in front of the mirror motor, pressurizes the printhead to keep paper dust, toner, and other contamination from settling on the optics.

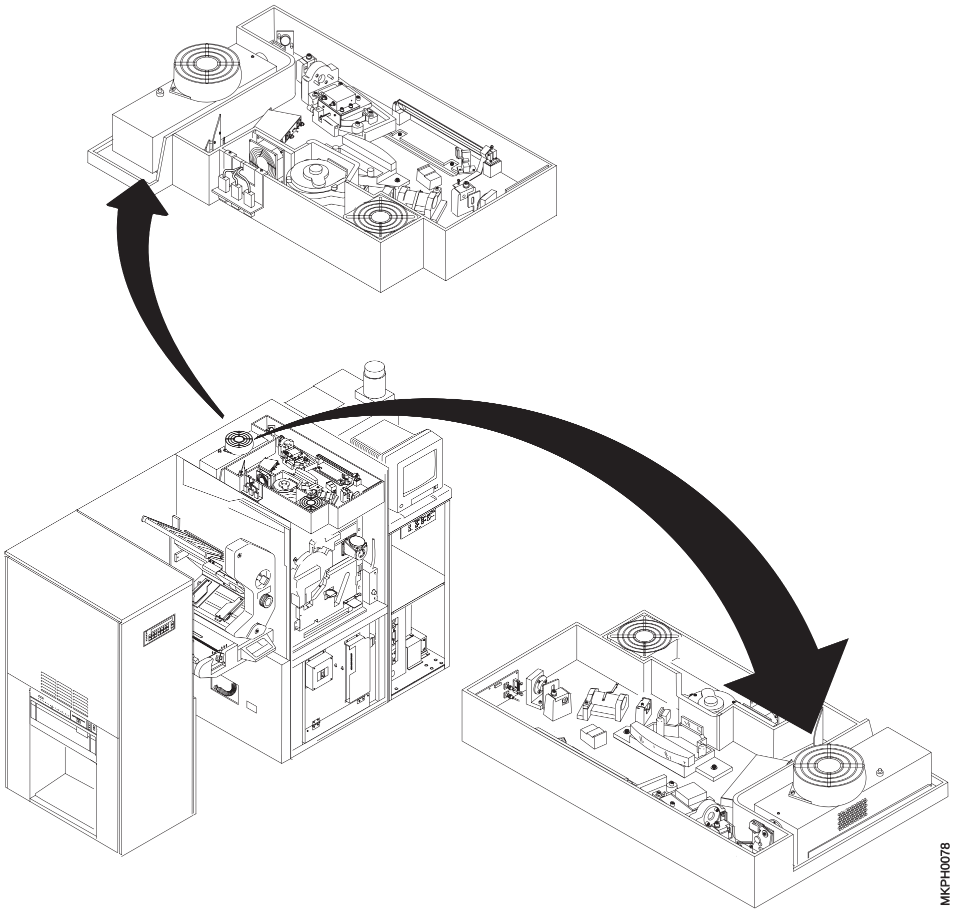
Printhead Specifications

Table 14. Single-Beam Printhead Specifications

Item	**Value**
Operating laser power	15.5 to 16.5 mW
Wavelength	488 nm
Beam diameter at laser	0.65 mm
Power loss through optics	57%%
Beam power at PC drum	7 mW
Safety filter	<1 mW
Interlock circuit	PC drum cover
Mirror facets	12
Mirror speed	25546 RPM for 150 ppm 39000 RPM for 229 ppm
Scan time	195 µsec – 150 ppm 123 µsec – 229 ppm

Printhead (Two-Beam, without Resolution Switching Lens)

Table 15. Two-Beam Printhead Views, Front and Rear

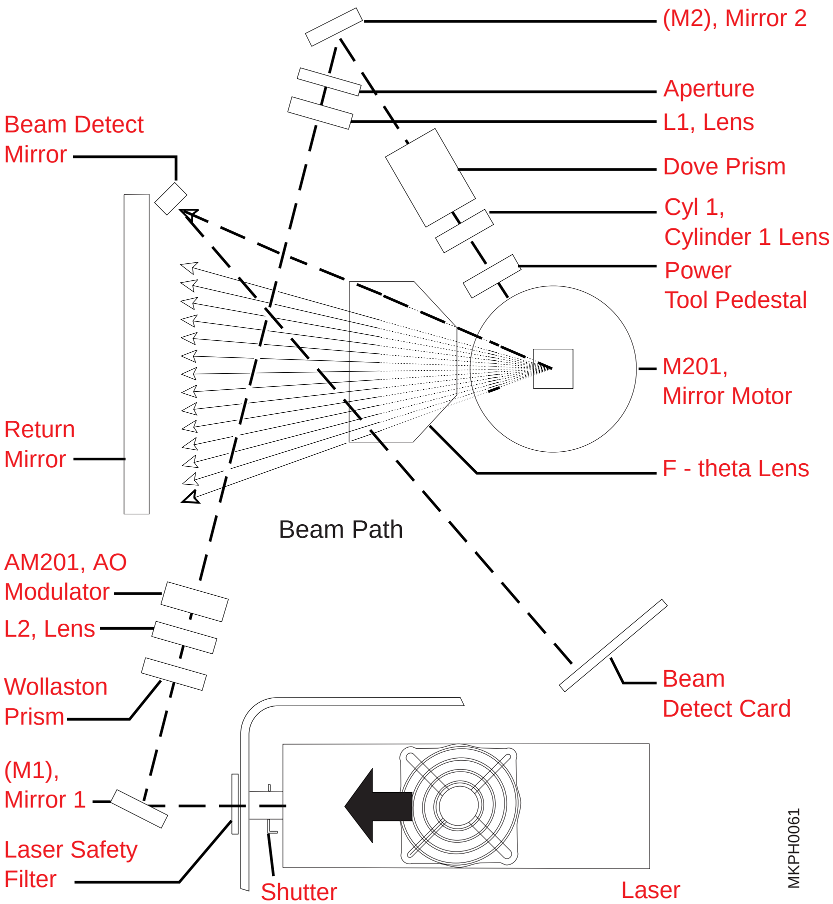


The two-beam (240 DPI only) printhead is used in printers with 310 PPM.

The printhead creates beams of light that discharge the charged PC drum to write the latent image. To generate the beams and write a series of dots on the drum, the printhead uses a laser, mirrors, lenses, prisms, a modulator, an aperture, and a beam-detect card. A multifaceted rotating mirror scans the beam along the axis of the rotating drum.

Table 15 shows two views of the two-beam printhead exploded from the printer. Table 16 on page 77 shows how the beam is generated and passes through the various elements of the printhead.

Table 16. Elements in the Two-Beam Path



You can compare the drawings in Table 15 on page 76 and Table 16 to orient yourself with regard to the position of the elements in the beam path. Refer to Table 16 as you read the descriptions that follow. In describing the condition of the laser beam, these terms are used:

Focus
: The rays of the beam are converging toward a point; that is, the diameter of the beam is becoming smaller.

Diverging or expanding
: The rays of the beam are spreading; that is, the diameter of the beam is becoming larger.

Parallel
: The rays of the beam are neither diverging or converging; that is, the diameter of the beam is not changing.

Laser

The argon gas laser provides a beam of visible blue light. The beam is produced at a power of 19.5 to 20.5 mW and a wavelength of 488 nm. The beam diameter is 0.65 mm. The laser power supply controls the output power of the laser.

The laser turns on during initialization process when power is applied to the printer and normally remains on as long as the printer is on. However, the laser can be off when printer power is on. The laser is off momentarily when the printer is powered on and can be turned off in diagnostic mode.

Laser Power Supply

The laser is current-controlled by the laser power supply to one of two possible states: full printing power and standby power.

The power output of the laser is constantly controlled during printing from 19.5 to 20.5 mW by varying the current as necessary. The end of life of the laser occurs when it requires more current than the supply can provide.

Standby power is used to prolong the life of the laser by reducing the output power from 0 to 3 mW. A timer causes the supply to drop to standby power after a few minutes of inactivity. The laser power can rise to full operating power within a few seconds.

Shutter

The shutter is a sliding mechanism that allows the laser beam to pass through when it is open and blocks the laser beam when it is closed. You use the shutter to block the beam if you must work on the printhead with power on.

Band Pass Filter

The band pass filter filters out extraneous side bands of light that could cause ghost images when printing at slower speeds.

Safety Filter

The operating power of the laser can damage the eyes. A filter is mounted between the laser and mirror M1 to reduce the operating power to a safe level for maintenance. The safety filter consists of an attenuating lens mounted in a filter mechanism which is spring loaded so that it automatically moves into place when the printhead cover is removed.

After the beam passes through the safety filter, it goes to mirror M1 and on through the rest of the beam path.

Mirror M1

As the beam leaves the shutter area, it strikes mirror M1. Mirror M1 turns the beam and directs it to the Wollaston prism.

Wollaston Prism

The Wollaston prism splits the laser beam into 2 equal power beams. The beams then go to Lens L2.

Lens L2

Lens L2 focuses the beam on the entry hole in the AO modulator.

AO Modulator

The laser beams must be turned off and on very quickly to write the desired image. Because it is not possible to cycle a gas laser at that rate, a beam-splitting device called an acousto-optic (AO) modulator is used. Because there are two beams to be controlled, the AO modulator has 2 channels. Each channel controls one of the beams.

The AO modulator is a transparent crystal that allows the laser beam to pass through it. When the individual channels of the crystal are driven, each laser beam is split into four beams that emerge at predictable angles from the input beams. One of these beams, called the *primary beam* (one for each channel), is used to write the image on the drum.

Placing a piece of white paper between the AO modulator and Lens L1, displays the beams as they leave the AO modulator. When the AO modulator is not driven, only the input, or zero beams, are present. The zero beams always pass through the AO modulator in a straight line, whether or not the modulator is driven. When the modulator is not driven, the beams leave the modulator as shown in Figure 6.

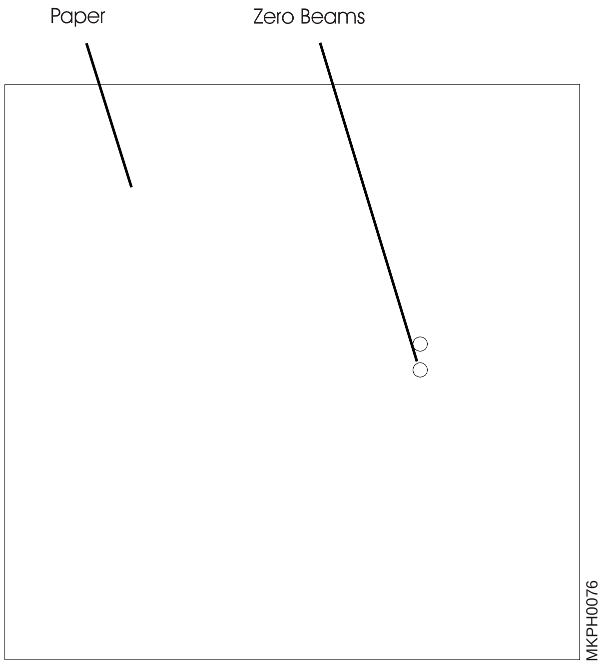


Figure 6. Two Unmodulated Beams from AO Modulator

With the paper still in place and with both channels of the modulator driven, the beams leave the modulator as shown in Figure 7 on page 81.

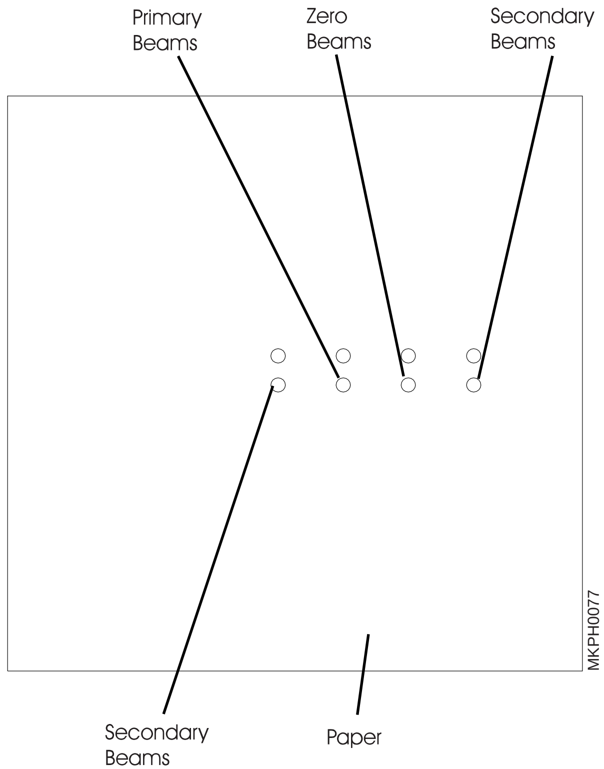


Figure 7. Two Modulated Beams from AO Modulator

The power is not the same in the four output beams (secondary, primary, zero, and secondary) of the AO modulator. The beam power can be greatly varied by changing the angle at which the beam strikes the crystal. For this reason, the AO modulator is mounted on a fixture that permits rotation in two directions. When the AO modulator is correctly adjusted, about 65% of the input beam power can be directed into the writing, or primary beam. Even a very small movement of the AO modulator can have a large effect on the beam power. For this reason, shaking of the printhead, which may occur in shipping, can cause a maladjustment of the AO modulator.

AO Driver and Video Data

The AO driver (not shown) converts the on/off logic signal from the control unit to a driving signal for the AO modulator. It can be adjusted to give more or less beam power at the AO modulator.

The on/off signal is called video data, or CVD. It is a high-frequency signal that is carried by coaxial cables for noise immunity.

Lens L1

The beams that leave the modulator are diverging from their focused condition. Lens L1 modifies the shape of the beams and transmits them to Mirror 2. The beams that leave lens L1 are circular and parallel.

Aperture

The zero beams always pass through the AO modulator and usually Lens L1. If they were allowed to reach the PC drum, they would write a totally black page for every page. The aperture is a hole in a metal fixture that passes the writing, or primary beams, and absorbs the idle, or zero beams, to prevent them from reaching the PC drum surface.

Mirror M2

Mirror M2 turns the beams and directs them to the Dove Prism and the Cylinder 1 lens.

Dove Prism

The Dove prism rotates the beams almost 90°. When leaving the Dove prism, the beams are spaced so that when they reach the PC drum, they are 1 pel apart vertically and about 31 pels apart horizontally.

Cylinder 1 Lens

The cylinder 1 lens focuses the shaped and aligned light beams onto the mirror surfaces of the rotating scanning mirror. The cylinder 1 lens focuses the beams only in the vertical direction. The result is that the beams that strike the rotating mirror (scanning mirror) are lines rather than circular spots.

Scanning Mirror

For the beams to be able to write on all printable positions of the PC drum, they must move across the drum and down the page area of the drum. The scanning mirror creates scan lines by moving the beams across the PC drum. Because the PC drum is also turning, each subsequent scan line is placed directly below the previous scan lines on the page area of the PC drum.

The scanning mirror is a 12-faceted mirror that is mounted on high-quality air bearing and turns at 26394 RPM for 310 ppm.

Each facet of the scan mirror creates 2 scan lines on the PC drum as it scans across, because there are 2 beams on each facet.

The mirror is driven by a three-phase synchronous motor. The high quality of the air bearing allows the mirror to spin for minutes after the motor has been turned off. The rotational speed of the mirror is checked internally by an LED light source and phototransistor receiver.

The scanning mirror is positioned just above the mirror motor as shown in Table 16 on page 77. As the mirror rotates, the beams strike the facet at a different angle, causing the beams to be reflected toward a different entry point on the F-Theta lens.

The motor is driven by it’s own control board, called the Mirror Motor Driver Board (MD141).

F-Theta Lens

The design of the F-Theta lens produces a beam of constant velocity and spot size with it’s curved surface. It also provides the correct magnification of the image.

Return Mirror

When the beams strike the return mirror, they are reflected down toward the PC drum, writing the latent image. The return mirror can be adjusted to control where the first line appears on the page.

Beam-Detect Mirror

The beam-detect mirror receives the beams from the F-Theta lens and reflects them to the beam-detect card.

Beam-Detect Card

The beam-detect card creates a short electrical pulse when the laser beams are scanned across it. This pulse is used by the MIC card to determine when to turn on the laser for each scan line on the page.

The electronics on the B1J11 Card and the factory adjust print function in the control unit allow you to change the start-of-scan position. This is done by changing the delay time between when the beam-detect pulse is sensed and when printing begins.

The beam-detect card requires that the beams be correctly aligned on it’s sensor and that the beams have enough power. Because this is the only sensor beyond the laser itself, it detects most of the problems in the printhead.

Fan

Three fans provide air to the printhead. One fan is mounted on the laser to provide cooling to the interior of the laser mechanism. A second fan mounted behind the mirror motor (viewed from the front of the printhead) cools the mirror motor. The third fan, mounted in front of the mirror motor, pressurizes the printhead to keep paper dust, toner, and other contamination from settling on the optics.

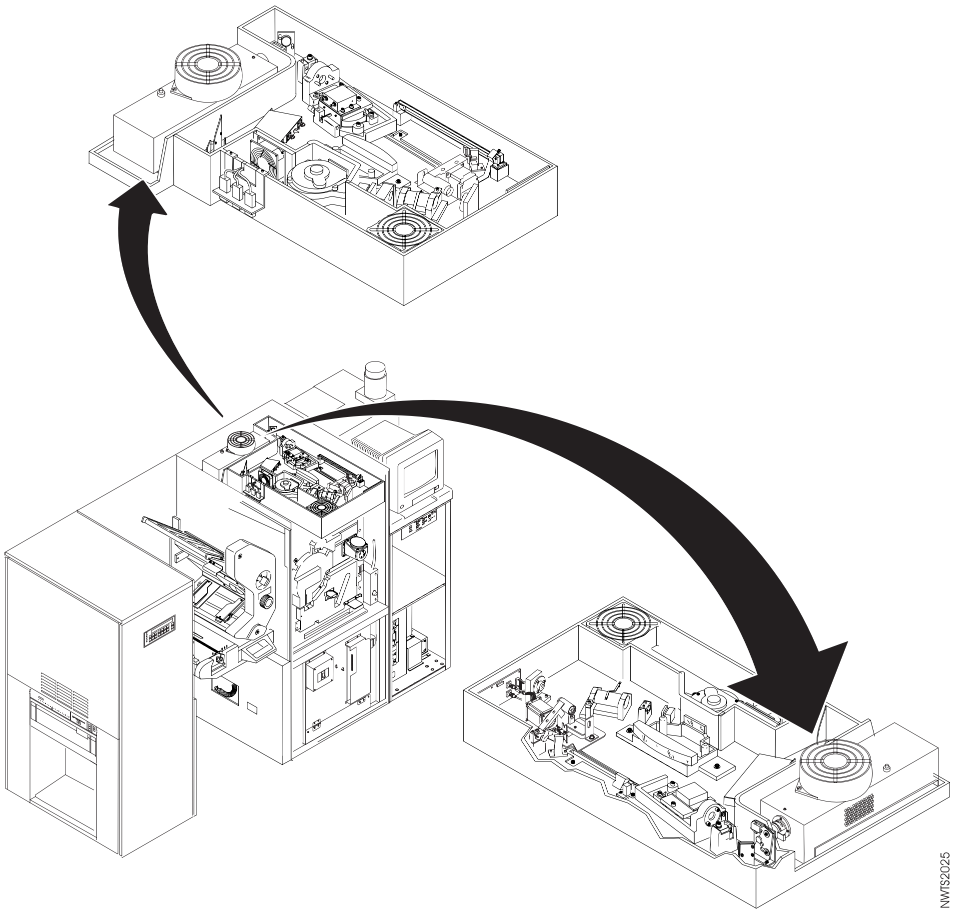
Two-Beam Printhead Specifications

Table 17. Two-Beam Printhead Specifications

Item	Value
Operating laser power	19.5 to 20.5 mW
Wavelength	488 nm
Beam diameter at laser	0.65 mm
Power loss through optics	57%%
Beam power at PC drum	>3.6 mW per beam (2)
Safety filter	<1 mW
Interlock circuit	PC drum cover
Mirror facets	12
Mirror speed	26394 RPM – 310 ppm
Scan time	189 µsec – 310ppm

Printhead (Two-Beam Switchable Resolution)

Table 18. Two-Beam Switchable Resolution Printhead Views, Front and Rear

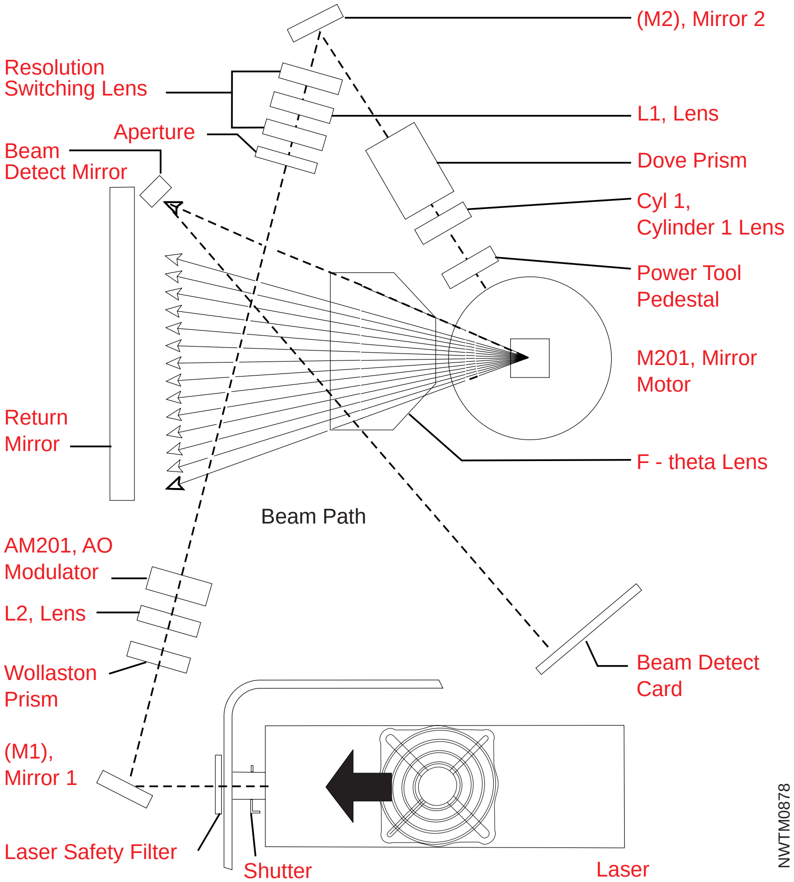


The two-beam (240 DPI only) printhead is used in printers with 310 PPM.

The printhead creates beams of light that discharge the charged PC drum to write the latent image. To generate the beams and write a series of dots on the drum, the printhead uses a laser, mirrors, lenses, prisms, a modulator, an aperture, and a beam-detect card. A multifaceted rotating mirror scans the beam along the axis of the rotating drum.

Table 18 shows two views of the two-beam switchable resolution printhead exploded from the printer. Table 19 on page 87 shows how the beam is generated and passes through the various elements of the printhead.

Table 19. Elements in the Two-Beam Switchable Resolution Path



You can compare the drawings in Table 18 on page 86 and Table 19 to orient yourself with regard to the position of the elements in the beam path. Refer to Table 19 as you read the descriptions that follow. In describing the condition of the laser beam, these terms are used:

Focus
: The rays of the beam are converging toward a point; that is, the diameter of the beam is becoming smaller.

Diverging or expanding
: The rays of the beam are spreading; that is, the diameter of the beam is becoming larger.

Parallel
: The rays of the beam are neither diverging or converging; that is, the diameter of the beam is not changing.

Laser

The argon gas laser provides a beam of visible blue light. The beam is produced at a power of 19.5 to 20.5 mW and a wavelength of 488 nm. The beam diameter is 0.65 mm. The laser power supply controls the output power of the laser.

The laser turns on during initialization process when power is applied to the printer and normally remains on as long as the printer is on. However, the laser can be off when printer power is on. The laser is off momentarily when the printer is powered on and can be turned off in diagnostic mode.

Laser Power Supply

The laser is current-controlled by the laser power supply to one of two possible states: full printing power and standby power.

The power output of the laser is constantly controlled during printing from 19.5 to 20.5 mW by varying the current as necessary. The end of life of the laser occurs when it requires more current than the supply can provide.

Standby power is used to prolong the life of the laser by reducing the output power from 0 to 3 mW. A timer causes the supply to drop to standby power after a few minutes of inactivity. The laser power can rise to full operating power within a few seconds.

Shutter

The shutter is a sliding mechanism that allows the laser beam to pass through when it is open and blocks the laser beam when it is closed. You use the shutter to block the beam if you must work on the printhead with power on.

Band Pass Filter

The band pass filter filters out extraneous side bands of light that could cause ghost images when printing at slower speeds.

Safety Filter

The operating power of the laser can damage the eyes. A filter is mounted between the laser and mirror M1 to reduce the operating power to a safe level for maintenance. The safety filter consists of an attenuating lens mounted in a filter mechanism which is spring loaded so that it automatically moves into place when the printhead cover is removed.

After the beam passes through the safety filter, it goes to mirror M1 and on through the rest of the beam path.

Mirror M1

As the beam leaves the shutter area, it strikes mirror M1. Mirror M1 turns the beam and directs it to the Wollaston prism.

Wollaston Prism

The Wollaston prism splits the laser beam into 2 equal power beams. The beams then go to Lens L2.

Lens L2

Lens L2 focuses the beam on the entry hole in the AO modulator.

AO Modulator

The laser beams must be turned off and on very quickly to write the desired image. Because it is not possible to cycle a gas laser at that rate, a beam-splitting device called an acousto-optic (AO) modulator is used. Because there are two beams to be controlled, the AO modulator has 2 channels. Each channel controls one of the beams.

The AO modulator is a transparent crystal that allows the laser beam to pass through it. When the individual channels of the crystal are driven, each laser beam is split into four beams that emerge at predictable angles from the input beams. One of these beams, called the *primary beam* (one for each channel), is used to write the image on the drum.

Placing a piece of white paper between the AO modulator and Lens L1, displays the beams as they leave the AO modulator. When the AO modulator is not driven, only the input, or zero beams, are present. The zero beams always pass through the AO modulator in a straight line, whether or not the modulator is driven. When the modulator is not driven, the beams leave the modulator as shown in Figure 8.

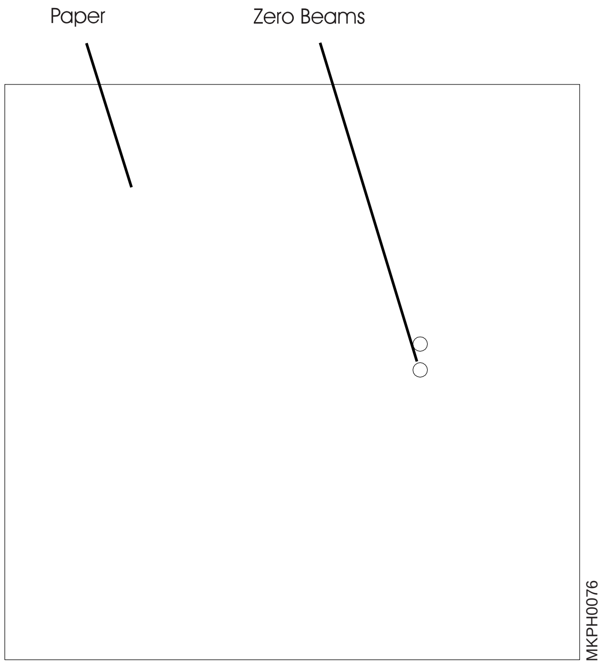


Figure 8. Two Unmodulated Beams from AO Modulator

With the paper still in place and with both channels of the modulator driven, the beams leave the modulator as shown in Figure 9 on page 91.

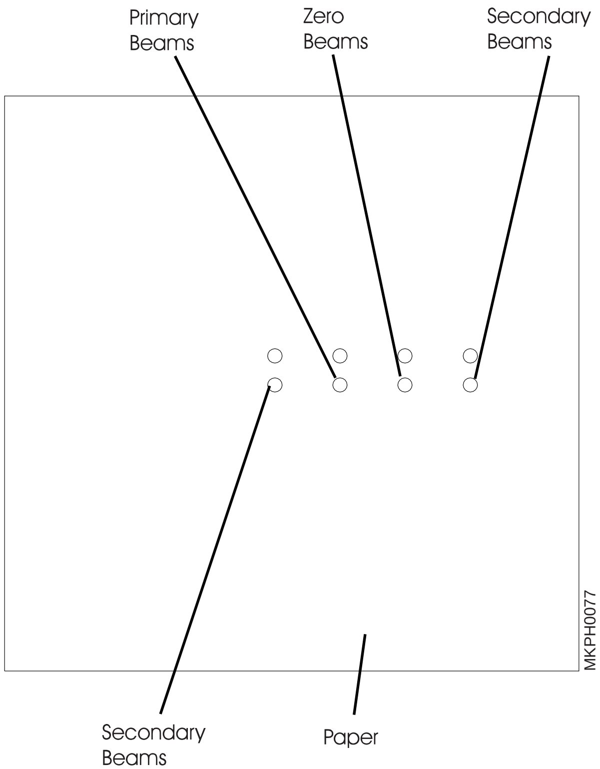


Figure 9. Two Modulated Beams from AO Modulator

The power is not the same in the four output beams (secondary, primary, zero, and secondary) of the AO modulator. The beam power can be greatly varied by changing the angle at which the beam strikes the crystal. For this reason, the AO modulator is mounted on a fixture that permits rotation in two directions. When the AO modulator is correctly adjusted, about 65% of the input beam power can be directed into the writing, or primary beam. Even a very small movement of the AO modulator can have a large effect on the beam power. For this reason, shaking of the printhead, which may occur in shipping, can cause a maladjustment of the AO modulator.

AO Driver and Video Data

The AO driver (not shown) converts the on/off logic signal from the control unit to a driving signal for the AO modulator. It can be adjusted to give more or less beam power at the AO modulator.

The on/off signal is called video data, or CVD. It is a high-frequency signal that is carried by coaxial cables for noise immunity.

Aperture

The zero beams always pass through the AO modulator. If they were allowed to reach the PC drum, they would write a totally black page for every page. The aperture is a hole in a metal fixture that passes the writing, or primary beams, and absorbs the idle, or zero beams, to prevent them from reaching the PC drum surface.

Resolution Switching Lens

The resolution switching lens allows the printhead to print at 240 DPI by changing the size of the beam when the lens is placed in the beam path. When the resolution switching lens is not in the beam path, the printhead prints at 300 DPI.

The two-piece lens is mounted on an arm that is lifted by a cam driven by a dc motor. The position of the lens is determined by the resolution value set in Printer Configuration.

Lens L1

The beams that leave the modulator are diverging from their focused condition. Lens L1 modifies the shape of the beams and transmits them to Mirror 2. The beams that leave lens L1 are circular and parallel.

Mirror M2

Mirror M2 turns the beams and directs them to the Dove Prism and the Cylinder 1 lens.

Dove Prism

The Dove prism rotates the beams almost 90°. When leaving the Dove prism, the beams are spaced so that when they reach the PC drum, they are 1 pel apart vertically and about 31 pels apart horizontally.

Cylinder 1 Lens

The cylinder 1 lens focuses the shaped and aligned light beams onto the mirror surfaces of the rotating scanning mirror. The cylinder 1 lens focuses the beams only in the vertical direction. The result is that the beams that strike the rotating mirror (scanning mirror) are lines rather than circular spots.

Scanning Mirror

For the beams to be able to write on all printable positions of the PC drum, they must move across the drum and down the page area of the drum. The scanning mirror creates scan lines by moving the beams across the PC drum. Because the PC drum is also turning, each subsequent scan line is placed directly below the previous scan lines on the page area of the PC drum.

The scanning mirror is a 12-faceted mirror that is mounted on high-quality air bearing and turns at 19500 RPM for 240 DPI and 24375 RPM at 300 DPI.

Each facet of the scan mirror creates 2 scan lines on the PC drum as it scans across, because there are 2 beams on each facet.

The mirror is driven by a three-phase synchronous motor. The high quality of the air bearing allows the mirror to spin for minutes after the motor has been turned off. The rotational speed of the mirror is checked internally by an LED light source and phototransistor receiver.

The scanning mirror is positioned just above the mirror motor as shown in Table 19 on page 87. As the mirror rotates, the beams strike the facet at a different angle, causing the beams to be reflected toward a different entry point on the F-Theta lens.

The motor is driven by it’s own control board, called the Mirror Motor Driver Board (MD192).

F-Theta Lens

The design of the F-Theta lens produces a beam of constant velocity and spot size with it’s curved surface. It also provides the correct magnification of the image.

Return Mirror

When the beams strike the return mirror, they are reflected down toward the PC drum, writing the latent image. The return mirror can be adjusted to control where the first line appears on the page.

Beam-Detect Mirror

The beam-detect mirror receives the beams from the F-Theta lens and reflects them to the beam-detect card.

Beam-Detect Card

The beam-detect card creates a short electrical pulse when the laser beams are scanned across it. This pulse is used by the MIC card to determine when to turn on the laser for each scan line on the page.

The electronics on the B1J11 Card and the factory adjust print function in the control unit allow you to change the start-of-scan position. This is done by changing the delay time between when the beam-detect pulse is sensed and when printing begins.

The beam-detect card requires that the beams be correctly aligned on it’s sensor and that the beams have enough power. Because this is the only sensor beyond the laser itself, it detects most of the problems in the printhead.

Fan

Three fans provide air to the printhead. One fan is mounted on the laser to provide cooling to the interior of the laser mechanism. A second fan mounted behind the mirror motor (viewed from the front of the printhead) cools the mirror motor. The third fan, mounted in front of the mirror motor, pressurizes the printhead to keep paper dust, toner, and other contamination from settling on the optics.

Two-Beam Resolution Switching Printhead Specifications

Table 20. Two-Beam Resolution Switchable Printhead Specifications

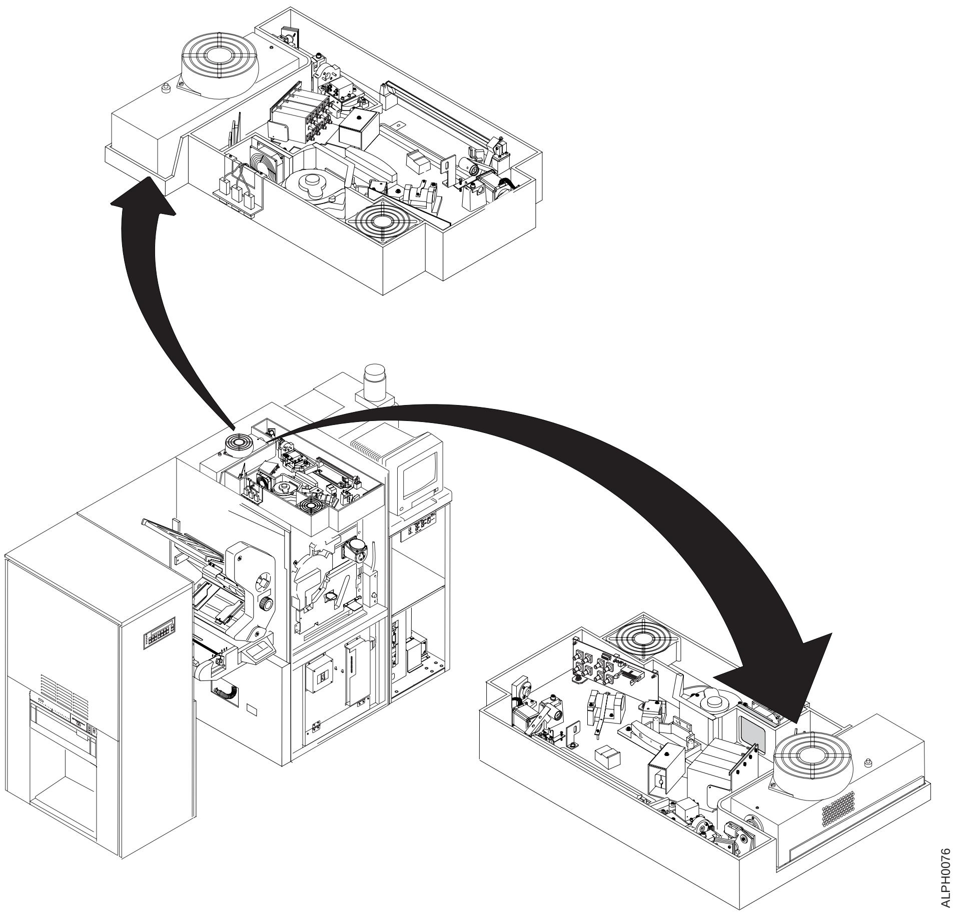
Item	**Value**
Operating laser power	19.5 to 20.5 mW
Wavelength	488 nm
Beam diameter at laser	0.65 mm
Power loss through optics	57%%
Beam power at PC drum	>3.6 mW per beam (2)
Safety filter	<1 mW
Interlock circuit	PC drum cover
Mirror facets	12
Mirror speed	19500 RPM – 240 DPI 24375 RPM – 300 DPI
Scan time	256 µsec – 240 DPI 320 µsec – 300 DPI

Table 21. Two-Beam Resolution Switchable Printhead Specifications (324 ppm)

Item	Value
Operating laser power	29.5 to 30.5 mW
Wavelength	488 nm
Beam diameter at laser	0.65 mm
Power loss through optics	57%%
Beam power at PC drum	>3.6 mW per beam (2)
Safety filter	<1 mW
Interlock circuit	PC drum cover
Mirror facets	12
Mirror speed	19500 RPM – 240 DPI 26325 RPM – 300 DPI
Scan time	256 µsec – 240 DPI 345 µsec – 300 DPI

Printhead (Four-Beam)

Table 22. Four-Beam Printhead Views, Front and Rear

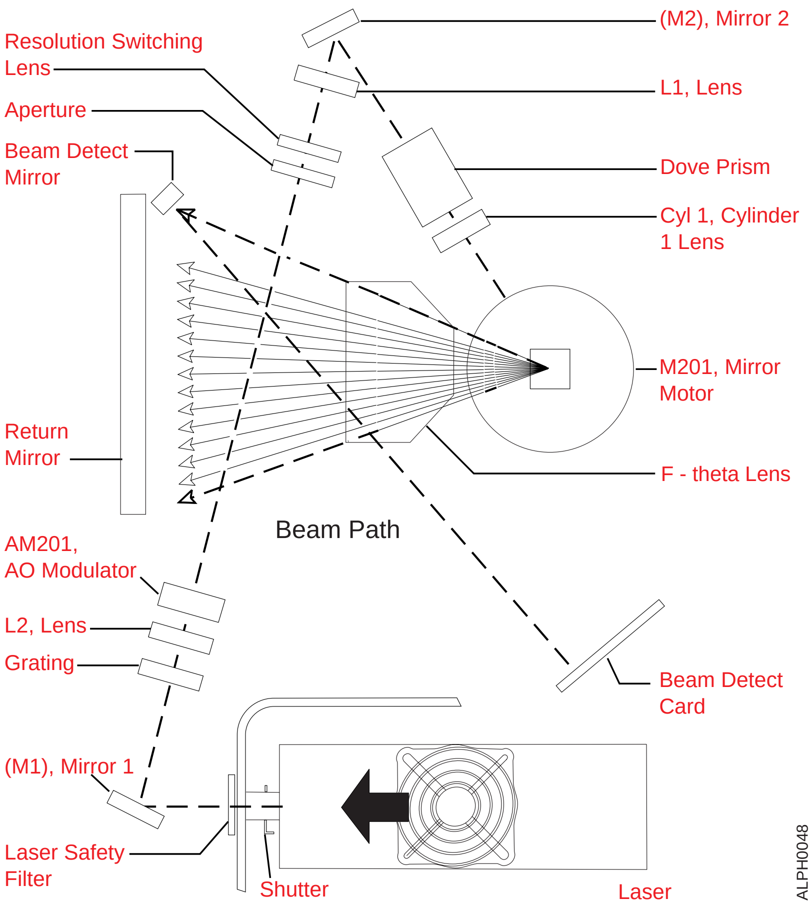


The four-beam printhead is used in printers with 600 DPI or 480/600 DPI resolution that run at 150 PPM only.

The printhead creates beams of light that discharge the charged PC drum to write the latent image. To generate the beams and write a series of dots on the drum, the printhead uses a laser, mirrors, lenses, prisms, a modulator, an aperture, and a beam-detect card. A multifaceted rotating mirror scans the beam along the axis of the rotating drum.

Table 22 shows two views of the two-beam switchable resolution printhead exploded from the printer. Table 23 on page 99 shows how the beam is generated and passes through the various elements of the printhead.

Table 23. Elements in the Four-Beam Path



You can compare the drawings in Table 22 on page 98 and Table 23 to orient yourself with regard to the position of the elements in the beam path. Refer to Table 23 as you read the descriptions that follow. In describing the condition of the laser beam, these terms are used:

Focus
The rays of the beam are converging toward a point; that is, the diameter of the beam is becoming smaller.

Diverging or expanding
The rays of the beam are spreading; that is, the diameter of the beam is becoming larger.

Parallel
The rays of the beam are neither diverging or converging; that is, the diameter of the beam is not changing.

Laser

The argon gas laser provides a beam of visible blue light. The beam is produced at a power of 19.5 to 20.5 mW and a wavelength of 488 nm. The beam diameter is 0.65 mm. The laser power supply controls the output power of the laser.

The laser turns on during initialization process when power is applied to the printer and normally remains on as long as the printer is on. However, the laser can be off when printer power is on. The laser is off momentarily when the printer is powered on and can be turned off in diagnostic mode.

Laser Power Supply

The laser is current-controlled by the laser power supply to one of two possible states: full printing power and standby power.

The power output of the laser is constantly controlled during printing from 19.5 to 20.5 mW by varying the current as necessary. The end of life of the laser occurs when it requires more current than the supply can provide.

Standby power is used to prolong the life of the laser by reducing the output power from 0 to 3 mW. A timer causes the supply to drop to standby power after a few minutes of inactivity. The laser power can rise to full operating power within a few seconds.

Shutter

The shutter is a sliding mechanism that allows the laser beam to pass through when it is open and blocks the laser beam when it is closed. You use the shutter to block the beam if you must work on the printhead with power on.

Band Pass Filter

The band pass filter filters out extraneous side bands of light that could cause ghost images when printing at slower speeds.

Safety Filter

The operating power of the laser can damage the eyes. A filter is mounted between the laser and mirror M1 to reduce the operating power to a safe level for maintenance. The safety filter consists of an attenuating lens mounted in a filter mechanism which is spring loaded so that it automatically moves into place when the printhead cover is removed.

After the beam passes through the safety filter, it goes to mirror M1 and on through the rest of the beam path.

Mirror M1

As the beam leaves the shutter area, it strikes mirror M1. Mirror M1 turns the beam and directs it to the Grating.

Grating

The Grating splits the laser beam vertically into 4 equal power beams. The beams then go to Lens L2.

Note: There are often several more very low power beams created by the Grating. These beams are eliminated within the printhead and do not reach the photoconductor.

Lens L2

Lens L2 focuses the beam on the entry hole in the AO modulator.

AO Modulator

The laser beams must be turned off and on very quickly to write the desired image. Because it is not possible to cycle a gas laser at that rate, a beam-splitting device called an acousto-optic (AO) modulator is used. Because there are four beams to be controlled, the AO modulator has 4 channels. Each channel controls one of the beams.

The AO modulator is a transparent crystal that allows the laser beam to pass through it. When the individual channels of the crystal are driven, each laser beam is split into four beams that emerge at predictable angles from the input beams. One of these beams, called the *primary beam* (one for each channel), is used to write the image on the drum.

Placing a piece of white paper between the AO modulator and Lens L1 (within 1 to 3 inches from the AO modulator), displays the beams as they leave the AO modulator. When the AO modulator is not driven, only the input, or zero beams, are present. The zero beams always pass through the AO modulator in a straight line, whether or not the modulator is driven. When the modulator is not driven, the beams leave the modulator as shown in Figure 10.

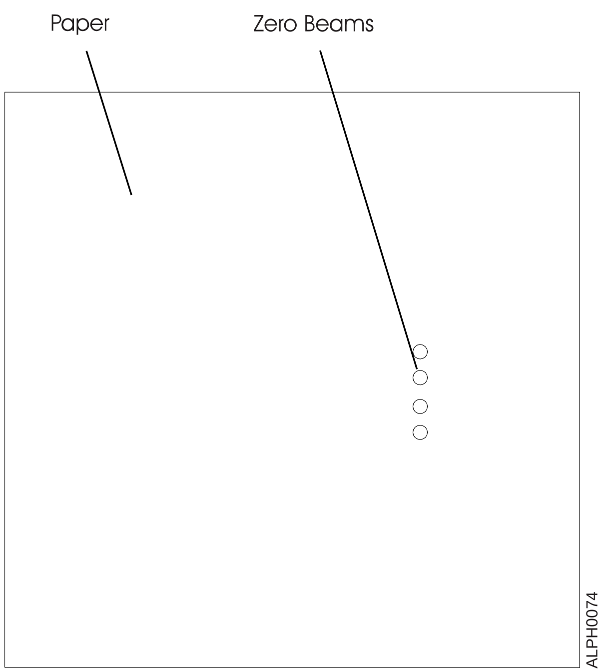


Figure 10. Four Unmodulated Beams from AO Modulator

When the four channels of the modulator are driven, the four beams leave the modulator as shown in Figure 11 on page 103.

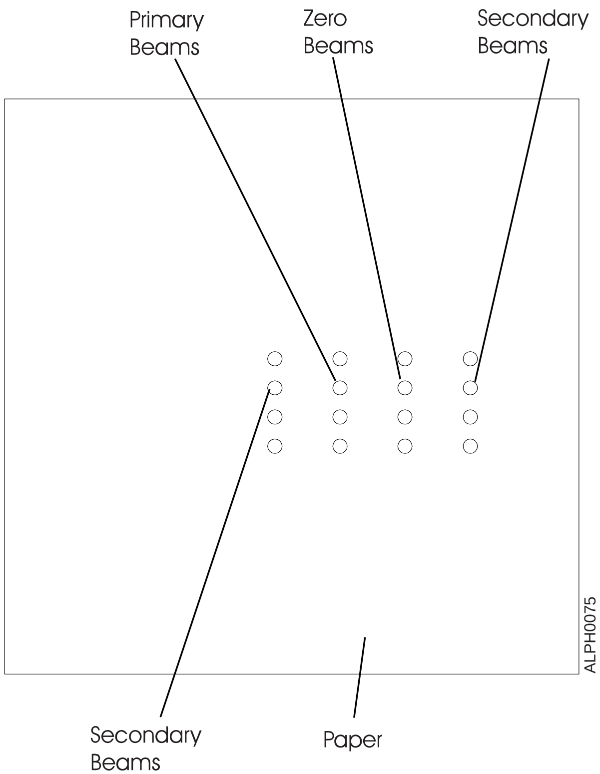


Figure 11. Four Modulated Beams from AO Modulator

The power is not the same in the four output beams (as viewed horizontally) of the AO modulator. The beam power can be greatly varied by changing the angle at which the beam strikes the crystal. For this reason, the AO modulator is mounted on a fixture that permits rotation in two directions. When the AO modulator is correctly adjusted, about 65% of the input beam power can be directed into the writing, or primary beam. Even a very small movement of the AO modulator can have a large effect on the beam power. For this reason, shaking of the printhead, which may occur in shipping, can cause a maladjustment of the AO modulator.

AO Driver and Video Data

The AO driver (not shown) converts the on/off logic signal from the control unit to a driving signal for the AO modulator. It can be adjusted to give more or less beam power at the AO modulator.

The on/off signal is called video data, or CVD. It is a high-frequency signal that is carried by coaxial cables for noise immunity.

Aperture

The zero beams always pass through the AO modulator. If they were allowed to reach the PC drum, they would write a totally black page for every page. The aperture is a hole in a metal fixture that passes the writing, or primary beams, and absorbs the idle, or zero beams, to prevent them from reaching the PC drum surface.

Resolution Switching Lens

The resolution switching lens allows the printhead to print at 480 DPI by changing the size of the beam when the lens is placed in the beam path. When the resolution switching lens is not in the beam path, the printhead prints at 600 DPI.

The two-piece lens is mounted on an arm that is lifted by a cam driven by a dc motor. The position of the lens is determined by the resolution value set in Printer Configuration.

Lens L1

The beams that leave the modulator are diverging from their focused condition. Lens L1 modifies the shape of the beams and transmits them to Mirror 2. The beams that leave lens L1 are circular and parallel.

Mirror M2

Mirror M2 turns the beams and directs them to the Dove Prism and the Cylinder 1 lens.

Dove Prism

The Dove prism rotates the beams almost 90°. When leaving the Dove prism, the beams are spaced so that when they reach the PC drum, they are 1 pel apart vertically and about 32–47 pels apart horizontally.

Cylinder 1 Lens

The cylinder 1 lens focuses the shaped and aligned light beams onto the mirror surfaces of the rotating scanning mirror. The cylinder 1 lens focuses the beams only in the vertical direction. The result is that the beams that strike the rotating mirror (scanning mirror) are lines rather than circular spots.

Scanning Mirror

For the beams to be able to write on all printable positions of the PC drum, they must move across the drum and down the page area of the drum. The scanning mirror creates scan lines by moving the beams across the PC drum. Because the PC drum is also turning, each subsequent scan line is placed directly below the previous scan lines on the page area of the PC drum.

The scanning mirror is a 10-faceted mirror that is mounted on high-quality air bearing and turns at 19128 RPM.

Each facet of the scan mirror creates 4 scan lines on the PC drum as it scans across, because there are 4 beams on each facet.

The mirror is driven by a three-phase synchronous motor. The high quality of the air bearing allows the mirror to spin for minutes after the motor has been turned off. The rotational speed of the mirror is checked internally by an LED light source and phototransistor receiver.

The scanning mirror is positioned just above the mirror motor as shown in Table 23 on page 99. As the mirror rotates, the beams strike the facet at a different angle, causing the beams to be reflected toward a different entry point on the F-Theta lens.

The motor is driven by it’s own control board, called the Mirror Motor Driver Board (MD192).

F-Theta Lens

The design of the F-Theta lens produces a beam of constant velocity and spot size with it’s curved surface. It also provides the correct magnification of the image.

Return Mirror

When the beams strike the return mirror, they are reflected down toward the PC drum, writing the latent image. The return mirror can be adjusted to control where the first line appears on the page.

Beam-Detect Mirror

The beam-detect mirror receives the beams from the F-Theta lens and reflects them to the beam-detect card.

Beam-Detect Card

The beam-detect card creates a short electrical pulse when the laser beams are scanned across it. This pulse is used by the MIC card to determine when to turn on the laser for each scan line on the page.

The electronics on the B1J11 Card and the factory adjust print function in the control unit allow you to change the start-of-scan position. This is done by changing the delay time between when the beam-detect pulse is sensed and when printing begins.

The beam-detect card requires that the beams be correctly aligned on it’s sensor and that the beams have enough power. Because this is the only sensor beyond the laser itself, it detects most of the problems in the printhead.

Fan

Three fans provide air to the printhead. One fan is mounted on the laser to provide cooling to the interior of the laser mechanism. A second fan mounted behind the mirror motor (viewed from the front of the printhead) cools the mirror motor. The third fan, mounted in front of the mirror motor, pressurizes the printhead to keep paper dust, toner, and other contamination from settling on the optics.

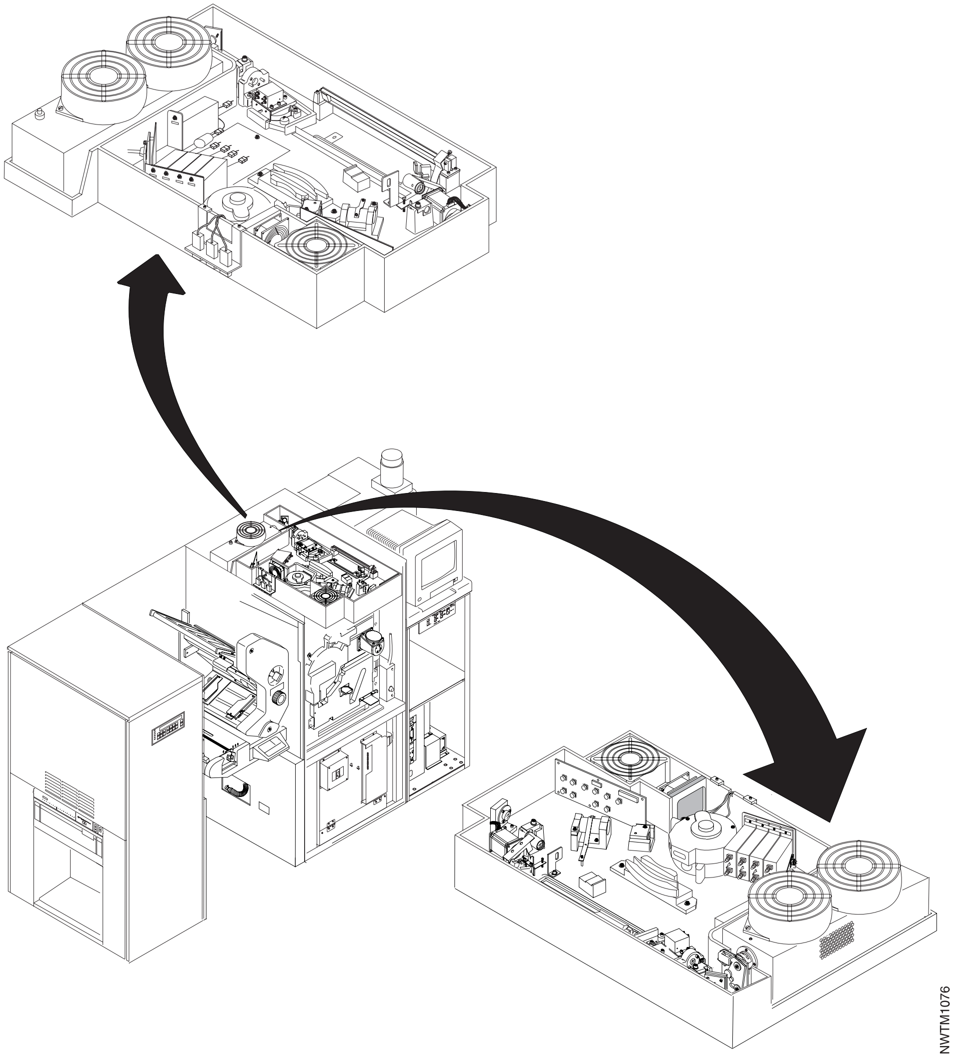
Four-Beam Printhead Specifications

Table 24. four-Beam Printhead Specifications

Item	Value
Operating laser power	19.5 to 20.5 mW
Wavelength	488 nm
Beam diameter at laser	0.65 mm
Beam diameter at PC drum	0.060 X 0.080 mm
Power loss through optics	57%%
Beam power at PC drum	>1.28 mW per beam (4)
Safety filter	<4.5% of operating power
Interlock circuit	PC drum cover
Mirror facets	10
Mirror speed	19128 RPM
Scan time	313.7 msec

Printhead (Five-Beam)

Table 25. Five-Beam Printhead Views, Front and Rear

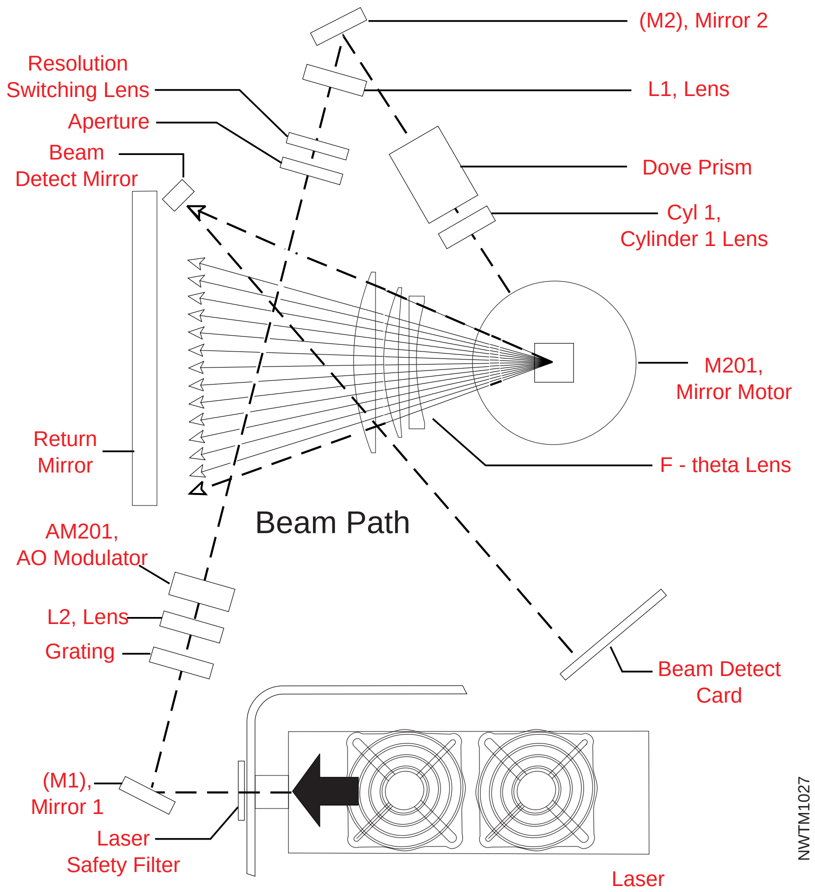


The five-beam printhead is used in printers with 600 DPI or 480/600 DPI resolution that run at 229 PPM only.

The printhead creates beams of light that discharge the charged PC drum to write the latent image. To generate the beams and write a series of dots on the drum, the printhead uses a laser, mirrors, lenses, prisms, a modulator, an aperture, and a beam-detect card. A multifaceted rotating mirror scans the beam along the axis of the rotating drum.

Table 25 shows two views of the two-beam switchable resolution printhead exploded from the printer. Table 26 on page 109 shows how the beam is generated and passes through the various elements of the printhead.

Table 26. Elements in the Five-Beam Path



You can compare the drawings in Table 25 on page 108 and Table 26 to orient yourself with regard to the position of the elements in the beam path. Refer to Table 26 as you read the descriptions that follow. In describing the condition of the laser beam, these terms are used:

Focus
: The rays of the beam are converging toward a point; that is, the diameter of the beam is becoming smaller.

Diverging or expanding
: The rays of the beam are spreading; that is, the diameter of the beam is becoming larger.

Parallel
: The rays of the beam are neither diverging or converging; that is, the diameter of the beam is not changing.

Laser

The argon gas laser provides a beam of visible blue light. The beam is produced at a power of 29.5 to 30.5 mW and a wavelength of 488 nm. The beam diameter is 0.65 mm. The laser power supply controls the output power of the laser.

The laser turns on during initialization process when power is applied to the printer and normally remains on as long as the printer is on. However, the laser can be off when printer power is on. The laser is off momentarily when the printer is powered on and can be turned off in diagnostic mode.

Laser Power Supply

The laser is current-controlled by the laser power supply to one of two possible states: full printing power and standby power.

The power output of the laser is constantly controlled during printing from 19.5 to 20.5 mW by varying the current as necessary. The end of life of the laser occurs when it requires more current than the supply can provide.

Standby power is used to prolong the life of the laser by reducing the output power from 0 to 3 mW. A timer causes the supply to drop to standby power after a few minutes of inactivity. The laser power can rise to full operating power within a few seconds.

Shutter

The shutter is a sliding mechanism that allows the laser beam to pass through when it is open and blocks the laser beam when it is closed. You use the shutter to block the beam if you must work on the printhead with power on.

Band Pass Filter

The band pass filter filters out extraneous side bands of light that could cause ghost images when printing at slower speeds.

Safety Filter

The operating power of the laser can damage the eyes. A filter is mounted between the laser and mirror M1 to reduce the operating power to a safe level for maintenance. The safety filter consists of an attenuating lens mounted in a filter mechanism which is spring loaded so that it automatically moves into place when the printhead cover is removed.

After the beam passes through the safety filter, it goes to mirror M1 and on through the rest of the beam path.

Mirror M1

As the beam leaves the shutter area, it strikes mirror M1. Mirror M1 turns the beam and directs it to the Grating.

Grating

The Grating splits the laser beam vertically into 5 equal power beams. The beams then go to Lens L2.

Note: There are often several more very low power beams created by the Grating. These beams are eliminated within the printhead and do not reach the photoconductor.

Lens L2

Lens L2 focuses the beam on the entry hole in the AO modulator.

AO Modulator

The laser beams must be turned off and on very quickly to write the desired image. Because it is not possible to cycle a gas laser at that rate, a beam-splitting device called an acousto-optic (AO) modulator is used. Because there are four beams to be controlled, the AO modulator has 5 channels. Each channel controls one of the beams.

The AO modulator is a transparent crystal that allows the laser beam to pass through it. When the individual channels of the crystal are driven, each laser beam is split into five beams that emerge at predictable angles from the input beams. One of these beams, called the *primary beam* (one for each channel), is used to write the image on the drum.

Placing a piece of white paper between the AO modulator and Lens L1 (within 1 to 3 inches from the AO modulator), displays the beams as they leave the AO modulator. When the AO modulator is not driven, only the input, or zero beams, are present. The zero beams always pass through the AO modulator in a straight line, whether or not the modulator is driven. When the modulator is not driven, the beams leave the modulator as shown in Figure 12.

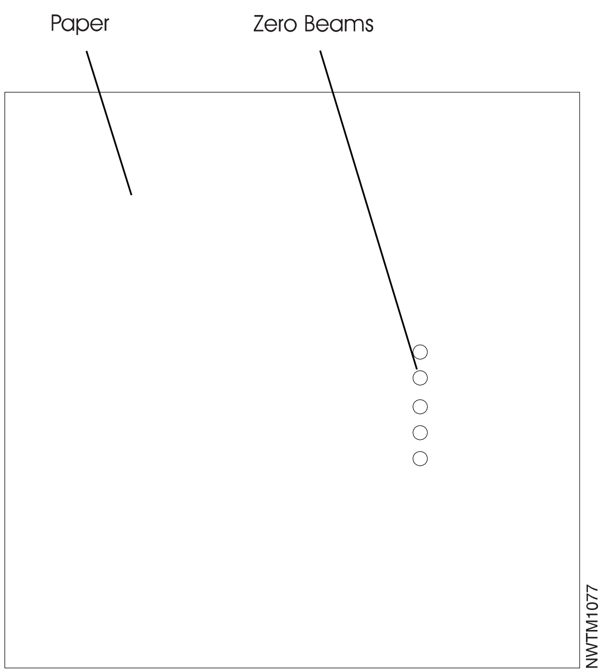


Figure 12. Five Unmodulated Beams from AO Modulator

When the five channels of the modulator are driven, , the five beams leave the modulator as shown in Figure 13 on page 113.

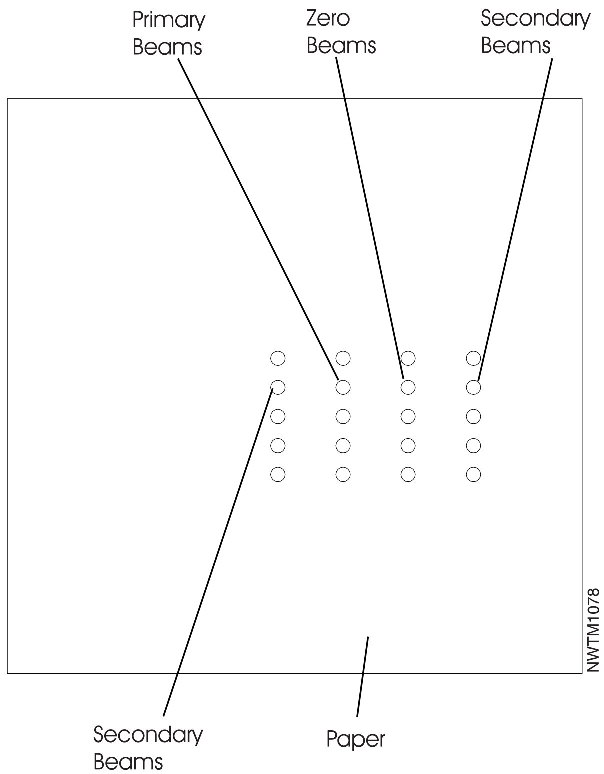


Figure 13. Five Modulated Beams from AO Modulator

The power is not the same in the four output beams (as viewed horizontally) of the AO modulator. The beam power can be greatly varied by changing the angle at which the beam strikes the crystal. For this reason, the AO modulator is mounted on a fixture that permits rotation in two directions. When the AO modulator is correctly adjusted, about 65% of the input beam power can be directed into the writing, or primary beam. Even a very small movement of the AO modulator can have a large effect on the beam power. For this reason, shaking of the printhead, which may occur in shipping, can cause a maladjustment of the AO modulator.

AO Driver and Video Data

The AO driver (not shown) converts the on/off logic signal from the control unit to a driving signal for the AO modulator. It can be adjusted to give more or less beam power at the AO modulator.

The on/off signal is called video data, or CVD. It is a high-frequency signal that is carried by coaxial cables for noise immunity.

Aperture

The zero beams always pass through the AO modulator. If they were allowed to reach the PC drum, they would write a totally black page for every page. The aperture is a hole in a metal fixture that passes the writing, or primary beams, and absorbs the idle, or zero beams, to prevent them from reaching the PC drum surface.

Resolution Switching Lens

The resolution switching lens allows the printhead to print at 480 DPI by changing the size of the beam when the lens is placed in the beam path. When the resolution switching lens is not in the beam path, the printhead prints at 600 DPI.

The two-piece lens is mounted on an arm that is lifted by a cam driven by a dc motor. The position of the lens is determined by the resolution value set in Printer Configuration.

Lens L1

The beams that leave the modulator are diverging from their focused condition. Lens L1 modifies the shape of the beams and transmits them to Mirror 2. The beams that leave lens L1 are circular and parallel.

Mirror M2

Mirror M2 turns the beams and directs them to the Dove Prism and the Cylinder 1 lens.

Dove Prism

The Dove prism rotates the beams almost 90°. When leaving the Dove prism, the beams are spaced so that when they reach the PC drum, they are 1 pel apart vertically and about 32–47 pels apart horizontally.

Cylinder 1 Lens

The cylinder 1 lens focuses the shaped and aligned light beams onto the mirror surfaces of the rotating scanning mirror. The cylinder 1 lens focuses the beams only in the vertical direction. The result is that the beams that strike the rotating mirror (scanning mirror) are lines rather than circular spots.

Scanning Mirror

For the beams to be able to write on all printable positions of the PC drum, they must move across the drum and down the page area of the drum. The scanning mirror creates scan lines by moving the beams across the PC drum. Because the PC drum is also turning, each subsequent scan line is placed directly below the previous scan lines on the page area of the PC drum.

The scanning mirror is a 10-faceted mirror that is mounted on high-quality air bearing and turns at 23400 RPM in 600 DPI mode and 18720 RPM in 480 DPI mode.

Each facet of the scan mirror creates 5 scan lines on the PC drum as it scans across, because there are 5 beams on each facet.

The mirror is driven by a three-phase synchronous motor. The high quality of the air bearing allows the mirror to spin for minutes after the motor has been turned off. The rotational speed of the mirror is checked internally by an LED light source and phototransistor receiver.

The scanning mirror is positioned just above the mirror motor as shown in Table 26 on page 109. As the mirror rotates, the beams strike the facet at a different angle, causing the beams to be reflected toward a different entry point on the F-Theta lens.

The motor is driven by it’s own control board, called the Mirror Motor Driver Board (MD192).

F-Theta Lens

The design of the F-Theta lens produces a beam of constant velocity and spot size with it’s curved surface. It also provides the correct magnification of the image.

Return Mirror

When the beams strike the return mirror, they are reflected down toward the PC drum, writing the latent image. The return mirror can be adjusted to control where the first line appears on the page.

Beam-Detect Mirror

The beam-detect mirror receives the beams from the F-Theta lens and reflects them to the beam-detect card.

Beam-Detect Card

The beam-detect card creates a short electrical pulse when the laser beams are scanned across it. This pulse is used by the MIC card to determine when to turn on the laser for each scan line on the page.

The electronics on the B1J11 Card and the factory adjust print function in the control unit allow you to change the start-of-scan position. This is done by changing the delay time between when the beam-detect pulse is sensed and when printing begins.

The beam-detect card requires that the beams be correctly aligned on it’s sensor and that the beams have enough power. Because this is the only sensor beyond the laser itself, it detects most of the problems in the printhead.

Fan

Four fans provide air to the printhead. Two fans are mounted on the laser to provide cooling to the interior of the laser mechanism. A third and fourth fan mounted in front of the mirror motor (viewed from the front of the printhead) cools the mirror motor and pressurizes the printhead to keep paper dust, toner, and other contamination from settling on the optics.

Five-Beam Printhead Specifications

Table 27. Five-Beam Printhead Specifications

Item	Value
Operating laser power	29.5 to 30.5 mW
Wavelength	488 nm
Beam diameter at laser	0.65 mm
Beam diameter at PC drum	0.060 X 0.080 mm
Power loss through optics	57%
Beam power at PC drum	>1.8 mW per beam (4)
Safety filter	<3.0% of operating power
Interlock circuit	PC drum cover
Mirror facets	10
Mirror speed	23400 RPM – 600 DPI 18720 RPM – 480 DPI
Scan time	256.41 msec– 600 DPI 320.51 msec– 480 DPI

Photoconductor Drum and Charging Mechanism

Table 28. PC Drum Subsystem

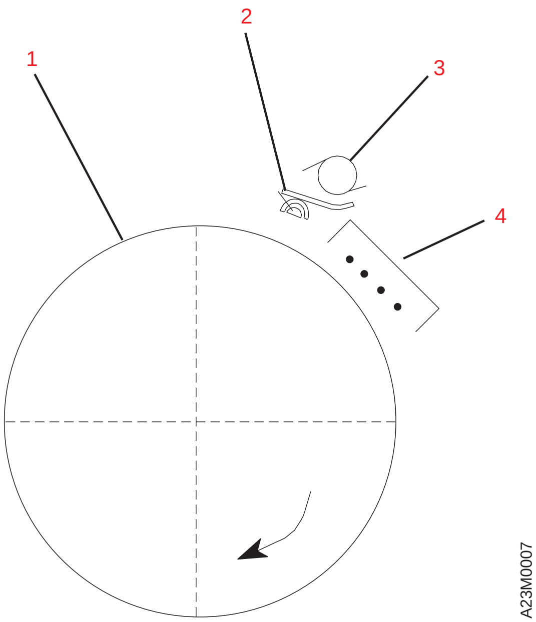


Table 28 shows a cross-sectional view of the photoconductor (PC) drum and the charging mechanism. The charging mechanism consists of coronas and an erase lamp.

The PC drum **(1)** is driven in the direction indicated by the arrow. The drum rotates at 54.3 cm (21.25 in.) per second when operating at 150 ppm, 82.55 cm (32.5 in.) per second when operating at 229 ppm, and at 73.15 cm (28.8 in.) per second when operating at 310 or 324 ppm. Assume that the point of interest on the drum has just passed the cleaning mechanism. It now will pass under the precharge corona **(2)**, the secondary erase lamp **(3)**, and the charge corona **(4)**, in that order.

Drum Drive

The drum is driven by a dc servo motor through a toothed belt. Speed control is maintained through a precision encoder mounted directly at the rear of the motor.

Precharge Corona

The precharge corona **(2)** helps to remove any remaining charge that could result in a residual image from the previous cycle.

The transfer corona gives the PC drum a negative charge. The precharge corona brings the surface voltage back to a positive charge. The precharge corona has a charge of 0.3 V dc.

Secondary Erase Lamp

The secondary erase lamp unit **(3)** consists of a fluorescent lamp, a blue filter, and a photosensor. The erase lamp lights the PC drum through the filter to discharge the PC drum to approximately 0 volt. The photosensor detects any failure of the lamp to remain lighted.

Charge Corona

The charge corona **(4)** charges the PC drum surface to approximately +480 to +800 V dc. The actual voltage depends on the position of the contrast setting and the life of the developer mix.

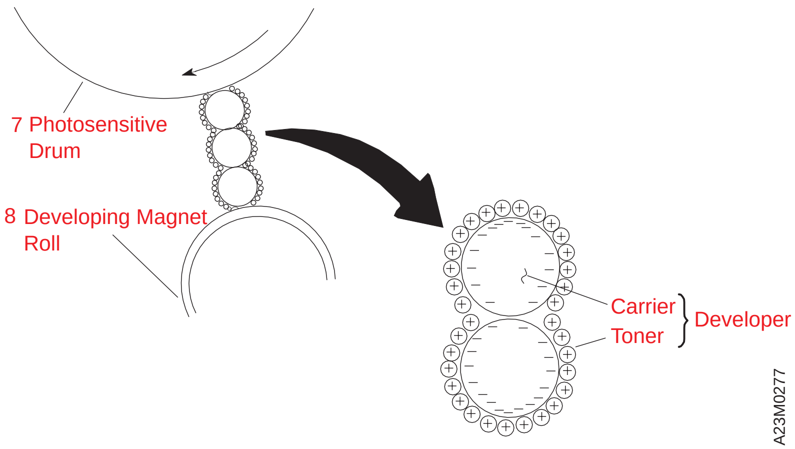
PC Drum and Charging Mechanism Specifications

Table 29. PC Drum and Charging Mechanism Specifications

Item	Value
Drum rotation speed (150 ppm)	54.0 cm/sec (21.25 in./sec)
Drum rotation speed (229 ppm)	82.5 cm/sec (32.5 in./sec)
Drum rotation speed (310 ppm)	111.8 cm/sec (44.0 in./sec)
Drum rotation speed (324 ppm)	116.8 cm/sec (46.0 in./sec)
Rotation per scan line	0.1024 mm
Precharge corona voltage	0.3 V dc
PC drum surface charge	+ 400 to + 900 V dc

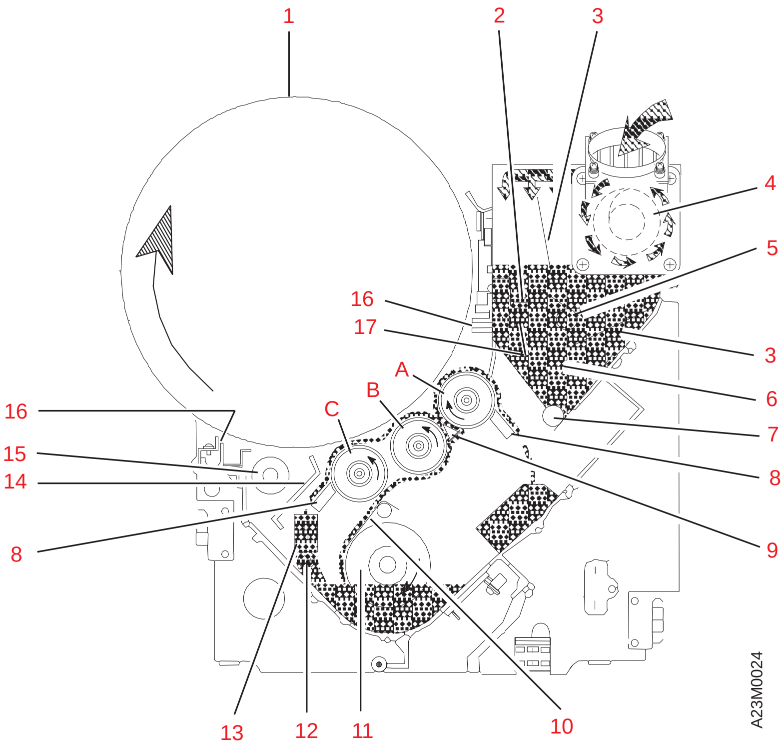
Developer

Table 30. Toner Transfer to the PC Drum



The developer brings developer mix into contact with the charged PC drum. When the developer mix is in contact with the PC drum, the toner can be transferred to the latent image on the drum.

Table 31. Developer Operation



The developer components are shown in Table 31. For discussion, the developer can be divided into two general areas: the toner flow area and the mix flow area. The upper right portion of the developer is the toner flow area **(6)**; the rest of the developer is the mix flow area.

Mix

The developer mix consists of plastic toner and iron beads. The beads become negatively charged and the toner becomes positively charged. Because of this opposite charging, the toner and beads are strongly attracted to each other. This coupling force must be overcome for the toner to leave the developer and become attached to the PC drum **(1)**. Some of the most common print-quality problems (light print, background, non-uniform prints, or end-of-life of the mix) can be caused by a toner charging problem.

The charge is developed through the friction of the toner on the beads and is affected by humidity, the amount of printing for which the carrier beads are used, and the amount of toner in the developer.

New beads have rough surfaces, and so new mix causes the toner to have a high charge. High charge causes the toner to adhere strongly to the beads and results in light print. Eventually, toner becomes packed in the rough surfaces of the beads, reducing the ability of the beads to charge the toner. The end-of-life of the mix occurs when low toner charge results in poor solid area fill, then background and dark print.

The addition of extra toner to the mix also results in low toner charge. This is because there are more toner particles for each carrier bead, and so the toner spends less time in contact with the beads. Increasing the amount of toner in the mix can result in darker prints by reducing the binding force to the carrier beads. However, this lower-charged toner can result in background and wider stroke width.

Table 32. Mix Specification Summary

Item	Value
Carrier bead diameter	70 to 140 µm; 100 µm avg
Toner particle diameter	11.5 to 12.5 µm

Mix Flow

Developer

A shear force is required to remove the toner from the carrier beads. The toner is rubbed from the beads when the PC drum drags through a pile of mix. One purpose of the developer is to provide a pile of the correct size, and constantly supply it with charged toner.

Table 30 shows one of the many stacks of carrier beads and toner that pile up on the mag brushes. As the PC drum rotates, the toner is wiped from the carrier beads and attaches itself to the discharged areas of the drum.

Conveyor Roll

The conveyor roll **(11)** (Table 31) lifts fresh mix from the bottom of the developer and passes it over the lift plate **(10)** (Table 31) to mag brush **C**. The roll consists of an aluminum sleeve rotating around fixed magnets. The magnets attract the beads, and the sleeve carries the mix to the lift plate. The positions of the magnets inside the roll can be adjusted.

Mag Brushes

The mag brushes **A , B, & C** are similar to the conveyor roll, because their function is to receive the mix from the roll and lift it to the PC drum.

The mag brushes get their name from the appearance of the mix in the area of contact with the PC drum. The magnetic field causes the beads to form chains that look like the bristles of a brush. The position of the magnets within the mag brushes is critical because the magnets affect the transfer and the shape of the bead chains that contact the drum.

Doctor Blade

The doctor blade **(9)** (Table 31) smooths and levels the mix on mag brushes **A and B** before it reaches the PC drum. The gap setting between it and the mag brushes is critical because it controls the amount of mix that reaches the drum. Too little mix can result in light print, and too much mix piles up because it cannot flow between the drum and the mag brushes. Between these extremes, other print quality problems can result from a poorly set gap.

Scraper Blades

The bead chains on the mag brushes have their toner removed when they contact the PC drum. The scraper blades **(8)** (Table 31) scrape off these beads so the mag brushes can pick up fresh mix from the conveyor roll.

The mix that is removed by the scraper blades returns to the developer mix. There, it is mixed with fresh toner and recharged to attract the toner to the carrier beads.

Lower Seal

The lower seal **(14)** (Table 31) rises vertically above the left scraper blade **(8)** (Table 31). It’s purpose is to contain the mix coming off mag brush **C** and prevent it from contaminating the PC drum cavity.

Developer Bias
The developer bias is applied to the mag brushes to aid in development of the black fill areas by repelling the toner toward the drum. The positively charged toner particles that are sheared off the beads are attracted to the more negative discharged areas. The developer bias is also applied to the doctor and scraper blades to keep toner from building up on these surfaces.

Scavenger Roll
Because the carrier beads are negatively charged, they are attracted to the positively charged PC drum. Occasionally, a bead is carried out by the drum. This bead will leave a large void on the print if it reaches the transfer point.

To prevent this problem, a strong magnetic roller called a scavenger roll **(15)**, (Table 31) is provided. The scavenger roll uses magnetic force to pull the iron beads from the surface of the PC drum. A motor constantly turns the scavenger roll to wipe the beads onto a plastic wiper.

Air Suction
To prevent loose toner from migrating from the developer and contaminating the rest of the printer, the developer has air suction gaps **(16)** (Table 31) at the left and right sides. The air suction gap is a metal bar with a groove in it. The groove is connected to the cleaning system through a grommet at the rear of the developer. The vacuum that draws toner through the cleaner station also draws the toner that tries to escape through the air suction and prevents if from migrating to the rest of the printer.

Toner Control System and Toner Flow
The amount of toner mixed with the carrier beads has a strong effect on print quality. For this reason, the toner is loaded and stored in a separate chamber and is fed slowly into the mixing area when needed.

Toner Loading

Toner cannot be loaded into the printer while the printer is running, unless the Enhanced Toner Loading Feature is installed.

Without the Enhanced Toner Loading Feature installed, the toner feed motor loads toner from a new bottle of toner into the toner hopper when rotating in one direction and feeds toner from the toner hopper down into the developer when rotating in the opposite direction.

With the Enhanced Toner Loading Feature installed, an additional motor is provided to just load toner into the toner hopper, while the toner feed motor just feeds toner from the toner hopper to the developer, thus allowing toner loading and toner feeding to occur at the same time.

Without the Enhanced Toner Loading Feature Installed: When the toner low sensor detects the absence of toner in the toner hopper, the printer continues printing for an additional 1000 feet of forms, then printing will stop and an `Add Toner` window is displayed on the Display/Touch Screen. Printing cannot resume until toner has been added to the toner hopper.

When a bottle of toner is attached to the toner inlet and the **Toner Supply** push-button is pressed, the toner feed motor turns the toner-loading auger **(4)** inTable 31 for 80 seconds to pull the toner toward the rear of the developer.

With the Enhanced Toner Loading Feature Installed: When the toner low sensor detects the absence of toner in the toner hopper, the printer continues printing for an additional 200 feet of forms, then a `Toner Supply Low` window is displayed on the Display/Touch Screen while printing continues. The operator has until an additional 800 feet of forms are processed to add toner while printing continues. Once the 800 feet of forms has been processed without adding toner, printing will stop and an `Add Toner` window is displayed on the Display/Touch Screen. Printing cannot resume until toner has been added to the toner hopper.

When a bottle of toner is attached to the toner inlet and the **Toner Supply** button is pressed while the `Toner Supply Low` window is displayed on the Display/Touch Screen, the new toner supply motor turns the toner-loading auger **(4)** (Table 31) for 100 seconds to pull the toner toward the rear of the developer.

Toner Feed

When the concentration of toner in the developer mix becomes too low:

Without the Enhanced Toner Loading Feature Installed: The toner feed motor is signaled to turn in the direction opposite to the direction that drives to toner loading auger.

With the Enhanced Toner Loading Feature Installed: The toner feed motor turns only in the direction required to feed toner to the developer.

Whether or not the Enhanced Toner Loading Feature is installed, the motor then drives the toner hopper paddle shaft **(5)** (Table 31) and the toner-feed shaft **(7)** (Table 31).

The toner hopper paddle drives the toner down toward the toner-feed shaft. At the same time, the hopper paddle strikes the toner-beat plates **(3)** (Table 31) and the tab **(2)** (Table 31) near the toner-empty sensor **(17)** (Table 31). The two toner-beat plates vibrate as they are released by the toner hopper paddle and keep the toner loose so it can fall through the hopper to the toner-feed shaft. The tab near the toner-empty sensor vibrates to keep toner from building up around the toner-empty sensor and preventing sensing of a toner-empty condition.

As the toner-feed shaft turns, notches in the shaft pick up measured amounts of toner and transfer it to the developer mix. The plate above the toner-feed shaft ensures that the toner does not pack into and remain in the notches.

Toner Concentration Control

Note: The following applies whether or not the Enhanced Toner Loading Feature is installed. The toner control box **(13)** (Table 31) is located under the left scraper blade. As the used mix is scraped back, it is collected in the toner control box for sampling.

An electrical coil in the toner control box acts as an inductor in the sensing circuit. The amount of iron in the developer mix that flows past the sensor affects the inductance. When more toner is fed into the developer, there is proportionately less iron in the developer mix as a result. Toner feeds are controlled in this manner. A roller **(12)** (Table 31) under the toner control box allows a measured flow of mix through it.

The toner concentration (TC) is controlled by the PC211/PC531/PC551 Card. The level of TC is automatically reduced at programmed intervals of 10000 feet or more of developer mix life to keep background low.

Toner-Empty Sensor

The level of toner in the developer is sensed by a vibrating crystal in the toner-empty sensor **(17)** (Table 31). When the toner level falls below the crystal, the crystal vibrations are no longer damped, and the increased voltage across the crystal is sensed by the PC211/PC531/PC551 Card.

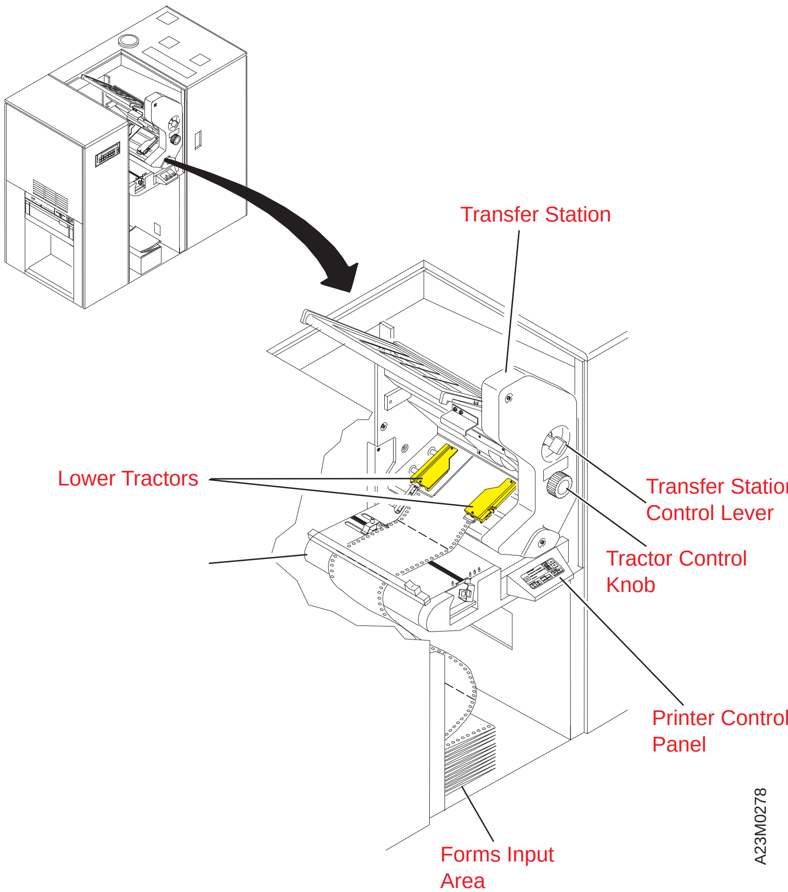
Without the Enhanced Toner Loading Feature Installed: The `Add Toner` message is posted when the crystal remains undamped for 1000 feet of forms processed.

With the Enhanced Toner Loading Feature Installed: The `Toner Supply Low` message is posted when the crystal remains undamped for 200 feet of forms processed.

The `Add Toner` message is posted when the crystal remains undamped for an additional 800 feet of forms processed after the `Toner Supply Low` message is posted.

Input Area and Transfer Station

Table 33. Paper Path through the Input Area & Transfer Station



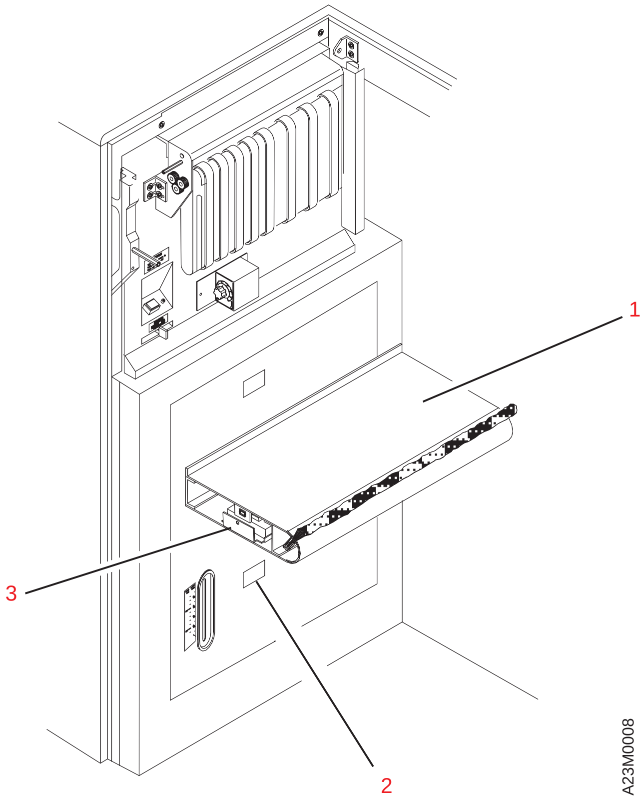
The input area and transfer station provide a place for the forms to enter the printer and make contact with the PC drum to transfer the developed image from the drum to the form. Table 33 shows the path the paper takes through the input area and transfer station.

Input Area

The input area provides a path for the forms from the stack of new forms to the transfer station as shown in Table 33. Elements in the input area are the input guide, end-of-forms sensors, and the splicing station.

Input Guide

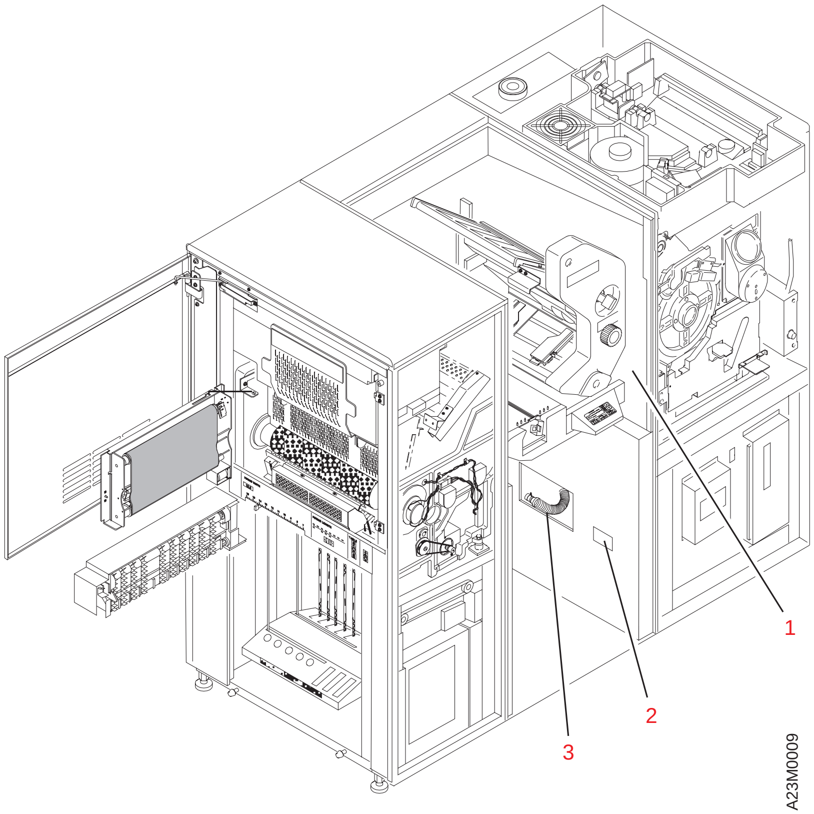
Table 34. Input Guide



This table shows the Input Guide **(1)** which is mounted on the left side of the input area. The input guide prevents multiple sheets of forms from feeding simultaneously and it also provides storage for the maintenance panel **(3)**

End-of-Forms Sensors

Table 35. Input Area

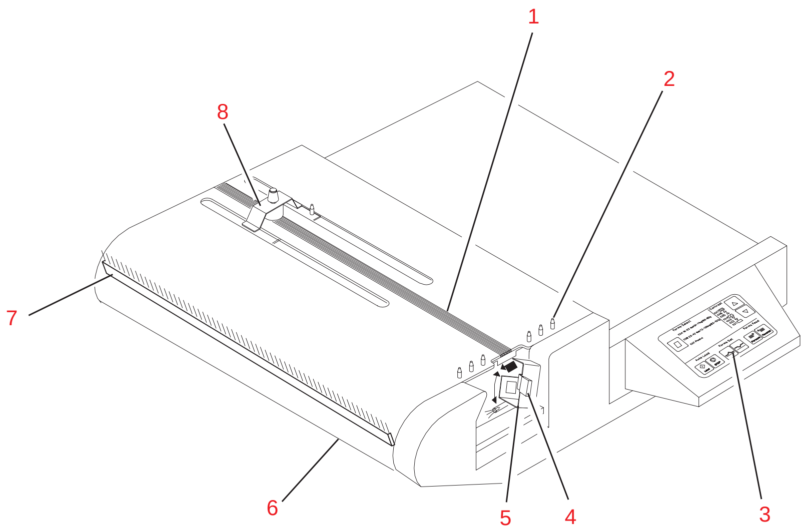


The last sheet in a box of forms is called the end of forms. It must be sensed early enough to stop the forms motion before the last form passes the splicing station.

The input area contains a sensor to detect the end of forms. The sensor consists of a visible red LED light source and a phototransistor receiver. The end-of-forms LED **(2)** in “Input Guide” on page 130 lights the end-of-forms phototransistor **(2)** on this page.

Splicing Station

Table 36. Splicing Station



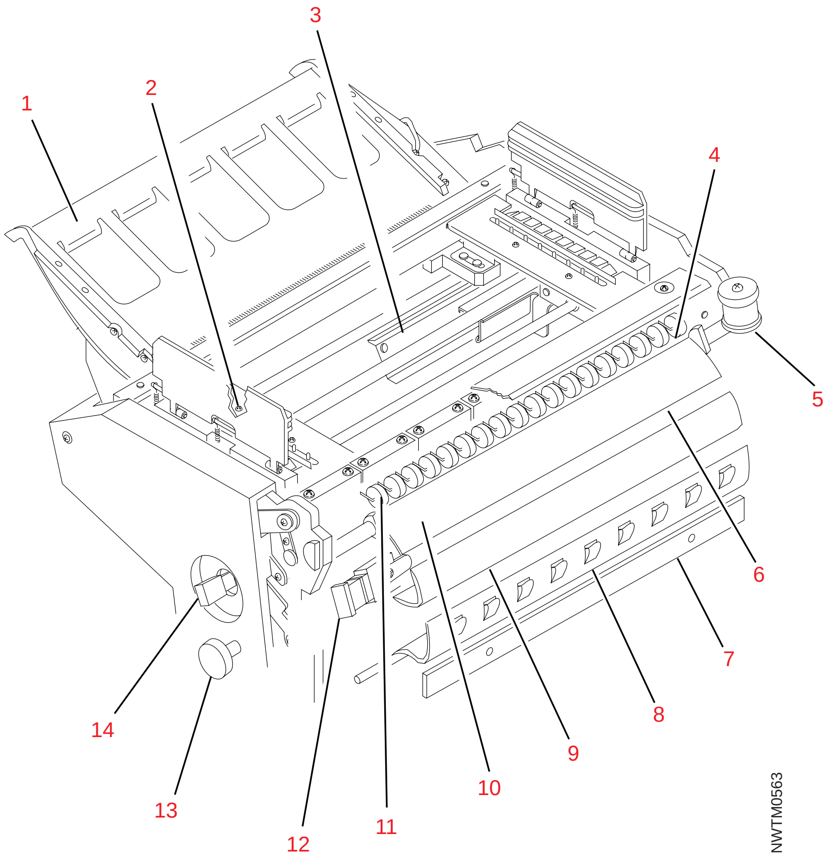
The splicing station provides a work surface to hold and align the forms while splicing tape is applied. An operator-controlled valve **(4)** applies vacuum to the tape slot **(1)** to hold the splicing tape in place. A sensor **(5)** detects the position of this valve to prevent vacuum loss at the vacuum plate in the fuser. Fixed pins **(2)** and movable pins **(8)** hold the forms while the splicing tape is applied.

As the forms enter the splicing table, they pass between two chad brushes The lower chad brush **(7)** is fixed to the splicing table. The upper chad brush (not shown) is hinged to the printer frame. The chad brushes remove loose material from the forms and remove any static charge that may build up on the forms.

The printer control panel **(3)** is mounted on the splicing table. This panel provides controls for loading forms into the printer, for moving paper through the printer, and for adjusting the heat used in the fusing station.

Transfer Station

Table 37. Transfer Station



The transfer station transfers the toner from the drum to the forms and moves the forms from the input area to the fuser. Its major components include the tractors, retractors, transfer corona, tension arm, jam sensors, premeasure shaft, forms width sensor, and the capstan pinch rolls.

Tractors

As the forms leave the splicing table, they enter the lower tractors (Table 33). The lower tractors are paired with the upper tractors (not shown) to move the forms through the transfer station to the fuser station. A single servo motor drives the upper and lower tractor drive shafts through a toothed belt. Each drive shaft drives two tractors, one in the front and one in the rear of the printer. The front tractors are fixed, and the rear tractors are adjusted to the correct forms width by cables wound by the tractor control knob.

Magnets, attached to the rear tractor, pass over the Hall-effect sensors on the forms width sensor board (PW091) **(3)** in “Transfer Station” on page 133 to register the forms width setting.

The rear tractor, when moved, pulls out a special tape **(5)** in “Transfer Station” on page 133 to shield the transfer corona from the toner on the drum in the area where no forms are present.

The tractor motor **(4)** “Tension Arm” on page 137 is a dc servo motor that is used during normal printing, during nonprocess runout (when the forms feed buttons are pressed) and during auto load. The servo motor allows the printer to count driving pulses to the motor to determine how far forms are being fed. Whenever forms feeding stops, the tractor motor reverses and positions the perforation ½ in. below the transfer point.

This operation allows for the time required to accelerate the forms to the speed of the drum before transfer begins. This reversing operation is called *backhitching,* and it is particularly noticeable when an extremely complex print job causes the forms path to stop often to allow the control unit to process the next page.

An encoder at the rear of the tractor motor gives a pulse every 0.167 inches. This is the basic clock unit between the printer and the control unit.

Retractors

The retractor **(9)** and **(10)** in Table 37 move the forms away from the drum at times when the forms and the drum are moving at different speeds. This occurs during nonprocess runout, forms acceleration, backhitching, and when the forms path is stopped but the drum continues to cycle during warm-up and between print jobs. Because of the difference in speeds, contact between the forms and the drum at these times would cause smearing from developed images and low-level background on the drum.

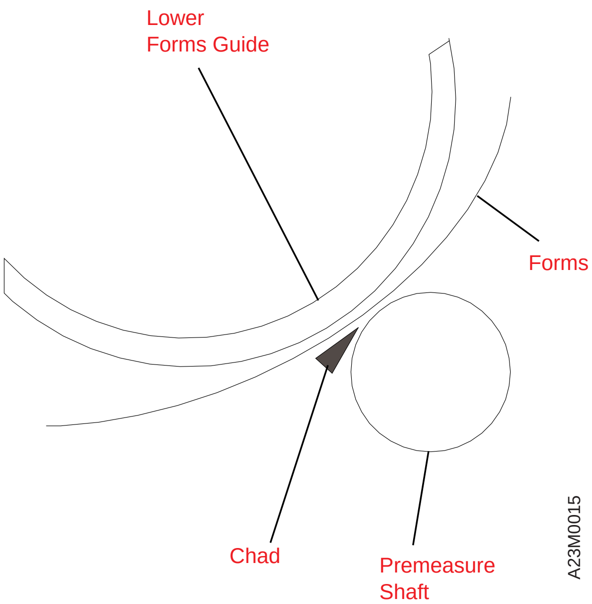
The retractors consist of two curved plates of the same width as the transfer station. They are moved by a crank mechanism driven by a dc servo motor directly through a coupling. The motor turns in only one direction.

Path Modifier

The path modifier **(8)** in (“Transfer Station” on page 133) is a plate that moves with the retractors to keep tension on the forms as they are pulled back from the drum. The tension is supplied by leaf springs on the plate.

Lower Forms Guide and Premeasure Shaft

Table 38. Chad Jam at the Premeasure Shaft



The lower forms guide **(7)** in “Transfer Station” on page 133 works with the premeasure shaft **(1)** in “End-of-Forms Sensors” on page 131 to prevent damage to the PC drum. Should a chad pile or other foreign substance be traveling with the form, it becomes wedged in the gap between the lower forms guide and the premeasure shaft as shown in Table 38. The gap is slightly smaller than the gap between the retractor and the PC drum.

This wedging of the form at the premeasure shaft causes the form to break and stop the printer, but also it prevents the chad pile or other foreign material from scratching the PC drum.

The premeasure shaft is mounted to the frame of the printer just below the area in which the PC drum is exposed to the transfer station. The lower forms guide is mounted to the transfer station.

When the transfer station is opened for manual forms loading, the lower forms guide is moved away from the premeasure shaft to provide clearance for inserting the forms. During auto loading, a cam pushes the premeasure shaft away from the lower forms guide to provide room for the forms to feed.

Transfer Corona

The transfer corona **(12)** in “Transfer Station” on page 133 is the only corona with a negative voltage. Its purpose is to attract the positively charged toner from the drum to the forms.

The transfer point is 18.9 in. along the PC drum surface from the laser beam scan line.

Normally, about 81% to 86% of the toner on the PC drum is transferred to the forms. This number is called the *transfer efficiency*. It is affected by:

- Contrast setting (thickness of toner on the PC drum)
- Forms tension at the PC drum surface
- Life of the developer mix
- PC drum surface voltage
- Retractor to PC drum gap
- Toner charge
- Transfer corona voltage

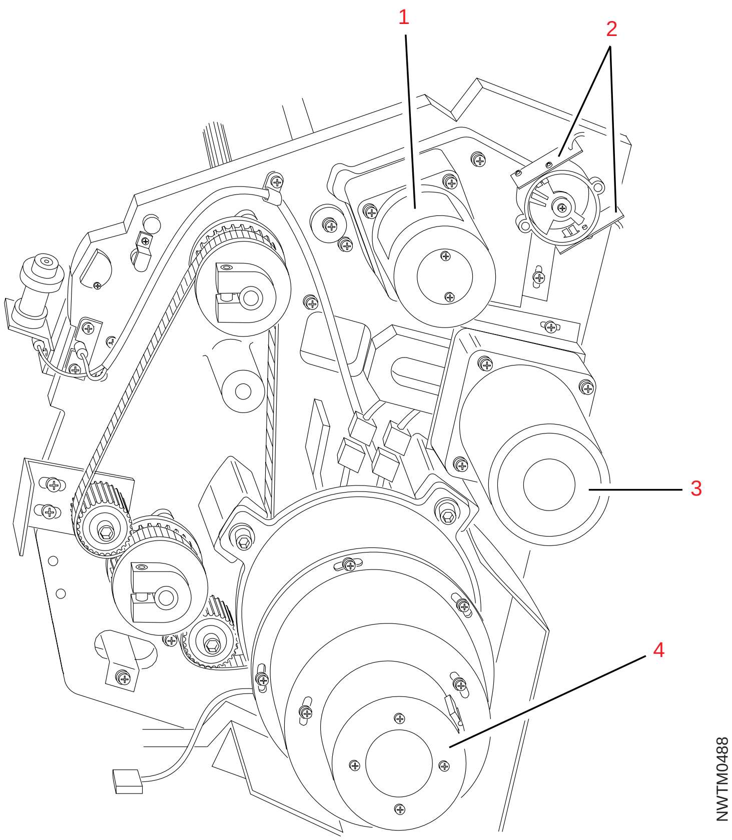
Jam Sensors

There is one forms jam sensor on the transfer station. It consists of a lamp and receiver in the same unit. These elements are aligned so that the light from the lamp reflects off the forms and onto the receiver. You cannot see this light because it is infrared.

The upper jam sensor **(2)** in “Transfer Station” on page 133 is located under the pin feed holes at the front edge of the forms. The logic checks for light and darkness as the holes pass over the sensor. When the logic detects constant light or darkness, a jam condition is reported.

Tension Arm

Table 39. Transfer Station, Rear View

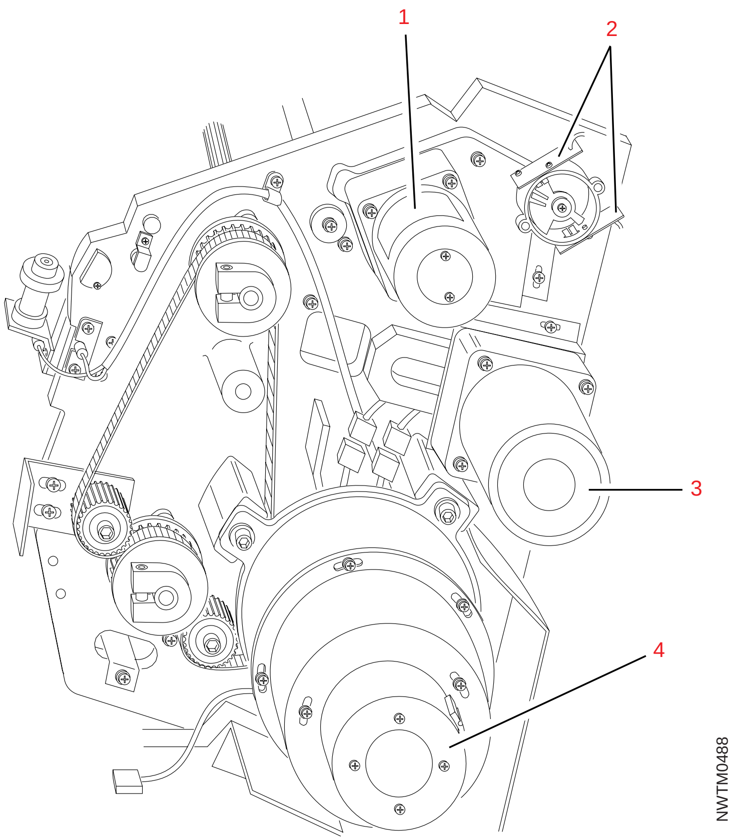


The tension arm **(1)** in “Transfer Station” on page 133 senses the tension in the forms as they pass between the transfer station and the fuser. Spring force is used to hold the tension arm against the forms.

Two encoders **(2)** on this page, sense the position of a slotted disk mounted to the tension arm shaft. These encoders detect the normal run position of the tension arm in addition to overtravel in the up and down positions. The printer electronics can determine from the position of the tension arm whether the forms are too tight or too loose.

Capstan Roll and Capstan Pinch Rolls

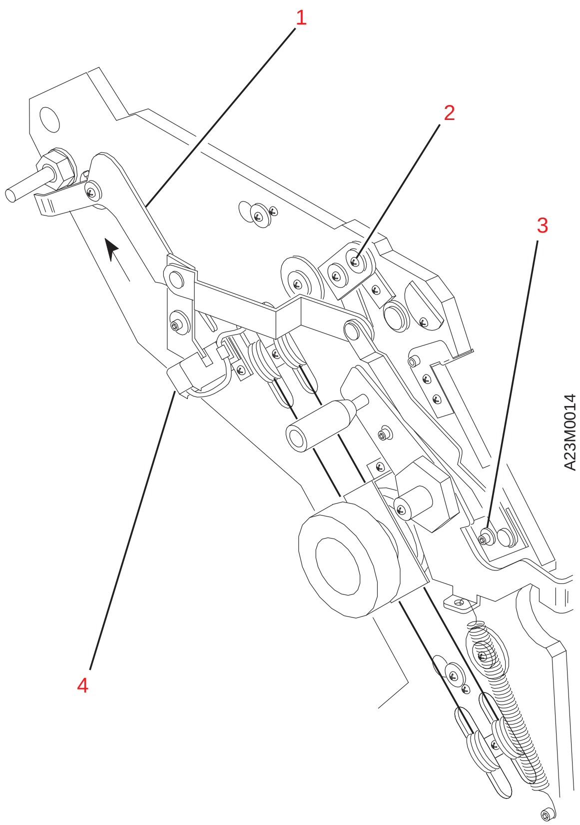
Table 40. Transfer Station, Rear View



The capstan roll and capstan pinch rolls **(11)** in "Transfer Station" on page 133 run during auto loading to move the forms to the upper forms tractors. The capstan roll is driven by the capstan roll motor **(3)** in "Capstan Roll and Capstan Pinch Rolls". The capstan pinch rolls are closed by the capstan pinch roll motor **(1)** in "Capstan Roll and Capstan Pinch Rolls" through the auto load linkage.

Auto Load Linkage

Table 41. Auto Load Linkage



When the capstan pinch roll motor rotates from its's home position, it operates the auto load linkage **(1)** in "Auto Load Linkage" on the front frame of the transfer station.

The rotation of the shaft from the motor drives the linkage in the direction of the arrow. The rotation of the shaft also drives the tension arm down to allow the forms to pass over it to the fuser station.

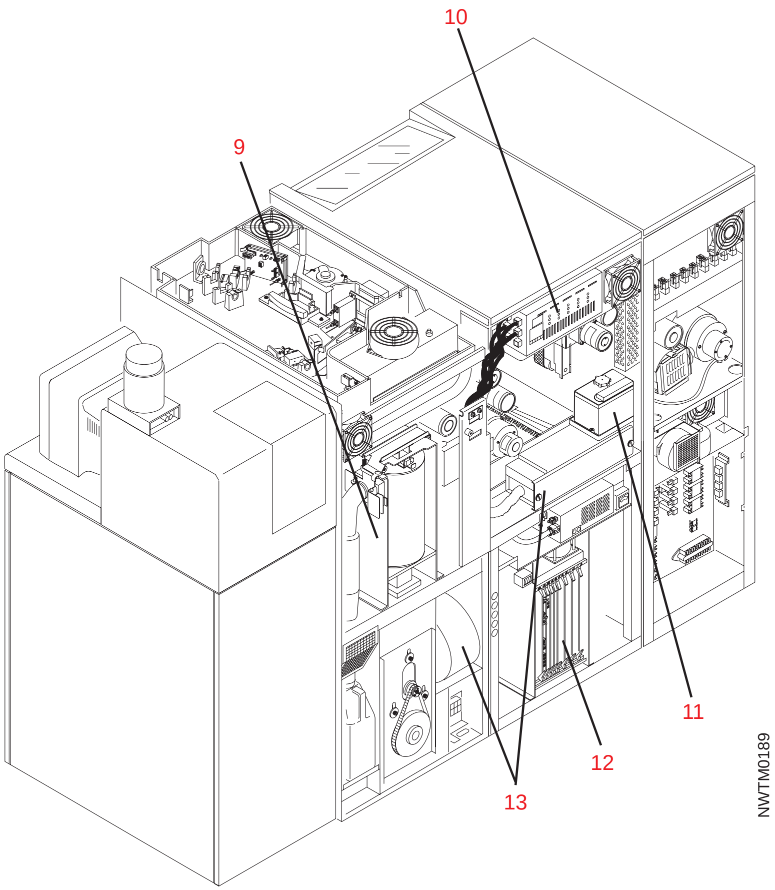
The motion of the autoload linkage causes the following to occur:

- The shaft **(2)** in "Auto Load Linkage" rotates to bring the capstan pinch rolls in contact with the capstan roll.
- The shaft **(3)** in "Auto Load Linkage" rotates and causes the cams on the shaft to move the premeasure shaft away from the lower forms guide. This opening of the premeasure shaft allows the forms from the lower tractor to follow the printing path up to the capstan roll and capstan pinch rolls.
- The flag moves out of the capstan pinch roll open switch **(4)** in "Auto Load Linkage" to indicate that the capstan pinch rolls are closed.

After the forms are picked up by the scuff rolls in the fuser station the capstan pinch roll motor rotates to it's home position. This leaves the tension arm providing spring tension to the forms, the capstan pinch rolls open, and the premeasure shaft at it's normal position close to the lower forms guide.

Drum Cleaning Mechanism

Table 42. Rear View of Infoprint 4000 and 3900 Wide Advanced Function Printer Showing Subsystems



The transfer station transfers about 80% of the toner that is deposited by the developer to the forms. The rest must be removed to prevent shadow printing. The drum cleaning mechanism removes this excess toner and disposes of it.

The drum cleaning mechanism has two areas: the drum cleaning area and the vacuum area. The drum cleaning area is located above and to the left of the PC drum. The vacuum area **(9)** is located at the back of the printer as shown.

Drum Cleaning Area

The drum cleaning area discharges the toner and the drum, and sweeps away the toner. The drum cleaning area consists of the preclean corona, the primary erase lamp, and the cleaner brush and housing. Figure 14 shows the drum cleaning area.

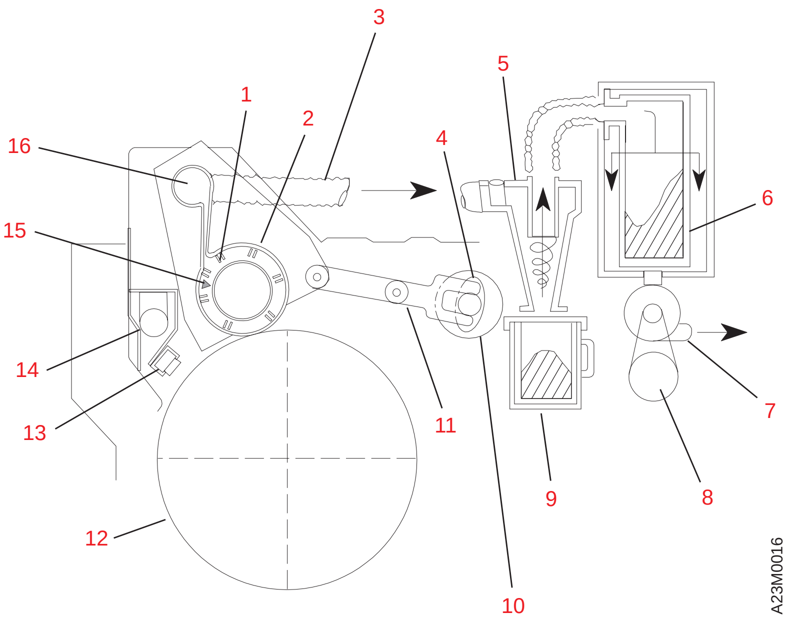


Figure 14. Drum Cleaning Area

Preclean Corona

The preclean corona **(13)** neutralizes any charge that remains on the toner that was not transferred to the paper. An ac voltage (4 kV) applied to the corona neutralizes the toner charge and the PC drum.

Primary Erase Lamp

The primary erase lamp unit **(14)** consists of a fluorescent lamp, a blue filter, and a photosensor. The erase lamp lights the PC drum through the filter to discharge the remaining charge on the surface of the drum. The photosensor detects any failure of the lamp to remain lighted.

Cleaner Brush and Housing

The cleaner brush **(1)** (Figure 14 on page 141), driven by an induction motor, sweeps the neutralized toner into the cleaner brush housing **(2)** (Figure 14 on page 141). The flicker bar **(15)** (Figure 14 on page 141) knocks the toner off the brush bristles so the toner can travel up the opening in the housing to the vacuum chamber **(16)** (Figure 14 on page 141). Vacuum from the vacuum area draws the toner away from the cleaner brush housing.

Some of the toner that is removed from the drum tends to collect on the sides of the cleaner brush housing. If it were not removed, this toner could drop onto the drum and cause poor print quality.

During initialization of the printer, the cleaner housing motor **(10)** (Figure 14 on page 141) rotates the cam **(4)** (Figure 14 on page 141) and causes the arm **(11)** (Figure 14 on page 141) to move the cleaner housing mounting and causes the cleaner brush to come in contact with each side of the cleaner housing.

The cleaner housing motor is a stepper motor that makes a partial revolution in each direction. A reed switch detects the direction in which the motor has rotated and when the motor is at the home position.

At the time that the right side of the cleaner housing is in contact with the cleaner brush, the cleaner brush motor reverses so that any toner on that side of the cleaner brush housing is driven toward the opening that leads to the vacuum chamber.

Cleaning System Vacuum

A strong vacuum is applied to the cleaner housing to remove toner that has been loosened by the cleaner brush. The toner exits through an air chamber at the top of the cleaner housing. This system also applies vacuum to the transfer corona to remove any toner that is attracted past the forms.

The vacuum system was designed to:

- Eliminate any chance of toner entering the blower motor
- Eliminate the need for frequent, costly filter changes.

To prevent toner from entering the motor, the blower **(7)** (Figure 14) is separated from the motor **(8)** (Figure 14 on page 141) and driven through a belt. A rotation sensor checks that the blower pulley is turning and, therefore, that the belt has not broken.

A two-stage air filtration system is used. First, a cyclone separator **(5)** (Figure 14 on page 141) is used to remove about 90% of the toner from the air without any filter element. As the air enters the cyclone separator, the air is forced to spin around inside the separator.

The spinning of the air causes the larger, heavier particles of toner to migrate to the outside of the cyclone. The toner particles that migrate to the outside area drop to the toner collector **(9)** (Figure 14 on page 141) at the bottom of the cyclone.

The migration of the toner particles separates the toner from the air stream, which continues out of the cyclone through the hose on top. Second, a fine filter **(6)** (Figure 14 on page 141) uses a paper element to filter the remaining toner from the air before it reaches the blower.

The toner that has been removed by the cyclone falls into the toner collector **(9)** (Figure 14 on page 141), which is an empty toner bottle. The `Change Toner Collector` message occurs when all of the following conditions exist:
1. End of forms or every 2000 feet
2. Out of toner
3. Toner load button has been pushed eight times.

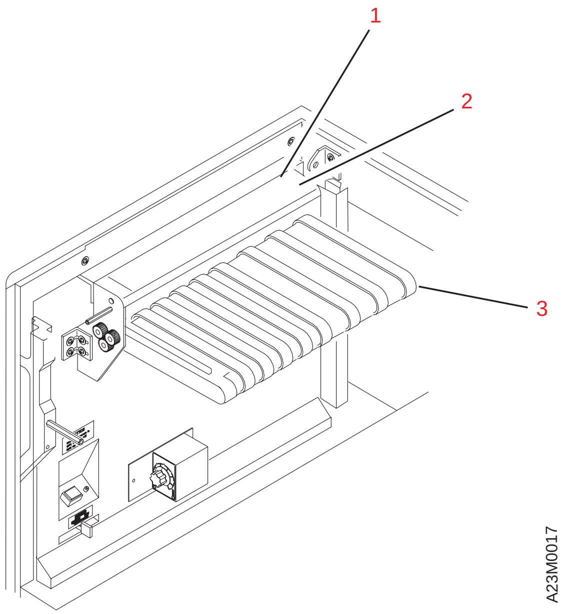
The toner collector must be in place and correctly seated for the cyclone to work correctly. The toner collector also must not be full; a full toner collector prevents the cyclone from working correctly.

A vacuum sensor checks the pressure drop across the fine filter. The pressure drop increases as the filter fills with toner. When the pressure difference becomes too great, the `Replace Fine Filter` message is displayed when an end-of-forms condition occurs.

There is no adjustment for this vacuum system. The amount of toner removed by the cyclone (and, therefore, the fine filter life) varies slightly with altitude and line frequency (50 or 60 Hz).

Auto Load Bridge

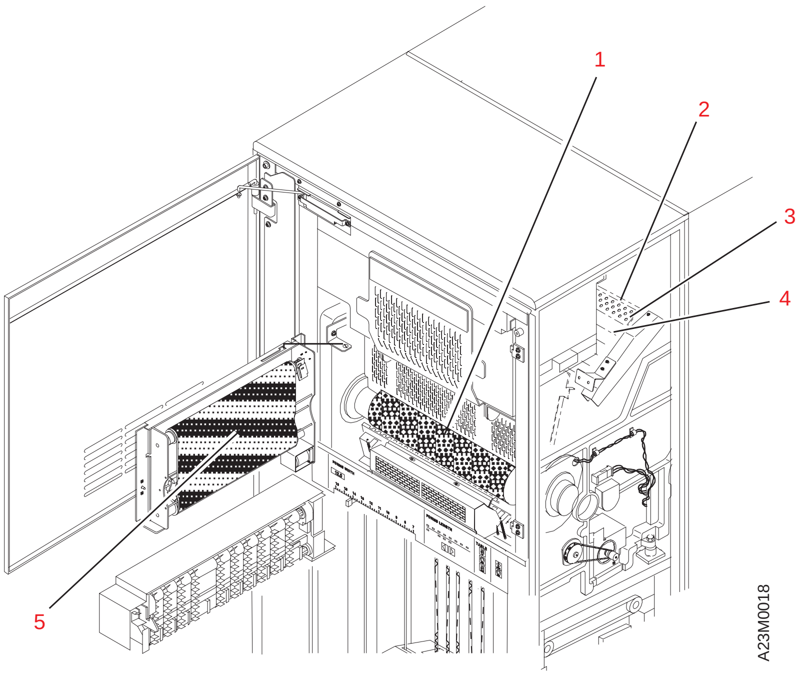
Table 43. Auto Load Bridge



The auto load bridge **(3)** transports the forms from the tension arm of the transfer station to the scuff rolls of the fuser station during auto load operations. Two motors operate the bridge mechanism. One motor raises and lowers the bridge and opens and closes the bridge-feed pressure rolls **(1)**. The second motor turns the bridge-feed rolls **(2)** and drives the belts on the auto load bridge.

Fuser

Table 44. Fuser Area



When the image is transferred from the PC drum to the forms, the toner remains as a powder that is not permanently fixed to the forms. The fuser applies heat and pressure to the forms to melt and bond the toner to the forms. The fuser station also moves the forms that leave the transfer station to the entrance of the stacker.

Some elements of the fuser are concerned mainly with forms movement and others are concerned mainly with toner bonding. The elements that are concerned with forms movement are:

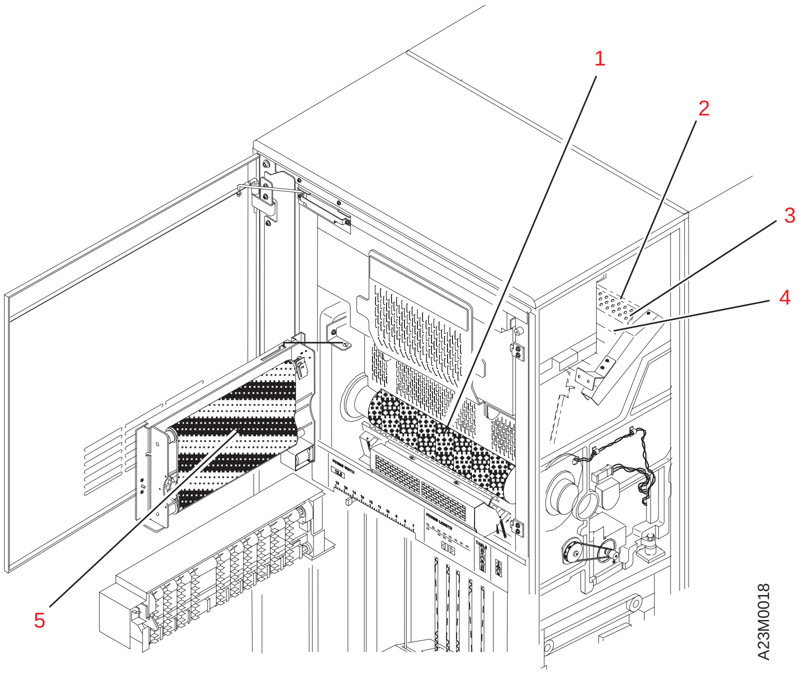
- Auto load bridge
- Scuff rolls
- Skew detection and steering mechanism.

The elements that are concerned with toner bonding are:

- Backup roll
- Backup idler roll (310 PPM, Duplex Printer 2 (except 480/600 DPI), IS1 and ID1/ID2)
- Hot roll
- Oiler belt/oiler roll
- Preheat platen
- Vacuum plate

Vacuum Plate

Table 45. Fuser Area



Vacuum through the vacuum plate **(2)** applies the correct amount of drag on the forms and holds the forms tightly against the preheat platen.

The vacuum chamber under the plate must match the forms width; otherwise, air will be drawn in around the forms and greatly reduce the hold-down force. The vacuum chamber width is changed by moving a plug, called the vacuum shutter, at the rear end of the chamber.

A stepper motor drives this shutter through a wire cable-and-pulley system. The shutter is first driven to a home-position sensor at the front of the printer forward of the vacuum inlet.

The width of the forms is known to the logic from the position of the rear tractor. The logic then drives the shutter motor the correct number of steps to position the shutter under the rear edge of the forms.

The vacuum shutter is moved to the home position to release the vacuum on the forms. This happens automatically during an auto load operation or whenever you press the vacuum button.

Preheat Platen & Preheat Control

To improve fusing, the forms are first heated from the back by the preheat platens **(4)**. There are two platens, each one running the full width of the printer. Each platen has a frond and a rear element.

The preheat platen heating elements are powered directly by the line voltage.

The temperature is maintained by turning the power off and on. To eliminate problems with mechanical relays, solid state relays are used.

The platen temperature is sensed through four thermistors: one in the front and one in the rear of each platen. Two over-temperature sensors drop power if there is a failure in the temperature control system that causes an over-temperature condition.

The upper preheat platen operates at 80°C and the lower preheat platen operates at 100°C in the simplex printer and in Printer 1 of a duplex printing system.

If operating a 150 ppm in duplex both the upper and lower preheat platens operate at 45°C in Printer 2. If operating at 229 ppm in duplex, both platens in Printer 2 operate at 58°C. For 600 DPI or 324 ppm the upper platen operates at 65°C and the lower platen operates at 85°C in Printer 2.

Vacuum is applied through the preheat platens to hold the forms tightly to their surfaces. On IS1, ID1/ID2, 324 ppm and Printer 2 of 480/600 DPI systems, no vacuum is applied to the lower preheat platen.

Hot Roll

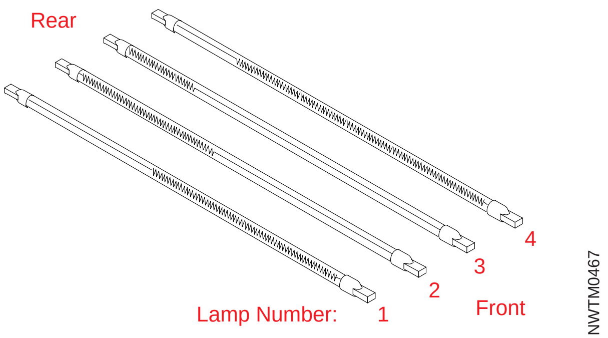
The hot roll **(1)** in Table 44, in conjunction with the backup roll, completes fusing the toner to the forms by a combination of heat and pressure. The heat from the hot roll melts the toner and the pressure applied by the backup roll forces the melted toner into the fibers of the form.

Speed Control

The hot roll is driven by a dc servo motor through a set of gears. Speed control is maintained through a precision encoder mounted directly at the rear of the motor. The motor has a tendency to run hot because of the heater lamps and a high load. For this reason a blower is attached to the motor to provide cooling air.

Heat Source

Table 46. Heat Lamps



Radiant heat is applied to the rotating hot roll by four stationary heat lamps. The positions of the heating elements inside the lamps (Table 46) allow heating of the hot roll only in the area contacted by the forms. The logic determines which fuser lamps are turned on based on the width of the forms. The width of the forms is known to the logic from the position of the rear tractor. For example, only two of the lamps are driven when the forms are very narrow. A different group of lamps is turned on for Printer 2, because the forms have already been heated by the fuser in Printer 1.

The heating elements are powered directly by the line voltage. Because of their low resistance, soft-start resistors are used to limit the in-rush current when power is first applied.

Temperature Control

The hot roll temperature is sensed through two thermal ferrite chips mounted at the surface of the hot roll. These chips sharply change their magnetic properties at a certain temperature. A stationary sensor near the front of the printer detects the chips when the hot roll is below the operating temperature. When the hot roll reaches or exceeds the operating temperature, the sensor can no longer detect the chips and stops driving the heat lamps.

Note: There are several different types of hot rolls currently in use. These hot rolls have different operating temperature ranges.

One chip changes its properties at approximately 185°C, (190°C with the 229 PPM Feature (DW1/DW2 only)), which is the normal operating temperature as set by positions A and B of the forms select switch.

The other chip changes its properties at approximately 165°C, (170°C with the 229 PPM Feature (DW1/DW2 only)), which is the lower operating temperature as set by position C (plastic) of the forms select switch.

The temperature is maintained by turning the power to the lamps off and on. To eliminate problems with mechanical relays, solid state relays are used. An over-temperature sensor drops the relays if there is a failure in the temperature control system that causes an over-temperature condition.

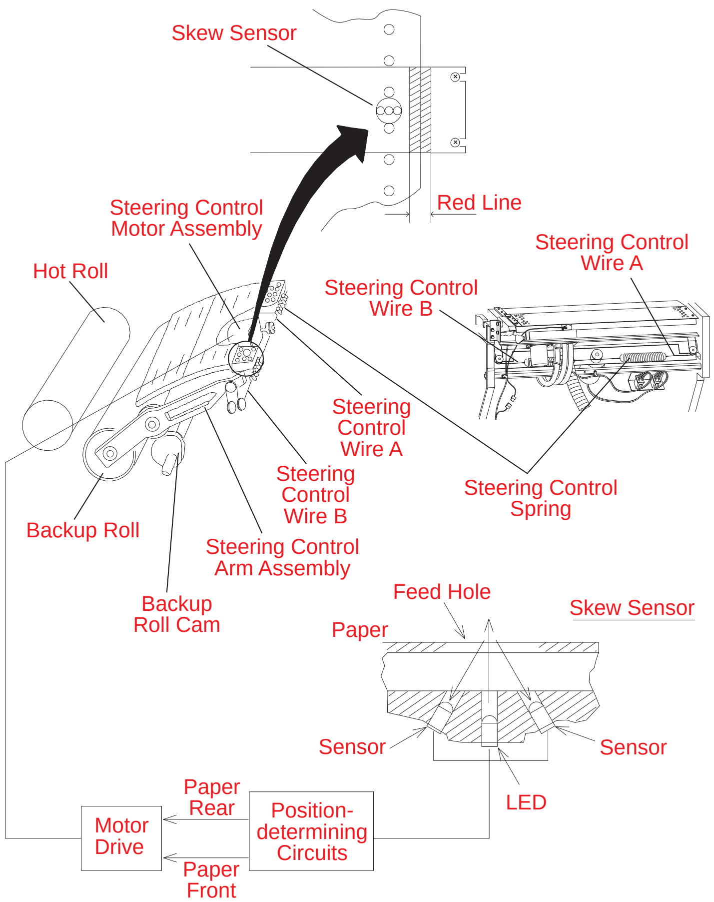
Temperature Control With Thermistors

In addition to using a thermal ferrite chip on the hot roll, some printers can enable a thermistor control of the hot roll temperature. This allows tighter temperature tolerances on the hot roll.

the thermistor control is enabled by a switch (S8–8) on the B1J11 card and requires thermistor hardware and unique hot rolls that are labeled “B” instead of “L”.

Backup Roll

Table 47. Backup Roll Mechanism



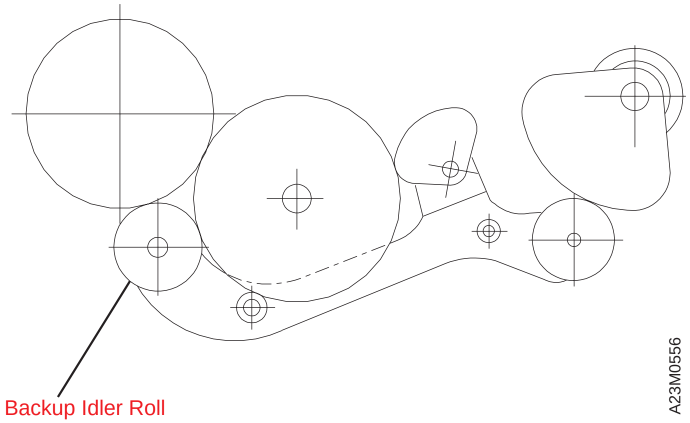
The backup roll applies pressure to the forms while the hot roll is applying heat to complete the fusing process. The backup roll also provides steering to the forms to correct for skew in feeding.

As shown in Table 47, the backup roll is mounted in a yoke assembly that can be pivoted away from the hot roll when the forms motion stops. The yoke is lifted by cams driven by an ac motor.

The loaded or unloaded position of the backup roll is detected by a slotted encoder disk sensor at the front of the cam shaft. The pressure of the backup roll against the hot roll is varied by the springs in the steering system.

Backup Idler Roll

Table 48. Backup Idler Roll Mechanism



Note: In some printers the backup idler roll is installed but not used.

The backup idler roll is installed only in Printer 2 of a duplex system (except 480/600 DPI), on 310 ppm printers, and Infoprint 4000. The preheat platen operating temperature on Printer 2 is lower to keep the toner on side 1 of the paper from melting during duplex operations. The backup idler roll keeps the forms in contact with the hot roll longer to ensure toner on side 2 is completely fused. The backup idler roll does not contact the hot roll.

The backup idler roll is mounted in a yoke assembly that can be pivoted away from the hot roll when the forms motion stops. The yoke is lifted by cams driven by an ac motor. At the start of printing the backup idler roll moves to the closed position **after** the backup roll closes, and it moves to the open position **before** the backup roll opens.

The loaded or unloaded position of the backup idler roll is detected by a slotted encoder disk sensor at the front of the cam shaft.

Backup Roll Lift Motor

When printing, the backup roll keeps the forms in contact with the hot roll to fuse the toner. When stopped, the backup roll lets the forms drop away from the hot roll to avoid damaging the paper.

Bloom, or double fusing, results from the backup roll bringing previously fused forms into contact with the hot roll when the forms begin to move. Bloom appears as a band of darkened, or bolder printing. On images, this band will also appear glossy.

Normally, a short length of the forms gets fused a second time when the forms begin to move to ensure that no region is left unfused. When the forms begins to move, the backup roll loads, bringing the forms in contact with the hot roll. Bloom is the result of two factors:

1. Double fusing
2. The loading dynamics of the backup roll against the hot roll

The purpose of the backup roll lift motor hardware is to reduce bloom by controlling more precisely the loading of the backup roll to the hot roll. This is done by adding a backup roll lift motor for controlling the backup roll separately from the preheat platen. With a smaller mass being moved, the precision and timing of the backup roll to hot roll loading can be optimized to reduce bloom.

Skew Detection and Steering

A worn backup roll, lack of parallelism between the tractors and the hot roll, and other causes can prevent the forms from feeding straight into the fuser. The error caused by feeding the forms at an angle is called *skew*.

As shown in Table 47, forms tracking is detected by skew sensors mounted on the vacuum plate. The sensors are aligned under the pin feed holes at the front edge of the forms. When a hole passes between the sensors, the sensors see the edges at the same time. If the hole passes closer to one sensor than to the other, the edges are seen at different times. The signal from the skew sensor feeds position-determining circuits that control the motor driver. The motor driver tells the skew control motor to turn in one direction or the other.

Skew is counteracted by varying the pressure along the backup roll against the hot roll to steer the forms. The backup roll is mounted in a yoke assembly. The arms of the yoke act as a lever, with the backup roll load cam as the fulcrum. A cable is attached to the arms of the yoke, and it can be pulled in either direction by a pulley that is driven by the skew control stepper motor. The tension in the cable applies the load to the backup roll. The additional pressure changes the nip “footprint” to correct the skew.

The skew sensor and position-determining circuits work on the difference in time between the signals from the two sensors in the skew sensor. As shown in Figure 15, the LED lights the tractor holes in the forms as the forms feed over the skew sensor.

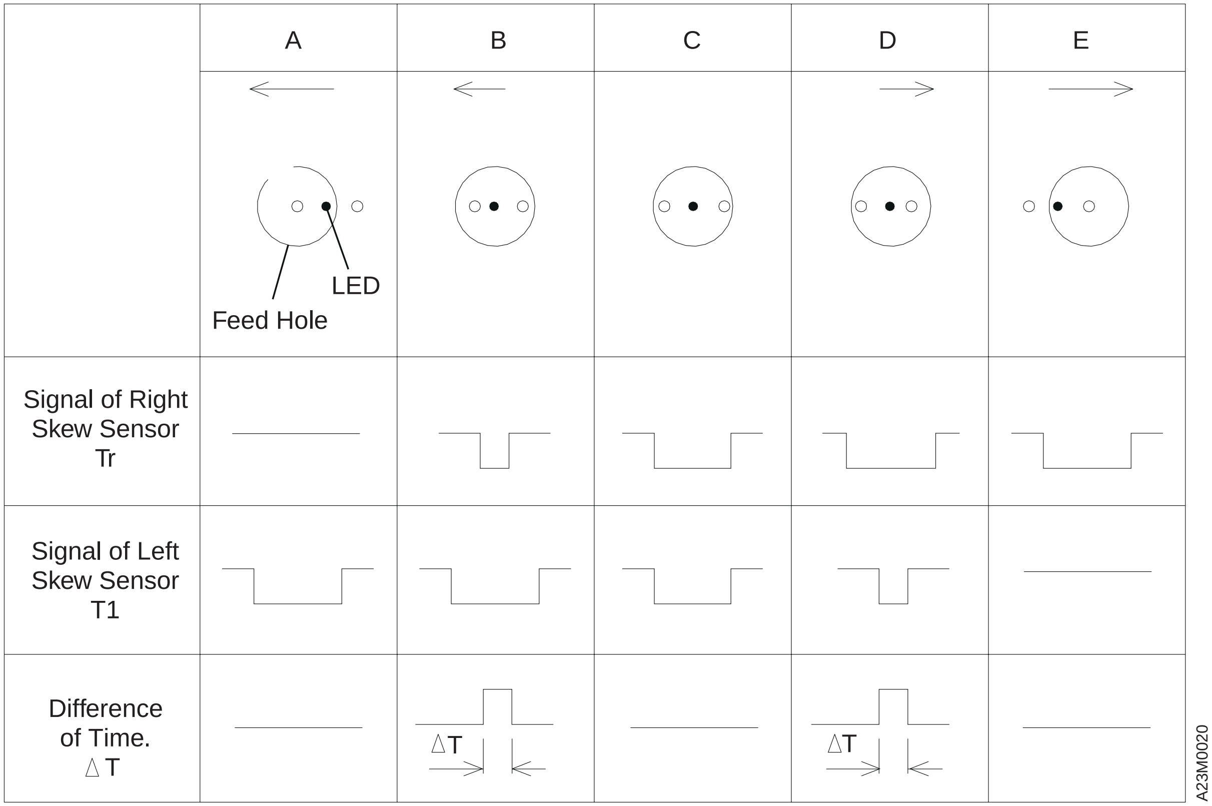


Figure 15. Skew Sensor Operation

If the forms are straight, the center of the hole passes over the skew sensor and both sensors detect the hole at the same time. If the forms are skewed, one sensor detects the hole before the other sensor does and detects the trailing edge of the hole after the other sensor does. The position-determining circuit then signals the motor driver to apply more pressure to the side of the backup roll that has the shorter signal.

Fuser Wrap Detection

Occasionally, a form may adhere to the backup roll and begin to wrap around it. If the form were to completely wrap the backup roll, it could not be cleared by the operator. On the simplex printer and Printer 1 of a duplex system, the fuser-wrap sensors are two microswitches that are located under the backup roll. Printers with the backup idler roll installed have only on switch. A wrapping form will activate one of the switches and stop the printer. The backup roll drops away from the hot roll, preventing a wrap.

Scuff Rolls

The purpose of the scuff rolls is to push the forms down through the pendulum, especially when the backup roll is unloaded and the hot roll cannot pull the forms. A set of spring-loaded pressure rollers load the forms against the scuff rolls.

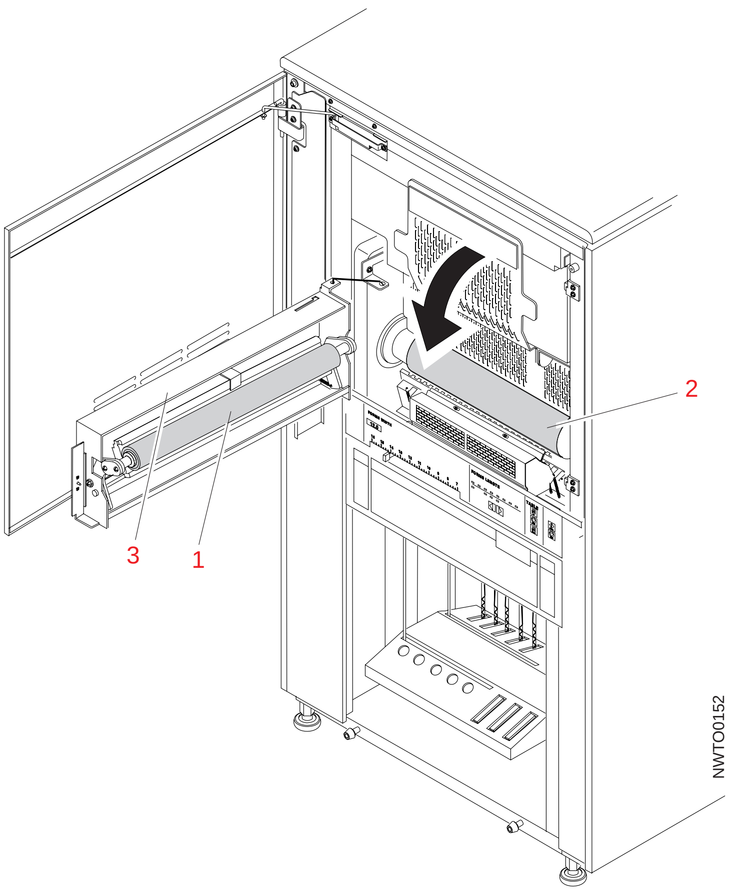
A scuff roll will slip between its inner and outer races when its torque limit is exceeded. This means that the scuff rolls can be driven even when the forms are not moving, to apply tension to the forms without scrubbing against the forms.

Oiling System (480/600 DPI Only)

The heat and pressure of fusing cause the toner and forms to tend to stick to the hot roll. An oiling system coats the hot roll with fuser oil, allowing the toner and forms to separate from the hot roll. An oiler wick roll **(1)** (in Table 50) supplies oil to the hot roll surface. The elements of the oiling system are:

- Oilerwick roll
- Oil pumps.

Table 49. Oiler Wick Roll Mechanism (480/600 DPI)



Oiler Wick Roll

The oiler wick roll **(1)** is a felt roll mounted on an oiler gate **(3)**. When the oiler gate is closed, the oiler wick roll touches the hot roll **(2)** causing the oiler wick roll to turn and coat the hot roll with oil.

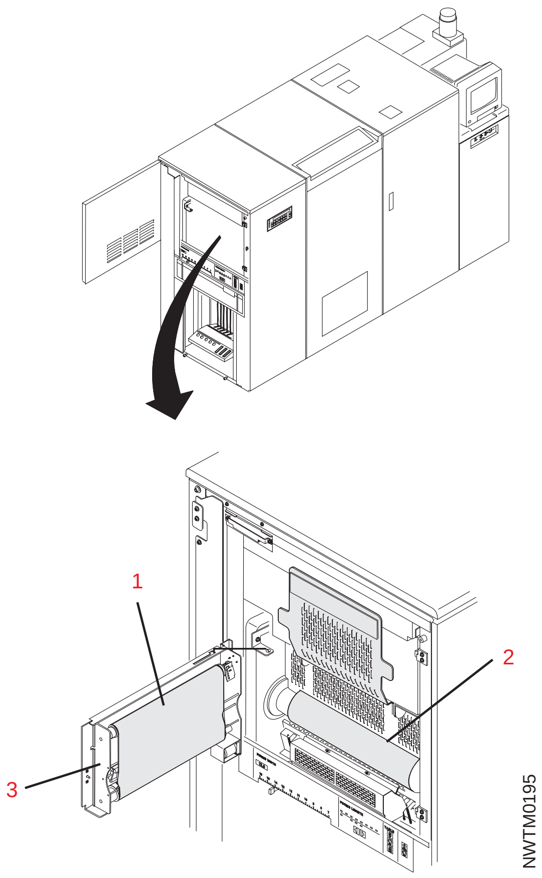
Oil pumps and an oil tank **(11)** (Table 11) supply fuser oil to the back of the oiler belt through flexible tubing. The amount of oil supplied by each tube varies according to the paper width and the position of the forms select switch.

Oiling System (All except 480/600 DPI)

The heat and pressure of fusing cause the toner and forms to tend to stick to the hot roll. An oiling system coats the hot roll with fuser oil, allowing the toner and forms to separate from the hot roll. An oiler belt **(1)** (in Table 50) supplies oil to areas of the hot roll surface. The elements of the oiling system are:

- Oiler belt
- Oiler belt drive
- Oil pumps.

Table 50. Oiler Belt Mechanism



Oiler Belt

The oiler belt **(1)** is a felt belt attached to two spools and mounted on the oiler belt gate **(3)**. One of the spools is a supply spool, and the other is a take-up spool. When the oiler belt gate is closed, the belt touches the hot roll **(2)**.

Oil pumps and an oil tank **(11)** (Table 11) supply fuser oil to the back of the oiler belt through flexible tubing. The amount of oil supplied by each tube varies according to the paper width and the position of the forms select switch.

Oil Pumps

Some printers have three oil pumps and others have six pumps. The amount of oil pumped onto the belt is controlled by driving certain pumps based on the forms width. In addition, oil is pumped every 20 minutes of standby time by turning on pump 2, except when running high speed (229 ppm) duplex. When operating with the 229 PPM Feature (DW1/DW2 Only) oil is not pumped unless printing. The oil rate can be increased or decreased by altering printer memory. For details about altering printer memory, see “Read from or Write to Memory (Position 2)“ in *Diagnostics*. For high speed (229 ppm) duplex printer, see “Memory Addresses and Values“ in *Diagnostics*.

A float switch in the oil tank senses when the fuser oil tank is empty, and the condition appears on the Display/Touch Screen at the time of end-of-forms and power-on reset.

Heavier weight forms require more oil. This is accomplished by increasing the oil pumping rate, selected by the operator through the forms select switch on the printer control panel (SW721). Positions A and B on the forms select switch are used to set the correct oiling rate for the weight of the forms being used.

Oiler Belt Drive

Because toner gradually builds up on the oiler belt, it must be advanced periodically to apply a clean surface to the hot roll. The oiler belt is driven by a stepper motor that steps once after a certain number of feet of forms are printed. A chain drive is used because of the high temperature and the oily environment.

The oiler belt rate can be increased or decreased by altering printer memory. For details about altering printer memory, see “Read from or Write to Memory (Position 2)” in *Diagnostics*.

The end of the oiler belt is sensed when plastic tab attached to the belt pushes a lever and trips the oiler belt end switch.

Oiler Belt Gate Switch

An interlock switch is provided on the oiler gate so that the operator is not exposed to rotating parts if the gate is opened during printing.

Oil Pump Control

The printer microcode activates the oil pumps at different rates based on the paper width. Each oil pump is cycled as defined in Table 51. The X in this table is the hexadecimal value in printer memory location FF20. Memory values can be between X'0B' (11) and X'FF' (255); the normal value for X in FF20 is X'64' (100). The oiling rate can be increased by decreasing the values in memory location FF20.

Example

For 9.0-in.-wide paper (60 to 82.5 m/g², 16 - 22 lb), Pump 1 cycles every

7 × X'64' ÷ 44 (for 310 ppm) = 7 × 100 ÷ 44 = 15.9 seconds between oil feeds.

PPM	Inches/second
150	21.25
229	32.5
310	44
324	45.9

Table 51. Oil Pump Rates For All Printers Except 480/600 DPI

Paper Width (inches)	Pump 1		Pump 2		Pump 3	
	Switch		Switch		Switch	
	16–22 lb	> 22 lb plastic	16–22 lb	> 22 lb plastic	16–22 lb	> 22 lb plastic
9.0	7X	3.5X	0	0	0	0
9.5	7X	3.5X	0	0	0	0
10.0	7X	3.5X	14X	7X	0	0
10.5	7X	3.5X	12X	6X	0	0
11.0	7X	3.5X	11X	5.5X	0	0
11.5	7X	3.5X	9X	4.5X	0	0
12.0	7X	3.5X	8X	4X	0	0
12.5	7X	3.5X	5X	2.5X	0	0
13.0	7X	3.5X	5X	2.5X	0	0
13.5	7X	3.5X	5X	2.5X	0	0
14.0	7X	3.5X	5X	2.5X	20X	10X
14.5	7X	3.5X	5X	2.5X	20X	10X
15.0	7X	3.5X	5X	2.5X	18X	9X
15.5	7X	3.5X	5X	2.5X	14X	7X
16.0	7X	3.5X	5X	2.5X	13X	6.5X
16.5	7X	3.5X	5X	2.5X	11X	5.5X
17.0	7X	3.5X	5X	2.5X	9X	4.5X
17.5	7X	3.5X	5X	2.5X	7X	3.5X
18.0	7X	3.5X	5X	2.5X	7X	3.5X

Upper Stacker

Pendulum

The purpose of the pendulum is to force the forms to fold on the perforations in the same manner as they were in the box. This is necessary for reliable stacking because the heat and pressure of the fuser tend to iron out the perforations. The pendulum also assists in stacking lightweight forms or those with strong perforations.

The pendulum is driven by a dc servo motor through a toothed belt. It’s position at power off is stored in memory so that it is not necessary to set the forms direction when power is restored.

The printer cannot detect the folding direction of the perforation (sometimes called the forms direction). Therefore, the operator must inform the printer by pressing a key on the printer control panel when prompted to do so.

The arc of the pendulum changes with the form length, which is sensed through the Hall-effect sensors in the stacker. The pendulum is precisely controlled by an encoder at the rear of the pendulum motor. An infrared sensor detects when the pendulum is at the vertical (home) position.

Finger Belts

The heat and pressure of the fuser stiffens the perforations, which could result in a “dishing” stack; that is, the edges are higher than the middle, which leads to curling and stacker jams. To prevent this, a rack of finger belts on the front and rear of the stacker constantly rub against the folds to press down the stack.

Each set of stacker belts has its own ac motor. These belts stop rotating when the stacker gate is opened.

Stacker Gate

The stacker gate swings out to allow forms to be removed from the printer. An interlock switch prevents the printer from running with the gate open.

Height-Detect Sensors

The top of the stack must be maintained at a certain position for correct operation of the pendulum and the finger belts. The stacker height-detect sensors cause the logic to lower the table when the top of the stack is sensed.

The height-detect sensors consist of two pairs of an LED light source and a photosensor. One pair is positioned over the right-side folds, and the other over the left-side folds. The logic lowers the table 6 to 7 mm when the light from the rear height-detect sensor and either the front height-detect sensor or the stacker jam sensor is blocked for 4 seconds.

Stacker Jam Sensor

The purpose of the stacker jam sensor is to detect loose misfolds at the top of the stack. The most common cause of this problem is that the operator did not correctly set the pendulum starting direction or the perforation on the scale.

The stacker jam sensor consists of an LED light source and a photosensor. The logic monitors the sensor for light and darkness as the pendulum causes the forms to block and unblock the light. Constant detection of either light or darkness during the time it takes to print 6 pages will cause a stacker jam message to be displayed.

Upper-Limit Sensor

An upper-limit sensor is used to stop the rising of the table when there are no forms in the stacker.

Pendulum Jam Sensor

This infrared sensor can detect only the presence of forms, not their motion. It’s primary function is to detect a jam between the tractors and the pendulum before an auto load.

Lower Stacker

Table-Lift Mechanism

The stacker table is raised through toothed belts and a worm gear driven by an ac motor. The table is held in position by the design of the worm gear and by a brake on the motor, which activates when the motor is powered off.

Lower-Limit Sensor

A lower-limit sensor is used by the logic to determine when the table has reached the bottom of its travel.

The stacker is determined to be full when this sensor detects the table, and the height-detect sensors are blocked.

Stacker Length Motor

The stacker can be adjusted for various form lengths by moving the front and rear finger belts together or apart as necessary. The stacker length motor does this by driving a lead screw when the operator presses the keys on the stacker end panel.

The motor is a +24 V dc stepper motor.

Stacker Length Sensing

The printer logic must know the length of the forms to control the pendulum travel and when to stop the forms during auto load.

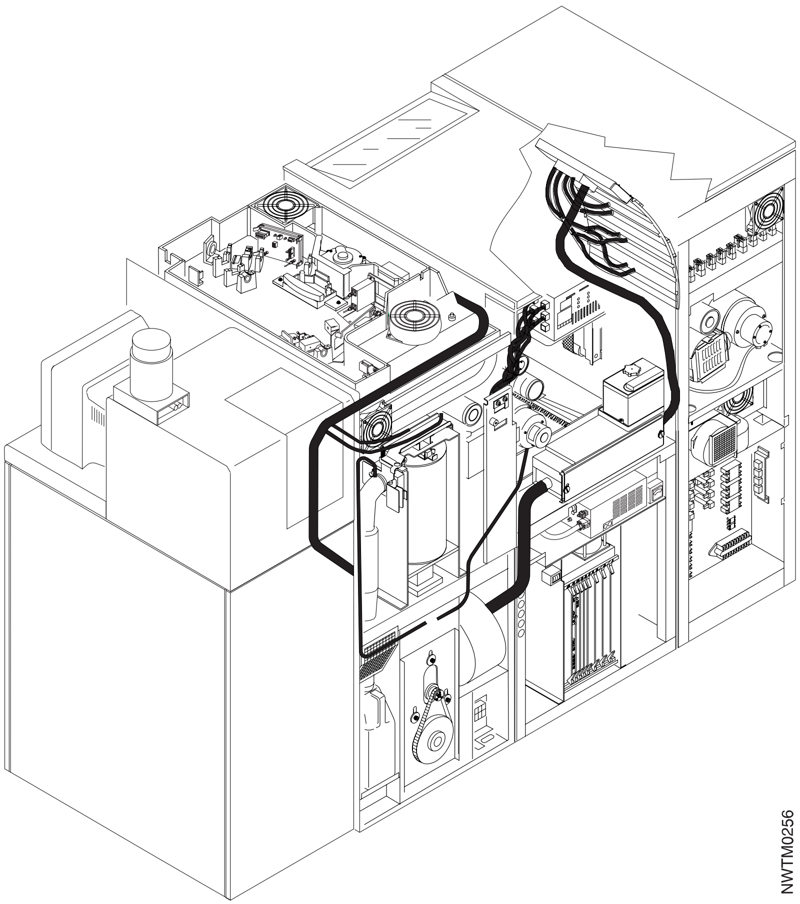
Two sensors are used to sense the stacker position. The Forms Length Sensor Board (FL061) can sense the length to the nearest ½ in. from the positions of magnets that travel over the card in a straight line. The stacker length rotary board (FL041) determines the correct fraction of an inch by sensing the rotational position of the lead screw that changes the stacker length.

Stacker Safety Bail

A safety bail and it’s position switch are mounted below the stacker gate. The safety switch automatically lowers the stacker table when the bail is raised. The switches are for the safety of the operator and the printer in case the table is raised and a person or obstacle is between the table and the closed stacker gate.

Air Systems

Table 52. Air System



The Infoprint 4000 and 3900 Wide Advanced Function Printers have two independent air systems which provide:

- Vacuum for cleaning the PC drum, transfer corona and developer
- Vacuum for holding the tape at the splicing station and the forms at the preheat platen.

The vacuum system for cleaning the PC drum and transfer corona is discussed in “Cleaning System Vacuum” on page 142.

Hold-Down Vacuum

A blower is used to provide vacuum for controlling the forms. The large motor is driven directly from the line voltage. The motor and blower are combined in one unit.

A single filter, called the manifold filter, is used to filter paper dust from the air.

The vacuum in this system can be adjusted through a bleeder port in the manifold filter. This adjustment may be necessary for proper fusing and drag when printing on unusual forms.

Electronics

Logic Cards

The printer logic consists of a card-on-board arrangement called the B1 Gate. The list in Table 53 shows the slot location and function of each card that is attached to the B1 board. The data connections between the cards can be seen in *Wiring Diagram* - WD93.

Table 53. Logic Cards

Card Location	Card Name	Function
B1J1	DV021 — Motor Driver 1	Tractor motor, cleaner housing motor, and steering motor driver circuits.
B1J3	DV022 — Motor Driver 2	Hot roll motor, shutter control motor, and oiler belt motor driver circuits.
B1J3	DV023 — Motor Driver 2	Hot roll motor, shutter control motor, and oiler belt motor driver circuits (324 PPM only).
B1J5	DV041 — Motor Driver 3	PC drum, retractor motor, stacker length motor, and oil pumps driver circuits.
B1J5	DV091 — Motor Driver 3	PC drum, retractor motor, stacker length motor, and oil pumps driver circuits 324 PPM, IR3/IR4, and newer versions of IR1/IR2 only).
B1J7	RH011 — Drum/Retractor/Heat Control	PC drum, retractor motor, and hot roll motor control.
B1J7	RH041 — Drum/Retractor/Heat Control	PC drum, retractor motor, and hot roll motor control (324 PPM only).
B1J8	FU011 — Fuser and Sensor Control	Control for the pendulum, hot roll lamps, preheat elements, mirror motor, and stacker control (for OW1 without 310 PPM, OW3, DW1/DW2).
B1J8	FU031 — Fuser and Sensor Control	Control for the pendulum, hot roll lamps, preheat elements, mirror motor, and stacker control (310 PPM only).

Table 53. Logic Cards (continued)

Card Location	Card Name	Function
B1J8	FU051 — Fuser and Sensor Control	Control for the pendulum, hot roll lamps, preheat elements, mirror motor, and stacker control (for older versions of IR1/IR2).
B1J8	FU061 — Fuser and Sensor Control	Control for the pendulum, hot roll lamps, preheat elements, mirror motor, and stacker control (for IS1, ID1/ID2).
B1J8	FU091 — Fuser and Sensor Control	Control for the pendulum, hot roll lamps, preheat elements, mirror motor, and stacker control (324 PPM only).
B1J8	FU092 — Fuser and Sensor Control	Control for the pendulum, hot roll lamps, preheat elements, mirror motor, and stacker control (for IR3/IR4).
B1J8	FU094 — Fuser and Sensor Control	Control for the pendulum, hot roll lamps, preheat elements, mirror motor, and stacker control (for newer versions of IR1/IR2).
B1J9	MC091 — Mechanism and Sequence Control	Motor and relay control logic, and power complete (for OW1 without 310 PPM, OW3, DW1/DW2).
B1J9	MC121 — Mechanism and Sequence Control	Motor and relay control logic, and power complete (310 PPM only).
B1J9	MC141 — Mechanism and Sequence Control	Motor and relay control logic, and power complete (for newer versions of IR1/IR2).
B1J9	MC151 — Mechanism and Sequence Control	Motor and relay control logic, and power complete (for IS1 and ID1/ID2).
B1J9	MC182 — Mechanism and Sequence Control	Motor and relay control logic, and power complete (for IR3/IR4).
B1J9	MC184 — Mechanism and Sequence Control	Motor and relay control logic, and power complete (324 PPM only).
B1J9	MC186 — Mechanism and Sequence Control	Motor and relay control logic, and power complete (for newer versions of IR1/IR2).

Table 53. Logic Cards (continued)

Card Location	Card Name	Function
B1J10	PF041 — Paper Feed Control	Servo control for the motors driving the tractors, hot roll, PC drum, and retractors (for all except 310 and 324 PPM printers).
B1J10	PF161 — Paper Feed Control	Servo control for the motors driving the tractors, hot roll, PC drum, and retractors (310 PPM only).
B1J10	PF081 — Paper Feed Control	Servo control for the motors driving the tractors, hot roll, PC drum, and retractors (324 PPM only).
B1J11	CP161 — Interface and Host Control	The 8085 microprocessor that controls the printer, 1MB of memory, the control program, and a maintenance switch (MASW).
B1J11	CP172 — Interface and Host Control	The 8085 microprocessor that controls the printer, 1MB of memory, the control program, and a maintenance switch (MASW) (IR3/IR4 only).
B1J11	CP173 — Interface and Host Control	The 8085 microprocessor that controls the printer, 1MB of memory, the control program, and a maintenance switch (MASW) (324 PPM only).
B1J11	CP175 — Interface and Host Control	The 8085 microprocessor that controls the printer, 1MB of memory, the control program, and a maintenance switch (MASW) (for newer versions of IR1/IR2).
Note: The following cards are located in other functional areas of the printer.		
Card Number	**Card Name**	**Function**
RB091	Relay Board	Fuser control (all printers EXCEPT those with backup idler roll).
RB092	Relay Board	Fuser control (printers with backup idler roll).
RB101	Relay Board	Power control.

Table 53. Logic Cards (continued)

Card Location	Card Name	Function
MD141	Mirror Motor Driver Board	Mirror motor control (for all printers EXCEPT those with the switchable resolution printhead).
MD192	Mirror Motor Driver Board	Mirror motor control (for printers with switchable resolution printhead).
BD121	Beam Detect	Printhead, beam detect (for single beam printhead).
BD131	Beam Detect	Printhead, beam detect (for two beam 240/300 DPI switchable printhead).
BD132	Beam Detect	Printhead, beam detect (for two beam 240 DPI printhead).
BD141	Beam Detect	Printhead, beam detect (for four and five beam printheads).
FS051	Fuser Control	Fuser Control Box door, switch and sensor control (all EXCEPT DW2 with 229 PPM feature, IS1, ID1/ID2 and 480/600 DPI).
FS053	Fuser Control	Fuser Control Box door, switch and sensor control (for IS1 and ID1/ID2).
FS551	Fuser Control	Fuser Control Box door, switch and sensor control (for High Speed (229 PPM) Duplex Printer 2).
FS071	Fuser Control	Fuser Control Box door, switch and sensor control (for older versions of IR1/IR2 and 324 PPM).
FS082	Fuser Control	Fuser Control Box door, switch and sensor control (for newer versions of IR1/IR2).
FS083	Fuser Control	Fuser Control Box door, switch and sensor control (for IR3/IR4).
HR091	Fuser Temperature Control	Controls the temperature of the hot roll.
PC211	Processor Control	All EXCEPT High Speed Simplex (310 PPM) and those with enhanced toner loading.

Table 53. Logic Cards (continued)

Card Location	Card Name	Function
PC531	Processor Control	310 PPM only.
PC551	Processor Control	For 480/600 DPI feature; switchable resolution printhead; and enhanced toner loading.
SC061	Stacker Control Board	Stacker, Pendulum control (all printers EXCEPT those with bloom improvement).
SC091	Stacker Control Board	Stacker, Pendulum control (for 480/600 DPI feature).
SC101	Stacker Control Board	Stacker, Pendulum control (for IS1, ID1/ID2, and bloom improvement).
SC103	Stacker Control Board	Stacker, Pendulum control (for 324 PPM only).
SC106	Stacker Control Board	Stacker, Pendulum control (for IR3/IR4).
SC108	Stacker Control Board	Stacker, Pendulum control (for newer versions of IR1/IR2).
SQ081/SQ082	Sequence Control Board	Printer power sequence control.
VI111	Printer Interface Card	Printhead, video (for single-beam printhead).
VI141	Printer Interface Card	Printhead, video (for two-beam printhead).
VI151	Printer Interface Card	Printhead, video (for four-beam printhead).
VI171	Printer Interface Card	Printhead, video (for five-beam printhead).
YS011	Forms Path Sensor and Switch Card	Under splicing station, forms path sensors and switches.

Autotransformer

The autotransformer transforms line voltages of 200, 208, 220, 230, or 240 V ac, 50 or 60 Hz, into 100, 120, and 220 V ac.

The phase input must be connected to the correct point for that particular line voltage in the jumper plugs on the side of the ac control box:

Line Voltage	Connector
240 V ac	JA02
220/230 V ac	JA03
200/208 V ac	JA04

Also see the *Wiring Diagrams* for the connections for the available line voltages.

Power Switches

- CIRCUIT BREAKER CB501 (printer main power): This circuit breaker is normally kept in the ON position and supplies ac voltage to the entire system.
- CIRCUIT BREAKER CB503: This circuit breaker is normally kept in the ON position and supplies power to the control unit ac control box, printer dc units 1 and 2, and the transformer. The transformer supplies power to ac motors and fans in the printer.
- CIRCUIT BREAKER CB504: This circuit breaker is normally kept ON and supplies power to the power sequencing circuitry.

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