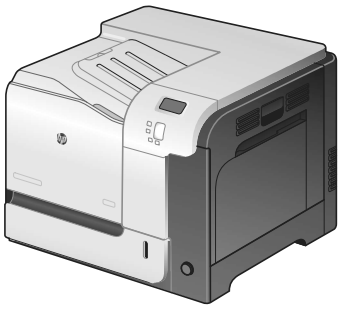
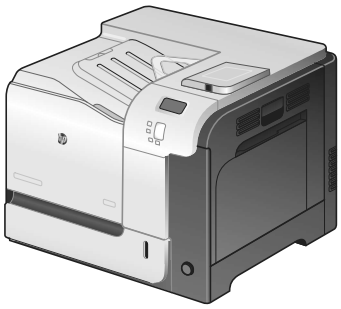
LASERJET ENTERPRISE 500 COLOR

Service Manual



M551n



M551dn

M551xh

HP LaserJet Enterprise 500 color M551 Printers

Service Manual

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Conventions used in this guide

TIP: Tips provide helpful hints or shortcuts.

NOTE: Notes provide important information to explain a concept or to complete a task.

CAUTION: Cautions indicate procedures that you should follow to avoid losing data or damaging the product.

WARNING! Warnings alert you to specific procedures that you should follow to avoid personal injury, catastrophic loss of data, or extensive damage to the product.

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1 Theory of operation

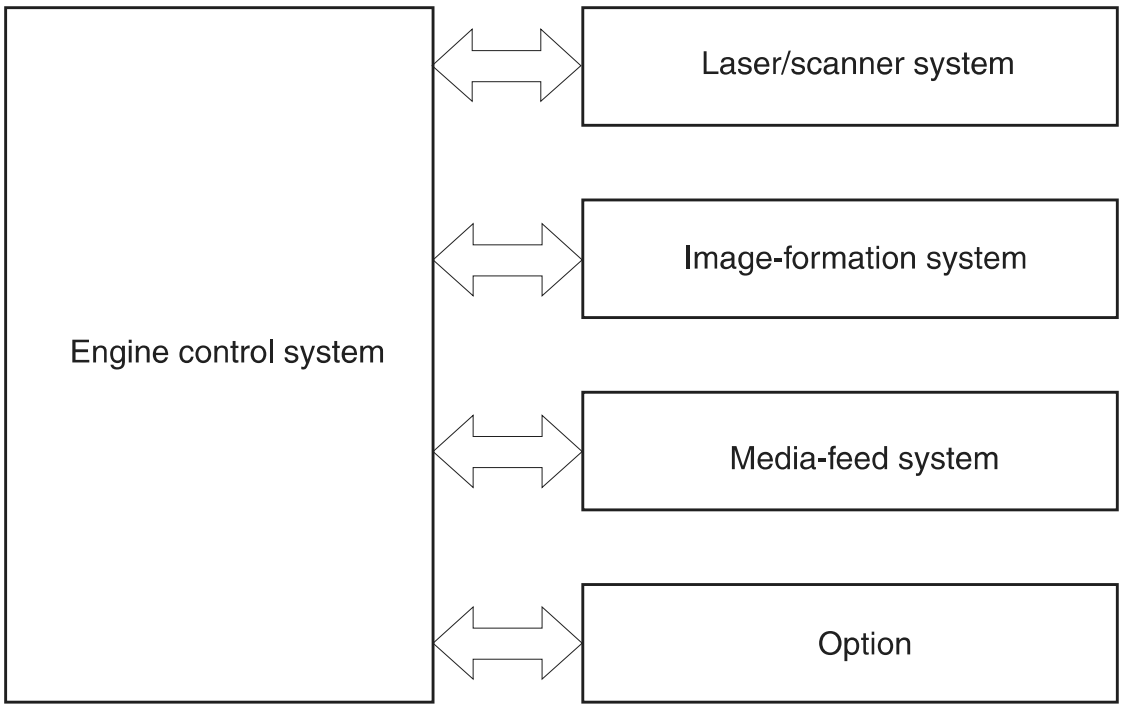
Basic operation

The product routes all high-level processes through the formatter, which stores font information, processes the print image, and communicates with the host computer.

The basic product operation comprises the following systems:

- The engine-control system, which includes the power supply and the DC controller printed circuit assembly (PCA)
- The laser/scanner system, which forms the latent image on the photosensitive drum
- The image-formation system, which transfers a toner image onto the paper
- The media feed system, which uses a system of rollers and belts to transport the paper through the product
- Option (optional paper feeder)

Figure 1-1 Relationship between the main product systems



Sequence of operation

The DC controller PCA controls the operating sequence, as described in the following table.

NOTE: The terms fusing and fixing are synonymous.

Table 1-1 Sequence of operation

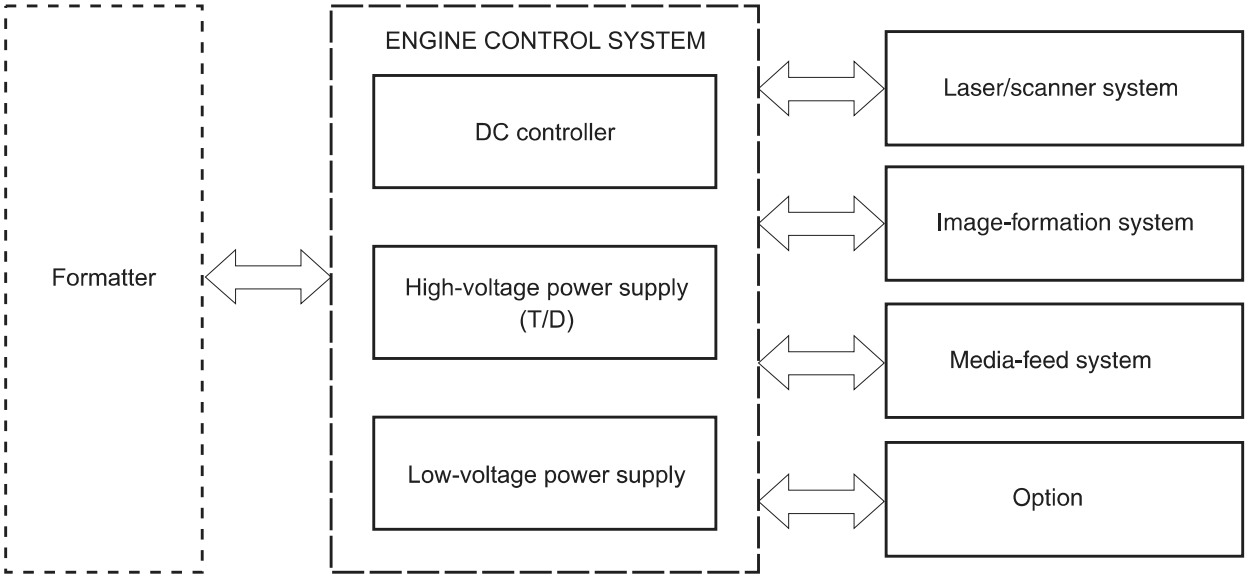
Period	Duration	Description
Waiting	From the time the power is turned on, the door is closed, or when the product exits Sleep mode until the product is ready for printing	• Heats the fuser sleeve • Pressurizes the fuser pressure roller • Detects the print cartridges • Detects the home position for the primary transfer roller and the developing unit • Cleans the secondary transfer roller
Standby	From the end of the waiting sequence or the last rotation until the formatter receives a print command or until the product is turned off	• The product is in the **READY** state. • The product enters Sleep mode after the specified length of time. • The product calibrates if it is time for an automatic calibration.
Initial rotation	From the time the formatter receives a print command until the paper enters the paper path	• Activates the high-voltage power supply • Prepares each laser/scanner unit • Warms the fuser to the correct temperature
Printing	From the time the first sheet of paper enters the paper path until the last sheet has passed through the fuser	• Forms the image on the photosensitive drums • Transfers the toner to the paper • Fuses the toner image onto the paper • Performs calibration after a specified number of pages
Last rotation	From the time the last sheet of paper exits the fuser until the motors stop rotating	• Moves the last printed sheet into the output bin • Stops each laser/scanner unit • Discharges the bias from the high-voltage power supply

Engine control system

The engine-control system receives commands from the formatter and interacts with the other main systems to coordinate all product functions. The engine-control system consists of the following components:

- DC controller
- High-voltage power supply
- Low-voltage power supply

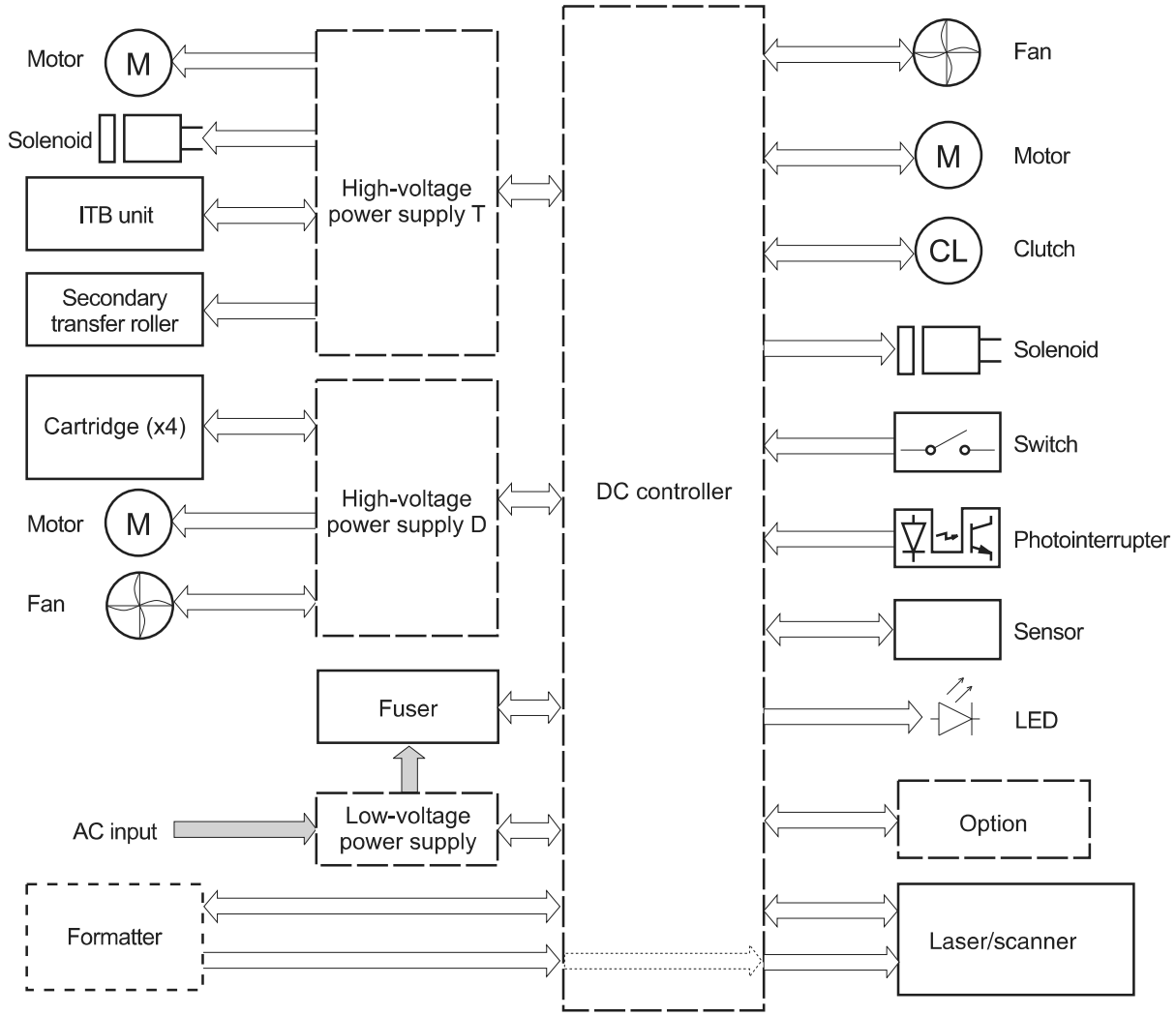
Figure 1-2 Engine control system



DC controller

The DC controller controls the operational sequence of the printer.

Figure 1-3 DC controller block diagram



Solenoids

Table 1-2 Solenoids

Component abbreviation	Component name
SL1	Primary transfer roller disengagement solenoid
SL2	Duplex reverse solenoid (HP LaserJet Enterprise 500 color M551dn and HP LaserJet Enterprise 500 color M551xh only)
SL3	Multipurpose-tray pickup solenoid
SL4	Cassette pickup solenoid

Clutches

Table 1-3 Clutches

Component abbreviation	Component name
CL1	Duplex re-pickup clutch (HP LaserJet Enterprise 500 color M551dn and HP LaserJet Enterprise 500 color M551xh only)

Switches

Table 1-4 Switches

Component abbreviation	Component name
SW1, SW2	5V interlock switch
SW3	24V interlock switch
SW4	Power switch
	Test print switch

Sensors

Table 1-5 Sensors

Component abbreviation	Component name
SR1	Drum home position sensor 1
SR2	Drum home position sensor 2
SR3	Drum home position sensor 3
SR5	Fuser output sensor
SR6	Output bin full sensor
SR7	Fuser pressure release sensor
SR8	Registration sensor
SR9	Fuser pressure release sensor
SR11	Developer alienation sensor
SR13	Tray 2 cassette sensor
SR14	Fuser loop 1 sensor
SR15	Fuser loop 2 sensor
SR17	ITB alienation sensor
SR20	Tray 2 paper sensor
SR21	Tray 1 paper sensor
SR22	Duplexer refeed sensor (HP LaserJet Enterprise 500 color M551dn and HP LaserJet Enterprise 500 color M551xh only)
	OHT sensor (in)
	OHT sensor (out)
	RD sensor (front)
	RD sensor (rear)
	Environmental sensor (temperature and humidity)
	Yellow toner-level sensor
	Magenta toner-level sensor
	Cyan toner-level sensor
	Black toner-level sensor
	Toner collection-box-full sensor

Motors and fans

The product has 11 motors and three fan motors. The motors drive the components in the paper-feed and image-formation systems. The fan motors cool the product's inside.

Table 1-6 Motors

Abbreviation	Name	Purpose	Type	Failure detection
M2	Fuser motor	Drives the Fuser roller, the delivery roller, and the Fuser pressure roller	DC motor	Yes
M3	Drum motor 1	Drives the photosensitive drum (yellow/magenta), developing unit (yellow), and primary charging roller (yellow/magenta)	DC motor	Yes
M4	Drum motor 2	Drives the photosensitive drum (cyan), developing unit (magenta/cyan), and primary charging roller (cyan)	DC motor	Yes
M5	Drum motor 3	Drives the photosensitive drum (black), developing unit (black), and ITB drive roller, and secondary transfer roller	DC motor	Yes
M7	Lifter motor	Drives the lifter for the cassette	Stepping motor	Yes
M8	Cyan/black scanner motor	Drives the scanner mirror in the cyan/ black laser scanner	DC motor	Yes
M9	Yellow/magenta scanner motor	Drives the scanner mirror in the yellow/ magenta laser scanner	DC motor	Yes
M10	Developing disengagement motor	Drives the developing unit disengagement	Stepping motor	No
M11	Duplex reverse motor (HP LaserJet Enterprise 500 color M551dn and HP LaserJet Enterprise 500 color M551xh only)	Drives the duplex reverse roller and duplex feed roller	Stepping motor	No

Table 1-6 Motors (continued)

Abbreviation	Name	Purpose	Type	Failure detection
M12	Residual toner-feed motor	Drives the residual toner feed screw	DC motor	Yes
M13	Pickup motor	Drives the cassette pickup roller, MP tray pickup roller, feed roller, registration roller, and re-pickup roller	Stepping motor	No

Table 1-7 Fans

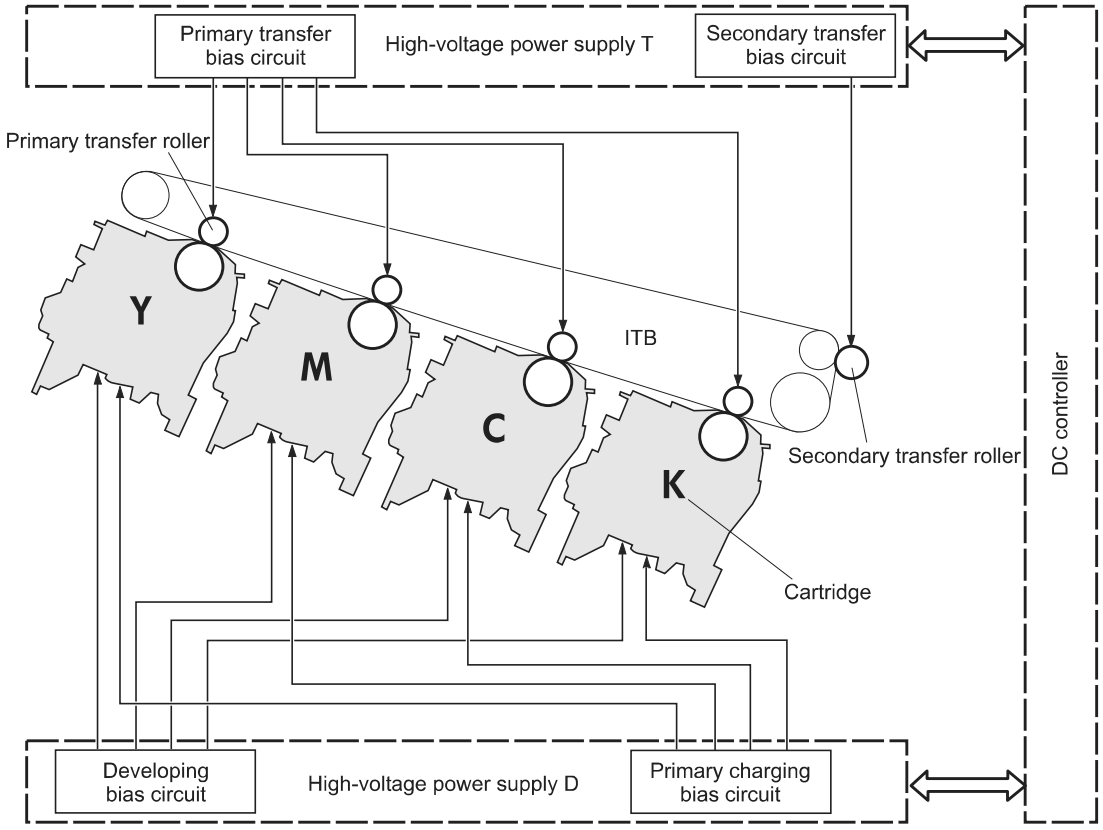
Abbreviation	Name	Cooling area	Type	Speed
FM1	Power supply fan	Around the power supply unit	Intake	Full/half
FM2	Cartridge fan	Around the cartridges	Intake	Full/half
FM3	Delivery fan	Around the delivery unit	Intake	Full/half

High voltage power supply

The high-voltage power supply delivers the high-voltage biases to the following components used to transfer toner during the image-formation process:

- Primary-charging roller (in the cartridge)
- Developing roller (in the cartridge)
- Primary-transfer roller
- Secondary-transfer roller

Figure 1-4 High voltage power supply circuits



The high voltage power supply contains several separate circuits.

Table 1-8 High voltage power supply circuits

Circuit	Description
Primary-charging-bias generation	DC negative bias is applied to the surface of the photosensitive drum to prepare it for image formation.
Developing-bias generation	DC negative bias adheres the toner to each photosensitive drum during the image-formation process.

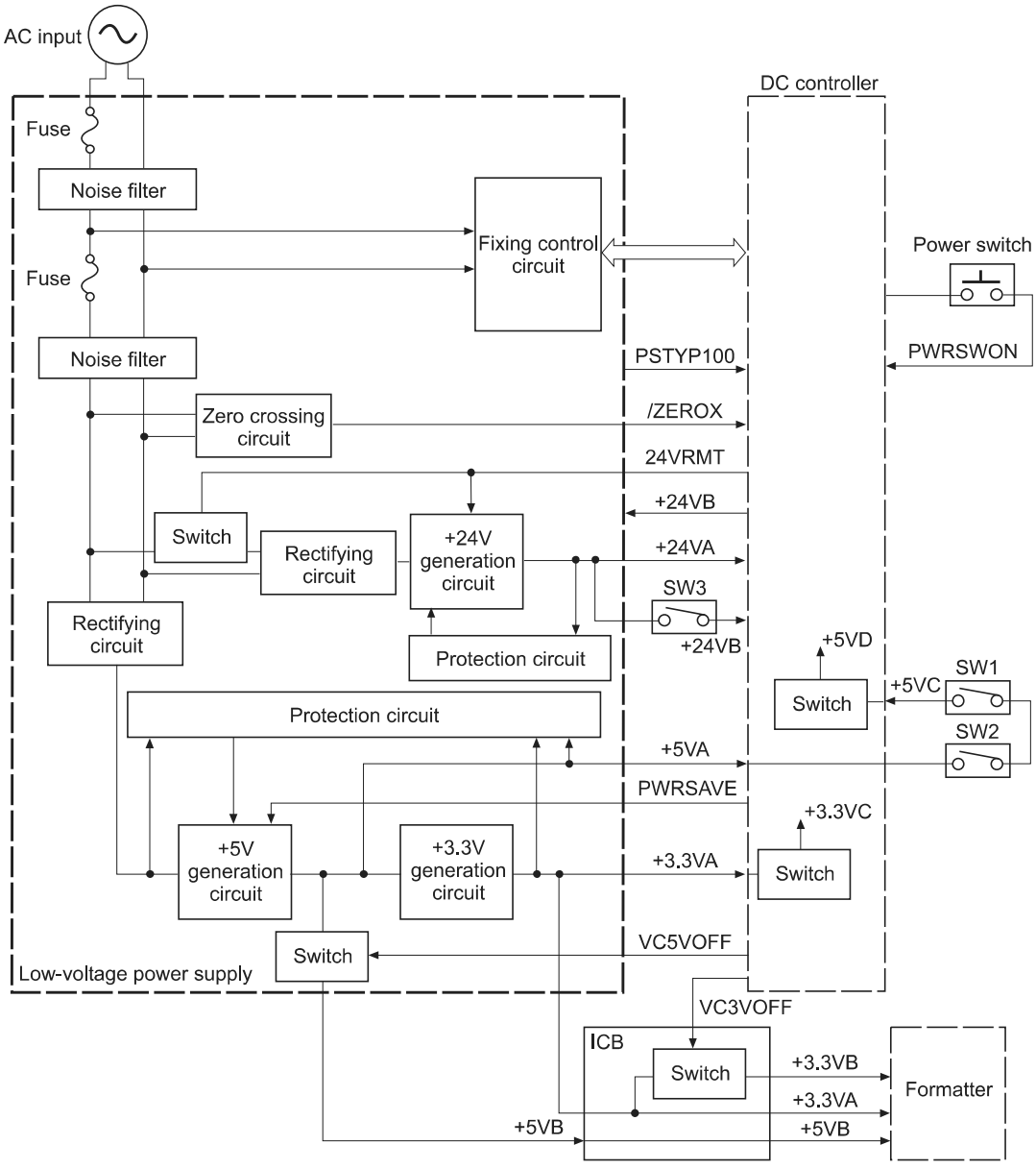
Table 1-8 High voltage power supply circuits (continued)

Circuit	Description
Primary-transfer-bias generation	DC positive bias transfers the latent toner image from each photosensitive drum onto the ITB.
Secondary-transfer-bias generation	Two DC biases, one positive and one negative, transfer the toner from the ITB onto the paper.

Low voltage power supply

The low-voltage power-supply circuit converts the AC power from the wall receptacle into the DC voltage that the product components use. The product has two low-voltage power-supplies for 110 Volt or 220 Volt input.

Figure 1-5 Low voltage power-supply circuit



The low voltage power supply converts the AC power into three DC voltages, which it then subdivides, as described in the following table.

Table 1-9 Converted DC voltages

Main DC voltage	Sub-voltage	Behavior	Notes
+24 V	+24VA	Stopped during Sleep (powersave) mode	The 24V POWER SUPPLY (24VRMT) signal controls supply or interruption of +24VA.
	+24VB	Interrupted when the front door or right door open Stopped during Sleep (powersave) mode	
+5 V	+5VA	Supplied during Sleep (powersave) mode 2 and Sleep (powersave) mode 3	The VOLTAGE CONVERSION (PWRSAVE) signal converts output voltage of +5VA into 3.2V.
	+5VB	Supplied during Sleep (powersave) mode 2 Stopped during Sleep (powersave) mode 3 Supplies power to the formatter	The 5V POWER SUPPLY (VC5VOFF) signal sontrols supply or interruption of +5VB. The VOLTAGE CONVERSION (PWRSAVE) signal converts output voltage of +5VB into 3.2V
	+5VC	Supplied during Sleep (powersave) mode 2 and Sleep (powersave) mode 3 Interrupted when the front door or right door open	the VOLTAGE CONVERSION (PWRSAVE) signal converts output voltage of +5VC into 3.2V.
	+5VD	Stopped during Sleep (powersave) mode Interrupted when the front door or right door open	
+3.3 V	3.3VA	Constantly supplied	
	3.3VB	Stopped only when the power is off Supplies power to the formatter	The 3V POWER SUPPLY (VC3VOFF) signal controls supply or interruption of +3.3VB.
	3.3VC	Stopped during Sleep (powersave) mode 2 and Sleep (powersave) mode 3	

Overcurrent/overvoltage protection

The low-voltage power supply stops supplying the DC voltage to the product components whenever it detects excessive current or abnormal voltage from the power source.

The low-voltage power supply has a protective circuit against overcurrent and overvoltage to prevent failures in the power supply circuit.

If the low-voltage power supply is not supplying DC voltage, the protective function might be running. In this case, turn the power off and unplug the power cord. Do not plug in and turn on the product until the cause is found and corrected.

In addition, the low-voltage power supply has two fuses (FU100/FU101) to protect against overcurrent. If overcurrent flows into the AC line, the fuse blows to stop AC power.

Safety

For safety, the product interrupts the power supply of +24VB by turning off the interlock switch (SW3) and +5VC by turning off the interlock switch (SW1/SW2).

The AC power is supplied to the product even when the power switch is turned off because the product uses the soft switch for turning on/off the product. Always unplug the power cord before disassembling the product.

Sleep (powersave) mode

Sleep mode conserves energy by stopping the power to several components when the product is idle. The product has three sleep modes depending on the power consumption. The DC controller supplies or converts each power supply according to the sleep mode.

- Sleep mode 1: Stops +24VA and +24VB
- Sleep mode 2: Stops +24VA, +24VB and +5VD. Converts +5VA, +5VB and +5VC into +3.2V.
- Sleep mode 3: Stops +24VA, +24VB, +5VB and +5VD. Converts +5VA and +5VC into +3.2V.

Power supply voltage detection

The product detects the power supply voltage that is connected to the product. The DC controller monitors the POWER SUPPLY VOLTAGE (PSTYP100) signal and detects power supply voltage, whether 100 V or 200 V, to control the fusing operation.

Low voltage power supply failure

The DC controller determines a low-voltage power supply failure and notifies the formatter when the low-voltage power supply does not supply +24 V.

Power off condition

The DC controller turns off the product with the 24V POWER SUPPLY (24VRMT) signal, 5V POWER SUPPLY (VC5VOFF) signal, 3V POWER SUPPLY (VC3VOFF) signal, and VOLTAGE CONVERSION (PWRSAVE) signal.

+5VA and +5VC, are converted into +3.2V, and +3.3VA and supplied during the power off condition.

Fuser control

The fuser-control circuit controls the fuser temperature. The product uses an on-demand fusing method.

Figure 1-6 Fuser components

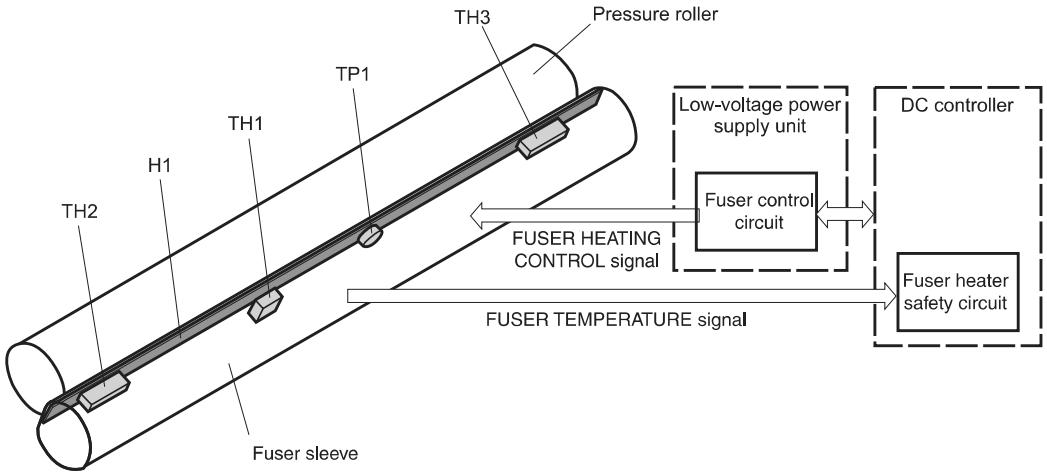


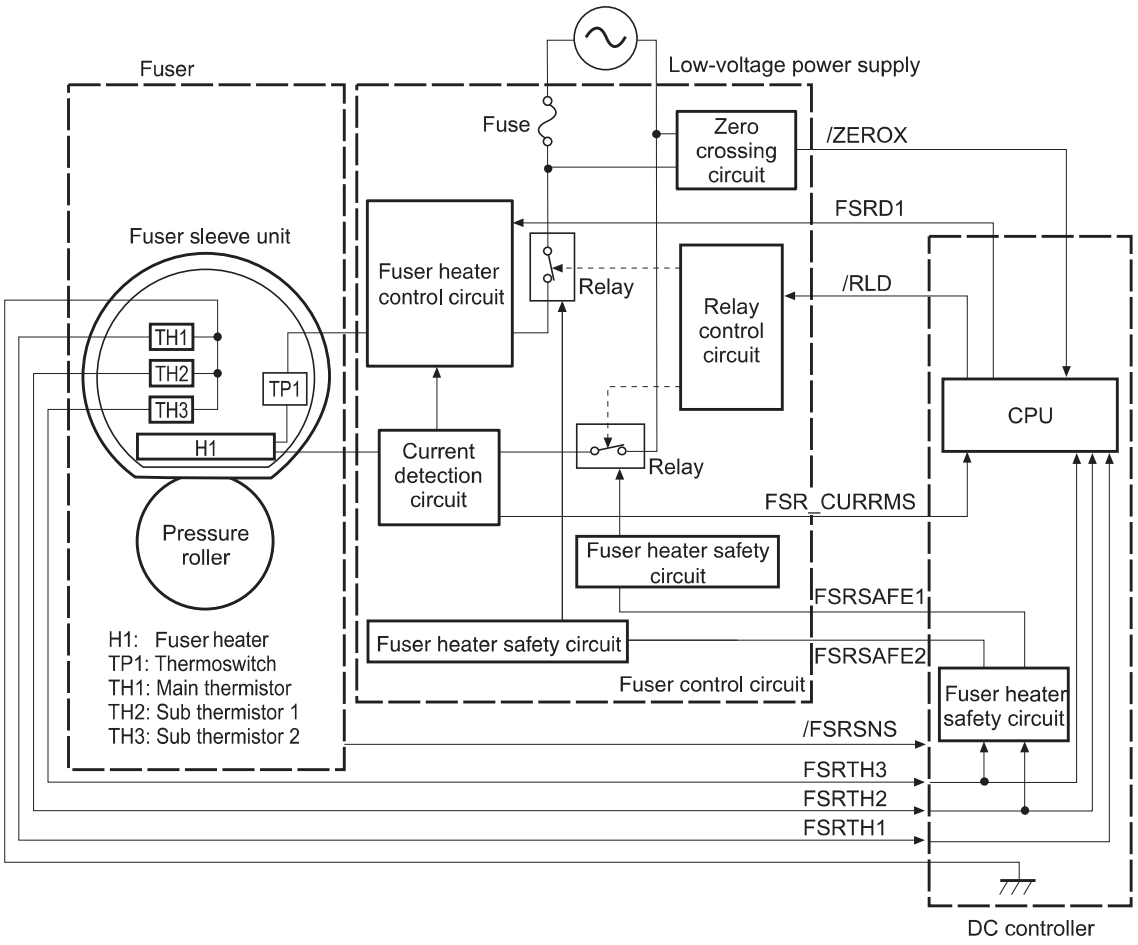
Table 1-10 Fuser components

Type of component	Abbreviation	Name	Function
Heaters	H1	Fuser heater	Heats the fuser sleeve.
Thermistors (Contact type)	TH1	Main thermistor	Each thermistor detects the center temperature of the fuser sleeve.
	TH2 TH3	Sub thermistor	Each thermistor detects the side temperature of the fuser heater.
Thermoswitches (Non-contact type)	TP1	For the fuser heater	Controls the fuser-roller main heater

Fuser temperature control circuit

The temperatures of the two rollers in the fuser fluctuate according to the stage of the printing process. The DC controller sends commands to the fuser-control circuit to adjust temperatures.

Figure 1-7 Fuser temperature control circuit



Fuser over temperature protection

To protect the fuser from excessive temperatures, the product has four layers of protective functions. If one function fails, the subsequent functions should detect the problem.

- **DC controller**: When a thermistor or thermopile detects a temperature above a certain threshold, the DC controller interrupts power to the specific heater. Following are the thresholds for each component:
  - TH1: 230° C (446° F) or higher
  - TH2: 285° C (545° F) or higher
  - TH3: 285° C (545° F) or higher
- **Fuser heater safety circuit**: If the DC controller fails to interrupt the power to the heaters at the prescribed temperatures, the fuser heater safety circuit deactivates the triac-drive circuit and releases the relay, which causes the heaters to stop at slightly higher temperature thresholds.
  - TH2: 290° C (554° F) or higher
  - TH3: 290° C (554° F) or higher
- **Current detection protection circuit**: If current flowing in each triac exceeds a specific value, the current detection protection circuit deactivates the triac-drive circuit and releases the relay, which interrupts the power supply to the heaters.
- **Thermoswitch**: If the temperature in the heaters is abnormally high, and the temperature in the thermoswitches exceeds a specified value, the contact to the thermoswitch breaks. Breaking this contact deactivates the triac-drive circuit and releases the relay, which interrupts the power supply to the heaters. Following are the thresholds for each thermoswitch:
  - TP1: 270° C (518° F) or higher

NOTE: When the thermoswitches reach this temperature, the temperature on the fuser rollers is about 320° C (608° F).

Fuser failure detection

When the DC controller detects any of the following conditions, it determines that the fuser has failed. The DC controller then interrupts power to the fuser heaters and notifies the formatter.

- **Abnormally high temperatures**: Temperatures are too high for any of the following components, at any time:
  - TH1: 230° C (446° F) or higher
  - TH2: 285° C (545° F) or higher
  - TH3: 285° C (545° F) or higher
- **Abnormally low temperatures**: Temperatures are too low at any of the following components after the product has initialized.
  - TH1: 120° C (248° F) or lower
  - TP2 or TP3: 100° C (212° F) or lower

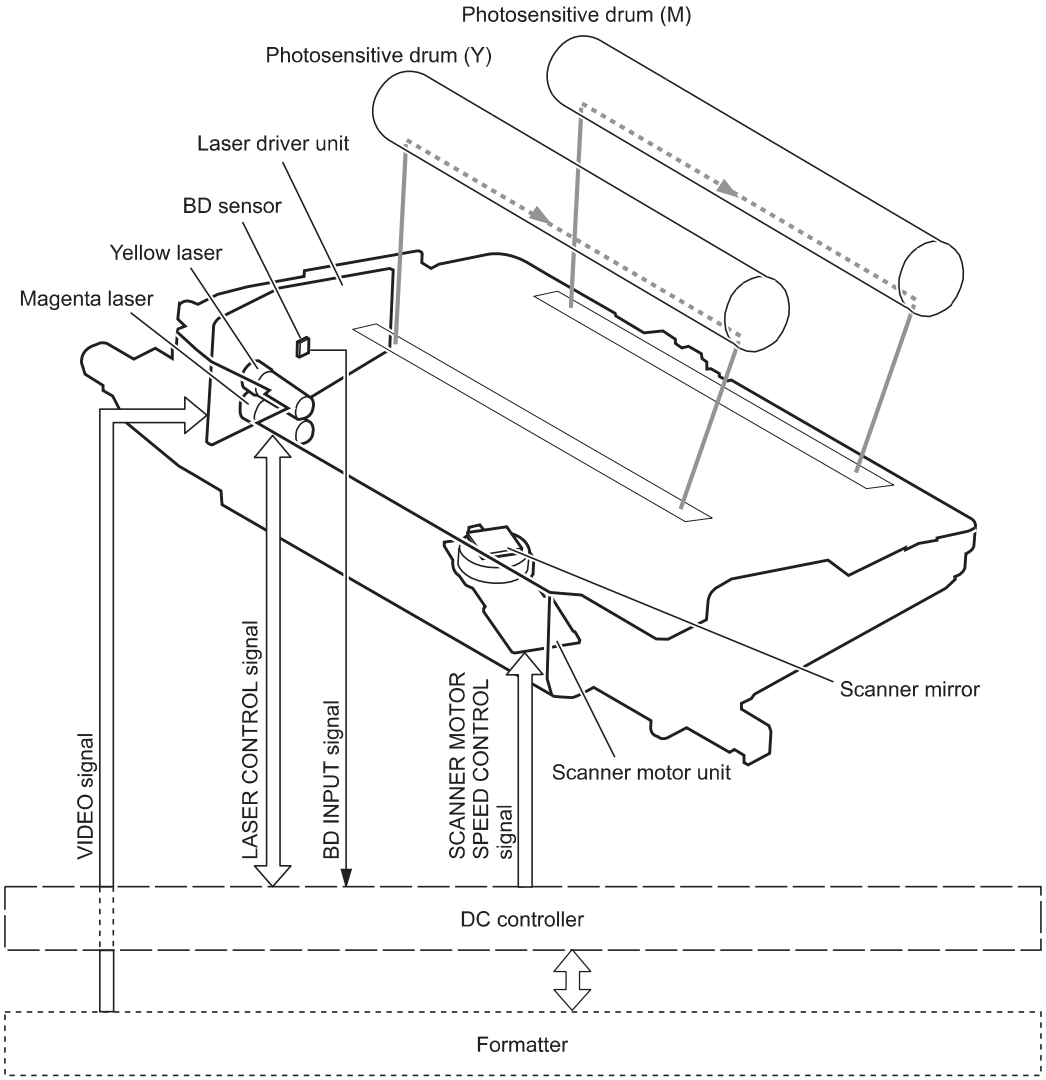
  Or, the temperature drops in either of the thermopiles (TP1 and TP2) by 30° C (86° F) or more within a specified length of time.
- **Abnormal temperature rise**: The DC controller determines an abnormal temperature rise if the detected temperature of TH1 does not rise 2° C within a specified time period after the fuser motor is turned on, or if the detected temperature of the thermistors does not rise to a specified temperature for a specified time after the fuser motor is turned on.
- **Thermistor open**: The DC controller determines a thermistor open if:
  - The detected temperature of TH1 is kept at 12° C (53° F) or lower for a specified time after the fuser motor is turned on.
  - The detected temperature of TH2 is kept at 4° C (39° F) or lower for a specified time.
  - The detected temperature of TH3 is kept at 4° C (39° F) or lower for a specified time.
- **Drive-circuit failure**: The DC controller determines a drive-circuit failure:
  - If the detected power supply frequency is out of a specified range when the printer is turned on or during the standby period
  - If the current detection circuit detects an out of specified current value
- **Fuser discrepancy**: The DC controller determines a fuser type mismatch when it detects an unexpected fuser unit presence signal. The product has two fusers for 110 V or 220 V input power.

Laser/scanner system

The laser/scanner system forms the latent electrostatic image on the photosensitive drums according to the VIDEO signals sent from the formatter. The product has two laser/scanners: one for yellow and magenta and the other for cyan and black.

The formatter sends the DC controller instructions for the image of the page to be printed. The DC controller signals the lasers to emit light, and the laser beams pass through lenses and onto the scanner mirror, which rotates at a constant speed. The mirror reflects the beam onto the photosensitive drum in the pattern necessary for the image, exposing the surface of the drum so it can receive toner.

Figure 1-8 Laser/scanner system



The DC controller determines that a laser/scanner has failed when any of the following conditions occurs:

- **Laser failure**: The detected laser intensity does not match a specified value when the product initializes.
- **Beam-detect (BD) failure**: The BD interval is outside a specified range during printing.
- **Scanner-motor failure**: The scanner motor does not reach a specified rotation speed within a certain time after it begins rotating.

Image formation system

The image-formation system creates the printed image on the paper. The system consists of the laser/scanners, print cartridges, imaging drums, ITB, and fuser.

Figure 1-9 Image formation system

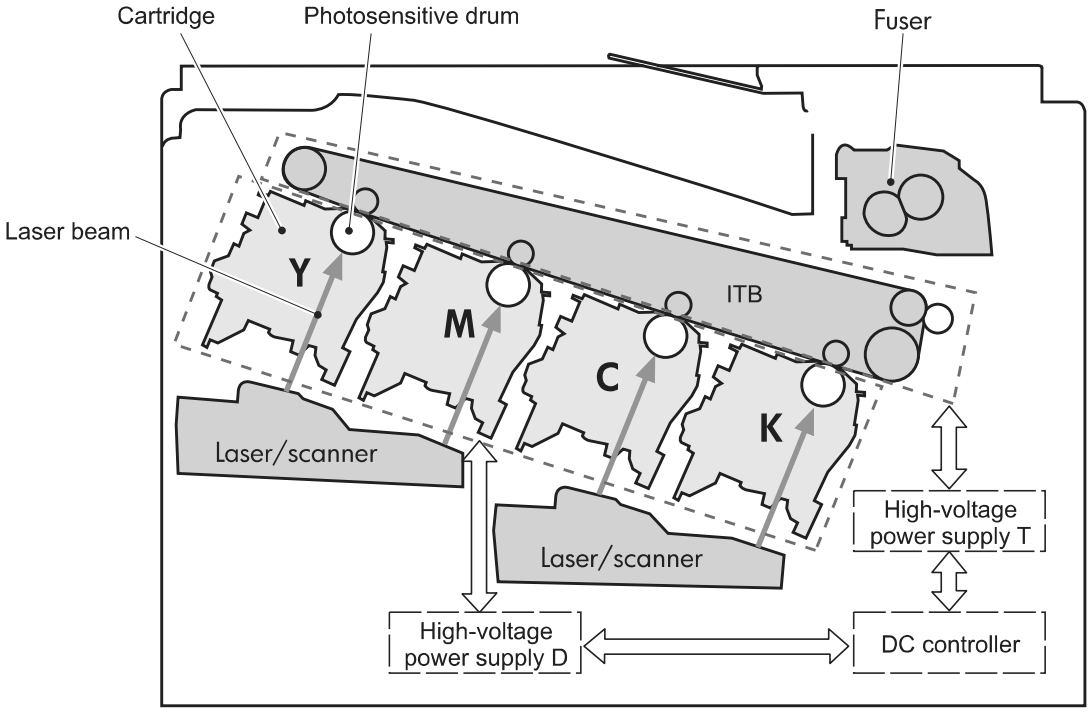


Image formation process

The image-formation system consists of ten steps divided into six functional blocks.

Figure 1-10 Image formation process

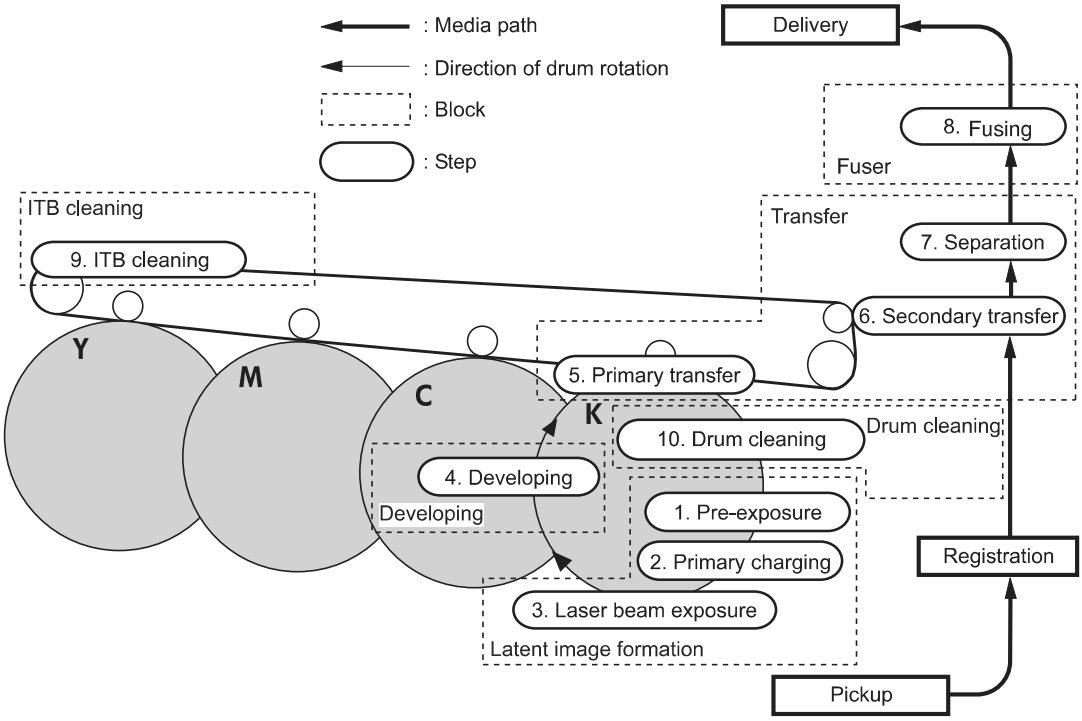


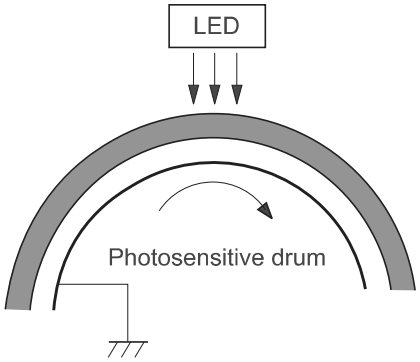
Table 1-11 Image formation process

Functional block	Steps	Description
Latent image formation	1. Pre-exposure 2. Primary charging 3. Laser-beam exposure	An invisible latent image forms on the surface of the photosensitive drums.
Development	4. Development	Toner adheres to the electrostatic latent image on the photosensitive drums.
Transfer	5. Primary transfer 6. Secondary transfer 7. Separation	The toner image transfers to the ITB and subsequently to the paper.
Fusing	8. Fusing	The toner fuses to the paper to make a permanent image.
ITB cleaning	9. ITB cleaning	Residual toner is removed from the ITB.
Drum cleaning	10. Drum cleaning	Residual toner is removed from the photosensitive drums.

Step 1: Pre-exposure

Light from the pre-exposure LED strikes the surface of the photosensitive drum to remove any residual electrical charges from the drum surface.

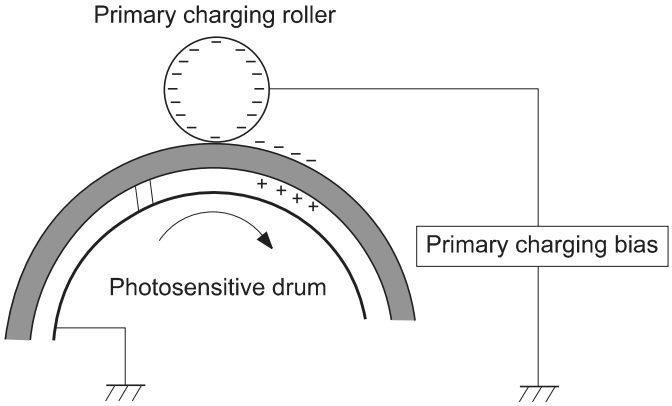
Figure 1-11 Pre-exposure



Step 2: Primary charging

The primary-charging roller contacts the photosensitive drum and charges the drum with negative potential.

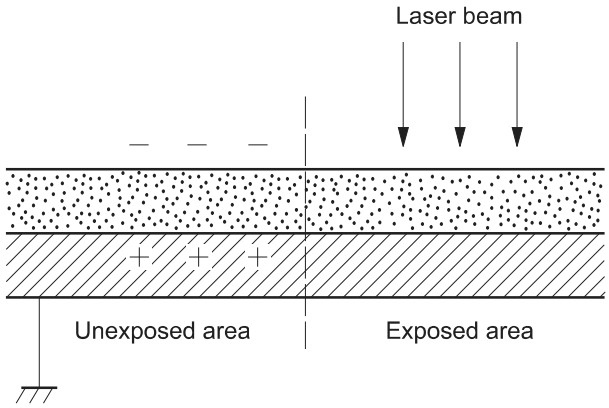
Figure 1-12 Primary charging



Step 3: Laser-beam exposure

The laser beam strikes the surface of the photosensitive drum in the areas where the image will form. The negative charge neutralizes in those areas, which are then ready to accept toner.

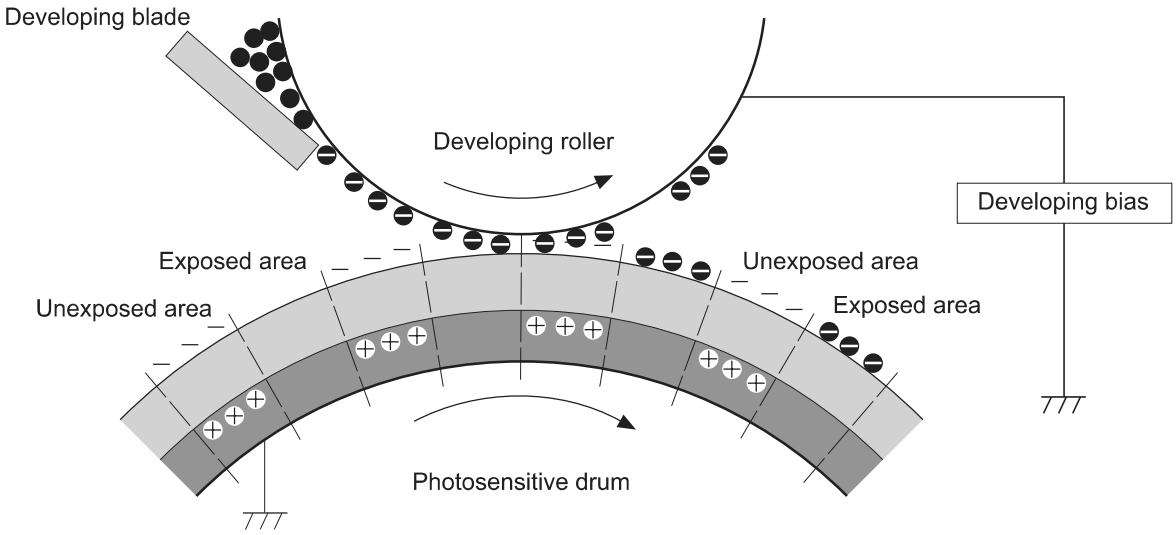
Figure 1-13 Laser-beam exposure



Step 4: Development

Toner acquires a negative charge as the developing cylinder contacts the developing blade. Because the negatively charged surface of the photosensitive drums have been neutralized where they have been struck by the laser beam, the toner adheres to those areas on the drums. The latent image becomes visible on the surface of each drum.

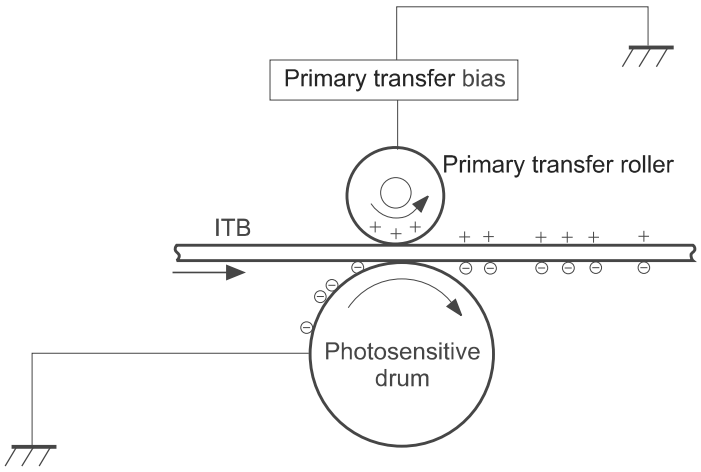
Figure 1-14 Development



Step 5: Primary transfer

The positively charged primary-transfer rollers contact the ITB, giving the ITB a positive charge. The ITB attracts the negatively charged toner from the surface of each photosensitive drum, and the complete toner image transfers onto the ITB, beginning with yellow, followed by magenta, cyan, and black.

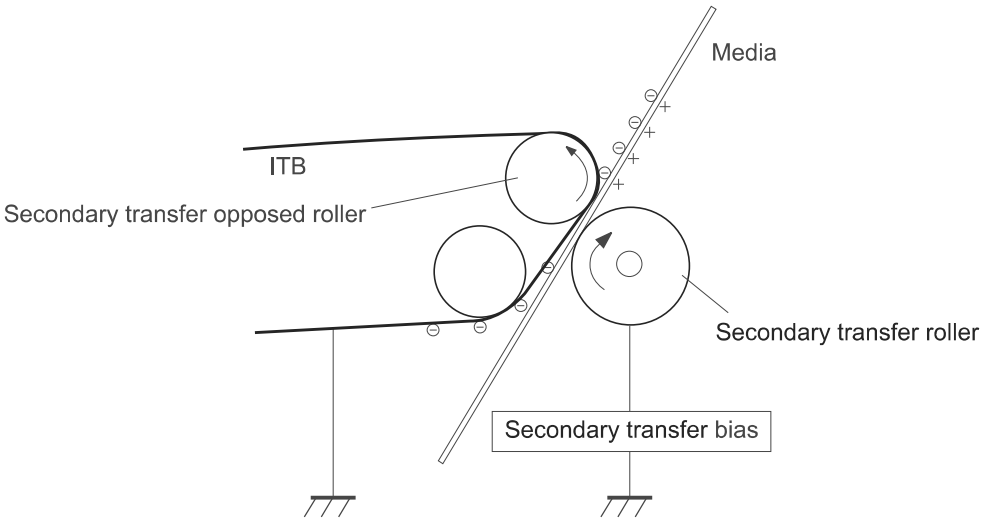
Figure 1-15 Primary transfer



Step 6: Secondary transfer

The paper acquires a positive charge from the secondary-transfer roller, and so it attracts the negatively charged toner from the surface of the ITB. The complete toner image transfers onto the paper.

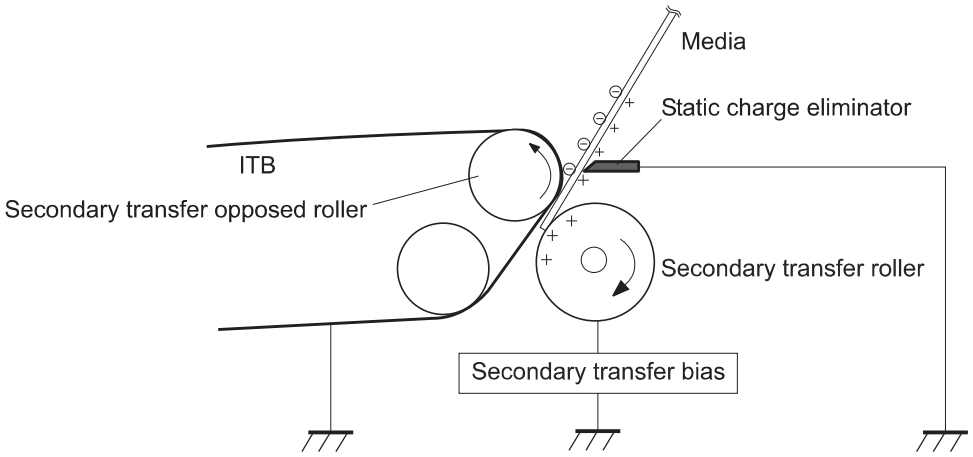
Figure 1-16 Secondary transfer



Step 7: Separation

The stiffness of the paper causes it to separate from the ITB as the ITB bends. The static-charge eliminator removes excess charge from the paper to ensure that the toner fuses correctly.

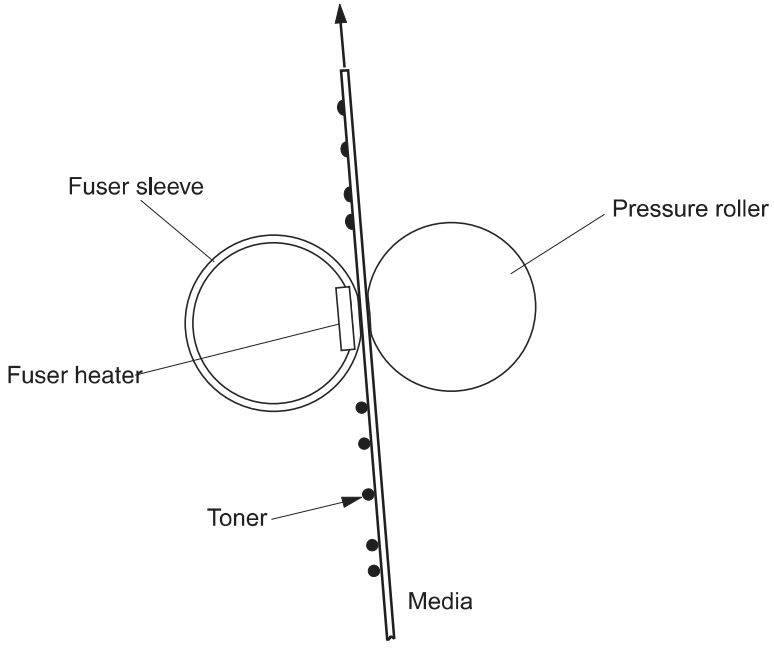
Figure 1-17 Separation



Step 8: Fusing

To create the permanent image, the paper passes through heated, pressurized rollers to melt the toner onto the page.

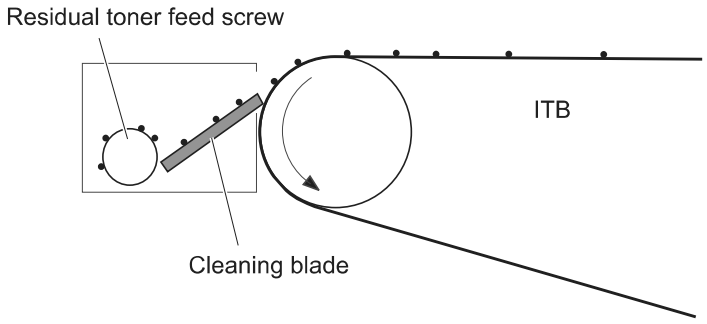
Figure 1-18 Fusing



Step 9: ITB cleaning

The cleaning blade scrapes the residual toner off the surface of the ITB. The residual toner feed screw deposits residual toner in the toner collection box.

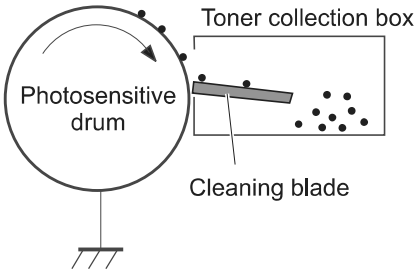
Figure 1-19 ITB cleaning



Step 10: Drum cleaning

Inside the print cartridge, the cleaning blade removes residual toner from the surface of the drum to prepare it for the next image. The waste toner falls into the hopper in the print cartridge.

Figure 1-20 Drum cleaning



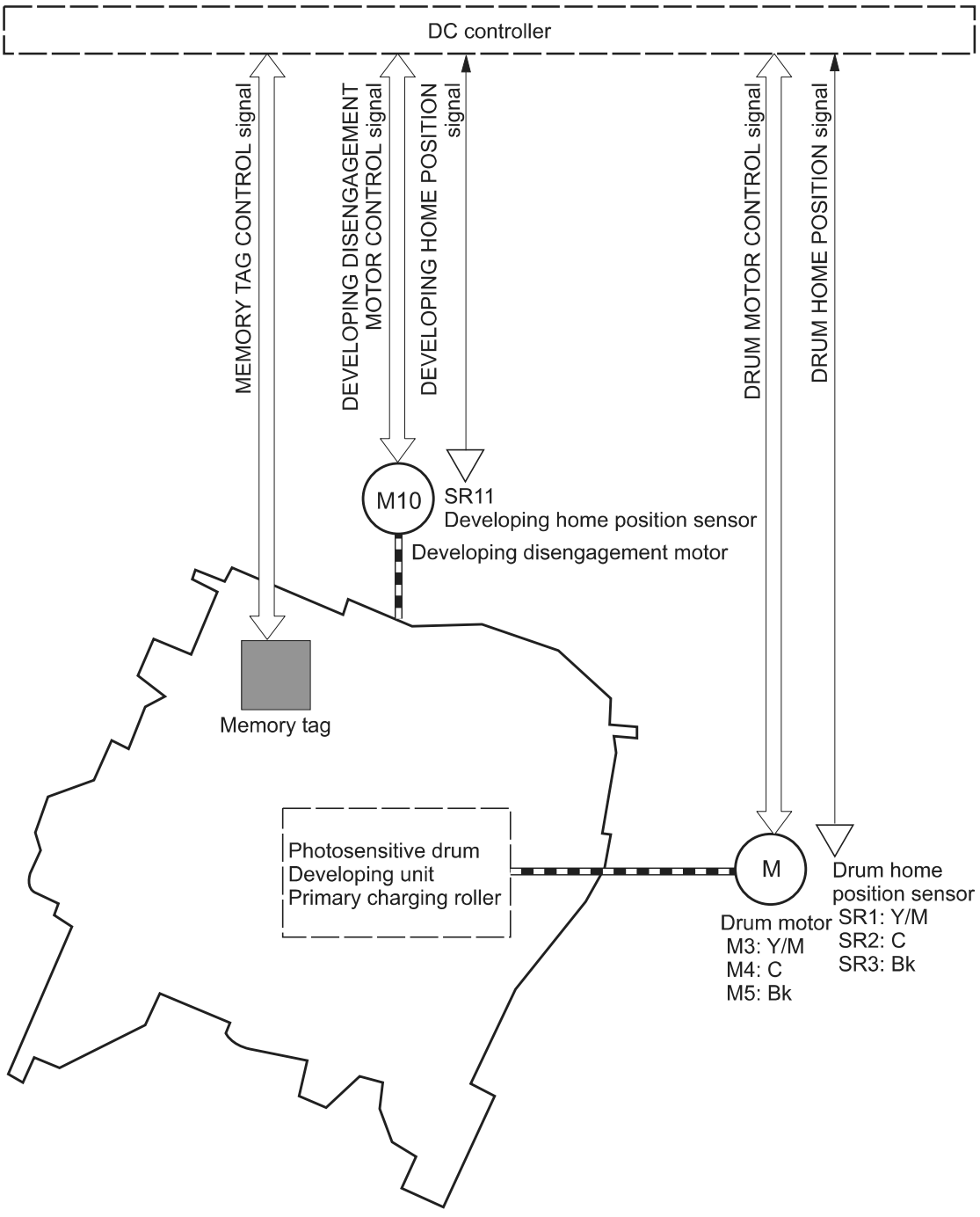
Print cartridge

The product has four print cartridges, one for each color. Each print cartridge contains a reservoir of toner and the following components:

- Photosensitive drum
- Developing roller
- Primary-charging roller

The DC controller rotates the drum motor to drive the photosensitive drum, developing roller, and the primary-charging roller.

Figure 1-21 Print-cartridge system



The DC controller rotates the drum motor to drive the photosensitive drum, developing unit, and primary charging roller.

The memory tag is a non-volatile memory chip that stores information about the usage for the print cartridge.

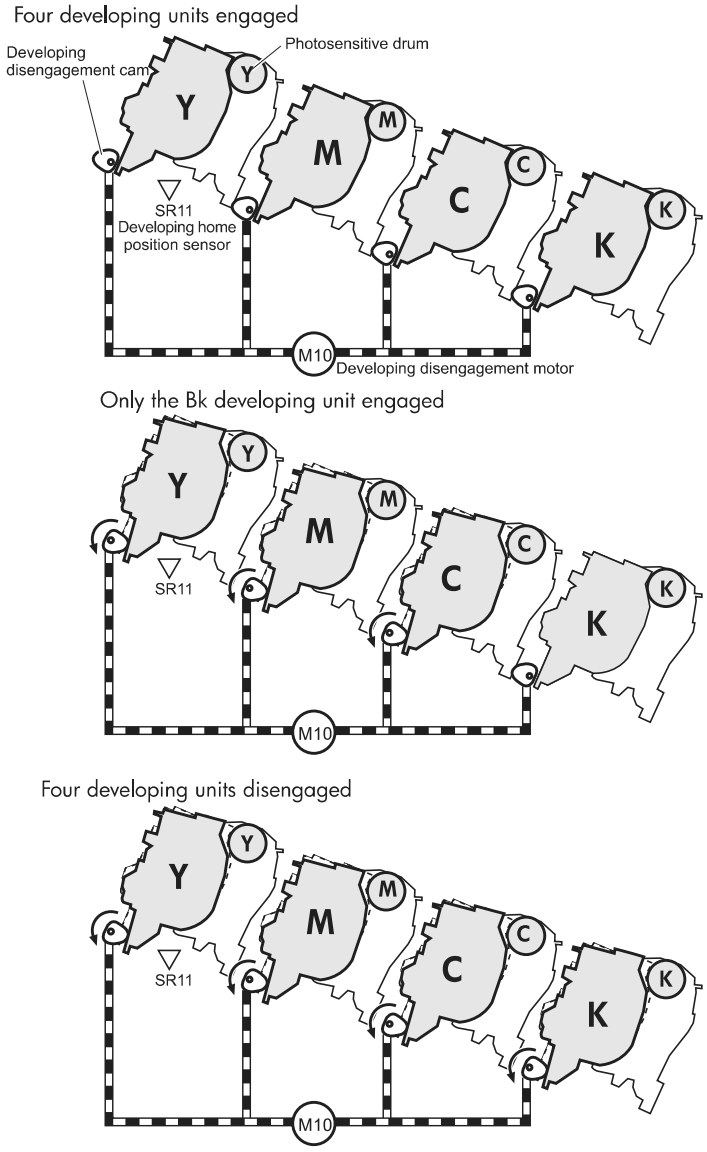
The DC controller notifies the formatter of an error if any of the following conditions exist:

- The memory tag fails to either read to or write from the DC controller
- The RD sensors detect a missing or incorrectly installed print cartridge.
- The accumulated print time reaches a specified time period or the cartridge runs out of toner.
- The toner level in any of the print cartridges drops below a certain level

Developing roller engagement and disengagement

The product can print in full-color mode or in black-only mode. To print in black-only mode, the product disengages the developing rollers in the cyan, magenta, and yellow print cartridges. This maximizes the life of the cartridges.

Figure 1-22 Developing-roller engagement and disengagement control



The DC controller rotates the developing disengagement motor and changes the direction of the cam according to the instructions from the formatter for each print job.

When the product is turned on and at the end of each print job, all four of the developing rollers disengage from the photosensitive drums. If the next print job is full-color mode, each of the developing rollers engage. If the next print job is black-only mode, only the black developing roller engages.

If the DC controller does not detect any output from the developing home-position sensor, it determines that the developing-disengagement motor has failed.

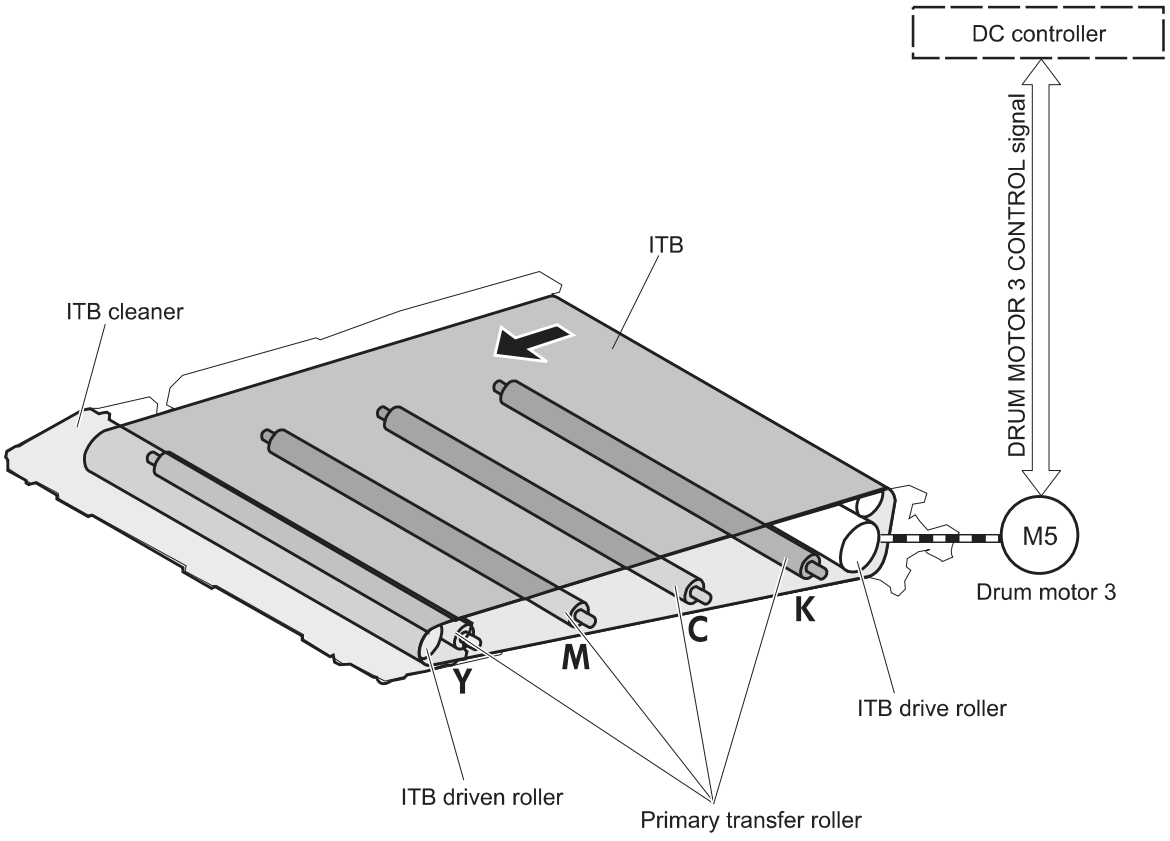
Intermediate transfer belt (ITB) unit

The ITB unit accepts the toner images from the photosensitive drums and transfers the completed image to the paper. The ITB unit has these main components:

- ITB
- ITB drive roller
- ITB-driven roller
- Primary-transfer rollers
- ITB cleaner

The ITB motor drives the ITB drive roller, which rotates the ITB. The motion of the ITB causes the primary transfer rollers to rotate. The ITB cleaner cleans the ITB surface.

Figure 1-23 ITB unit



Primary-transfer-roller engagement and disengagement

Depending on the requirements of the print job, the primary-transfer rollers engage with the ITB so it can receive toner from the photosensitive drums.

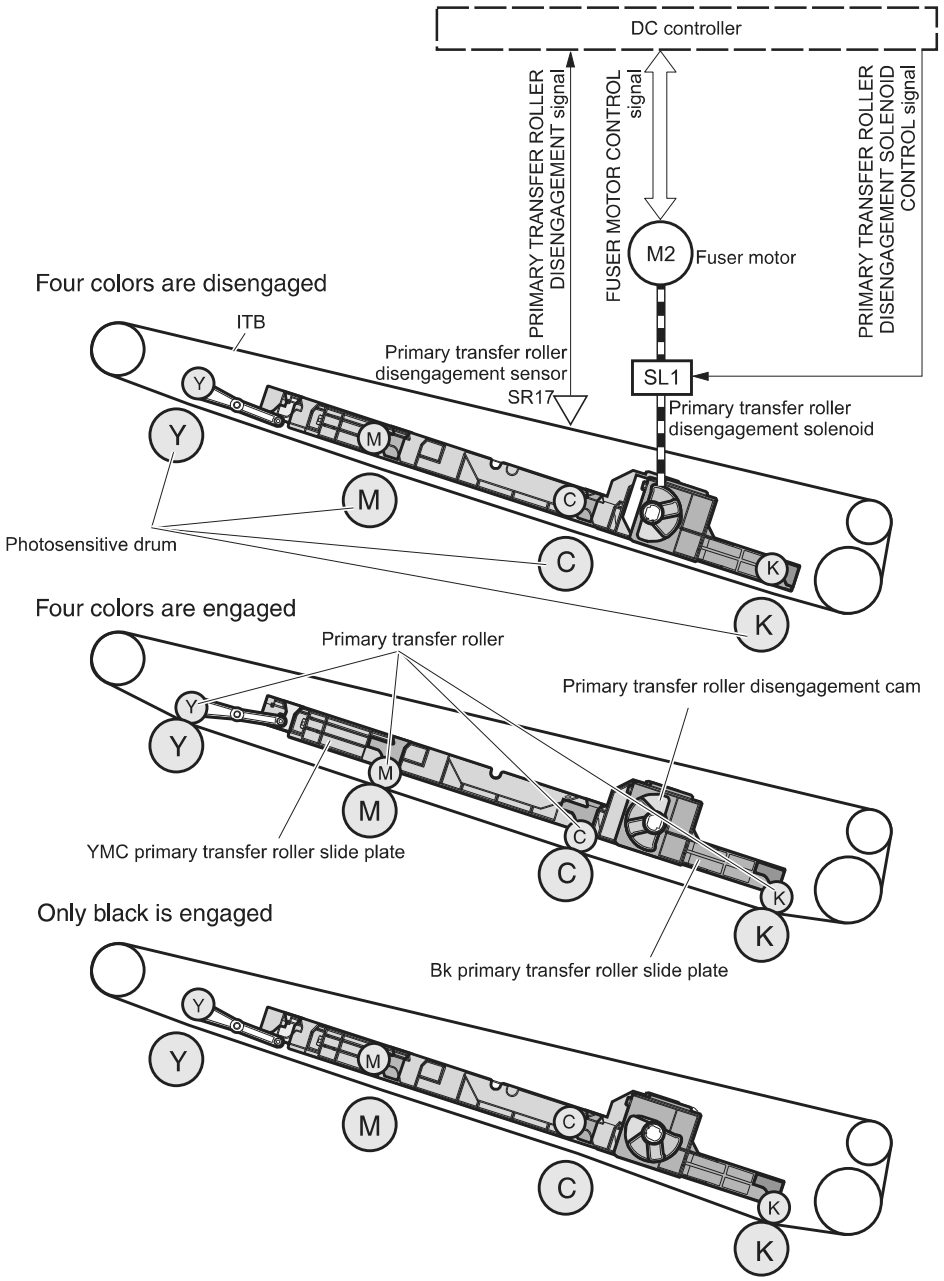
Table 1-12 Primary-transfer-roller engagement states

Roller state	Product state
All rollers disengaged	The home position for the ITB unit

Table 1-12 Primary-transfer-roller engagement states (continued)

Roller state	Product state
All rollers engaged	The state for a full-color print job
Black roller engaged	The state for a black-only print job

Figure 1-24 Three states of primary-transfer-roller engagement and disengagement



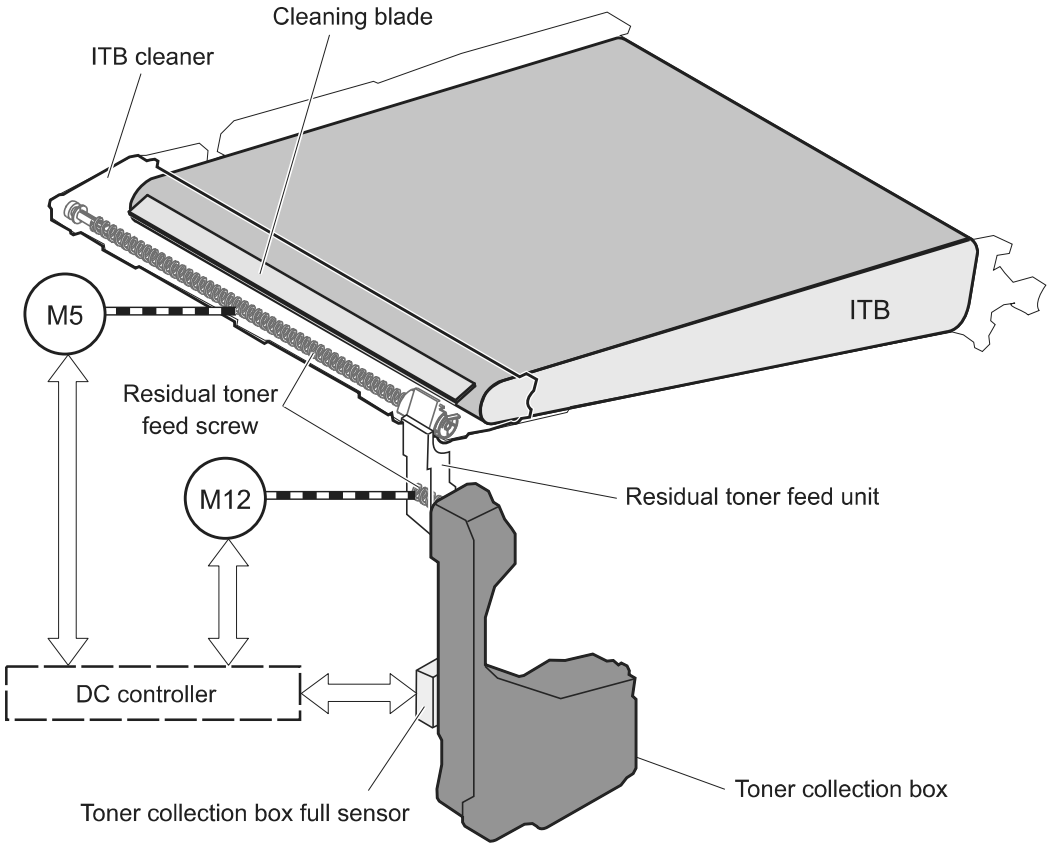
The primary-transfer-roller disengagement motor rotates or reverses to place the primary-transfer-roller disengagement cam into one of three positions. The cam causes the transfer-roller slide plate to move to the right or left. This movement causes the primary-transfer rollers to move up to engage the ITB with the photosensitive drum or down to disengage it.

If the DC controller does not receive the expected signal from the ITB home-position sensor when the primary-transfer-roller engages or disengages, but the primary-transfer-roller disengagement motor is rotating, the DC controller determines that the primary-transfer-disengagement mechanism has failed, and notifies the formatter.

ITB cleaning

The cleaning blade in the ITB cleaner scrapes the residual toner off the ITB surface. The drum motor (M5) drives the residual toner feed screw. The screw feeds the residual toner to the residual toner feed unit. The residual toner feed motor (M12) drives the residual toner feed screw. The residual toner feed screw deposits the residual toner in the toner collection box. The DC control detects whether the toner collection box is full, using the toner collection-box-full sensor, and then notifies the formatter.

Figure 1-25 ITB cleaning process

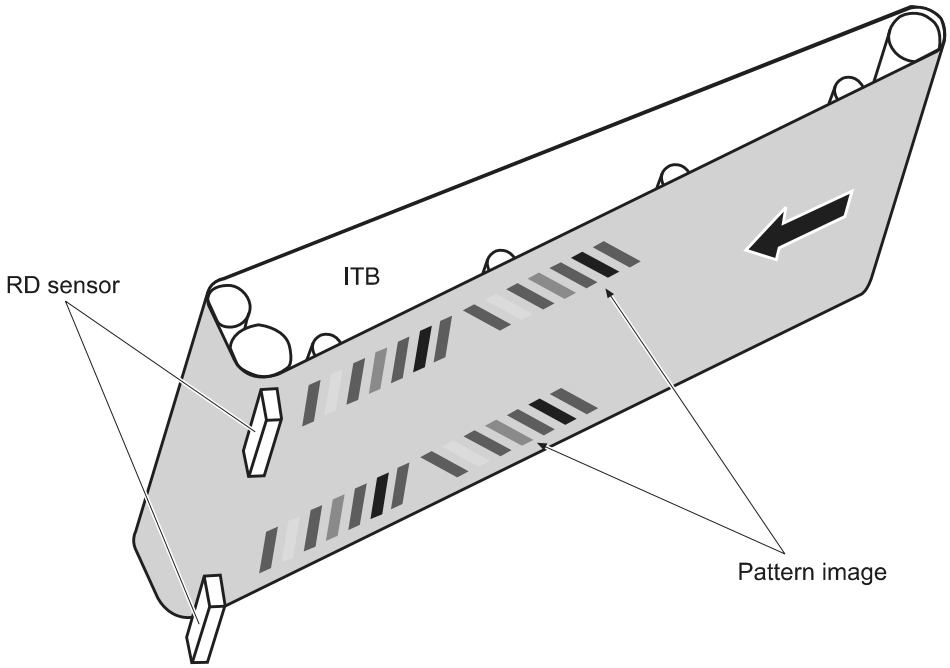


Calibration

The product calibrates itself to maintain excellent print quality. Calibration corrects color-misregistration and color-density variation.

During calibration, the product places a specific pattern of toner on the surface of the ITB. Sensors at the end of the ITB read the toner pattern to determine if adjustments are necessary.

Figure 1-26 Toner patterns for calibration



Color misregistration control

Internal variations in the laser/scanners can cause the toner images to become misaligned. The color-misregistration control corrects the following problems:

- Horizontal scanning start position
- Horizontal scanning magnification
- Vertical scanning start position

The calibration occurs when any of the following occurs:

- A cartridge is replaced
- The temperature of the sub thermistor is 50 C (122 F) or lower when the product recovers from sleep mode after a specific number of pages print.
- A specified number of pages have printed.
- The formatter sends a command.
- The user requests a calibration by using the control-panel menus.

If data from the color-misregistration and image-density sensors is outside a specified range when the product is turned on or when it is beginning the calibration sequence, the DC controller determines that these sensors have failed, and it notifies the formatter.

Image stabilization control

Environmental changes or deterioration of the photosensitive drums and toner can cause variations in the image density. The image-stabilization control reduces these fluctuations. There are three kinds of image stabilization controls.

Table 1-13 Image-stabilization controls

Image stabilization control	Description
Environment change control	The environment change control calibrates each high-voltage bias to obtain an appropriate image according to the environment changes. The DC controller determines the environment where the product is installed based on the surrounding temperature and humidity data from the environment sensor, controls, and related biases. This control occurs under the following circumstances: • The print cartridge is replaced. The DC controller notifies the formatter when it encounters a communication error with the environmental sensor.
Image density control (DMAX)	This control corrects variations in image density related to deterioration of the photosensitive drum or the toner. The DC controller adjusts the high-voltage biases to correct the problem under the following conditions: • The sub thermistor detects a temperature that is too low when the product is turned on. • After a specific period of the completion of a print operation • A print cartridge is replaced. • The ITB is replaced. • A specified number of pages have printed. • The formatter sends a command. • The environment is relatively charged.
Image halftone control (DHALF)	The DC controller measures the halftone pattern according to the command from the formatter. The formatter performs this control to calibrate the halftone, based on the halftone-density measurements, under the following conditions: • The formatter sends a command. • DMAX is completed.

The DC controller determines a RD sensor failure and notifies the formatter if it detects an out-of-specified-data value from the RD sensor when the product is turned on or when the color misregistration control starts.

Pickup, feed, and delivery system

The pickup, feed, and delivery system uses a series of rollers to move the paper through the product.

Figure 1-27 Switches and sensors for the pickup, feed, and delivery system (1 of 2)

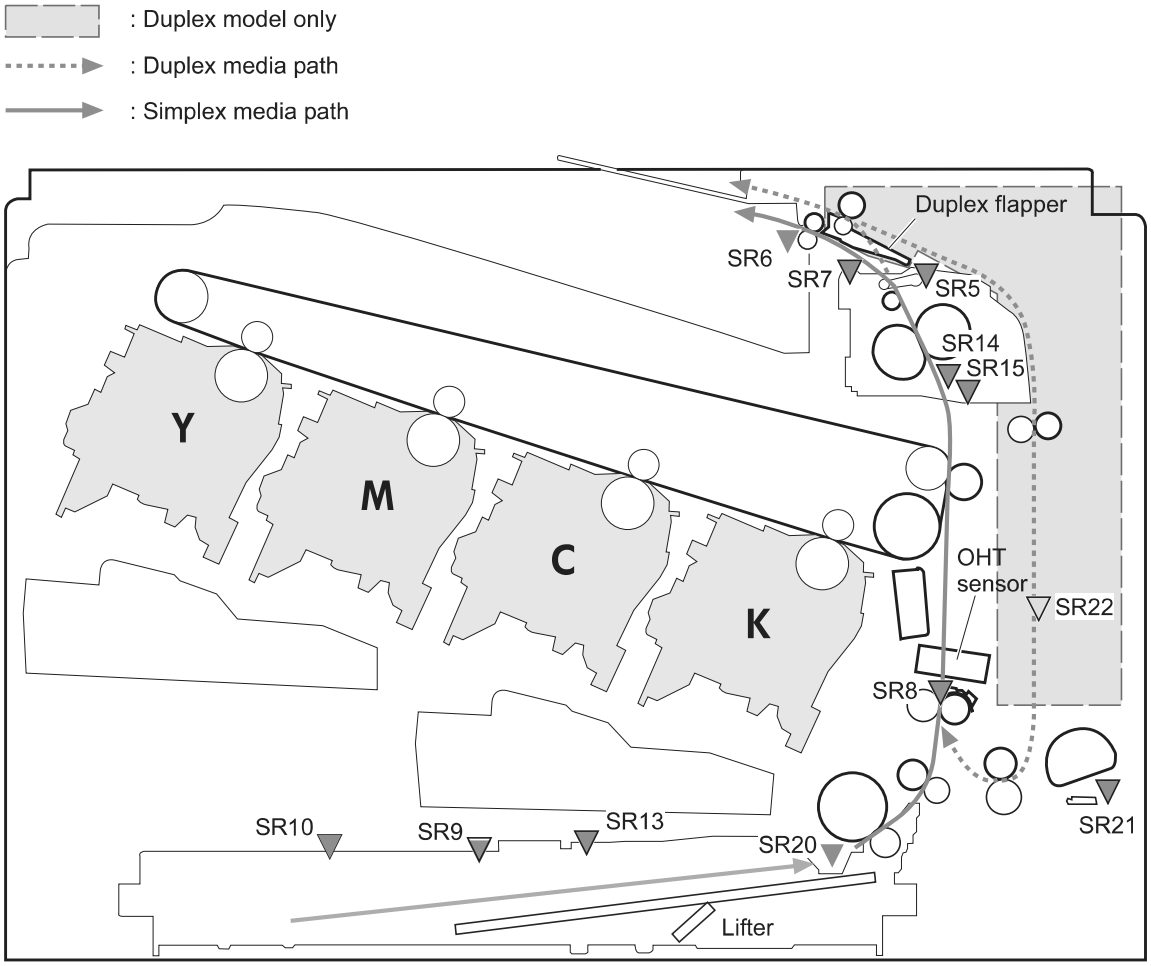


Table 1-14 Switches and sensors for the pickup, feed, and delivery system (1 of 2)

Abbreviation	Component
SR5	Fuser output
SR6	Output bin full
SR7	Fuser pressure release
SR8	Registration
SR9	Tray 2 cassette lifter
SR13	Tray 2 cassette sensor
SR14	Fuser loop 1
SR15	Fuser loop 2
SR20	Tray 2 paper

Table 1-14 Switches and sensors for the pickup, feed, and delivery system (1 of 2) (continued)

Abbreviation	Component
SR21	Tray 1 paper
SR22	Duplexer refeed (duplex models only)

Figure 1-28 Switches and sensors for the pickup, feed, and delivery system (2 of 2)

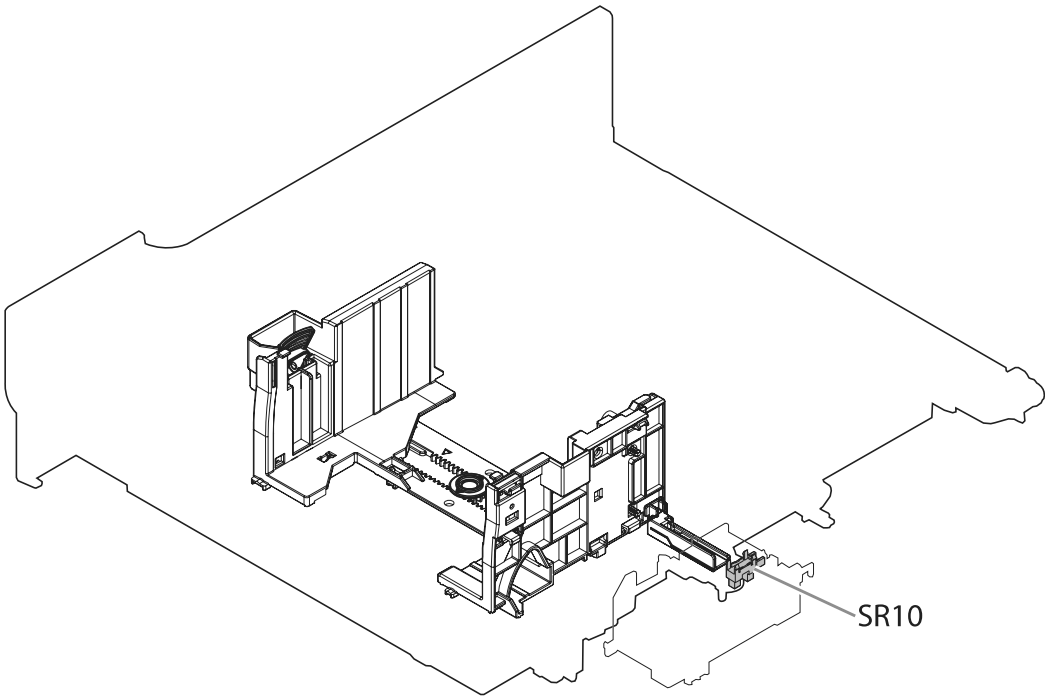


Table 1-15 Switches and sensors for the pickup, feed, and delivery system (2 of 2)

Abbreviation	Component
SR10	Paper Width (Tray 2) **NOTE:** For more information about this sensor, see Cassette media width detection on page 47.

Figure 1-29 Motors and solenoids for the pickup, feed, and delivery system

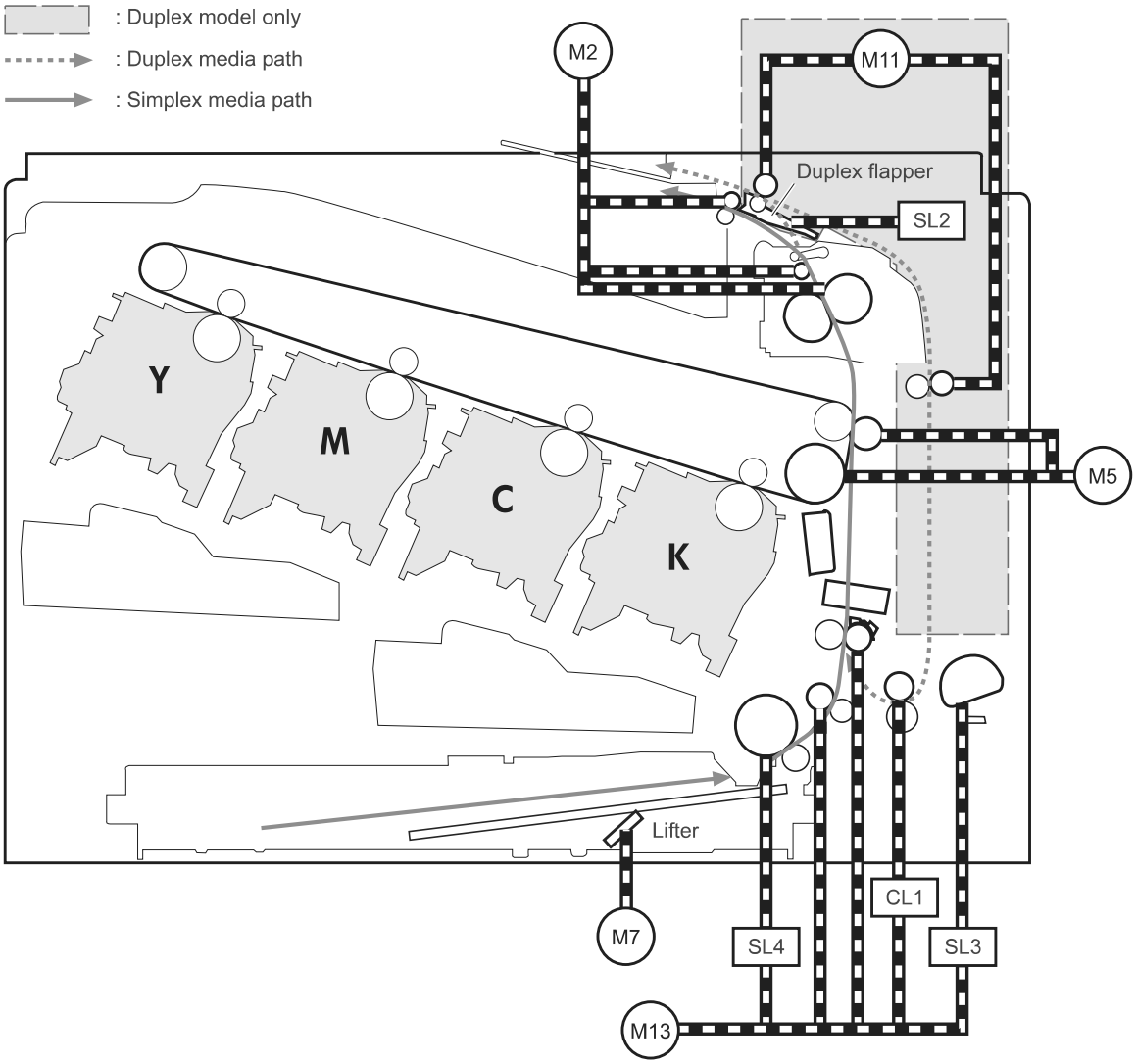
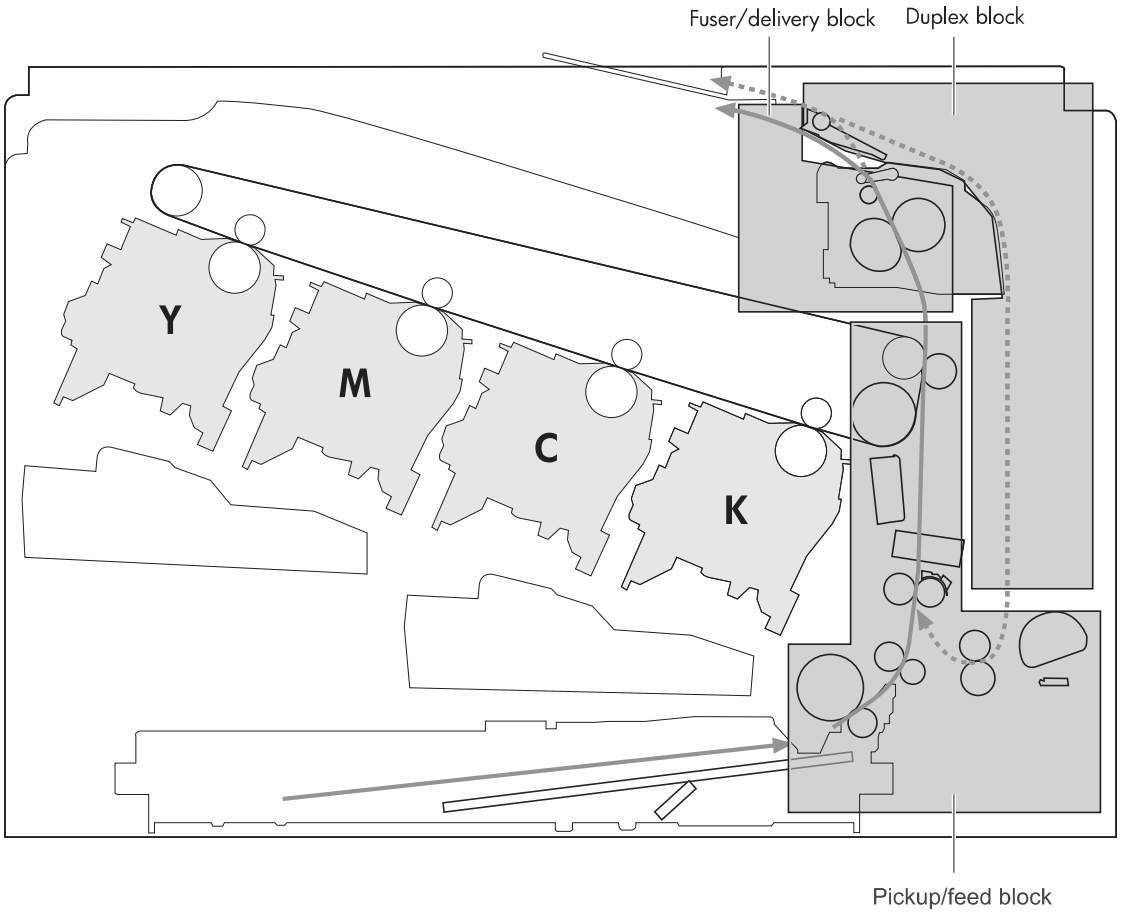


Table 1-16 Motors and solenoids for the pickup, feed, and delivery system

Abbreviation	Component
M2	Fuser motor
M5	Drum motor 3
M7	Lifter motor
M11	Duplex reverse motor (duplex models only)
M13	Pickup motor
CL1	Duplex re-pickup clutch (duplex models only)
SL2	Duplex reverse solenoid (duplex models only)
SL3	Multipurpose tray pickup solenoid
SL4	Cassette pickup solenoid

Figure 1-30 Three main units of the pickup, feed, and delivery system



Pickup-and-feed unit

The pickup-and-feed unit picks an individual sheet of paper from the multipurpose tray or the cassettes, carries it through the secondary-transfer unit, and feeds it into the fuser.

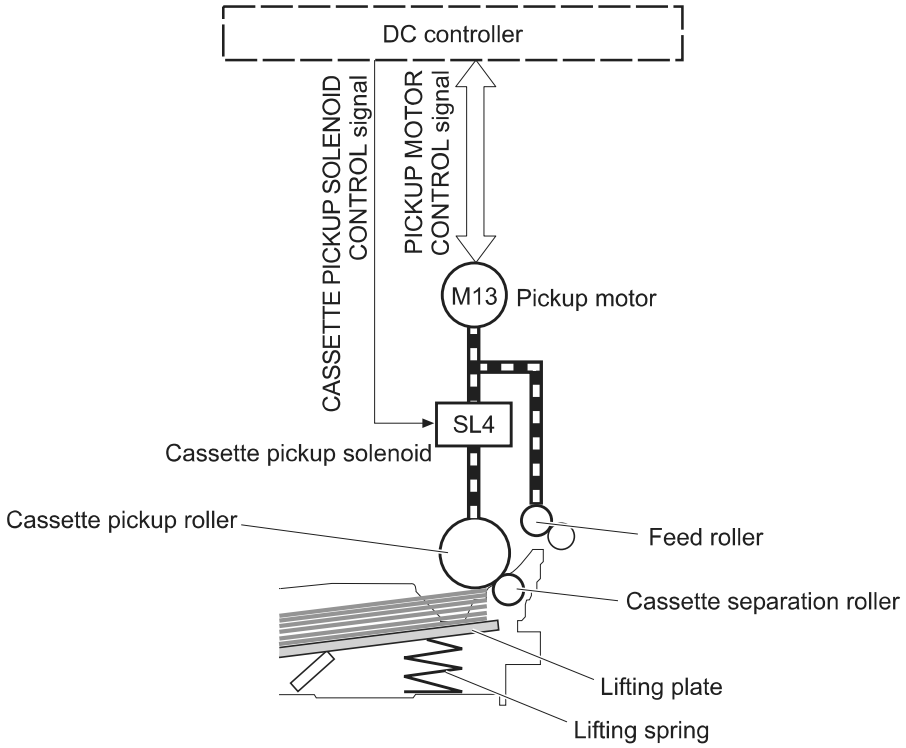
Figure 1-31 Pick feed mechanism

Cassette pickup

The sequence of steps for the cassette-tray pickup operation is the following:

1. When the product starts or the tray closes, the lifting mechanism lifts the paper stack so it is ready.
2. After receiving a print command from the formatter, the DC controller rotates the pickup motor, which causes the cassette pickup roller, cassette feed roller, and cassette separation roller to rotate.
3. The DC controller drives the cassette pickup solenoid, which rotates the cassette pickup cam. As the pickup cam rotates, the pickup arm moves down, and the cassette pickup roller touches the surface of the paper stack. The cassette pickup roller then picks up one sheet of paper.

Figure 1-32 Cassette-pickup mechanism

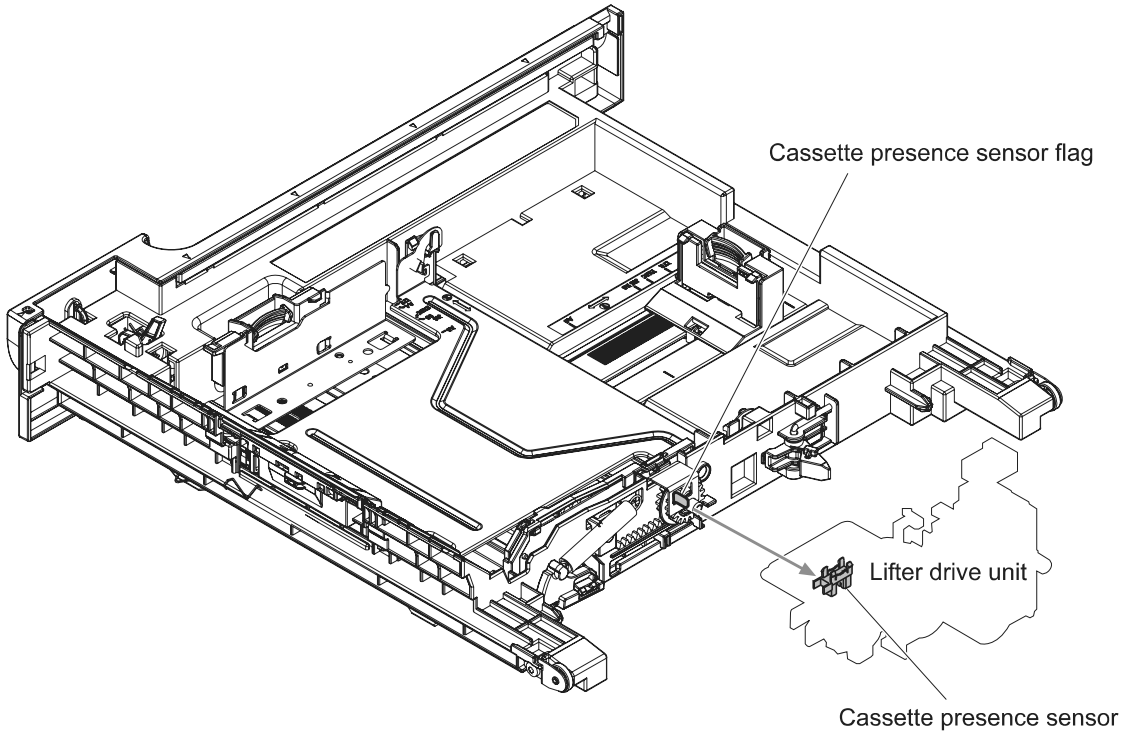


NOTE: The lift-up operation lifts the lifting plate to keep the stack surface of the media at a pickup position. The lifting spring helps support the lifting plate depending on the media size and amount.

Cassette presence detection

The cassette presence sensor is in the lifter drive unit. The sensor detects the cassette-presence sensor flag and determines whether the cassette is installed correctly.

Figure 1-33 Cassette presence sensor



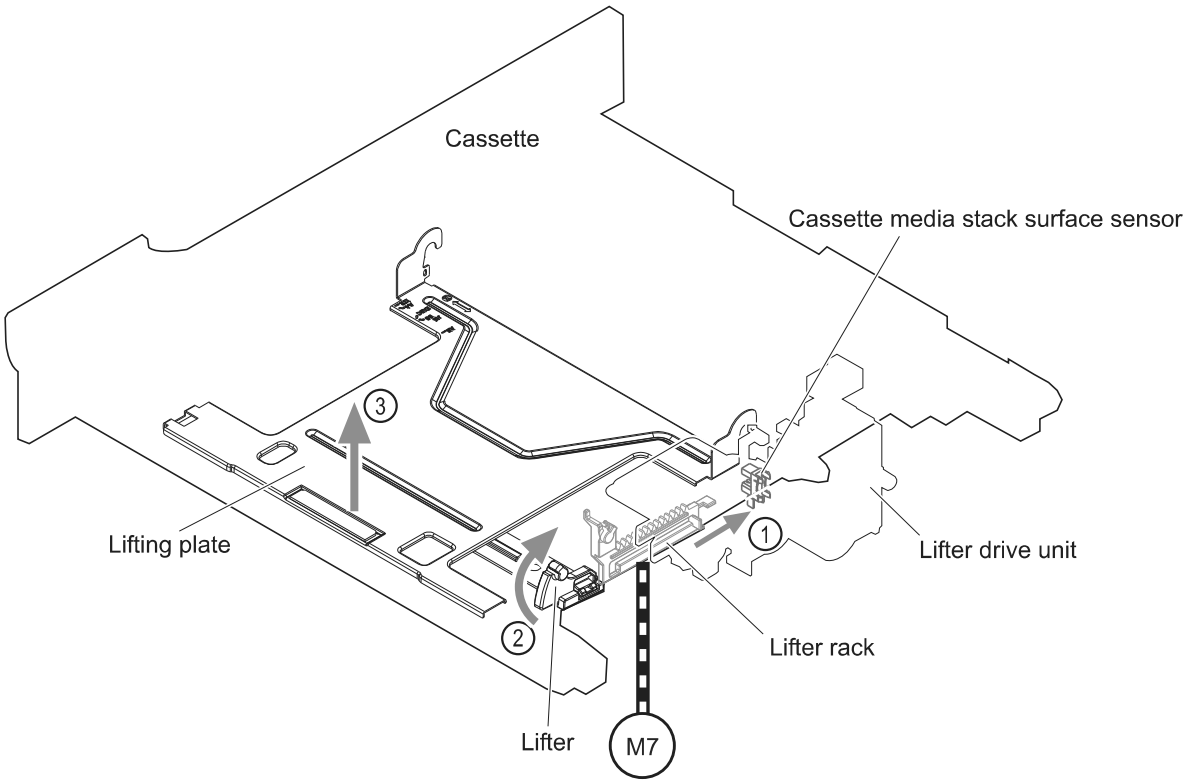
Cassette lift operation

The DC controller rotates the lifter motor (M7) and moves the lifter rack until the Tray 2 cassette lifter sensor (SR9) detects it. The lifter lifts, and the lifting plate moves up to the position where the media can be picked up. The lift operation is performed by monitoring the cassette media-stack-surface sensor when the printer is turned on, when the cassette is installed, or as needed during a print operation.

If the paper-stack surface sensor does not detect the paper within a specified time after the lifter motor begins rotating, the DC controller notifies the formatter that the lifter motor has failed.

The DC controller lowers the lifting plate when no printing occurs to prevent media damage and pickup failure. If a print operation does not occur for a specified time, the DC controller reverses the lifter motor and moves the lifter rack until the cassette media-stack surface sensor stops detecting it.

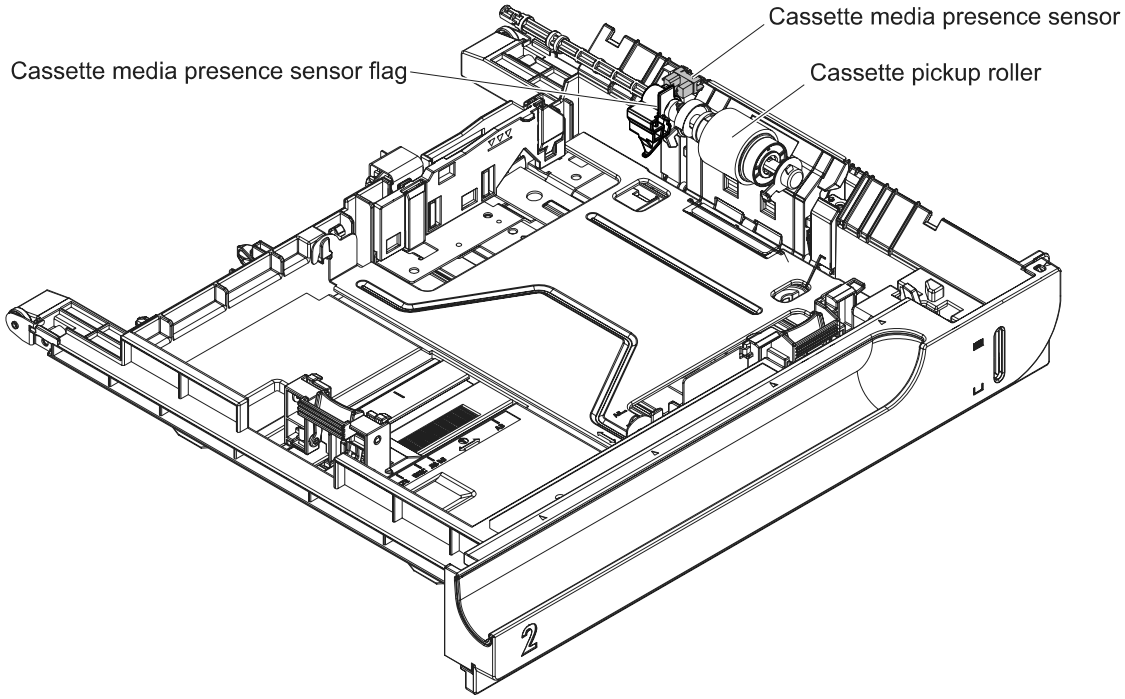
Figure 1-34 Cassette lift mechanism



Cassette paper presence detection

The cassette media-presence sensor detects whether paper is in the cassette.

Figure 1-35 Paper level detection mechanism

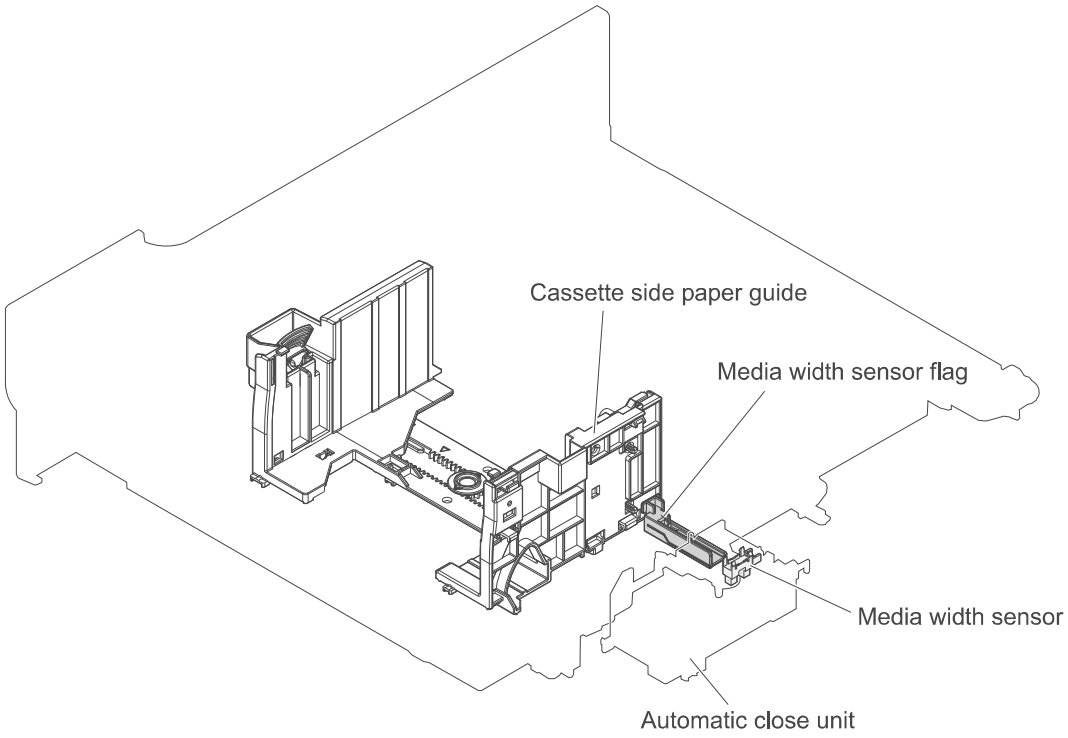


Cassette media width detection

The paper width 1 sensor (SR10) detects the size of the paper loaded in the cassette. The DC controller determines the paper size using the paper-width sensor. The paper-width sensor flag moves relative to the cassette-side paper guide.

The pickup pressure is adjusted according to the paper size to prevent a pickup failure. The pickup pressure increases when large paper sizes (Letter, A4, and A5-R) are loaded and decreases when small paper sizes (Executive, B5, A5, A6, and 4 x 6) are loaded.

Figure 1-36 Cassette media width detection

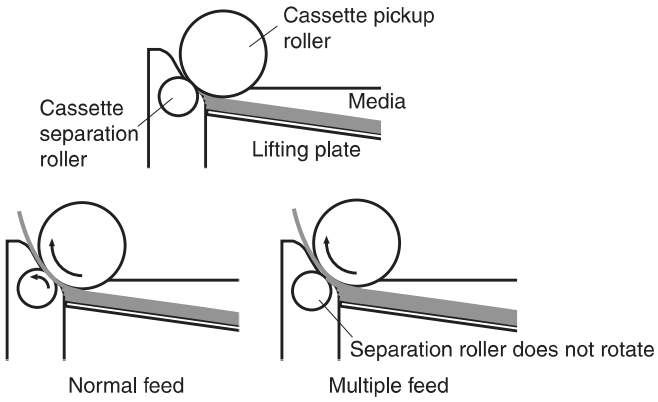


Multifeed prevention

In the cassette, a separation roller prevents multiple sheets of paper from entering the paper path. The cassette pickup roller drives the separation roller through a sheet of paper.

The low friction force between the sheets weakens the driving force from the cassette pickup roller. Because some braking force is applied to the cassette separation roller, the weak rotational force of the pickup roller is not enough to rotate the separation roller. Therefore, the separation roller holds back any multiple-fed sheets, and one sheet of media is fed into the printer.

Figure 1-37 Multifeed prevention



Multipurpose tray pickup

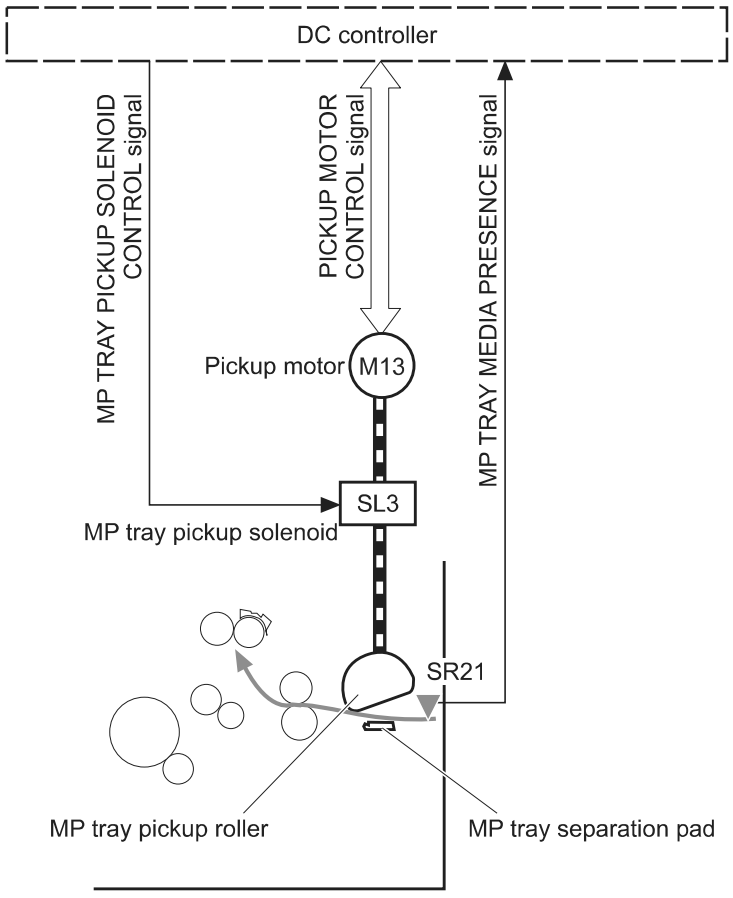
The multipurpose tray paper-presence sensor detects whether paper is in the tray. If no paper is present, the DC controller notifies the formatter. Printing does not occur until paper is in the tray.

The sequence of steps for the multipurpose tray pickup operation as follows:

1. After receiving a print command from the formatter, the DC controller reverses the pickup motor, which causes the multipurpose tray separation roller to rotate.
2. The DC controller turns on the multipurpose tray pickup solenoid (SL3), causing the multipurpose tray pickup roller to rotate.
3. The multipurpose tray separation roller isolates a single sheet of paper in case more than one sheet was picked. The single sheet of paper feeds into the product.

The Tray 1 paper sensor (SR21) detects whether the media is present in the MP tray. No printing occurs if no media is loaded.

Figure 1-38 Multipurpose tray pickup mechanism

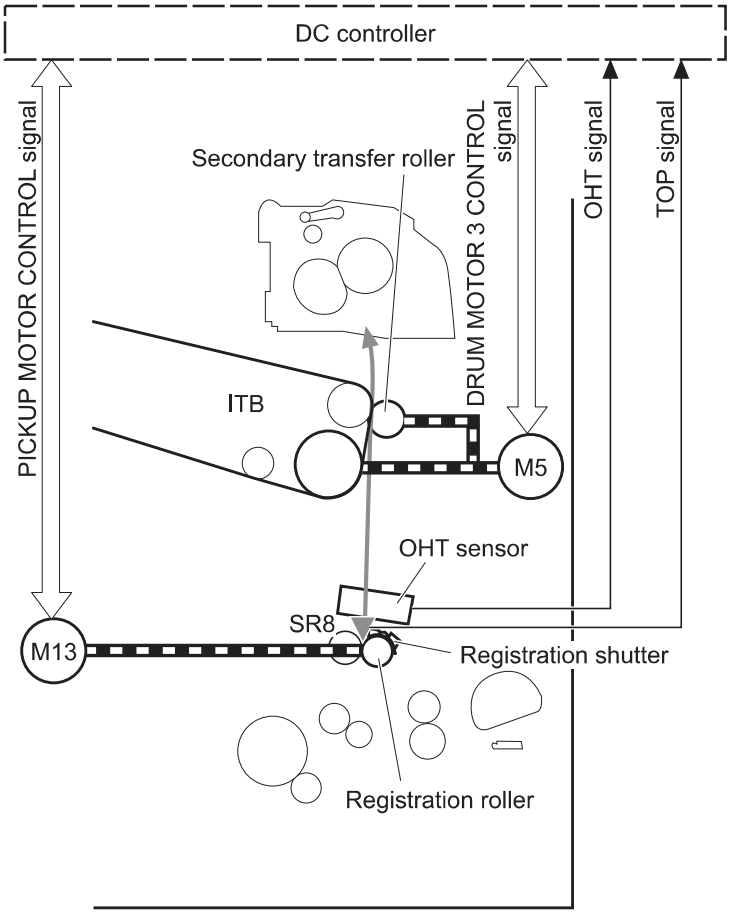


Paper feed

After the pickup operation, the paper feeds through the product and into the fuser.

1. The paper passes through the feed rollers. The registration shutter aligns the paper correctly to prevent skewed printing.
2. The DC controller detects the leading edge of paper by the Registration sensor (SR8) and controls the rotational speed of the pickup motor to align with the leading edge of image on the ITB.
3. The DC controller detects whether or not the media is overhead transparency, using the OHT sensor.
4. The toner image on the ITB transfers onto the media, which feeds to the fuser.

Figure 1-39 Paper-feed mechanism

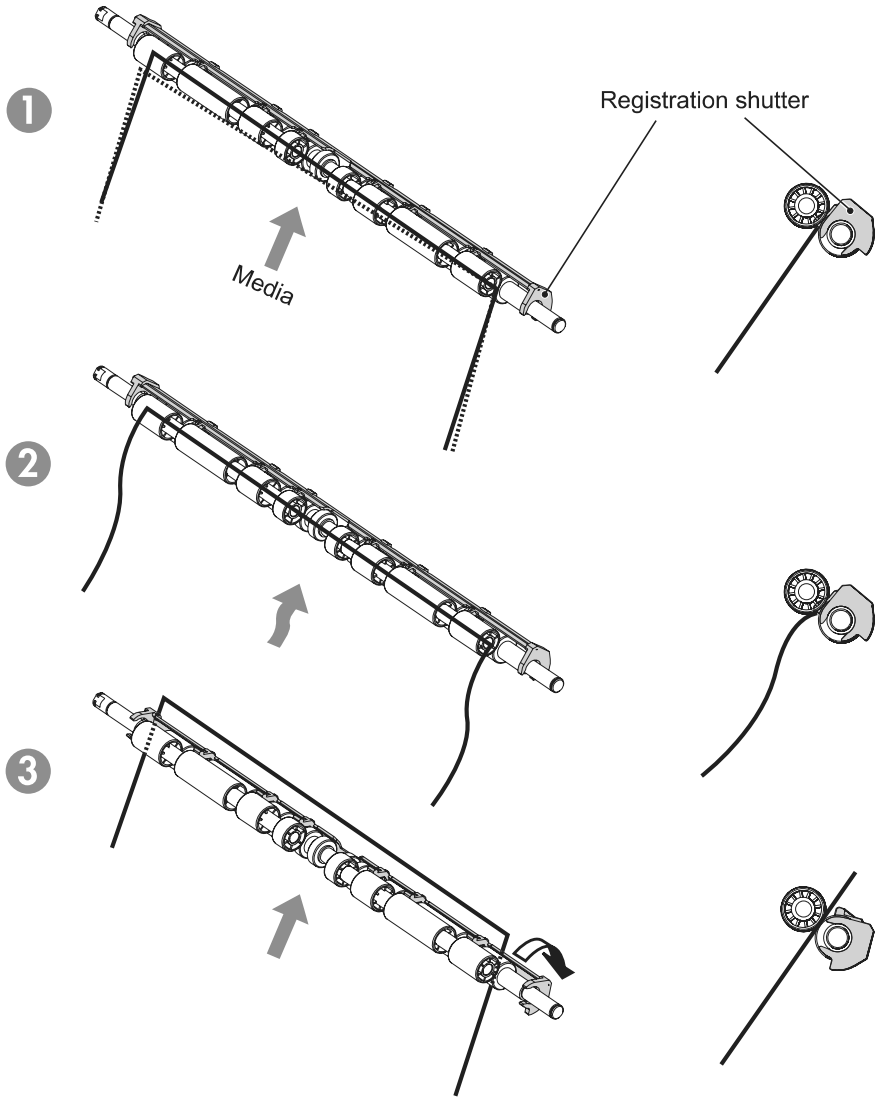


Skew-feed prevention

The product can straighten the paper without slowing the feed operation.

1. As the paper enters the paper path, the leading edge strikes the registration shutter, which straightens the paper. The paper does not pass through the shutter .
2. The feed rollers keep pushing the paper, which creates a force on the leading edge against the registration shutter.
3. When the force is great enough, the registration shutter opens and the paper passes through.

Figure 1-40 Skew-feed prevention



OHT detection

The OHT sensor detects overhead transparencies. The OHT sensor is a transmission sensor that uses an LED. The DC controller determines a media mismatch and notifies the formatter when the media type differs from the media type detected by the OHT sensor. The DC controller turns the LED in the OHT sensor on and off during the wait or initial rotation period. If the intensity of the light does not match the specified value, the DC controller determines that the OHT sensor has failed.

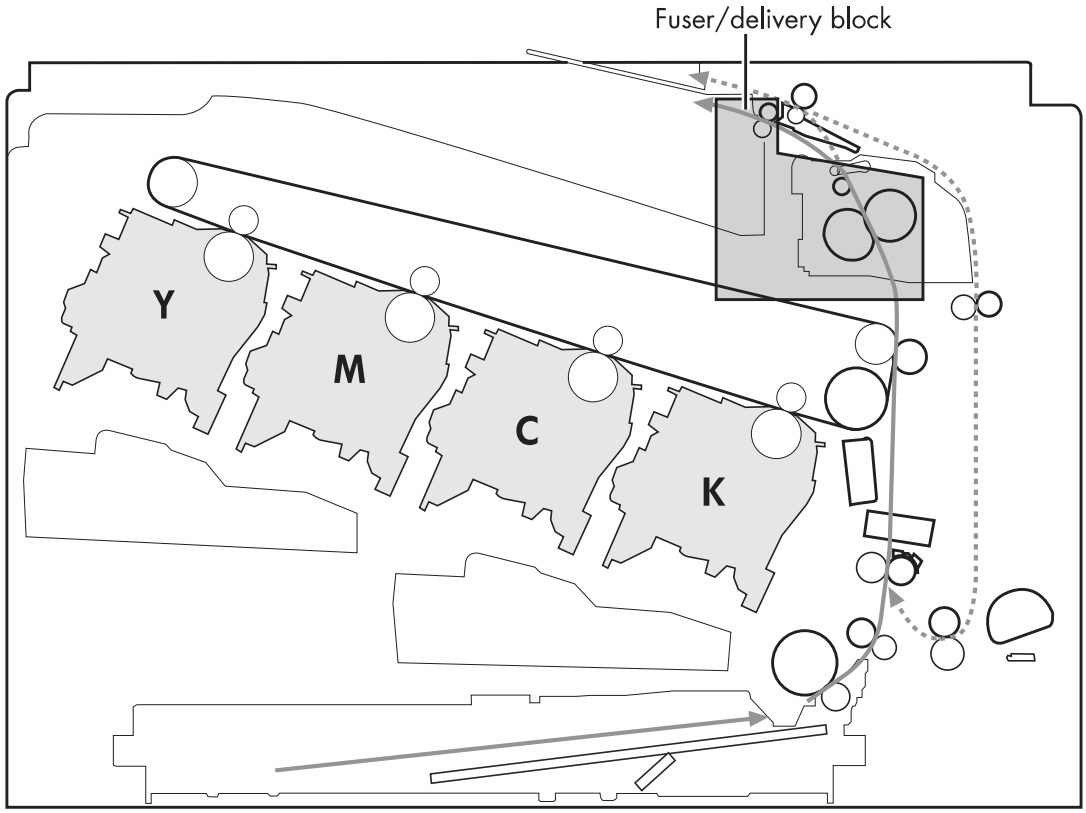
Fusing and delivery unit

The fusing and delivery unit fuses the toner onto the paper and delivers the printed page into the output bin. The following controls ensure optimum print quality:

- Loop control
- Pressure roller pressurization/depressurization control

A sensor detects when the output bin is full, and the DC controller notifies the formatter.

Figure 1-41 Fuser and delivery unit



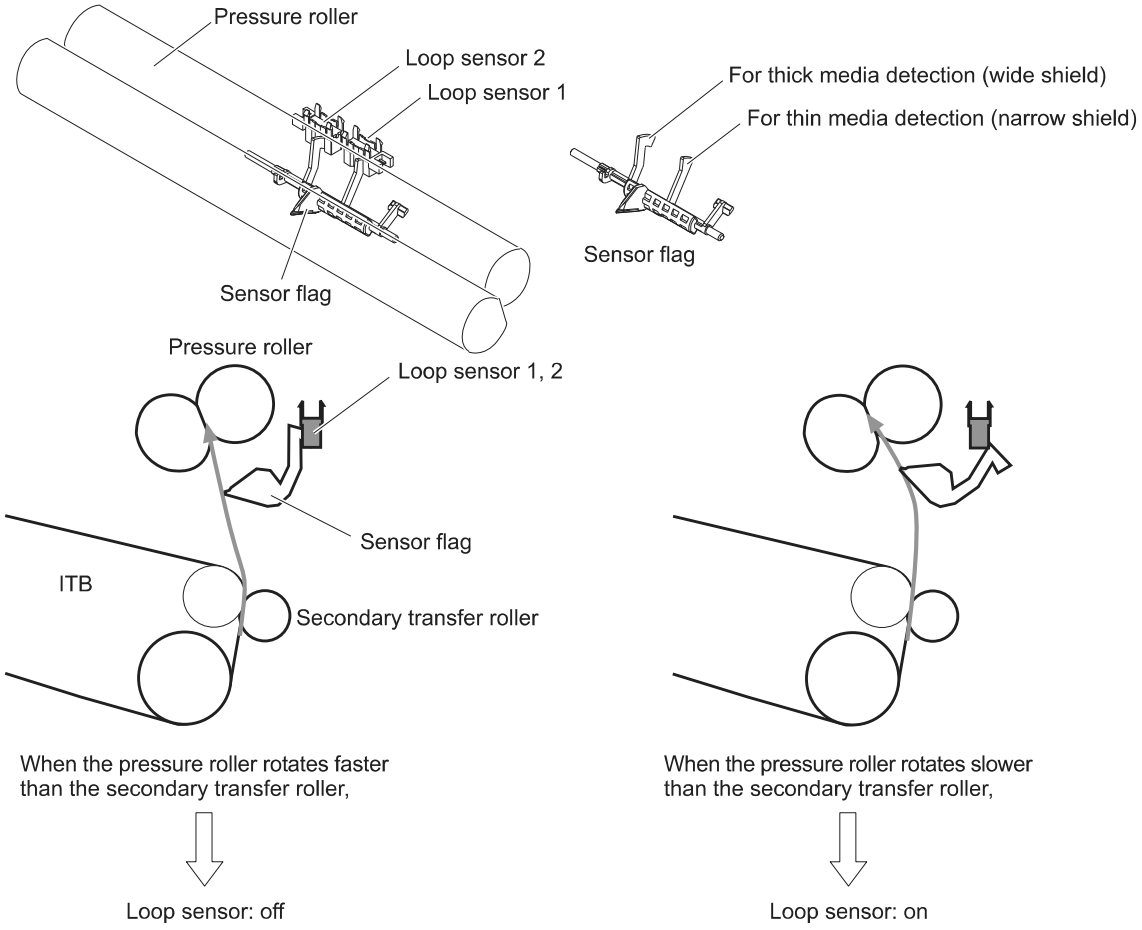
Loop control

The loop control monitors the tension of the paper between the second-transfer roller and the fuser.

- If the fuser rollers rotate more slowly than the secondary transfer rollers, the paper warp increases and an image defect or paper crease occurs.
- If the fuser rollers rotate faster than the secondary transfer rollers, the paper warp decreases and the toner image fails to transfer to the paper correctly, causing color misregistration.

To prevent these problems, the loop sensors, which are located between the secondary transfer rollers and the fuser rollers, detect whether the paper is sagging or is too taut. The DC controller adjusts the speed of the fuser motor.

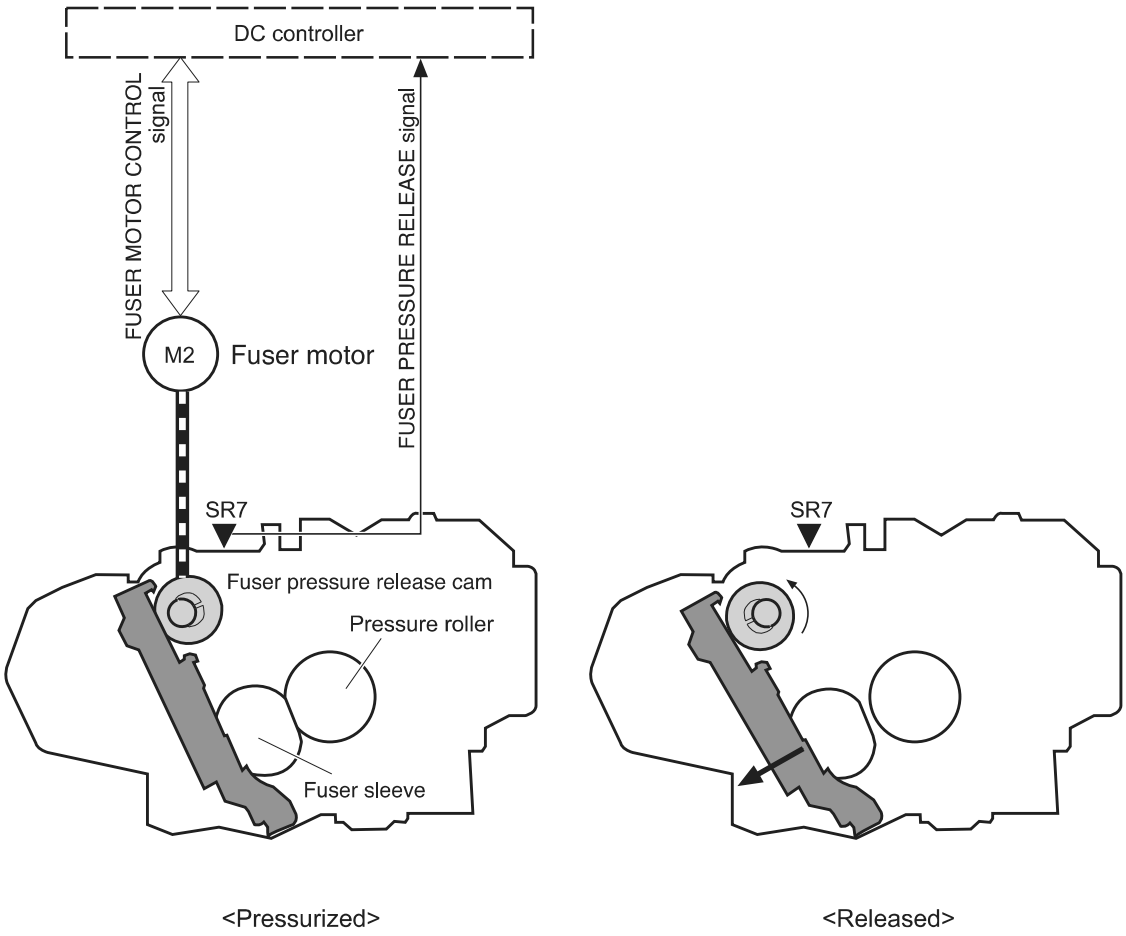
Figure 1-42 Loop-control mechanism



Pressure-roller pressurization control

To prevent excessive wear on the pressure roller and help with jam-clearing procedures, the pressure roller pressurizes only during printing and standby. The DC controller reverses the fuser motor. The fuser motor rotates the fuser pressure-release cam.

Figure 1-43 Pressure-roller pressurization control



The pressure roller depressurizes under the following conditions:

- The product is turned off with the on/off switch
- Any failure occurs other than a fuser pressure-release mechanism failure
- During powersave mode
- When a paper jam is detected

If the DC controller does not sense the fuser pressure-release sensor for a specified period after it reverses the fuser motor, it notifies the formatter that a fuser pressure-release mechanism failure has occurred.

NOTE: The fuser remains pressurized if the power is interrupted when the power cord is removed or the surge protector is turned off, or if the fuser is removed without turning off the product.

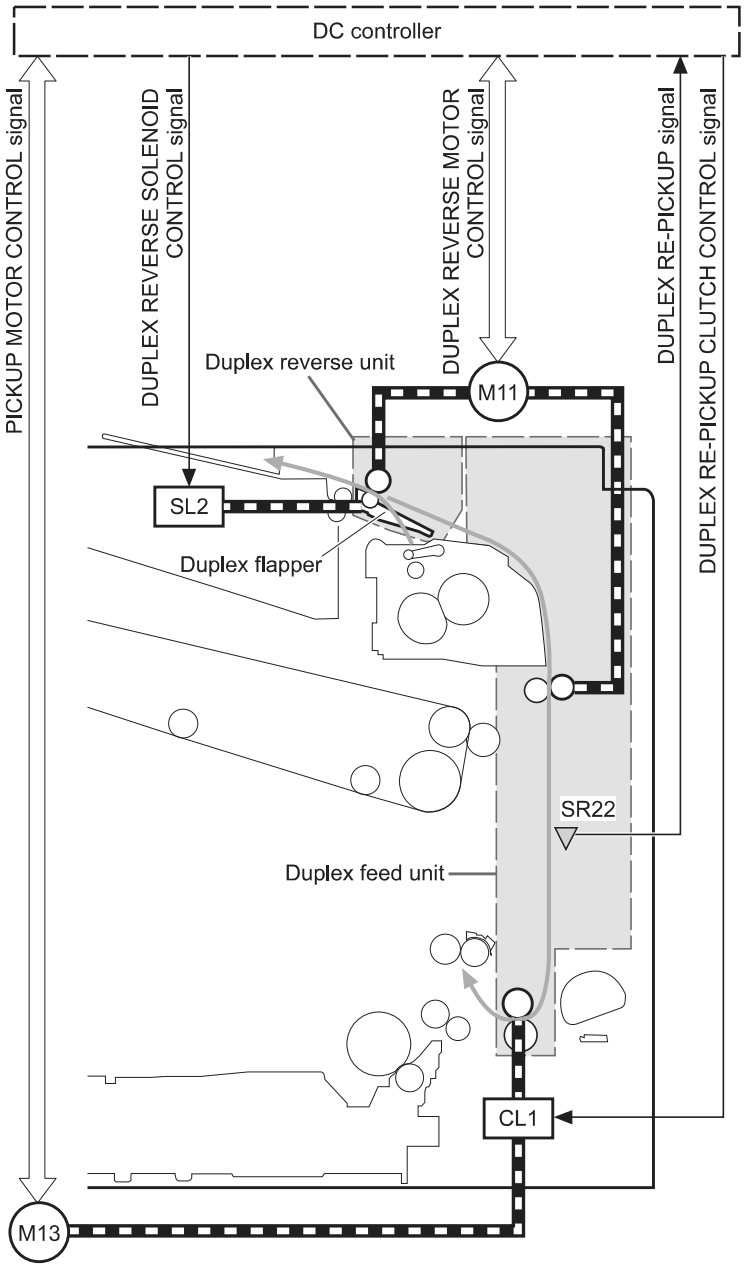
Duplexing unit (duplex models)

For supported models, the duplexing unit reverses the paper and feeds it through the paper path to print the second side. The duplexing unit consists of the following components:

- **Duplexing-reverse unit**: Installed on top of the product
- **Duplexing-feed unit**: Along the right side

The DC controller controls the operational sequence of the duplex block. The DC controller drives each load, such as motors, solenoid, and clutch, depending on the duplex reverse unit and duplex feed unit controls.

Figure 1-44 Duplexing unit



Duplexing reverse and feed control

The duplexing reverse procedure pulls the paper into the duplexing unit after it exits the fuser. The duplexing feed procedure moves the paper through the duplexer so it can enter the product paper path to print the second side of the page.

1. After the first side has printed, the duplexing flapper solenoid opens, which creates a paper path into the duplexing-reverse unit.
2. After the paper has fully entered the duplexing-reverse unit, the duplexing-reverse motor reverses and directs the paper into the duplexing-feed unit.
3. The duplexing re-pickup motor and duplexing feed motor move the paper into the duplexing re-pickup unit.
4. To align the paper with the toner image on the ITB, the duplexing re-pickup motor stops and the paper pauses.
5. The paper re-enters the paper path, and the second side prints.

Duplex pickup operation

The product has the following two duplex-media-feed modes depending on the media sizes:

- One-sheet mode: Prints one sheet that is printed on two sides in one duplex print operation
- Two-sheet mode: Prints two sheets that are printed on two-sides in one duplex print operation (maximum paper size is A4)

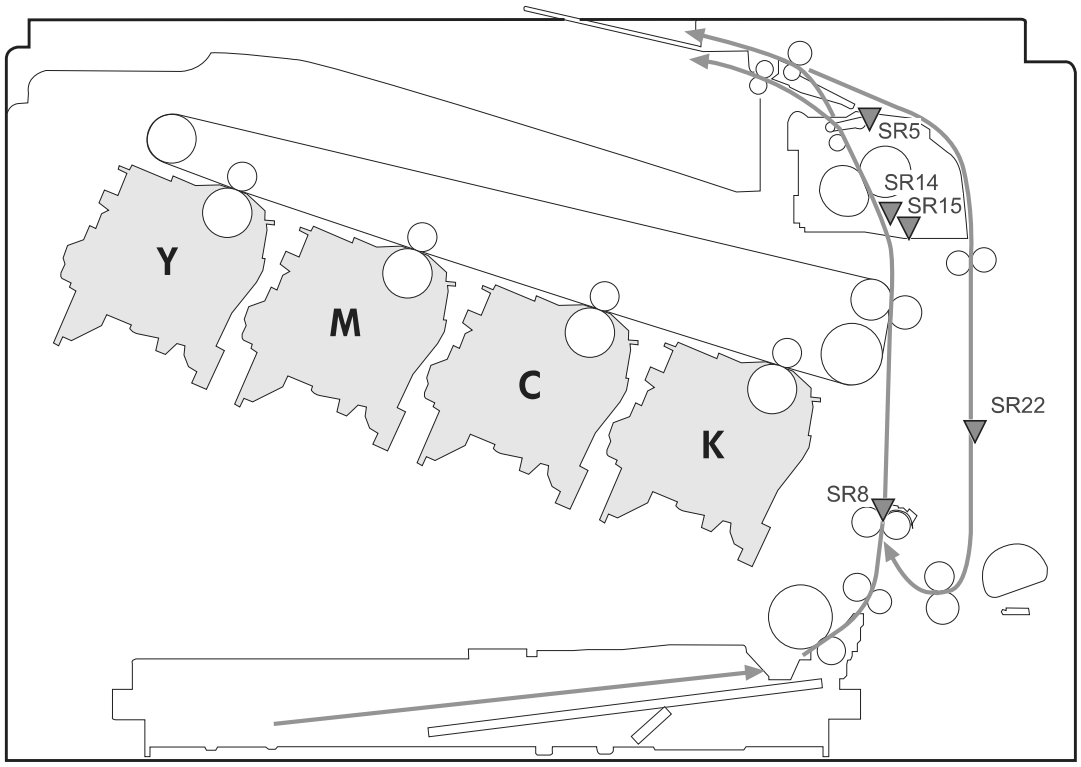
The formatter specifies the duplex-media-feed mode.

Jam detection

The product uses the following sensors to detect the paper as it moves through the paper path and to report to the DC controller if the paper has jammed.

- Fuser output sensor (SR5)
- Registration sensor (SR8)
- Fuser loop 1 (SR14)
- Fuser loop 2 (SR15)
- Duplexer refeed (SR22)

Figure 1-45 Jam detection sensors



The product determines that a jam has occurred if one of these sensors detects paper at an inappropriate time. The DC controller stops the print operation and notifies the formatter.

Table 1-17 Jams that the product detects

Jam	Description
Pickup delay jam 1	**Cassette pickup**: The TOP sensor does not detect the leading edge of the paper within a specified period after the cassette pickup solenoid has turned on.
	Multipurpose tray pickup: The TOP sensor does not detect the leading edge of the paper within a specified period after the multipurpose tray solenoid has turned on.
Pickup stationary jam	The TOP sensor does not detect the trailing edge of the paper within a specified time from when it detects the leading edge.

Table 1-17 Jams that the product detects (continued)

Jam	Description
Fuser delivery delay jam	The fuser delivery paper-feed sensor does not detect the leading edge of the paper within a specified period after the TOP sensor detects the leading edge.
Fuser delivery stationary jam	The fuser delivery paper-feed sensor does not detect the trailing edge of the paper within a specified period after it detects the leading edge.
Wrapping jam	After detecting the leading edge of the paper, the fuser delivery paper-feed sensor detects the absence of paper, and it has not yet detected the trailing edge.
Residual paper jam	One of the following sensors detects paper presence during the initialization sequence: • Fuser delivery paper-feed sensor • TOP senosor • Loop sensor 1 • Loop sensor 2
Door open jam	A door is open while paper is moving through the product.
Duplexing re-pickup jam 1	The duplex re-pickup sensor does not detect the leading edge of the paper within a specified period after the media reverse operation starts in the duplex reverse unit.
Duplexing re-pickup jam 2	The TOP sensor does not detect the leading edge of the paper within a specified period after the paper is re-picked.

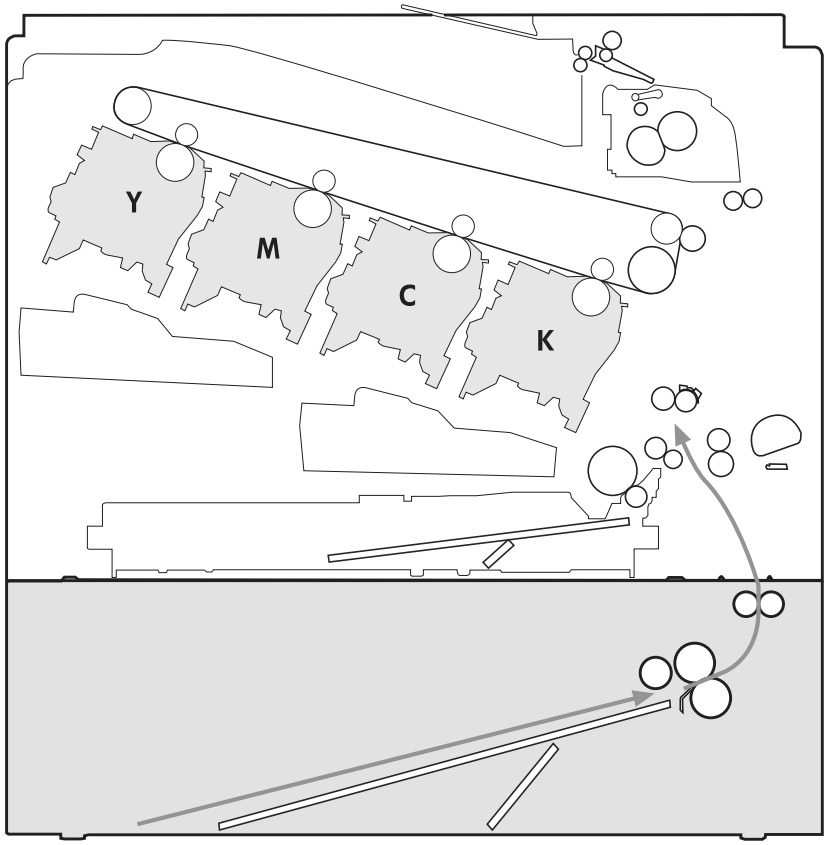
After a jam, some sheets of paper might remain inside the product. If the DC controller detects residual paper after a door closes or after the product is turned on, the product automatically clears itself of those residual sheets.

Optional paper feeder

The 1x500-sheet paper feeder is optionally installed at bottom of the printer. The paper feeder picks up the print media and feeds it to the printer.

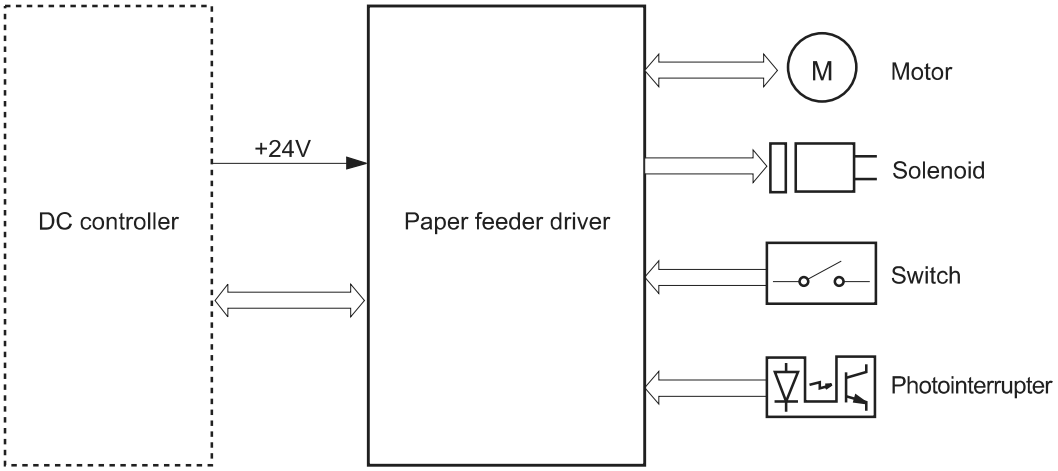
NOTE: These optional trays are *not* identical to the main cassette (Tray 2).

Figure 1-46 Optional paper feeder



The paper-deck drivers contain a microcomputer and control the paper feeder. The paper-deck drivers receive commands from the DC controller. If the DC controller is unable to communicate with a paper-deck driver, it notifies the formatter that the optional paper feeders is not connected correctly.

Figure 1-47 Signals for the paper feeder



The input trays contain several motors, solenoids, sensors, and switches, as described in the following table.

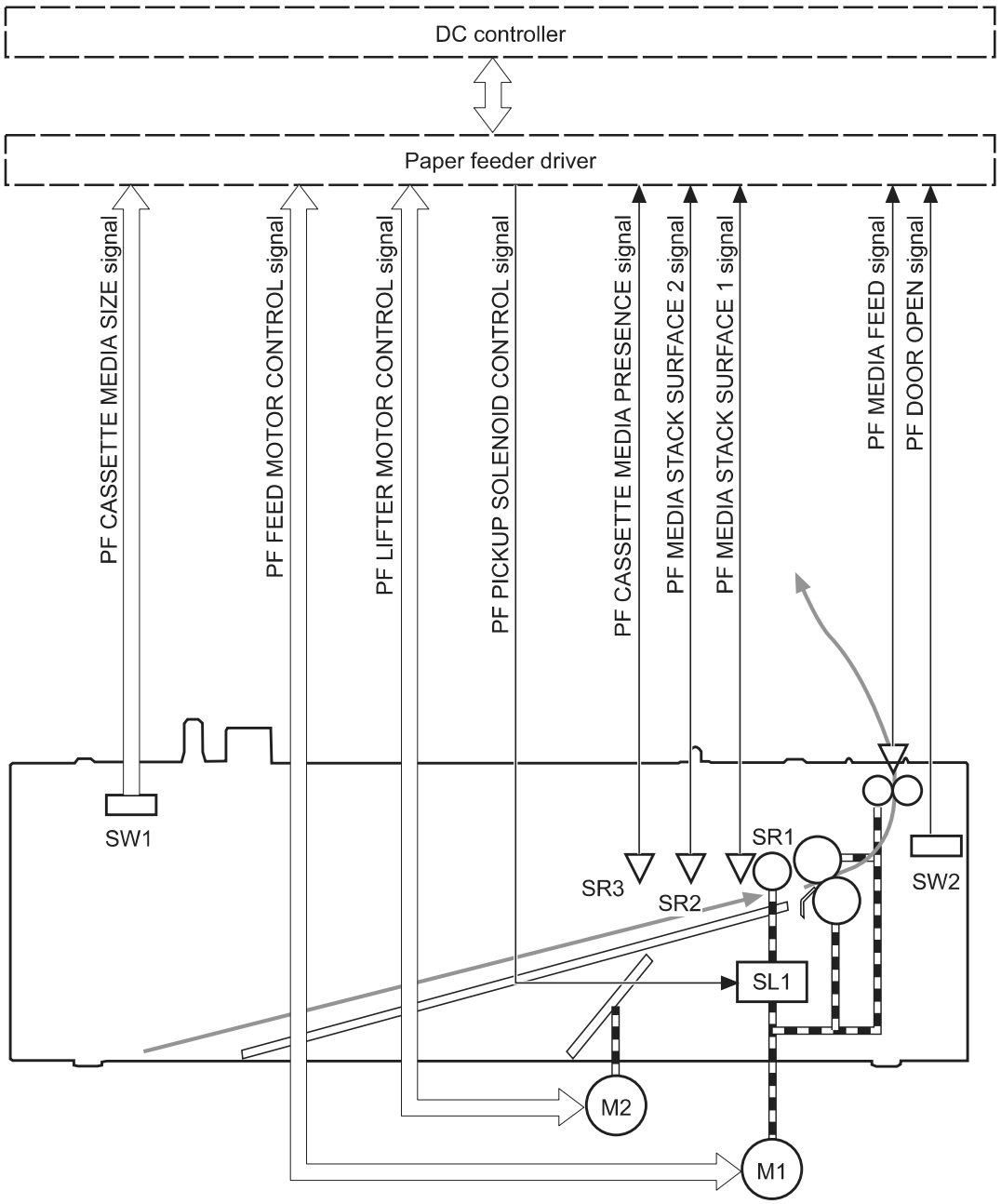
Table 1-18 Electrical components for the paper feeder

Component type	Abbreviation	Component name
Motors	M1	Paper feeder motor
	M2	Paper feeder lift motor
Solenoids	SL1	Paper feeder pickup solenoid
Sensors	SR1	Tray 3 installed sensor
	SR2	Tray 3 stack surface sensor 2
	SR3	Tray 3 paper present sensor
	SR4	Tray 3 feed sensor
Switches	SW1	Paper feeder cassette media-size switch
	SW2	Paper-feeder door switch

Paper-feeder pickup and feed operation

The paper feeder picks up one sheet from the paper-feeder cassette and feeds it to the product.

Figure 1-48 Paper-feeder pickup and feed operation



Paper size detection and cassette presence detection

The paper-feeder cassette media-size switch (SW1) detects the size of paper loaded in the paper-feeder cassette. The paper-feeder driver determines the media size by monitoring the combination of the switches.

Figure 1-49 Paper size detection

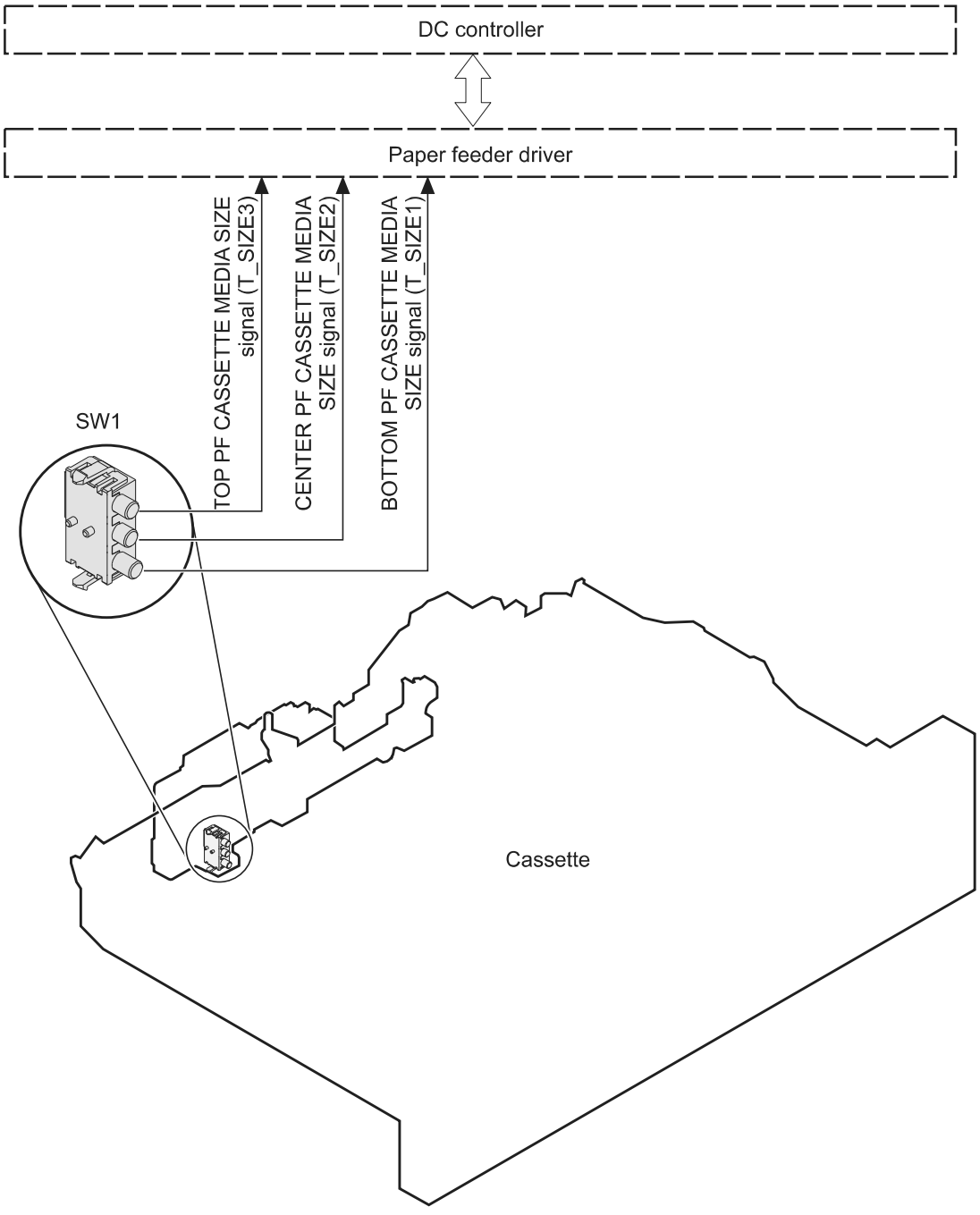


Table 1-19 **Paper size detection**

Paper size	Paper-feeder cassette media-size switch settings		
	Top switch	Center switch	Bottom switch
Universal	On	On	On

Table 1-19 Paper size detection (continued)

Paper size	Paper-feeder cassette media-size switch settings		
	Top switch	**Center switch**	**Bottom switch**
A5	**On**	**Off**	**Off**
B5	**Off**	**On**	**On**
Executive	**On**	**Off**	**On**
Letter	**Off**	**On**	**Off**
A4	**Off**	**Off**	**On**
Legal	**On**	**On**	**Off**
No cassette	**Off**	**Off**	**Off**

The paper-feeder cassette media size switch (SW1) detects whether the paper-feeder cassette is installed correctly. The paper-feeder driver determines if a cassette is absent when all three switches are turned off. The paper-feeder driver determines a cassette presence when one of the switches is turned on.

Paper feeder cassette lift operation

The cassette lift operation keeps the stack surface of paper at a specified height to maintain stable media feeding. The paper-feeder driver controls the paper-feeder lifter motor (M2) and monitors the paper-feeder media stack surface sensors (SR1, SR2) to adjust the stack height when the printer is turned on, when the printer recovers from sleep mode, when the paper-feeder cassette is installed or as needed during a print operation. The paper feeder has two paper-feeder media-stack surface sensors. The paper-feeder media stack surface sensor 1 detects the stack height during a print operation. The paper-feeder media-stack surface sensor 2 detects the stack height when the printer is turned on, when the printer recovers from sleep mode and when the paper-feeder cassette is installed. The operational sequence of the lift operation is as follows:

1. The paper-feeder driver rotates the paper-feeder lifter motor to lift the lifting plate.
2. The paper-feeder driver stops the paper-feeder lifter motor when the paper-feeder media-stack surface sensor 2 detects the stack surface.
3. The paper-feeder driver rotates the lifter motor again when paper-feeder media stack surface 1 detects that the media surface is lowered during a print operation.

Figure 1-50 Paper-feeder cassette lift