

Chapter Four O P E R A T I O N O V E R V I E W

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Electrophotographics system 4-4

- Electrophotographic cycle 4-4
- Amorphous-silicon drum 4-5
- Charging the drum 4-6
- Toner 4-7
- Exposure 4-8
- Scanner unit 4-10
- Laser scanning 4-13
- Development 4-14
- Developing roller bias 4-15
- Image transfer 4-17
- Fusing 4-18
- Drum cleaning and erasing static charge 4-20
- Typical photo process timing chart 4-21

Paper feeding system 4-23

- Paper control signals 4-24
- Paper feeding components 4-25
- Control devices 4-26
- Paper feeder (PF-30) control devices 4-27
- Printing from PF-30 cassettes 4-28
- Printing from the MP tray 4-29
- Printing from the optional envelope feeder 4-30
- Paper jam detection 4-31
- Message display at a paper jam 4-33

Print timing charts 4-34

Basic engine functions 4-37

Engine controller system 4-38

- Configuration memory 4-38
- High-voltage generator 4-38
- Laser scanner control 4-39
- Polygon motor control 4-39
- Safety interlock 4-40
- The engine gate arrays 4-41
- Pin assignment 4-43
- GATE ARRAY B 4-44
- Power supply 4-47
- Power distribution 4-50

Logic controller system 4-51

- Main logic controller overview 4-52

Controller block diagram 4-53
Printing data processing 4-54
Main logic component 4-55
API ROM socket (U09) 4-56
API ROM socket pin assignment 4-57
System DiMM (YS3) 4-58
RAM (U11 and U12) 4-58
Memory card slot interface (YC4) 4-58
Option interface (YC5) 4-59
Option interface pin assignment - Continued 4-60
KUIO interface (YC6) 4-61
Parallel interface 4-62
Serial interface 4-62
Engine interface 4-62
Engine interface connector assignment 4-63
Signals used for the engine interface 4-64
Engine interface signals 4-64

Electrophotographics system

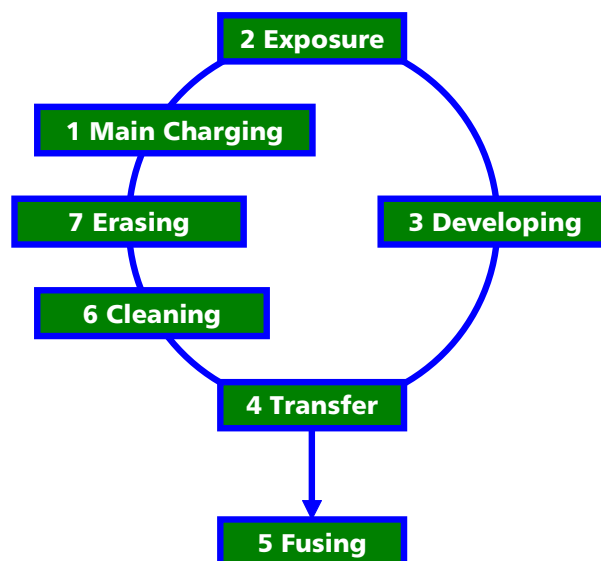
Electrophotography is the technology used in laser printing which transfers data representing texts or graphics objects into a visible image which is developed on the photosensitive drum, finally fusing on paper, using light beam generated by a laser diode.

The key features for the electrophotography system of the FS-7000 printer are:

- Real 600 dpi resolution (equivalent to 2400 dpi resolution thanks to KIR smoothing technique)
- Ultra long life amorphous silicon drum (non-heating)
- Paper support for up to A3 (Ledger) size
- Microfine mono component toner

Electrophotographic cycle

The electrophotography system of the printer performs a cyclic action made of seven steps as follows. Each step is technically explained in the following sections.

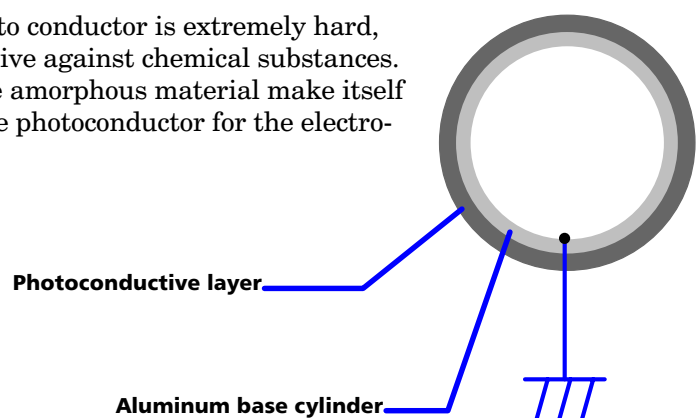


Amorphous-silicon drum

The printer uses the long lasting amorphous silicon (a-Si) drum. The photoconductive layer is coated over the aluminum cylinder base as shown below. The aluminum base is electrically grounded to the ground.

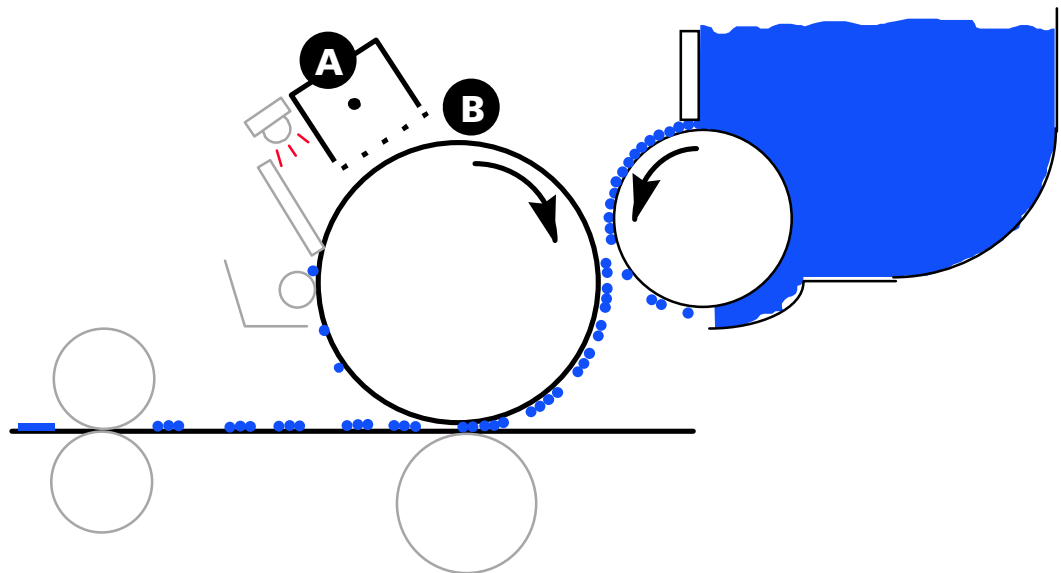
The photoconductive layer is charged evenly over its surface by positive high voltage charging (corona charging) given by the main charger unit (the wire and grid). The area on the charged drum surface which is exposed to the laser beam, as the print image is statistically drawn over the drum, loses the charge as it is escaped through the ground. The resultant electrostatic latent (negative) image is then developed by toner and transfer to the medium like paper.

The amorphous silicon photo conductor is extremely hard, non-toxic, and highly resistive against chemical substances. These characteristics of the amorphous material make itself up to a most durable, stable photoconductor for the electrophotography printer.



Charging the drum

Figure below is a simplified diagram of the electrophotographics components. Charging the drum is done by the main charger unit marked **A** in the diagram.

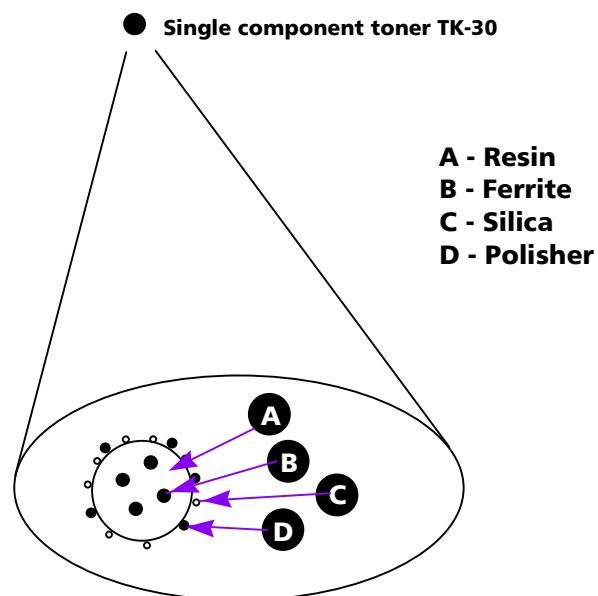


As the drum (**B**) rotates in a “clean (neutral)” state, its photoconductive layer is given a uniform, positive (+) corona charge dispersed by the main charger wire (**A**).

Due to high-voltage scorotron charging, the charging wire can get contaminated by oxidization and therefore must be cleaned periodically from time to time using the method explained in chapter 3. Cleaning the charging wire prevents print quality problems such as black streaks caused by the oxide accumulated around the charging wire.

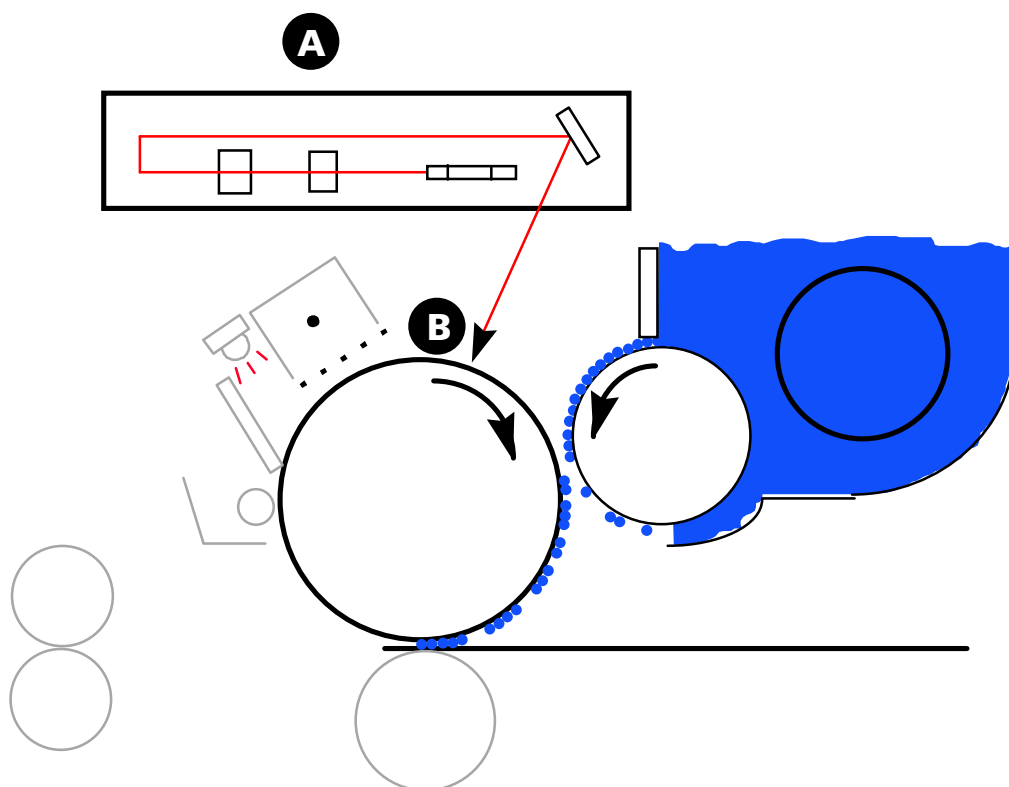
Toner

The toner is fed from the toner pack TK-30. The toner is of dry mono component type and comprised of the following substances as depicted below.

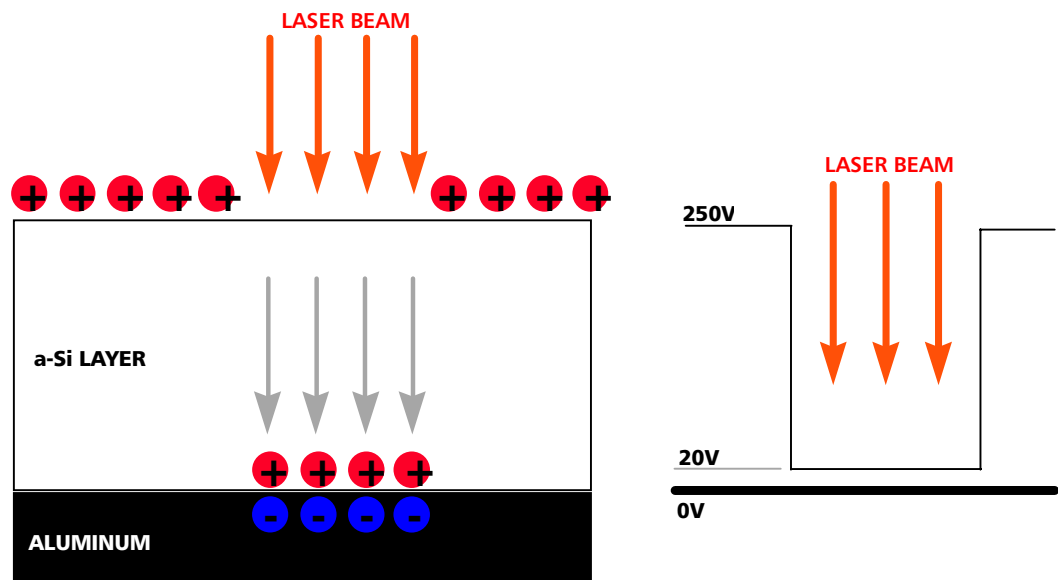


Exposure

The charged surface of the drum (B) is then scanned by the laser beam from the scanner unit (A).



The laser beam is switched on for a black dot and off for a white (blank) dot according to the print data. Whenever it is illuminated by the laser beam, the electrical resistance of the photoconductor is reduced, the potential on the photoconductor is also lowered from approximately 250V to 20V, effectively driving the charge through the a-Si layer down to the aluminum base.

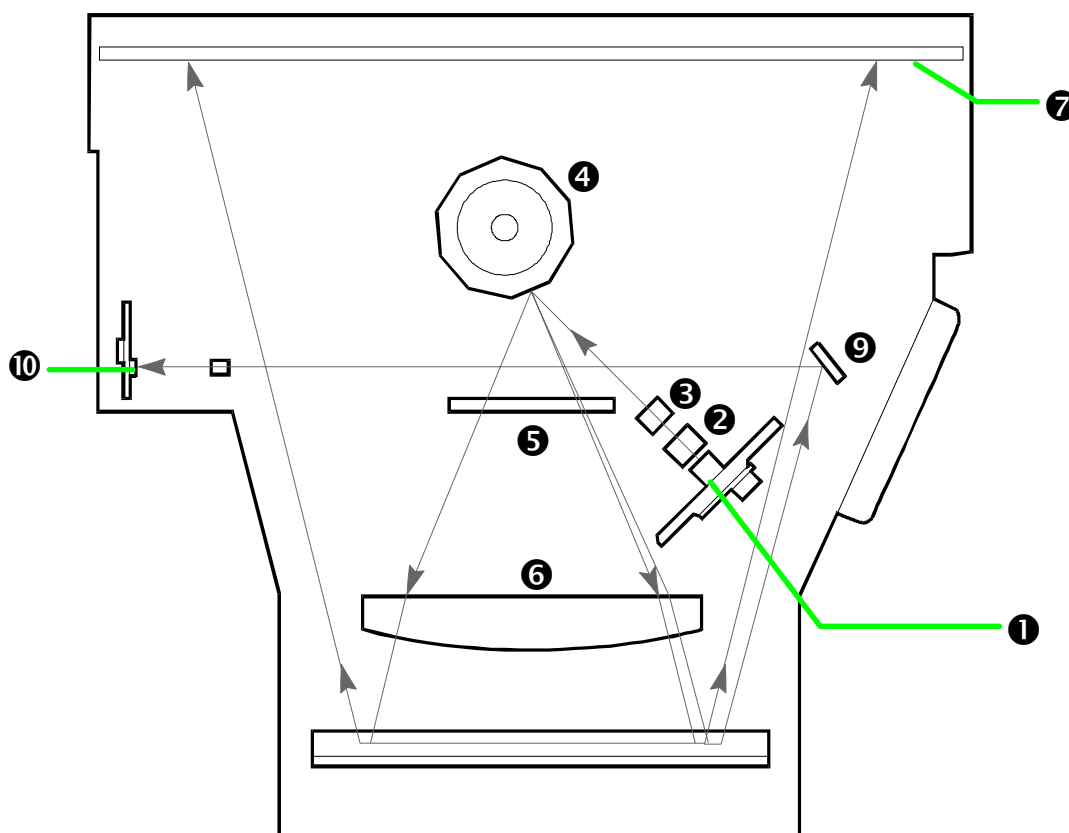


Scanner unit

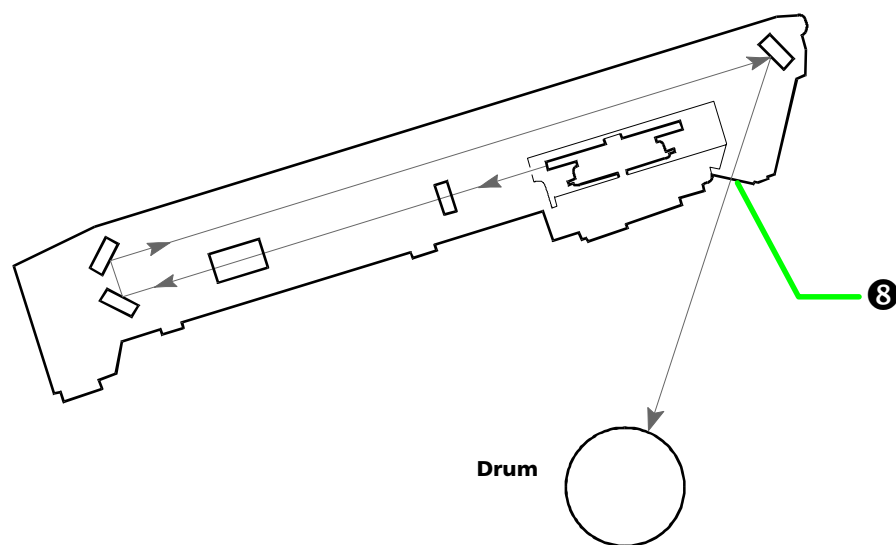
The 600 dpi scanner unit includes the laser diode that produces the 670 nm wavelength laser beam. This wavelength is specifically designed to match the photoconductive response of amorphous silicon.

The diagrams below show the components inside the scanner unit in two views—horizontal and vertical. The function of each component is described in the following pages. Note that the directive arrows indicate the laser beam paths.

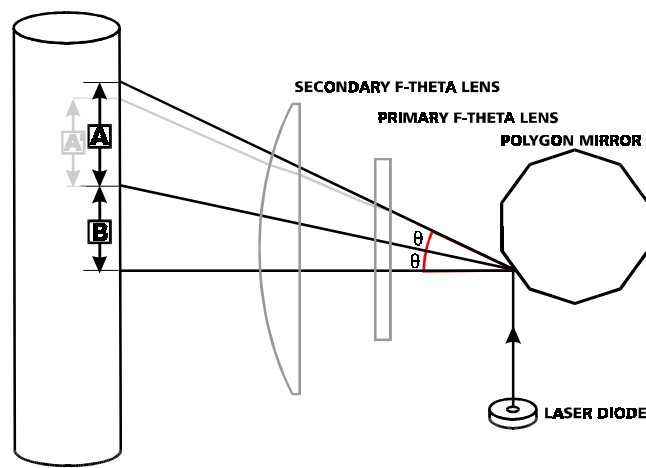
TOP VIEW



SIDE VIEW



- ❶ **Laser diode**—emits diffused, visible laser.
- ❷ **Collimeter lens**—aligns the laser beam to the cylindrical lens.
- ❸ **Cylindrical lens**—compensates the slant angle at which the laser beam hits a polygon mirror segment.
- ❹ **Polygon mirror (motor)**—has ten mirror segments around its octagonal circumference; each mirror corresponding to one scanned line width on the drum when laser beam scans on it.
- ❺ **Primary f-theta lens**—See below.
- ❻ **Secondary f-theta lens**—The primary (above) and secondary f-theta lenses equalize focusing distortion on the drum edges. The effective length of line ("A," "B" below) the laser beam draws on the drum becomes longer as the laser beam hits closer to the drum edges. In the figure below, distances represented by "A" and "B" are not the same ($A > B$) until the f-theta lenses are provided between the polygon mirror and the drum ($A' = B$).



- ⑦ **Diversion mirror** —diverts the laser beam vertically onto the drum. Note the diffused laser beam finally pin-points on the drum.
- ⑧ **Protective glass** —prevents dust, debris, etc., from entering the scanner assembly.
- ⑨ **Sensor mirror** —bends the very first shot of a laser scan towards the beam detection sensor (See next.).
- ⑩ **Beam detector sensor** —when shone by the sensor mirror above, this photosensor generates a trigger signal for the engine controller to start activating the paper feeding system.

Laser scanning

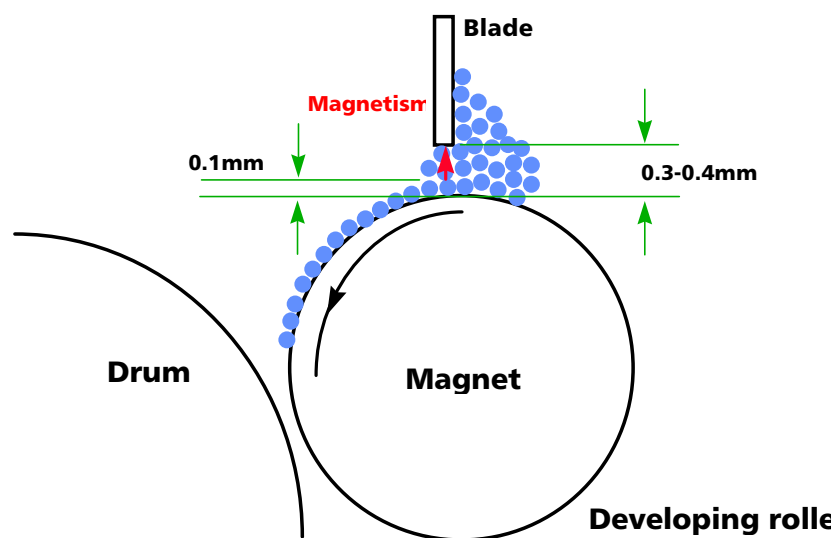
The laser beam hits one of ten polygonal mirrors. As the mirror revolves (at the nominal revolution of 17,700 rpm), the laser beam reflects off of it and reaches the charged drum surface in a lengthwise manner.

A pair of (plastic) lenses provides focusing the horizontally sweeping laser beam onto the drum. As the drum rotates, the laser beam sweeps the entire length of the drum so that the drum's entire circumference is exposed to the laser beam. The revolution of the polygon mirror motor and the drum itself is timing-controlled so that each successive sweeping of the laser beam produces a $\frac{1}{600}$ inch offset. The printer's controller system continuously turns the laser beam on and off to put a dot at every $\frac{1}{600}$ inch distance horizontally.

Synchronizing the output data with one scanning line is achieved by the photo sensor provided next to the first mirror. At the beginning of each laser sweeping, the beam hits the photo sensor which in turn sends a command to the logic controller for synchronization.

Development

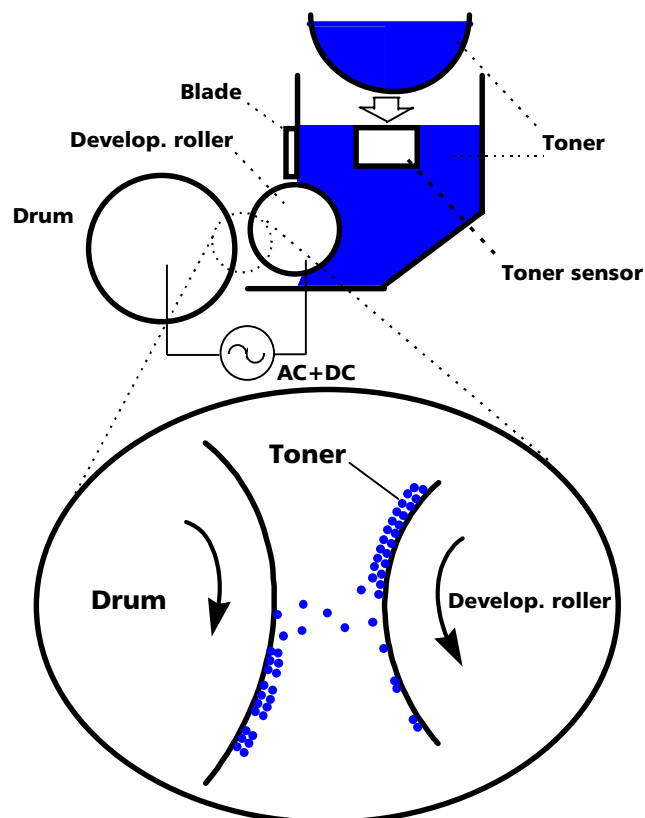
The latent image constituted on the drum is *developed* into a visible image. The developing roller contains a magnet core and an aluminum cylinder rotating around the magnet core at a speed twice faster than that of the drum. Toner attracts to the developing roller since it is magnetic. A magnetized blade above the developing roller constitutes a smooth layer of toner in accordance with the roller revolution.

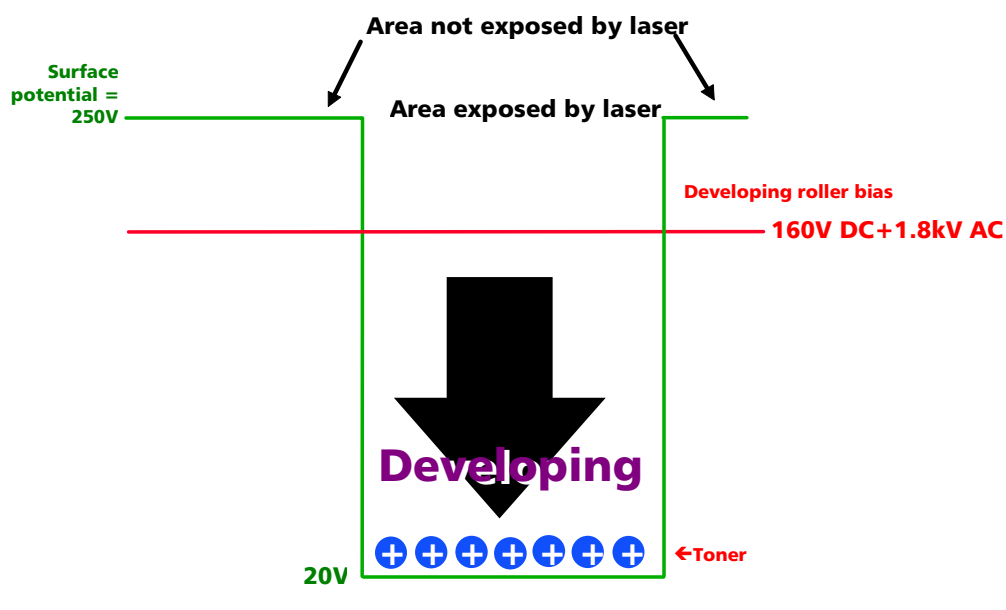


Developing roller bias

The developing bias is adjusted so that the toner, charged positive while each particle is rubbing each other in the developer, is selectively developed onto the area of low potential by adhering.. The bias is AC weighted, positive DC power source.

Since the gap between the developing roller and the drum is wider than the average diameter of the toner, the toner should *fly* over to the drum surface to accomplish development. This method is known as the non-contact development method.





A toner replenishment sensor is provided within the developer. As the toner supply from the toner container dwindles and the toner level lowers in the reservoir, the sensor translates it through its sensing plate, urging the toner motor to feed more toner.

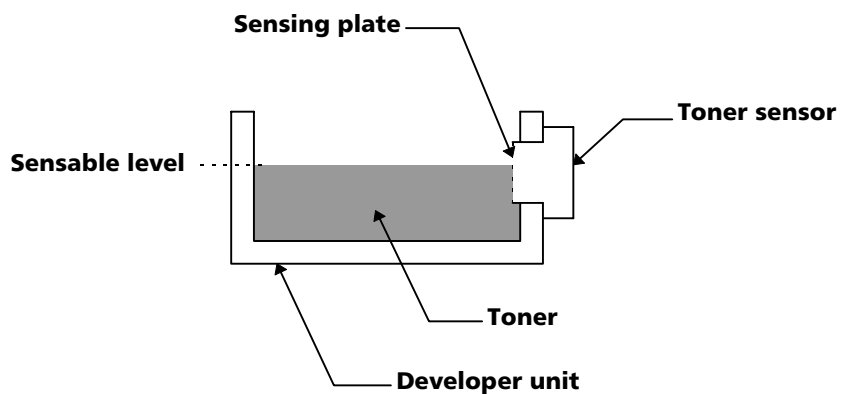
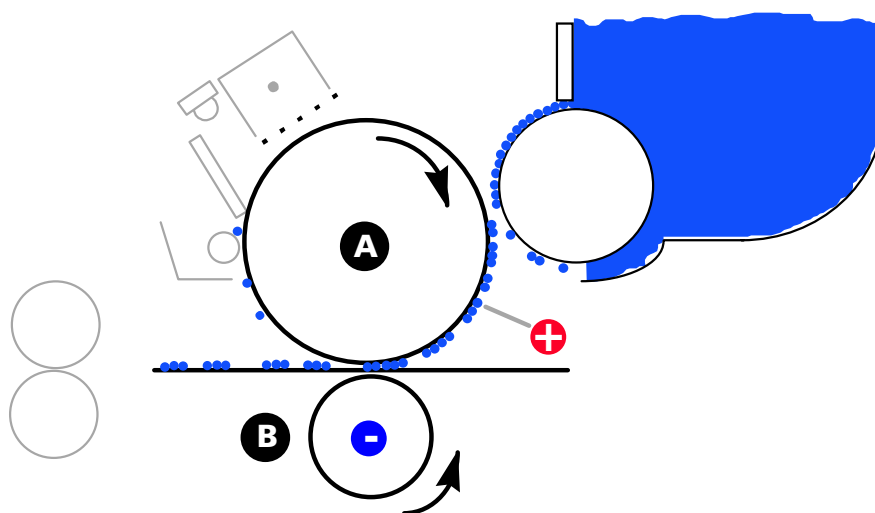


Image transfer

The image developed by toner on the drum (**A** below) is transferred onto the paper using the electric charge attraction given by the toner itself and the transfer roller (**B** below). The transfer roller is negatively biased so that the positively charged toner is attracted onto the paper while it is pinched by the drum and the transfer roller.

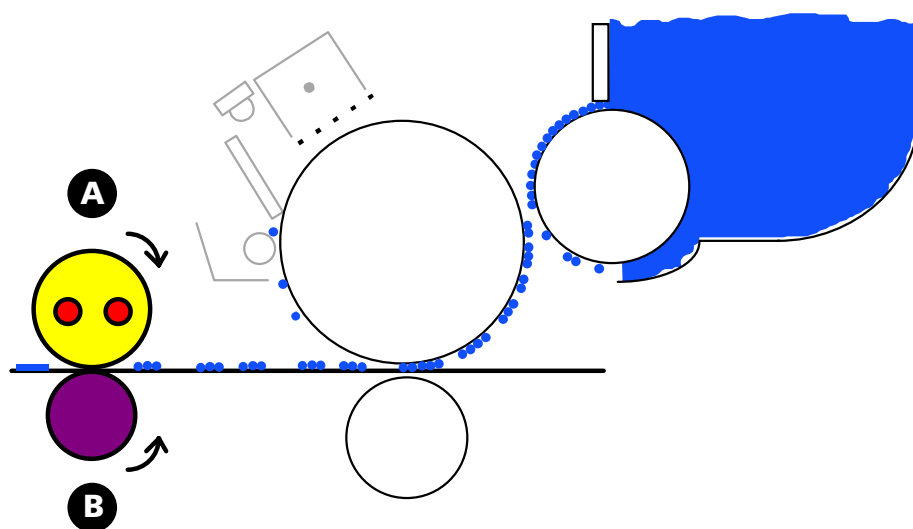


The nominal transfer bias is set to approximately -1.7 kV (limit) with the 55 μ A current. Since the ideal potential of the transfer bias varies depending on the thickness of paper, the bias is raised to approximately -2.2 kV/55 μ A for thicker paper (91 to 200 g/m²). Double-sided printing using a DU-30 duplexer automatically increases the transfer bias to the above value. On the other hand, the bias current is reduced to 40 μ A (-1.7 kV) for thin paper. The bias is switched automatically as the printer detects the thickness of the paper, and also switchable manually on the printer's control panel. For details on switching the transfer bias, refer to section Chapter 2 or the printer's user's manual.

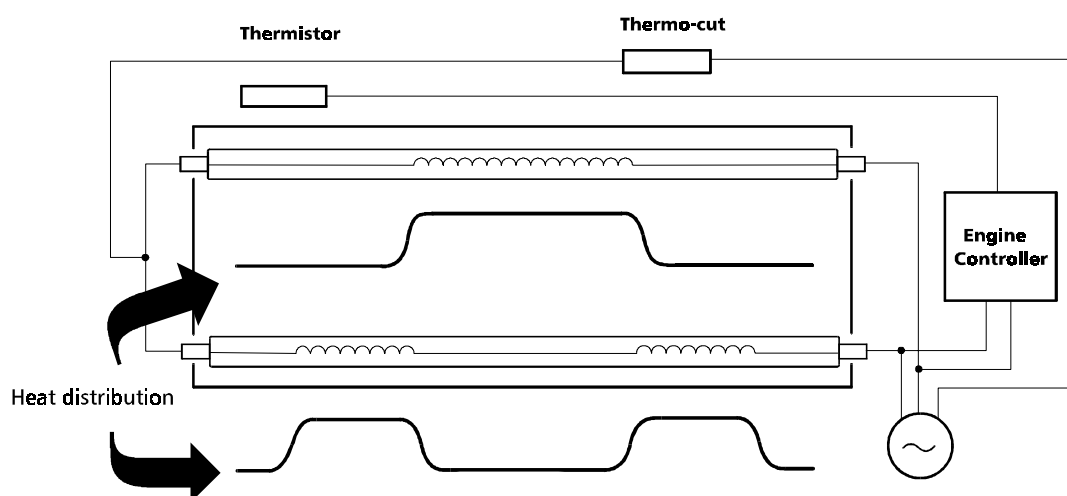
Paper separation—After the image transfer process, the paper is forcibly peeled off the drum by means of the separation electrode. The separation electrode is located next to the transfer roller, giving the positive charge to attract paper downwards.

Fusing

The toner on the paper is permanently fused onto the paper as it passes between the fluorin-finished heat roller (**A** below) and the pressure roller (**B** below) in the fuser unit. The toner is molten and pressed into the paper.



The heat roller has two halogen lamps, turning alternatively on depending on the size of the paper passing through to maintain the preheat temperature at approximately 185°C. This ensures the even temperature dispersal over the long heat roller. See the picture and table below.

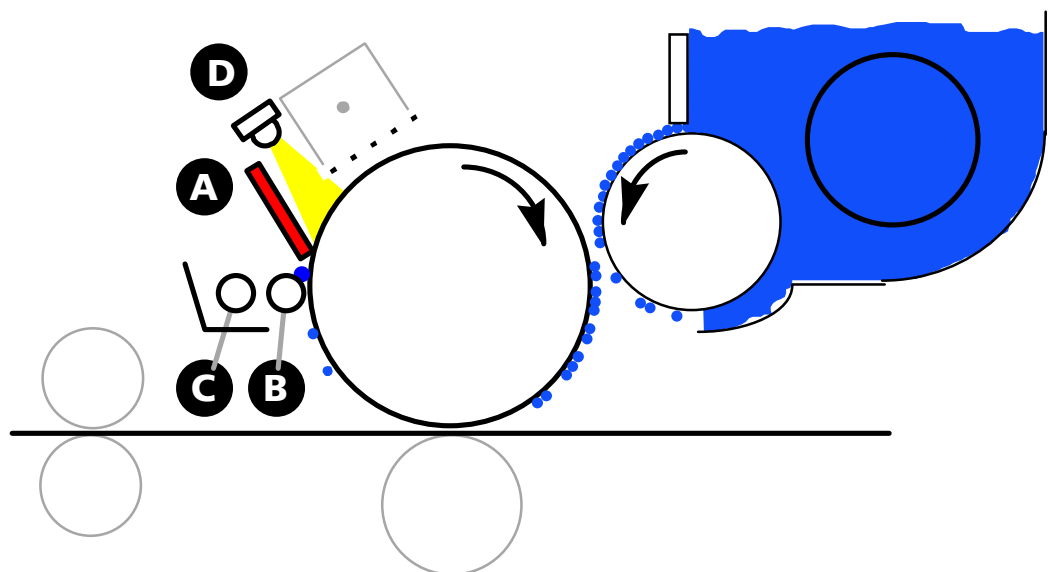


Paper size	Heater(s) activated	
	Middle heater	Edge heater
Idle	Off	On
A3, A4 landscape	On	On
B4	On+	On
Letter landscape	On+	On
Letter, A4, A5	On	Off
Ledger	On	On

The heat roller temperature is constantly monitored by the engine control circuit using the thermistor. In the above table, each heater is turned “On” as commanded by the thermistor. The “On+” status for paper sizes of B4 and letter (landscape) mean that the heater is turned on a couple of seconds longer than that commanded by the thermistor.

Drum cleaning and erasing static charge

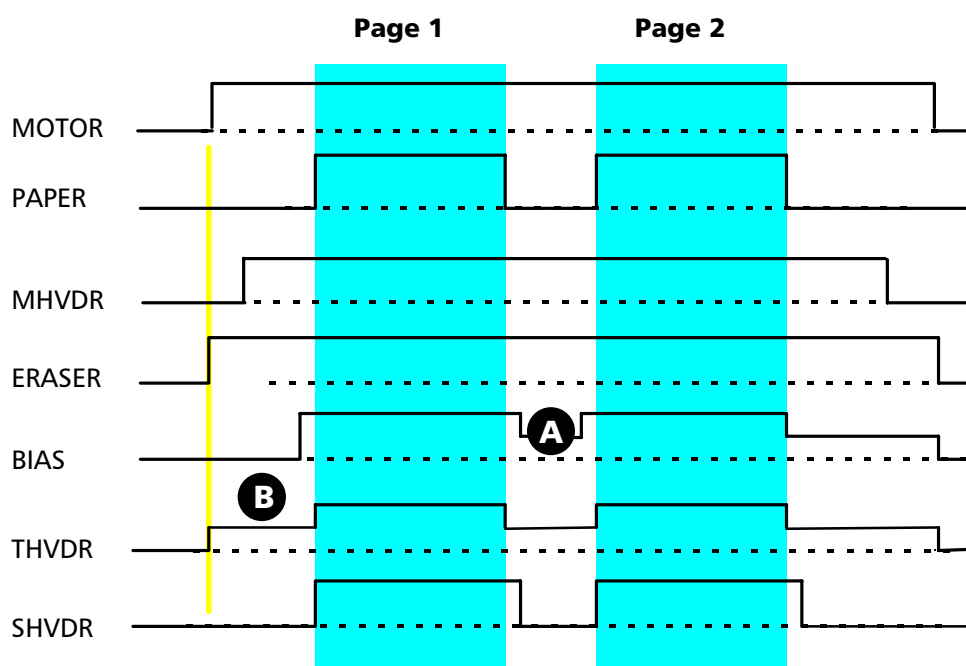
The drum needs to be physically cleaned of toner which is remaining on its surface in the development process. The cleaning blade (**A** below) is constantly pressed against the drum and scrapes the residual toner on the drum off to the refresher roller (**B** below). The refresher roller drives the toner to the spiral (fins) roller (**C** below). The waste toner is collected at the output end of the spiral roller and sent back to the toner container, into the waste toner reservoir.



After the drum is physically cleaned, it then must be cleaned to an electrically neutral state. This is necessary to erase any residual positive charges, ready to accept the next uniform charge. The residual charge is canceled by exposing the drum to the light emitted from the eraser LED (**D** above). This lowers the electrical conductivity of the drum surface making the residual charge on the drum surface escape to the ground.

Typical photo process timing chart

The following chart shows the signals used for photo processing. These signals activate the corresponding device in the following timing sequences. A simple description for these signals follow.



MHVDR (Main High Voltage Drive) - turns on the main charger bias for charging the toner. This signal is kept on during the job is being processed.

ERASER - turns on the eraser (LED array) as soon as the motor begins to rotate.

BIAS - turns on the developer bias on the magnet roller. The duration of this signal is dependent on the current paper size. The bias is reduced to approx. 100V between paper (A). This avoids gray background effect by attracting excessive toner on the magnet roller onto the drum (which will subsequently be collected back in the drum unit by means of the cleaning blade).

THVDR (Transfer High Voltage Drive)—turns on the transfer bias. Note that the transfer bias is weakened (from -1—2kV to -600V) while paper is not present between the transfer roller and the drum unit. This avoids contamination on the back side of paper (**B**).

SHVDR (Separation-charger High Voltage Drive)—turns on the separator to scrape the paper off of the drum unit.

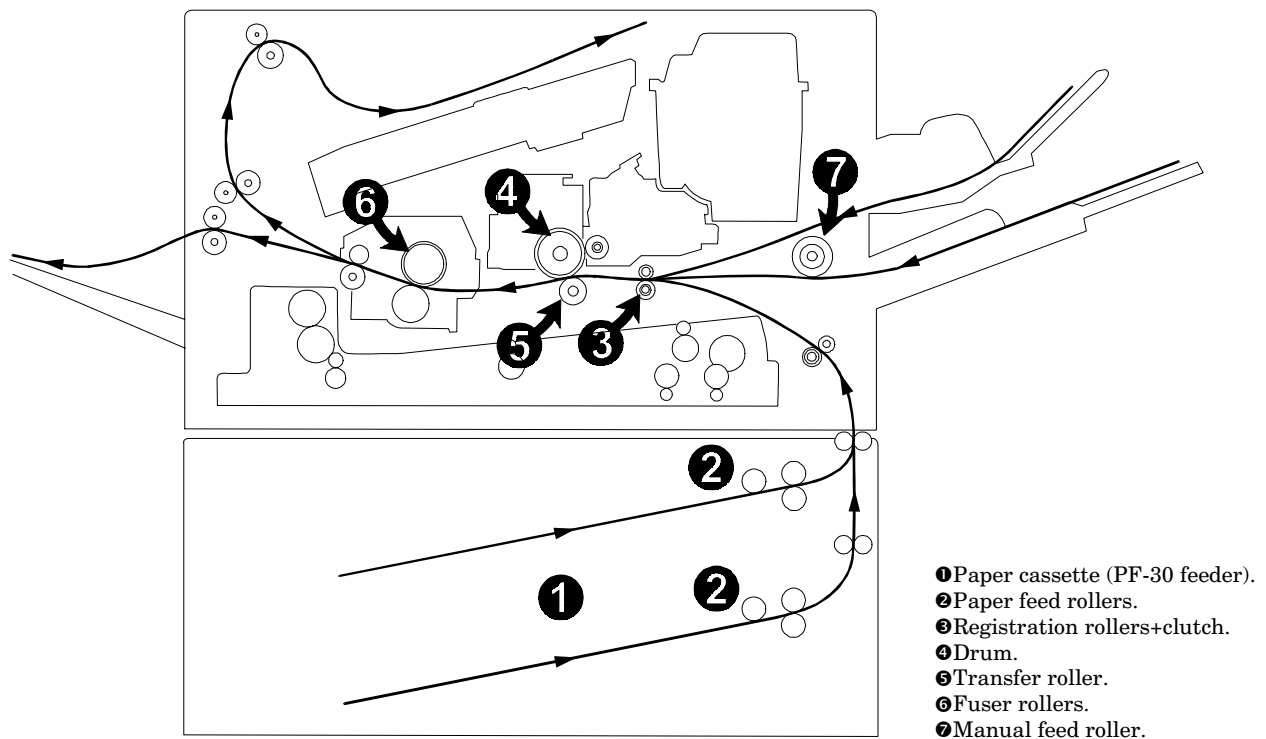
Paper feeding system

The paper feeder providing two paper cassettes is fitted to the printer externally at the bottom of the printer. The printer can be installed with up to 6 cassettes by adding up to two more paper feeder options (PF-30, basically the same paper feeder fitted as the standard paper feeder).

The paper feeding system picks up paper from the cassette or the MP tray. At a precise timing, it feeds it to the electrophotography system. It finally delivers the printed page to either the face-down or face-up tray, or to the optional stacker/finisher.

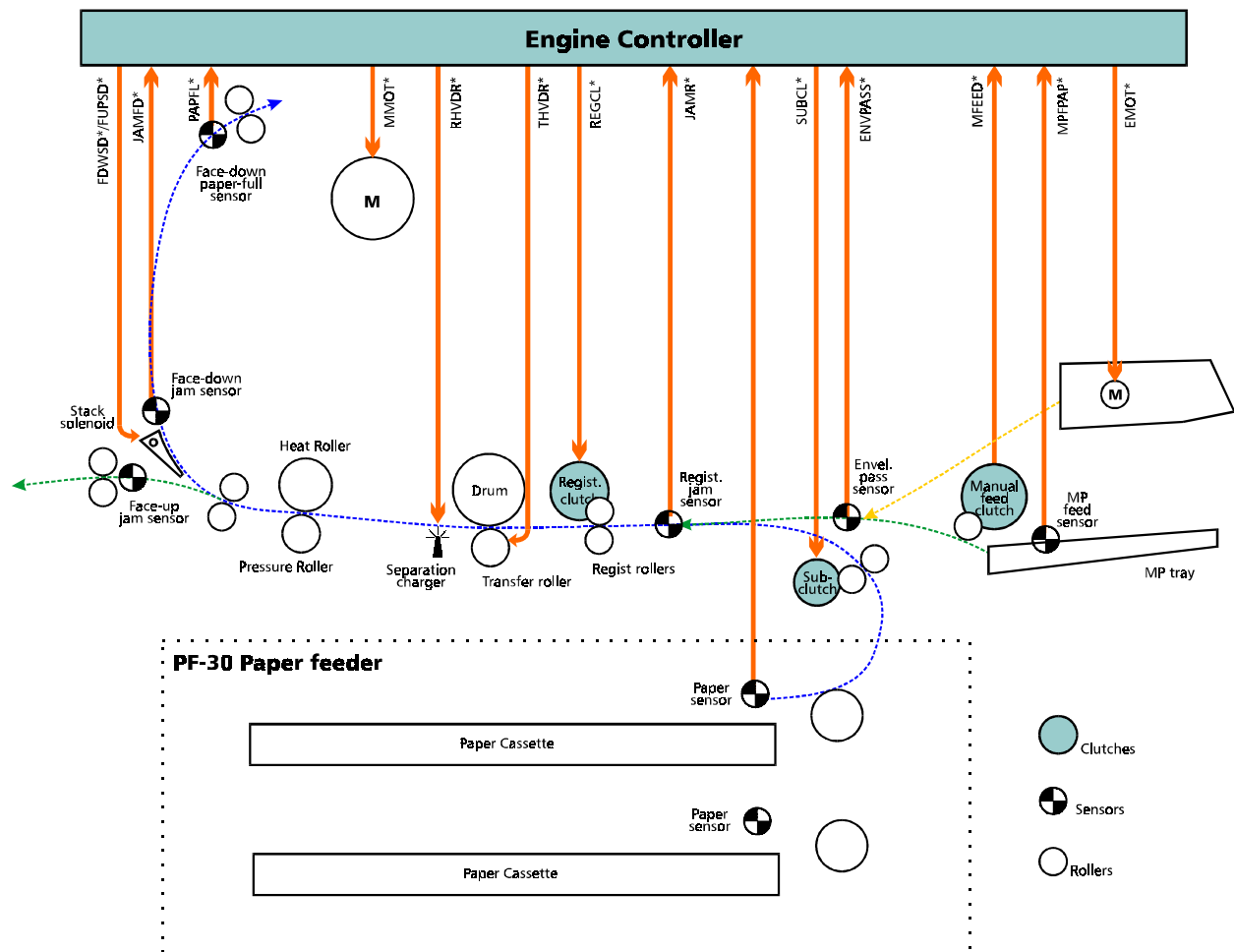
The figure below shows the components in the paper path within the printer. The sensors, solenoids, etc., are also described in the following pages.

PAPER FEEDING DIAGRAM



Paper control signals

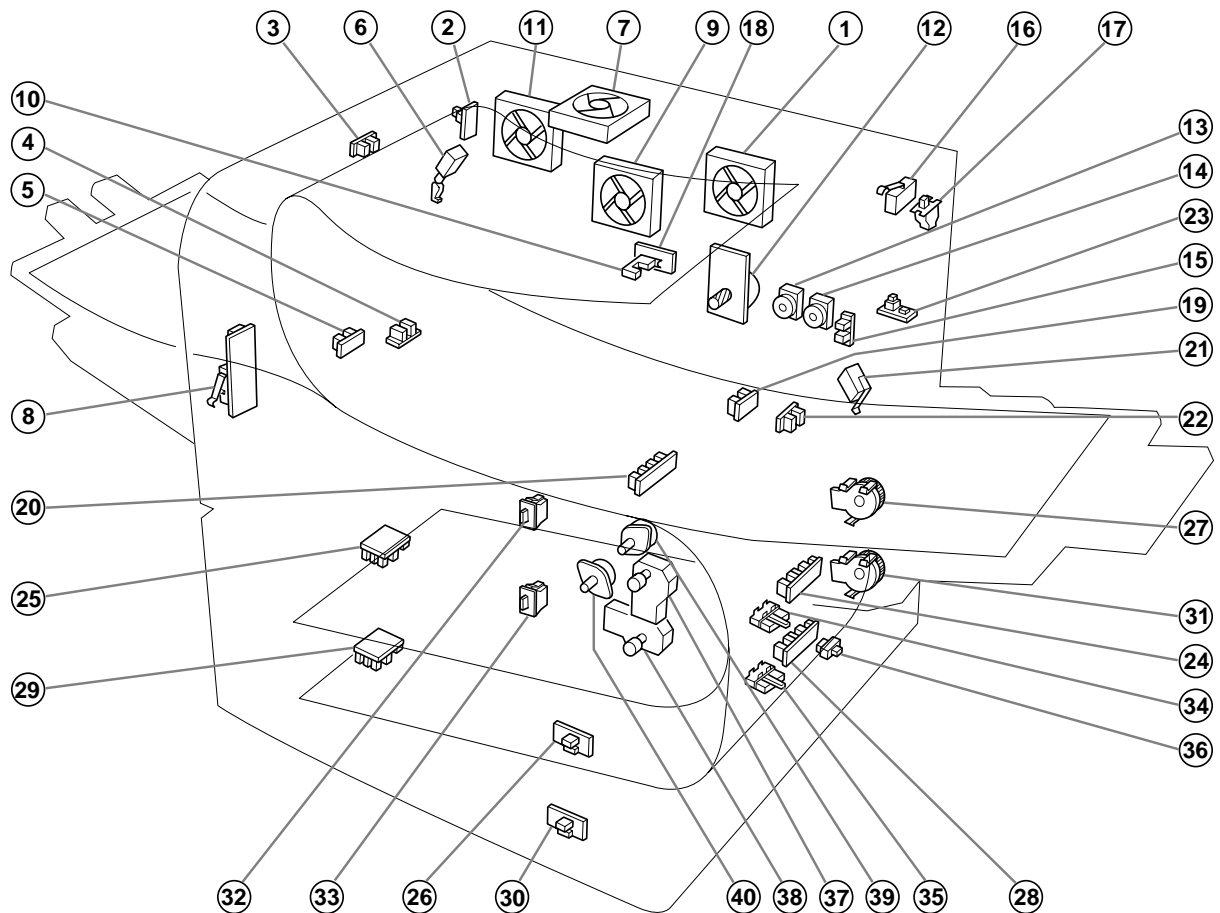
The following diagram shows the control signals that control the sensors and the rollers for guiding paper. The engine controller provides these signals in conjunction with the electrophotography process that is driven by the main controller system.



PAPER CONTROL SIGNALS

Paper feeding components

The figure below shows the locations of the sensors, clutches, microswitches, and fans. Each number corresponds to the description in the table on the next page. The board Ids accompany those parts mounted on the board.



Control devices

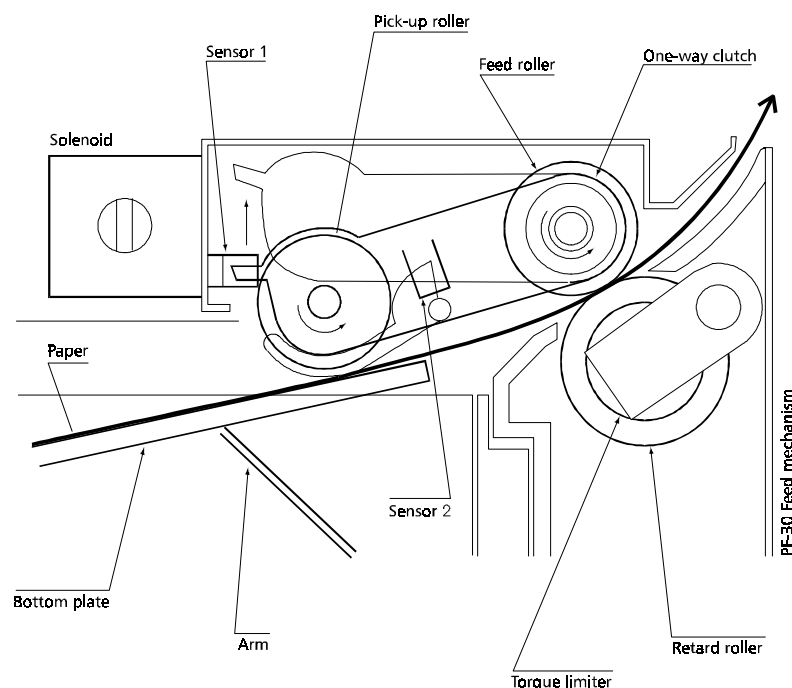
Symbol	Title	Location	Board
1	Controller box fan (FAN3)	Controller box	
2	Printer side cover switch	Face-down unit	KP-552
3	Face-down paper-full sensor	Face-down unit	
4	Face-down jam sensor	Face-down unit	
5	Face-up jam sensor	Face-down unit	
6	Face-up/down solenoid	Face-down unit	
7	Scanner fan (FAN4)	Top cover	
8	Interlock switch—front	Front frame	KP-556
9	Drum/fuser fan	Rear frame	
10	Tower sensor	Rear frame	KP-574
11	Power supply fan (FAN2)	Shield box	
12	Main motor	Drive unit	
13	Registration clutch	Drive unit	
14	Intermediate clutch	Drive unit	
15	Registration jam sensor	Rear frame	
16	Interlock switch—top	MP feed unit	
17	Top cover switch	MP feed unit	
18	Toner container sensor	MP feed unit	KP-603
19	MPF paper sensor	MP feed unit	
20	MPF paper size sensors 1 and 2	MP feed unit	KP-576
21	MPF solenoid	MP feed unit	
22	Envelope feeder sensor	MP feed unit	
23	Toner container switch	Rear frame	

Paper feeder (PF-30) control devices

Symbol	Title	Location	Board
24	Upper cassette paper sensor/bottom limit sensor	Upper cassette	KP-583
25	Upper cassette paper size sensors 1/2/3	Upper cassette	KP-581
26	Upper cassette LED	Upper cassette	KP-585
27	Upper cassette paper level switch	Upper cassette	
28	Lower cassette paper sensor/bottom limit sensor	Lower cassette	KP-583
29	Lower cassette paper size sensors 1/2/3	Lower cassette	KP-581
30	Lower cassette LED	Lower cassette	KP-585
31	Lower cassette paper level switch	Lower cassette	
32	Upper cassette switch	Drive plate	
33	Lower cassette switch	Drive plate	
34	Upper jam sensor		
35	Lower jam sensor		
36	Right side cover switch		
37	Upper cassette base elevation motor	Drive plate	
38	Lower cassette base elevation motor	MP feed unit	
39	Intermediate stepping motor	Drive plate	
40	Feed stepping motor	Drive plate	

Printing from PF-30 cassettes

At the moment the logic controller finishes data processing, the logic controller passes PRINTN signal to the engine controller. The engine controller then activates the clutch for the feed roller of the currently selected cassette (in the PF-30 feeder) and the sub clutch in the printer to start feeding paper. As the paper kicks the registration jam sensor, it momentarily stops there before the print data starts laser scanning on the drum.



When the laser scanner and the fuser are ready, the engine controller sends VSREQN signal to the logic controller to verify the readiness of data. When the logic controller finishes data processing, it sends VSYNCN and VDATA to the engine controller. Now the paper is released from the registration rollers and through under the drum unit, starting the image development, transferring, and fusing. The paper having passed through the fuser unit kicks the face-down or face-up paper jam sensor (and the paper-full sensor at the face-down outlet, if the paper was destined to the face-down stack). When the paper is not detected by these sensors in the expected

time of period, depending on the current paper size, the engine controller halts printing and report the occurrence of a paper jam.

The size of the paper currently in the selected cassette is acknowledged to the engine controller by means of the on-off status of the photosensors PT1, PT2, and PT3 in the PF-30, at the end of the paper cassette. The table below summarizes the on-off status of these photosensors in accordance with the supported paper sizes.

PF-30 PAPER SIZE SENSING

Paper size	PT1	PT2	PT3
Ledger (portrait)	Off	On	On
A3 (portrait)	On	On	On
B4 (portrait)	Off	Off	Off
Legal (portrait)	Off	Off	On
B5 (portrait)	Off	On	Off
Letter (landscape)	On	On	Off
A4 (landscape)	On	Off	On
A5 (landscape)	On	Off	Off

Off=high/On=low

Printing from the MP tray

The presence of paper in the MP tray is detected by the MP feed sensor (See page 4-24). When the controller is ready to print, the engine controller activates the clutch for the manual feed roller. The manual feed roller pulls the paper on the MP tray and sends it forward to the registration roller after the envelope pass sensor is cleared. The rest of the printing process is the same as that of the PF-30 explained on page 4-28.

The size of the paper currently on the MP tray is detected by two sensors (See page 4-25). Photosensors PT1 and PT2 are activated in accordance with the setting of the paper guides (adjusted manually). The table below summarizes the on-off status of these photosensors.

MP TRAY SIZE SENSING

Paper size	PT1	PT2
A3	On	On
Ledger	On	On
A4 (landscape)	On	On
Letter (landscape)	On	On
B4	Off	On
8" width	Off	On
Letter (portrait)	Off	Off
Legal	Off	Off
A4 (portrait)	Off	Off
8" width (portrait)	Off	Off
B5 (portrait)	Off	Off
A5 (portrait)	Off	Off
Hagaki	Off	Off
5" width	Off	Off

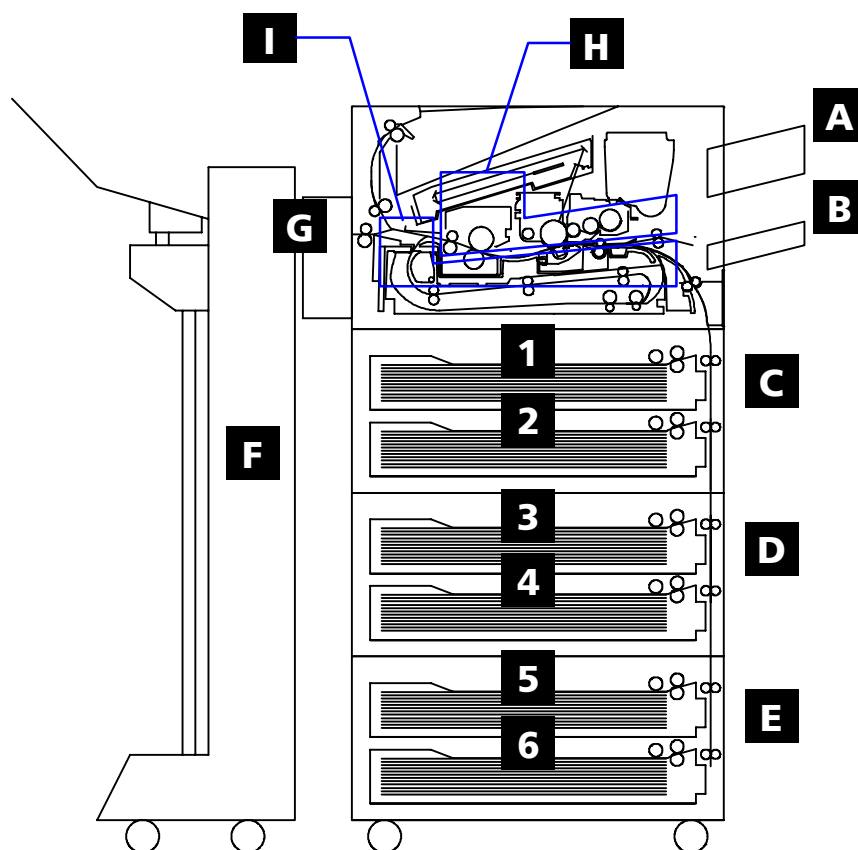
Printing from the optional envelope feeder

The envelope feeder EF-1 (or UF-1) is electrically connected to the printer via a connector at the right side panel. This connector provides connection of the paper presence and the envelope feeder motor to the printer's engine system.

The envelope feeder motor sends the paper towards the registration roller after the envelope pass sensor is cleared. The rest of the printing process is the same as that of the PF-30 explained on page 4-28.

Paper jam detection

The sensors illustrated in the following diagram are used to track the paper while it is moving through the printer. More detailed sensor information can be found from the diagrams in section **Paper feeding components** on page 4-25.



Each sensor coded above represents the following locations. When a paper jam occurs, the code(s) is actually indicated on the message display in order for the user to easily know where to remove the jammed paper.

Code	Suggested jam location
A	Envelope feeder (optional)
B	MP tray
C	Top paper feeder jam door
D	Middle paper feeder jam door
E	Bottom paper feeder jam door
F	Optional stacker
G	Face-up stack outlet/Printer side cover
H	Paper feed unit/Fuser unit
I	Duplexer (optional)
1	First paper cassette
2	Second paper cassette
3	Third paper cassette (optional)
4	Fourth paper cassette (optional)
5	Fifth paper cassette (optional)
6	Sixth paper cassette (optional)

Message display at a paper jam

When paper jammed within the printer system, the sensor(s) triggers the signal to the engine controller, which indicates the jam position. At the same time, the engine controller causes the message display to show *Open front cover*. This urges the user to refer to the instructions that is affixed at the back side of the front cover of the printer.

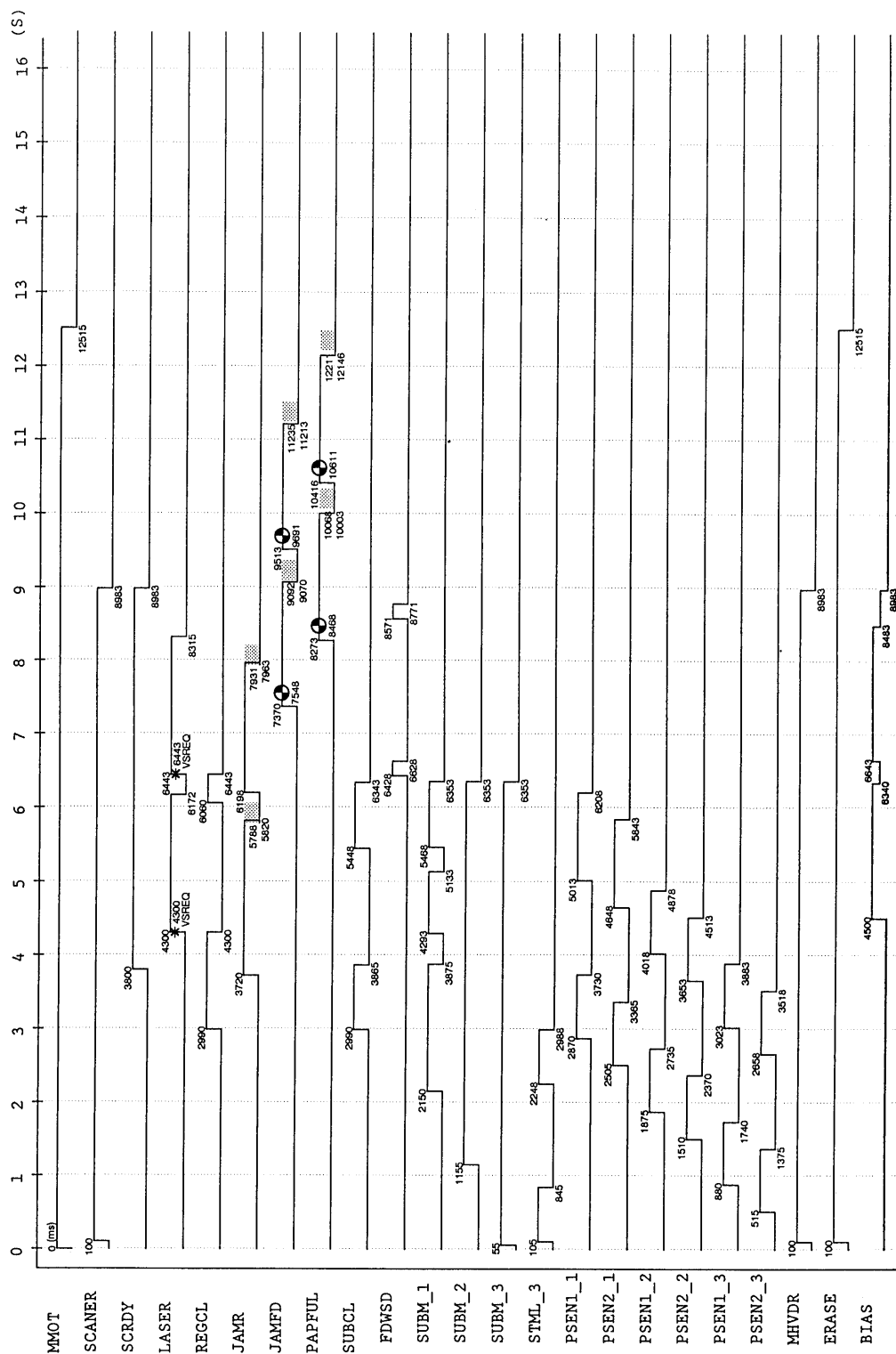
A sample of the display transition when a jam occurred follows. Read through from top to bottom.

When a paper jam occurs, the display shows:	Paper jam Open front cover
After opening the front cover, the actual jam positions are indicated:	Paper jam C, F, G, H, I, 6
As the paper is removed in order of the display, the specific position code will go out.	Paper jam F, G, H, I, 6
When all jam locations are cleared of jam, the display shows:	Front cover Open
Close the front cover. The printer starts warming up.	Please wait
When the printer reverts to normalcy, the printing job resumes.	Processing PAR 600 A4 001

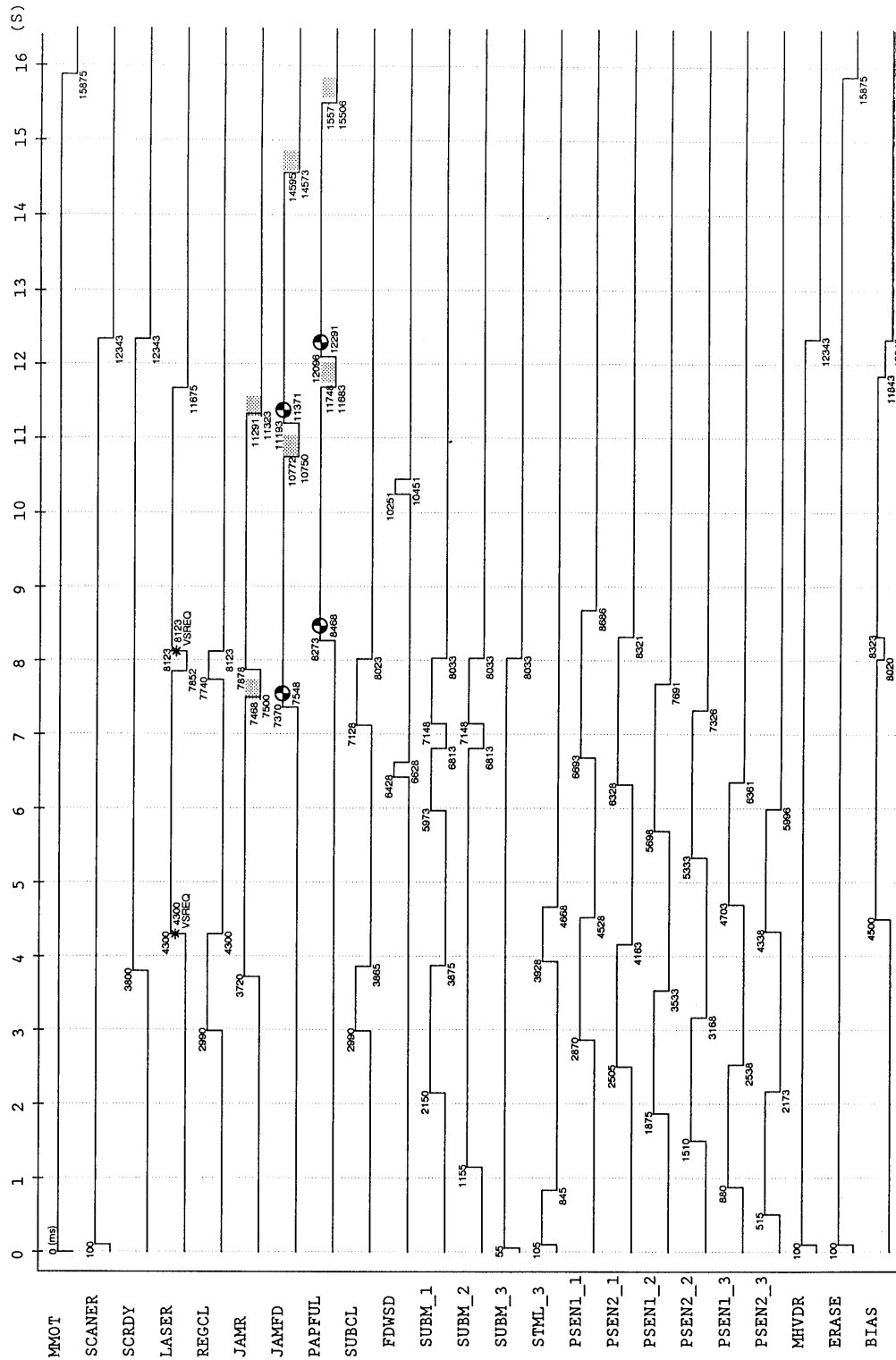
Print timing charts

Line speed=125 mm/s; feed speed=263 mm/s [paper feeder], 125 mm/s [MP tray]

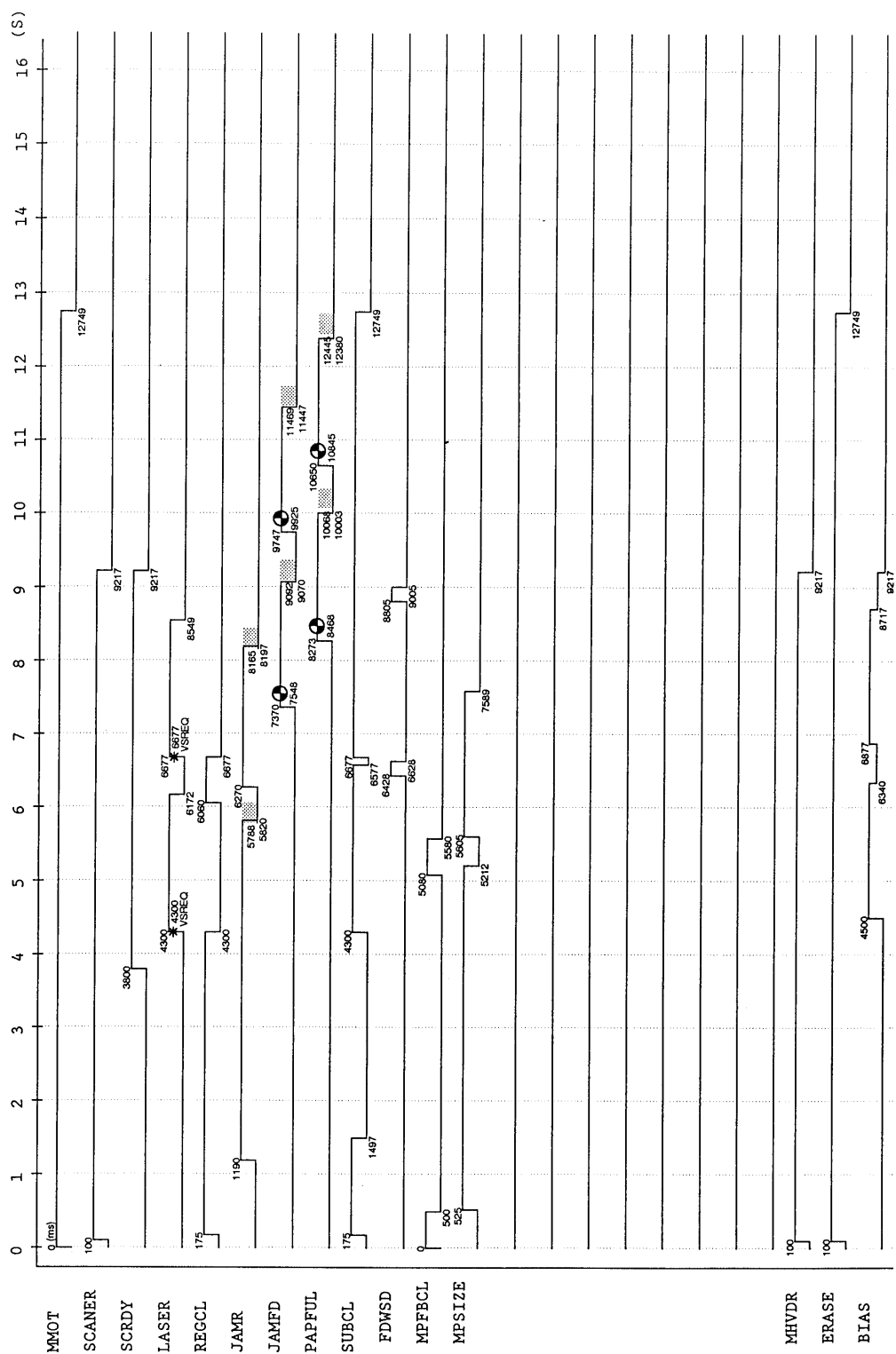
A4 landscape feed [210mm]/28 ppm/Cass 6



A3 [420 mm]/16 ppm/Cass6



A4 [210 mm]/26 ppm/MP tray [Cassette mode]



Basic engine functions

This section presents a general functional overview of the engine system of the printer. It was intended to provide a comprehensive knowledge on basic functions that the engine system performs during printing. The following printer functions are covered:

- Engine controller system
- Main logic controller system
- Paper feed system
- Power supply system

Engine controller system

The engine controller provides control over all print engine activities. It drives laser depending on the video data transmitted from the main controller, provides control over the devices for paper transportation, such as motors, clutches, solenoids, the heater lamp, the eraser, etc., and collects information given by the sensors.

The engine controller is also responsible for the following systems, explained step by step through the following pages:

Configuration memory

The engine controller uses a flash memory to store the user-selected parameters for configuring the printer. The flash memory is driven by +5 V power and designed to stand rewriting operations of at least 100,000 times at an identical address.

High-voltage generator

The engine controller produces clocks (HVCLK1 and HVCLK2) and apply programmed divisor to generate high-voltage outputs for main charging. The clock oscillation can be toggled on and off by the engine controller CPU.

Laser scanner control

In order to activate the laser scanner, the engine controller does the following tasks:

- Generation of laser timing
- Polygon motor activation (start-up and stabilized states)
- Monitoring laser beam paths

Polygon motor control

The output frequency signal to the polygon motor is generated by the engine gate array as it divides the engine system clock (16.9344 MHz).

The revolution of the polygon motor (N) = $10 \cdot f$, where f is the clock frequency (1769.9 Hz) = 17,699 rpm.

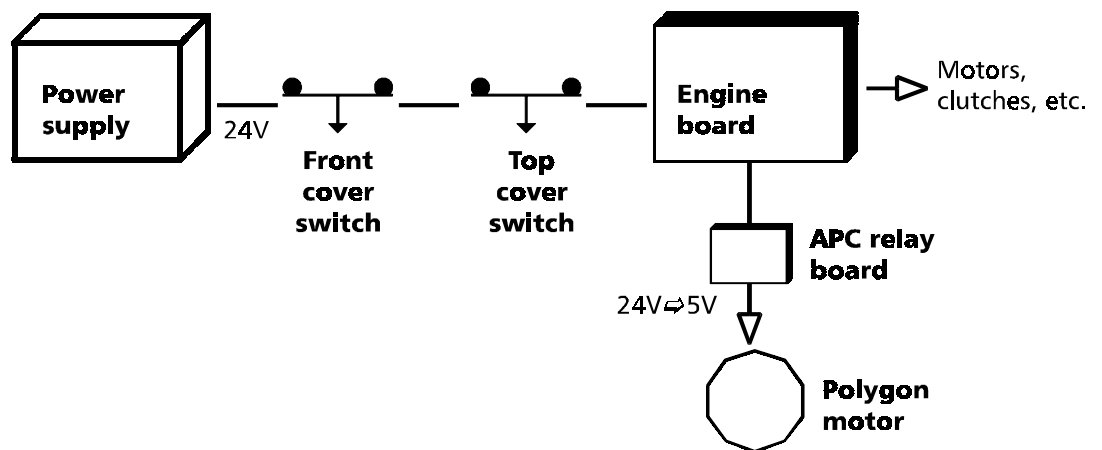
As the laser beam reaches the beam detector sensor (See page 4-10), the sensor board generates the horizontal synchro signal (PD*). This signal makes the engine gate array consequently turn the video output signal (VDO*) and the APC signal (LONB*) high which respectively activate the laser light and the APC controller.

The engine CPV attempts to detect the horizontal synchronization signal so that the laser diode is normally triggered. If the horizontal synchronization output is not found after the laser driving current control (LENB*) is set low, the engine CPV recognizes it as the failure on the APC board and gives the E3 error.

Safety interlock

For safety purpose, and in order for the product to conform to the safety standards required by the U.S. FDA and several European regulations (IEC 825), the printer is facilitated with the safety interlock circuit.

If the top and/or front cover is open, the laser emission is stopped by means of the following circuit (simplified):



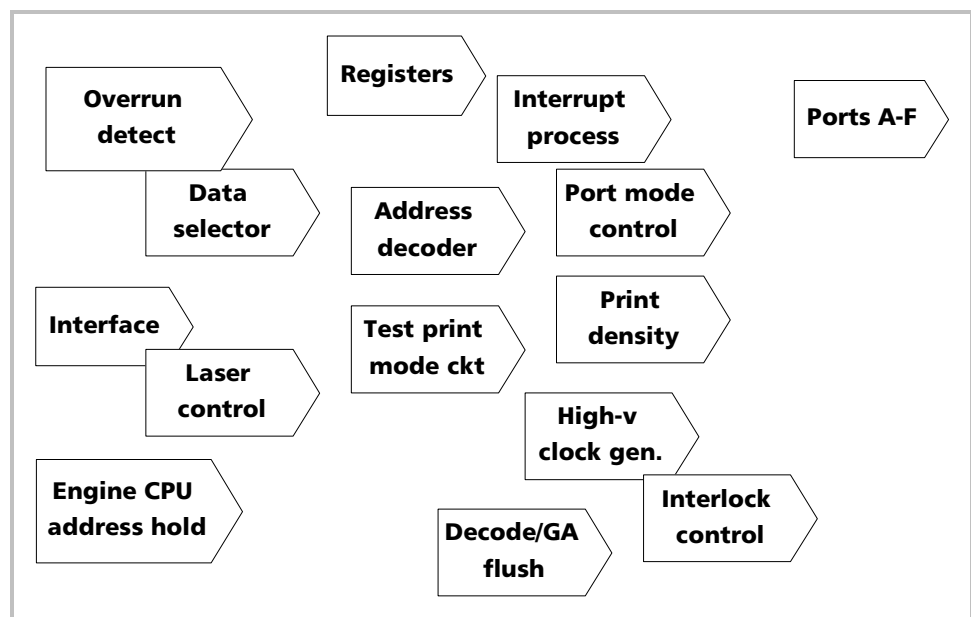
The switch at the top and front covers, when open, cuts the +24V power from the power supply to the engine board, in turn deactivating the APC relay board which downverts the +24V power to +5 V for driving the polygon motor.

The engine gate arrays

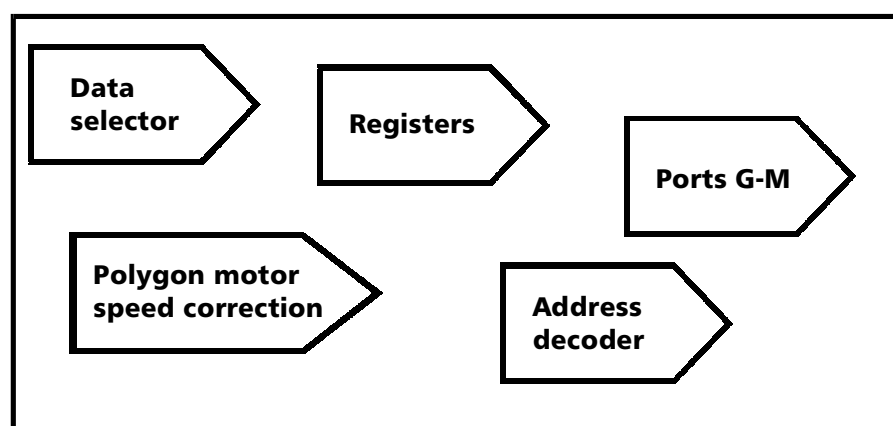
These two engine gate arrays are supplementary devices to the engine CPU. Both are a 100-pin CMOS-type QFP type that has the internal blocks of functionality as shown below.

GATE ARRAY "A"

This gate array, for the reference, is identical with the one used with models FS-1700 and FS-3700. This contains the following functional segments.



GATE ARRAY B



Pin assignment

Pin assignment for the engine gate array is table on the following pages. The device in **Remarks** column means those which the signal is forwarded to.

Note that only the pins with meaningful assignment are shown below and those for the power line and ground are excluded.

ENGINE GATE ARRAY A

Pin No	Circuit signal	GA signal	Direct.	Function	Remarks
1	THVDR*	THVDR	Out	Transfer charger control output, L: On	High-volt. board
2	THPIDR*	REVBVN	Out	Reverse bias control output, L: Rev.bias	High-volt. board
5	MHVDR*	MHVDR	Out	Main charger control output , L: On	High-volt. board
6	—	—	In	Reserve port	—
7	ERASE	ERASEN	Out	Eraser control output, L: On	Eraser
8	TCOUNT*	PC3	Out	Page counter drive, L: Count up	Page counter
9	TNMOC	PC2	In	Toner motor overcurrent, H: Overcurrent	Toner motor
10	FDWSD*	PA1	Out	Stack selection, L: Face-down	Stack solenoid
11	FUPSD*	PA0	Out	Stack selection, L: Face-up	Stack solenoid
12	JAMR*	PB5	In	Registration sensor, L: Paper exist.	Regist. sensor
14	REGCL*	PA2	Out	Regist. roller clutch, L: Off	Regisr. clutch
16	TCOVOP	PA4	In	Toner cover status, L: Open	Top cover
17	SUBCL*	PA3	Out	Sub feed clutch, L: On	Sub feed clutch
18	THVRDR*	PB1	Out	Reverse transfer bias, L: On	High-volt. board
19	—	PB4	In	Reserved	—
20	ENVPASS*	PB3	In	Env. feeder paper sens., L: Paper exist.	Envelope feeder
21	RHVDR*	PB2	Out	Separation charger, L: On	Separation charger
22	—	PC5	In	Reserved	—
23	TNEND*	PC4	In	Toner run-out threshold, L: Threshold	Threshold sensor
24	HTT1ON*	PD1	Out	Heater lamp (Mid), L: On	Fuser
25	HTT2ON*	PD0	Out	Heater lamp (Outer), L: On	Fuser
31	ILOCKOP	PBO	In	Interlock sens., H: Lock (+24V off)	Interlock
32	TBSEN*	PA5	In	Toner container exist., H: Exist	Toner container
33	—	PD5	In	Reserved	—

Pin No	Circuit signal	GA signal	Direct.	Function	Remarks
35	TNMOT*	PC1	Out	Toner motor drive, L: Drive	Toner motor
36	SCANR*	PC0	Out	Polygon motor drive, L: Drive	Laser scanner
37	STOP*	PD7	Out	WDT timeout, L: Timeout	Gate array B
45	LASER	PC7	Out	Laser drive current, H: Laser off	Laser scanner
47	TOWSEN*	PC6	In	Waste toner conveyer exist., L: Exist	Waste toner conveyer sensor
48	ERADC*	PA7	In	Eraser blow-out, L: Blown out	Eraser
49	THMDC	PD3	In	Fuser thermistor blow-out, L: Blown out	Fuser
50	EGIR*	PFO	Out	Communication error, used as EGIR	Main controller
87	HTSTBY	PD2	Out	Fuser heater idle, H: Ready	Fuser
88	HTREADY*	PD6	In	Fuser heater ready, L: Ready	Fuser
99	LCOVOP	PA6	In	Left cover status, L: Open	Left cover sensor
100	HVOL	HVOL	Out	Transfer limit current, H: Thick paper; L: Thin paper	High-volt. board

GATE ARRAY B

Pin No	Circuit signal	GA signal	Direct.	Function	Remarks
1	THVI2	PG3	Out	Transfer bias 2, default high	High-volt. board
2	THVI1	PG2	Out	Transfer bias 1, default high	High-volt. board
3	BSSEL	PG1	Out	Transfer bias select signal	High-volt. board
4	RHVI1	PG0	Out	Separation select signal, default low	High-volt. board
13	—	PH7	In	Reserved	—
14	—	PH6	In	Reserved	—
15	—	PH5	In	Reserved	—
16	—	PH4	In	Reserved	—
21	—	PH3	In	Reserved	—
22	OPSEL2	PH2	Out	Option handshake 2	Options
23	OPSEL1	PH1	Out	Option handshake 1	Options
24	OPSEL0	PH0	Out	Option handshake 0	Options
25	EMOT*	PI7	Out	Env. feeder motor drive, L: On	Envelope feeder
26	EUNIT*	PI6	In	Env. feeder existence, L: Exist	Envelope feeder
27	EPAP	PI5	In	Env. feeder paper exist., L: Exist	Envelope feeder

Pin No	Circuit signal	GA signal	Direct.	Function	Remarks
28	HANDS*	PI4	In	Bulk feeder paper presence, L: Present	Bulk feeder
29	PF7UNT*	PI3	In	Bulk feeder presence, L: Present	Bulk feeder
30	MPFBCL*	PI2	Out	MP tray solenoid, L: On	MP tray
31	MPFPAP*	PI1	In	MP tray paper presence, L: Present	MP tray
32	—	PI0	In	Reserved	—
33	JANFU*	PJ7	In	Face-up outlet paper presence, L: Present	Face-up sensor
35	JAMFD*	PJ6	In	Face-down outlet paper pres., L: Present	Face-down sensor
36	FANIF*	PJ5	Out	Fan 1 revolution, L: High	Fan 1
37	FCOVOP*	PJ4	In	Front cover status, L: Open	Front cover
38	ETEMP*	PJ3	In	Toner container gauge, L: No toner	Toner container
39	FAN3*	PJ2	Out	Fan 3 drive, L: Drive	Fan 3
42	DEFMER	PJ1	In	Developer life fuse, H: Intact	Developer fuse
43	FUFMER	PJ0	In	Fuser life fuse, H: Intact	Fuser fuse
44	DVUNT*	PK7	In	Developer presence, L: Present	Developer
45	DRUNT*	PK6	In	Drum unit presence, L: Present	Drum unit
46	FUUNT*	PK5	In	Fuser installation, L: Installed	Fuser
47	MPSIZE2	PK4	In	MP tray paper width 2	MP tray
48	MPSIZE1	PK3	In	MP tray paper width 1	MP tray
49	TVSEN	PK2	In	Transfer voltage, L: <-800V	High-volt. board
50	TISEN	PK1	In	Transfer current, L: <30μA	High-volt. board
51	—	PK0	In	Reserved	—
52	—	PL7	In	Reserved	—
53	—	PL6	In	Reserved	—
54	—	PL5	In	Reserved	—
55	—	PL4	In	Reserved	—
56	ETNLED*	PL3	Out	Toner presence validat., L: Valid	Toner container
57	HTNLED*	PL2	Out	Waste toner conveyer pres. valid.; L: Valid	Waste toner convey.
58	—	PL1	In	Reserved	—
60	—	PL0	In	Reserved	—
61	—	PM7	In	Reserved	—
62	—	PM6	In	Reserved	—
63	—	PM5	In	Reserved	—
66	WRENB	PM4	Out	Flash ROM write-enable, H: Enabled	Flash ROM

Pin No	Circuit signal	GA signal	Direct.	Function	Remarks
67	HTDEMON*	PM3	Out	Heater 1 thermistor ignore, L: Ignore	Fuser
68	HTABNOR*	PM2	In	Fuser abnormal temp., L: Abnormal high	Fuser
97	DEVHIT*	PG7	Out	Developer fuse blow, L: Blown	Developer
98	FUSHIT*	PG6	Out	Fuser fuse blow, L: Blown	Fuser
99	FAN2*	PG5	Out	Fan 2 (power supply), L: Drive	Fan 2
100	FANI*	PG4	Out	Fan 1 (Main unit), L: Middle rev.	Fan 1

Power supply

The power supply contains the AC and DC power inputs and outputs. The high voltage bias generator circuit is mounted on a separate board. A simplified schematic diagram and a power distribution diagram are shown on the following pages.

AC INPUT AND RECTIFIER

The primary AC input power arrives at CN1 and enters AC line filter circuit (L1, L2, C1, C2, etc.). BD1 rectifies it to DC; Q1 provides switching on it for downverting by T1 to develop +24V and +5V AC.

24V DC POWER LINE

The 24V AC appearing at the secondary side of T1 is rectified by D30 and smoothed by C31, C32, etc., and distributed through CN3. The 24V DC line is represented as VDD or VDDCOM and used to feed the following engine component:

- Face-up/down stack solenoids, MP tray paper feed solenoid
- Clutches (registration, intermediate)
- Fans
- High-voltage generator (board)
- Main motor, laser polygon motor, toner motor
- Clutches, motors, solenoids within the option units
- Laser APC, fuser heater control, eraser LED

The 24V DC power is forcibly interrupted for safety whenever the printer top cover or the drum unit access door is opened. For details, see the **Safety interlock** section, page 4-40.

5V DC POWER LINE

The +5V DC line is generated by switching (IC40) the +24V DC to develop the 5V AC which is subsequently rectified and smoothed by D40, C40, etc. It is also distributed through CN3. The main controller circuits, sensors, engine controller circuits, etc., are fed by the +5V DC line (also referred to as VCC).

POWER PROTECTION CIRCUIT

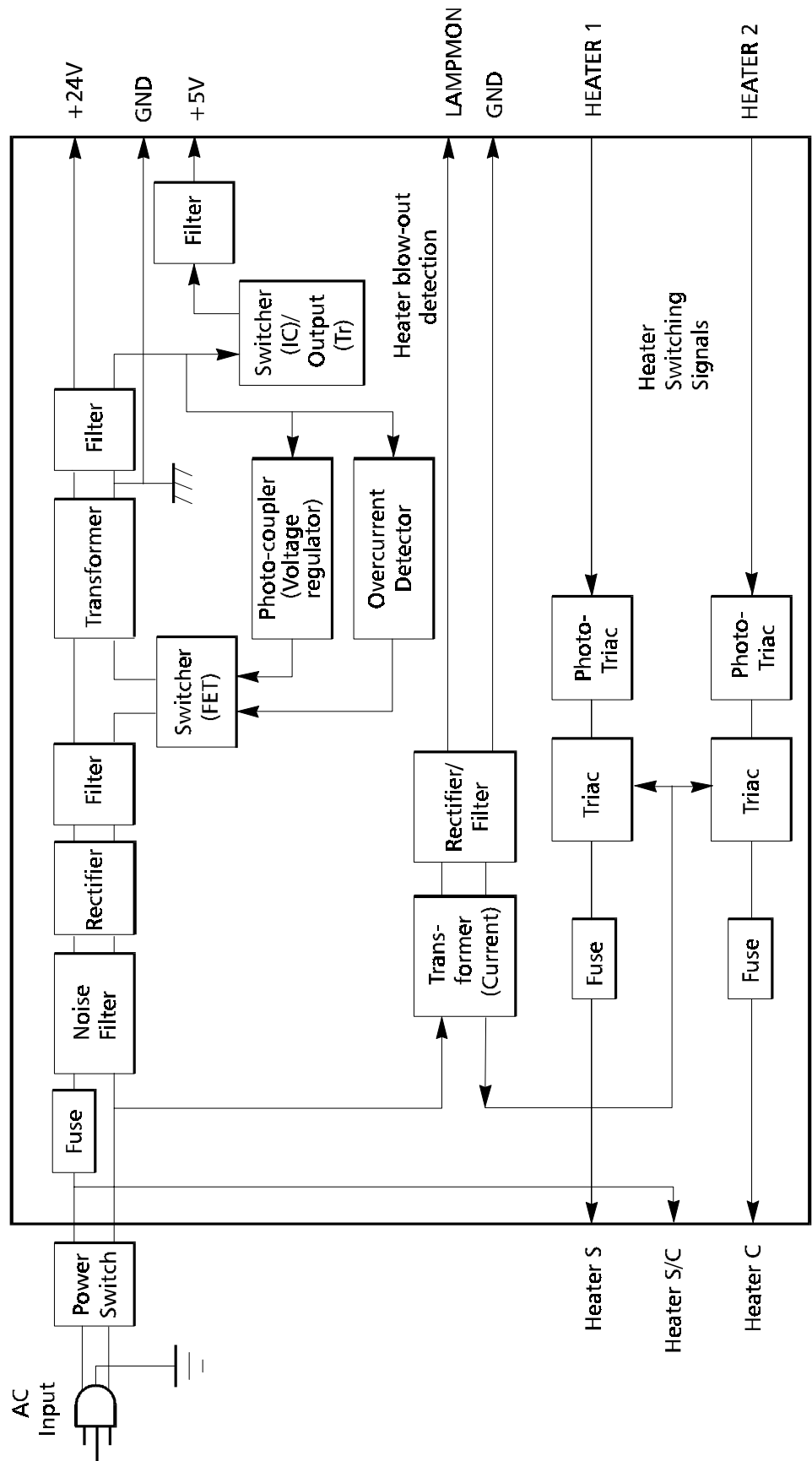
A fraction of the +24V DC power is connected to the protection diode PC1 for provides protection action for the power supply. In case the output of the 24V DC line is short-circuited, the diode segment of PC1 drives the transistor segment of PC1 to turn on Q2 which in turn disconnects the output of switching regulator Q1.

FUSER HEATER POWER CONTROL

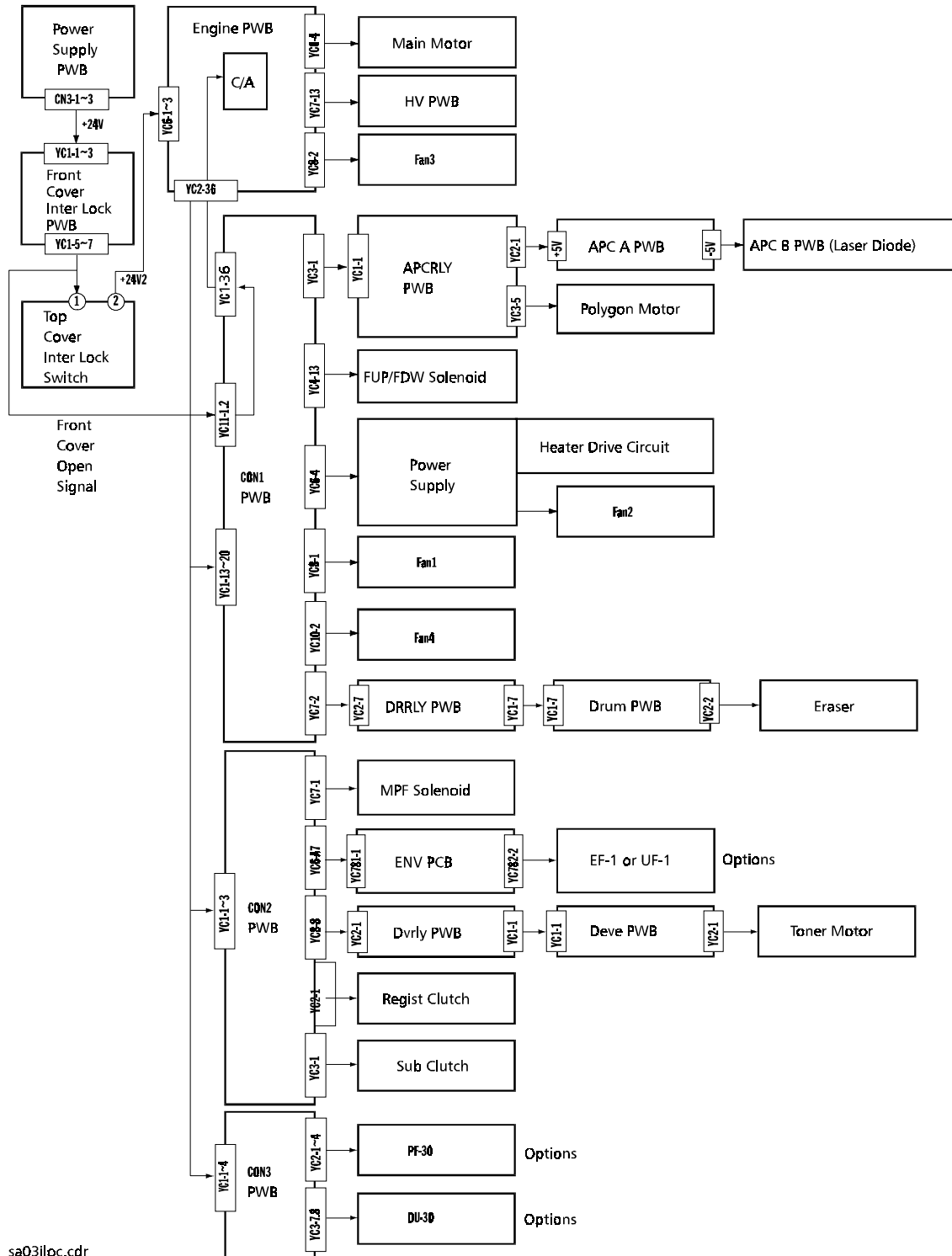
In the primary circuit, two fuser heater lamps and a thermostat is connected parallel across CN2. The heater lamps are controlled by triacs TRC20 and TRC21. Each is turned on when pin 1 (HEATER1) or 2 (HEATER2) is triggered, respectively energizing the appropriate heater lamp.

For details on the fuser function, refer to **Fusing** on page 4-18.

POWER SUPPLY CIRCUIT



Power distribution



sa03illoc.cdr

Logic controller system

The logic controller system does the following:

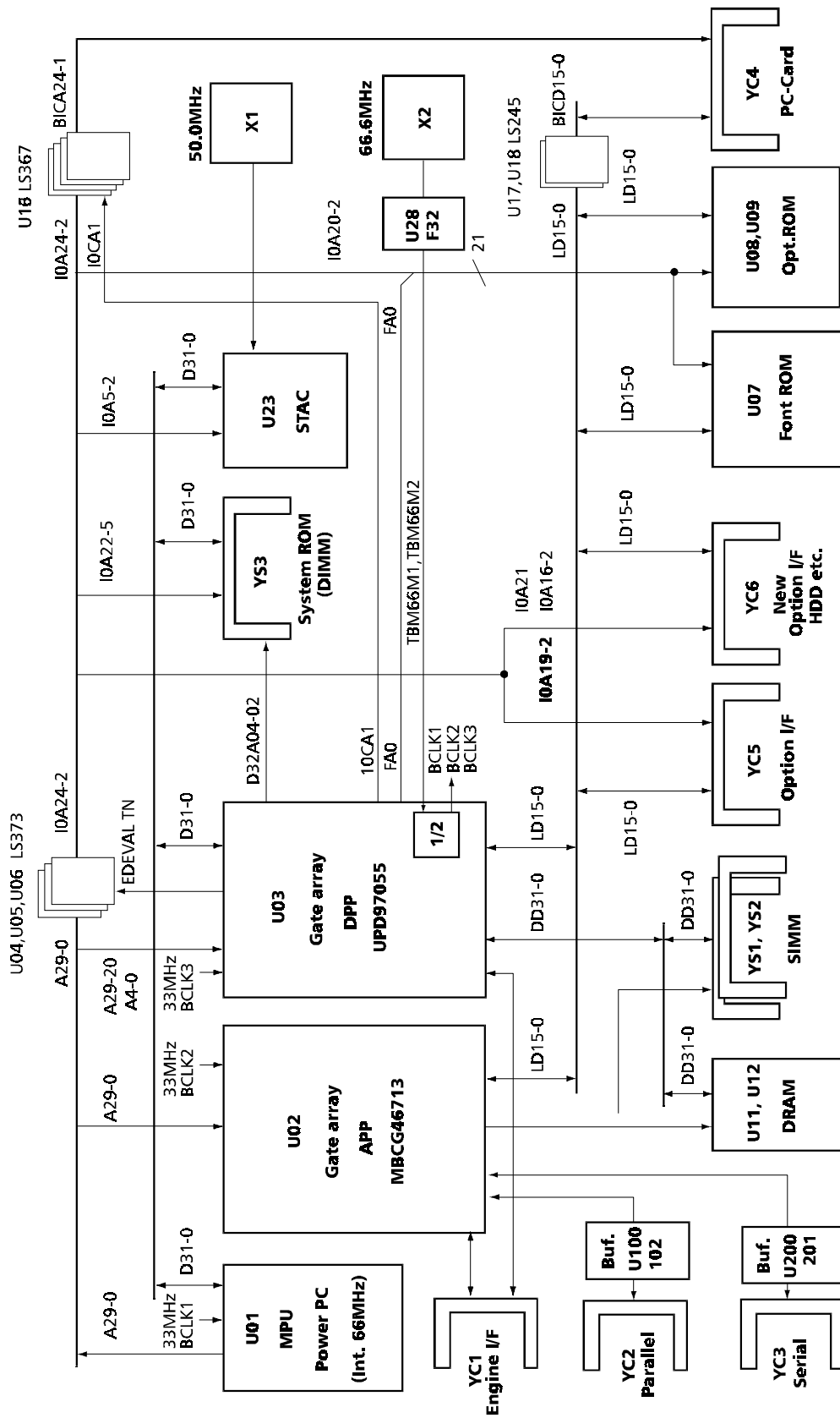
- Communicates with the host computer to receive data at one of the printer's interface
- Analyzes and translates the print data to be the dot data in the raster memory
- Communicates with the engine system to discern readiness for printing
- Stores fonts and macro information

The main logic controller has specifications as shown in the following section. A simplified diagram is illustrated on page 4-53.

Main logic controller overview

Item		Specification
CPU		PowerPC603e/100 MHz
System ROM size		4 MB
RAM size	Standard	4 MB
	Option	64 MB (in two SIMM sockets)
Fonts	Resident	4 MB
	Custom	2 MB [PK-4]
Application program interface		512 kB
Memory card		1 slot, JEIDA4.2/PCMCIA2.1
Interface	Parallel	High-speed bi-directional [IEEE 1284]
	Serial	RS-232C/422A (Jumper setting)
	Option 1	See <i>Interface</i> above.
	Option 2	KUIO [for harddisk unit HD-1]
Engine communication		Serial interface (Kyocera's original)
Front panel communication		Serial interface
Other features	Smoothing	KIR2 (Vector compensation method)
	Toner saver	EcoPrint [On/Off]
	Enlarge/reduction	Main scan/sub scan
	Video clock	50.4872 MHz

Controller block diagram



Printing data processing

The printer communicates with the host computer for receiving the print data at one of the printer's interfaces and temporarily store them in the interface buffer. The main logic controller analyzes the data for translating them into the dot data according to the original print image. The resultant dot data are depicted in the raster memory (DRAM's).

While data processing is in course, on the other hand, the main logic controller CPU talks to the engine CPU via the engine interface, to discern the readiness of the printer's engine for printing.

If the engine is ready to start printing, the main controller issues print signal towards the engine controller which request the paper feed. In synchronization with the procession of the paper within the printer, U3 releases video data in the raster memory. Thus the video data are transferred to the laser scanner together with the horizontal synchronization signal and the video clock.

On reception of the video data, the laser diode turns on and off to constitutes the print image over the drum. The image on the drum, referred to as the static latent image, is applied with toner, transferred onto the paper, and finally fused permanently on the paper by means of heat and pressure.

Main logic component

CPU (U01)

A PowerPC603e/100 MHz is used, operating at 32-bit mode. The external clock of 50 MHz is doubled to 100 MHz by the internal PLL circuitry.

ASIC (U02)

This ASIC includes the following circuitry's as module:

- Parallel interface
- Serial interface (including UART)
- DMA controller
- DRAM controller
- Engine communication
- Front panel communication
- Optional equipment interface

ASIC (U03)

This ASIC implements generation of video data to print and deployment of the video output. This includes:

- *KIR2* (Image smoothing)
- *EcoPrint* (Toner saver)
- Computation for video deployment over VRAM (raster memory)
- Compression/decompression

provides control over:

- Memory card
- Font management
- System DIMM

and this ASiC provides conversion on such devices as the memory card, fonts, etc., which use 16-bit data bus width for the 32-bit CPU.

COMPRESSOR/DECOMPRESSOR (U23)

This implements the memory saver (EcoMemory), operating at 50 MHz. The local bus for this IC is connected to two SRAMs (U21 and U22; 256 kb) which are used as buffers.

API ROM socket (U09)

This accepts an API (Application Program Interface) ROM. The 16-bit type EPROM is converted to 32-bit inside ASIC, U03. Therefore, a 32-bit access done by CPU triggers causes access two times.

The API EPROM should have the following specifications:

Socket No.	U14
Size	4 Mbits
Composition	256 k by 16 bits
Access speed	>120 ns

The following table shows the pin-to-signal assignments for the ROM to be used.

API ROM socket pin assignment

Pin No.	Terminal description	Signal name	Pin No.	Terminal description	Signal name
1	Vpp	VCC (fixed)	21	A0	FA0
2	CE*	FONTOEN3	22	A1	IOA2
3	D15	LD15	23	A2	IOA3
4	D14	LD14	24	A3	IOA4
5	D13	LD13	25	A4	IOA5
6	D12	LD12	26	A5	IOA6
7	D11	LD11	27	A6	IOA7
8	D10	LD10	28	A7	IOA8
9	D9	LD9	29	A8	IOA9
10	D8	LD8	30	GND	GND
11	GND	GND	31	A9	IOA10
12	D7	LD7	32	A10	IOA11
13	D6	LD6	33	A11	IOA12
14	D5	LD5	34	A12	IOA13
15	D4	LD4	35	A13	IOA14
16	D3	LD3	36	A14	IOA15
17	D2	LD2	37	A15	IOA16
18	D1	LD1	38	A16	IOA17
19	D0	LD0	39	A17	IOA18
20	OE*	GND (fixed)	40	VCC	VCC

* Negative logic

System DIMM (YS3)

This is the device that contains the firmware information for controlling the controller CPU. Depending on the firmware version, this device will be a flash ROM, that is rewritable, or a masked ROM, in 72-pin DIMM configuration.

RAM (U11 and U12)

Two 72-pin sockets are for two 16 Mb DRAMs in fast page mode for memory expansion. The standard RAM size is 4 MB and is expandable up to 68 MB using comprehensive PC SIMMs.

The expansion SIMM should meet the following requirements:

Number of sockets	2
Socket Nos.	YS1/YS2
Pins	72
Size	1/2/4/8/16/32 MB
Access speed	<80 ns

Memory card slot interface (YC4)

The controller accepts memory cards of flush type as well as SRAM type. The maximum storage capacity is 32 MB. The cards should conform to the PCMCIA (version 2.1) standards.

The interface can detect the level of the batteries and the write-protection status in the SRAM cards. For flush cards, it also can detect the write-protection status. Either a flash or SRM card should not be inserted or removed from the interface while the printer power is active.

Option interface (YC5)

The printer has an open socket for installing an optional interface card such as an Ethernet card or a Token Ring card. The option interface connector is a 80-pin, AMP 176372-3 type or equivalent.

The interface has a video interface that can receive video data of either 300 dpi or 600 dpi. Video data should be sent in synchronization with the video data transferring clock, EVCLK, which is issued by the controller gate array towards the video interface. Video data sent in synchronization with the clock is stored temporarily in the line buffer (SRAM) and subsequently transferred to the engine controller.

The pin assignment table is given below.

Pin No.	Terminal	Signal	Pin No.	Terminal	Signal
1	+5V	VCC	16	A16	IOA17
2	+5V	VCC	17	A15	IOA16
3	+5V	VCC	18	A14	IOA15
4	+5V	VCC	19	A13	IOA14
5	+5V	VCC	20	A12	IOA13
6	+5V	VCC	21	A11	IOA12
7	NC	NC (Not used)	22	A10	IOA11
8	NC	NC (Not used)	23	A9	IOA10
9	NC	NC (Not used)	24	A8	IOA9
10	NC	NC (Not used)	25	A7	IOA8
11	NC	NC (Reserved)	26	A6	IOA7
12	NC	NC (Reserved)	27	A5	IOA6
13	NC	NC (Reserved)	28	A4	IOA5
14	A18	IOA19	29	A3	IOA4
15	A17	IOA18	30	A2	IOA3

Option interface pin assignment - Continued

Pin No.	Terminal	Signal	Pin No.	Terminal	Signal
31	A1	IOA2	56	D10	LD10
32	NC	NC (Reserved)	57	D9	LD9
33	NC	NC (Reserved)	58	D8	LD8
34	OPIF*	OPICS*	59	D7	LD7
35	OPRDY*	OPRDY	60	D6	LD6
36	ID6	ID6	61	D5	LD5
37	ID5	ID5	62	D4	LD4
38	ID4	ID4	63	D3	LD3
39	ID3	ID3	64	D2	LD2
40	ID2	ID2	65	D1	LD1
41	ID1	ID1	66	D0	LD0
42	ID0	ID0	67	VDO%	EXTVDO
43	NC	NC (Reserved)	68	LSYNC*	ELSYNCN
44	NC	NC (Reserved)	69	VCLK	EVCLK
45	AS*	LASN	70	PRINT*%	EPRINTN
46	DS*	OP1DSN	71	VSREQ*	VSREQN
47	OPAC*	OP1ACKN	72	VSYNC*%	EVSYN CN
48	RW	LTRWN	73	RDY*%	ERDYN
49	OPIR*	OP1IR*	74	NC	NC (Reserved)
50	RESET*	RESETN3	75	GND	GND
51	D15	LD15	76	GND	GND
52	D14	LD14	77	GND	GND
53	D13	LD13	78	GND	GND
54	D12	LD12	79	GND	GND
55	D11	LD11	80	GND	GND

KUIO interface (YC6)

This is the interface for a slot-in option device conforming to the KUIO interface specifications. For model F-7000, this accepts an optional harddisk drive (HD-1).

The pin assignment for the connector is given below.

Pin No.	Terminal	Signal	Pin No.	Terminal	Signal
A1	VCC (+5V)	VCC	A16	CTLRDY	CTLRDY
B1	VCC (+5V)	VCC	B16	OP2DREQ	OP2DREQ
A2	VCC (+5V)	VCC	A17	GND	GND
B2	NC	NC	B17	OP2DACKN	OP2DACKN
A3	GND	GND	A18	IOR*	LIORN
B3	NC	NC	B18	IOW*	LIOWN
A4	NC	NC	A19	RESET*	RESETN3
B4	A16	IOA16	B19	NC	NC
A5	GND	GND	A20	D15	LD15
B5	A15	IOA15	B20	D14	LD14
A6	A14	IOA14	A21	GND	GND
B6	A13	IOA13	B21	D13	LD13
A7	A12	IOA12	A22	D12	LD12
B7	A11	IOA11	B22	D11	LD11
A8	A10	IOA10	A23	D10	LD10
B8	A9	IOA9	B23	D9	LD9
A9	GND	GND	A24	D8	LD8
B9	A8	IOA8	B24	D7	LD7
A10	A7	IOA7	A25	GND	GND
B19	A6	IOA6	B25	D6	LD6
A11	A5	IOA5	A26	D5	LD5
B11	A4	IOA4	B26	D4	LD4
A12	A3	IOA3	A27	D3	LD3
B12	A2	IOA2	B27	D2	LD2
A13	GND	GND	A28	D1	LD1
B13	NC	NC	B28	D0	LD0
A14	OP2CS	OP2CSN	A29	GND	GND

Pin No.	Terminal	Signal	Pin No.	Terminal	Signal
B14	OP2ACK	OP2ACKN	B29	VCC (+5V)	VCC
A15	OP2IRN	OP2IRN	A30	VCC (+5V)	VCC
B15	NC	NC	B30	VCC (+5V)	VCC

Parallel interface

The printer has a port for the parallel interface that is compatible with the current line-up of the Ecosys series printers. The parallel interface supports the protocols defined by the IEEE 1284 standards. To gain conformity to these standards, the printer supports the ECP and nibble modes.

Details on the signals on the parallel interface are described in the appropriate appendix in this manual.

Serial interface

The printer incorporates a port for the serial interface. The serial interface controller is included within the gate array and supports both the RS-232C and RS-422A protocols. Since the RS-232C support is designed to be compatible with SNMP (Simple Network Management Protocol), CTS and DSR signals are included. Switching to either mode is toggled by changing a jumper wire arrangement on the controller board. A 25-pin D-sub connector is used for the serial port. The RS-422A's extra signal lines are assigned to some of the vacant RS-232C terminals. (See *Appendix A* for the interface later in this manual for details.)

The serial interface has the following features:

Connector type	25-pin, D-sub
Baud rates/sec.	300/600/1200/2400/4800/9600/19200/38400/57600/115200
Protocol	RS-232C/RS-422A (switchable)

Engine interface

The interface to the engine system is based on the serial interface, not the parallel interface that was used with the previous line-up of the Ecosys printers. The serial-to-parallel conversion is executed on a hardware basis.

The engine board is detachable from the printer at its interface connector. The engine interface connector has the following pin assignments:

Engine interface connector assignment

Pin No.	Signal	Pin No.	Signal
1	GND	18	PPRDY
2	GND	19	CPRDY
3	GND	20	RST*
4	VIDEO	21	ESIGIR
5	GND	22	CINHN
6	NC	23	SBSYN
7	LSRENB	24	CBSYN
8	PRINT*	25	VCC
9	NC	26	VCC
10	PDN	27	VCC
11	VSYNCR*	28	VCC
12	VSREQ*	29	VCC
13	RDYN	30	SC
14	NC	31	GND
15	FPCLK	32	SCLK
16	FPPDIR	33	GND
17	FPPDATA	34	GND

* Means negative logic.

Engine interface signals

Signals used for the engine interface

The following signals are used for the engine interface communication. Figure on next page shows a simplified function diagram of the engine interface and the signals.

Signal	Meaning	Active	Definition
SBSYN	Status-BuSY-sigNal	Low	Determines which direction for the engine system to transfer the status data. If SBSYN is true, the controller is unable to transfer the command data towards the engine system. The controller can read in the status data transferred from the engine system by forwarding SCLK to the engine.
CBSYN	Command-BuSY-sigNal	Low	Determines which direction for the controller system to transfer the command data. If CBSYN is true, the controller can transfer the command data towards the engine system by forwarding SCLK to the engine system
S/C	Status-data/Command-data	-	This is a bi-directional serial datum containing the status data and command data as well as attributive information. The transfer data commences with LSB, then to MSB.
SCLK	Serial CLoCK	-	The width of the clock pulse is approx. 1 μ sec (960 ns). SCLK is the clock delivered by the controller and used to synchronize the status data and command data with each other.
CINHN	Command IN-Hibit sigNal	Low	This signal inhibits the signal transmission. If CINHN is low, the controller is not allowed to ready the transmission data. This inhibit is canceled when the engine controller reads in the reception data.