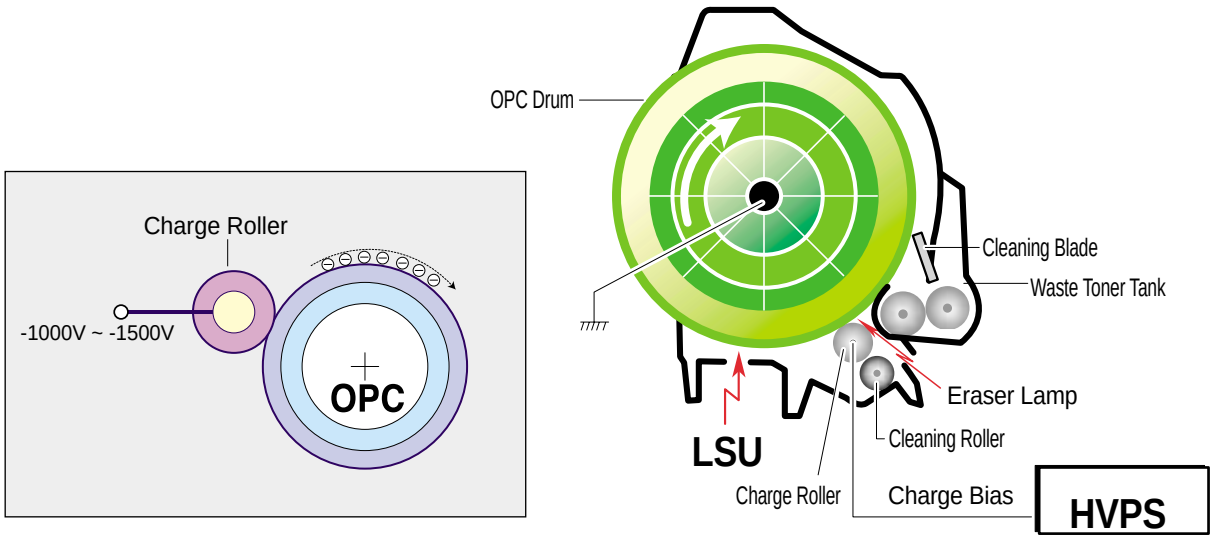
5 System Outline

This chapter describes the functions and operating principals of the main components.

5.1 CLP (Color Laser Printing) Process

5.1.1 OPC Drum Unit (Charge Section)

The OPC Unit is the image formation unit and it consists of the OPC drum, waster toner assembly, charge roller assembly, etc. (see diagram below).



1) Structure

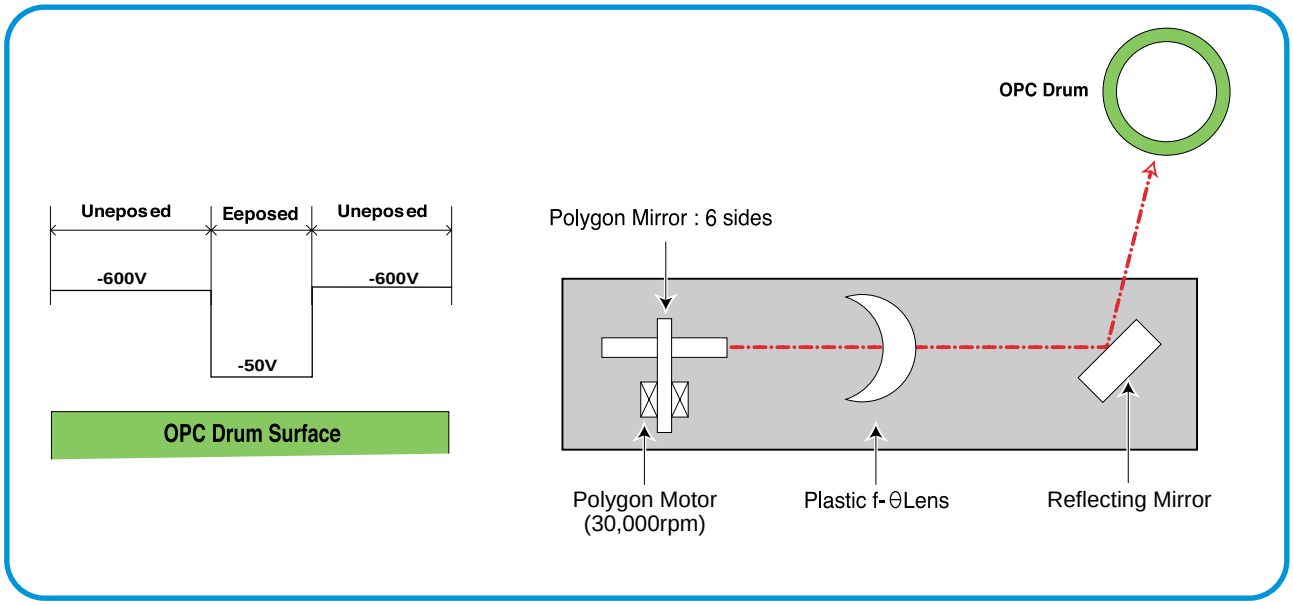
* OPC drum: The laser light coming from the LSU forms an latent electric image on the surface of the OPC drum.
* Cleaning Blade: Removes remaining unwanted toner from the OPC drum.
* Waste toner tank: Collects and stores the waste toner.
* Charge roller: The charge roller is charged to a negative high voltage (-1KV~1.5KV) It is in contact with the OPC drum and produces a uniform (-) voltage on its surface of approximately -500~-800V.

2) Type

* Life span: 50K Images (Color 12.5K)
* Waste toner removal: Transferred to a user replaceable tank
* Waste tank sensors: LED type, detects tank present and tank full
* OPC drum diameter: 120mm
* Power: Main motor (BLDC)
* Charging method: Charge roller
* Eraser method: LED lamp (+5V/2Pin)
* PTL: LED lamp (+5V/2Pin)

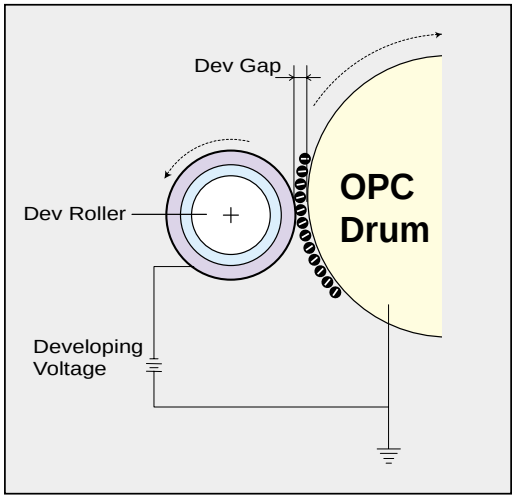
5.1.2 LSU (Exposure)

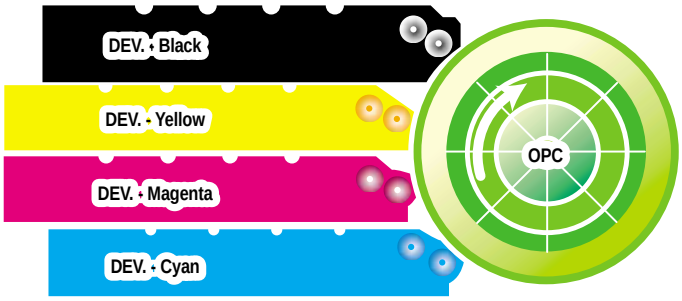
The bitmap image data stream is used to switch the LSU data beam. Where white paper is required the beam is off, where ink is required the beam is turned on. When the laser is on and the beam strikes the OPC drum surface the charge is reduced to -50V, where the beam is switched off the charge on the OPC surface remains at -600V. In consequence a latent image is formed on the drum surface.



5.1.3 Toner Cartridge (Development Section)

In the development stage toner particles are transferred from the toner cartridge onto the surface of the OPC drum. The OPC drum and the developer roller rotate in opposite directions. Toner on the developer roller is charged to the developing voltage (see page 5-7). Toner is attracted to the OPC drum in those areas where the OPC drum surface charge is -50V. Toner is not attracted to those areas of the surface carrying a -600V charge.





1) Type

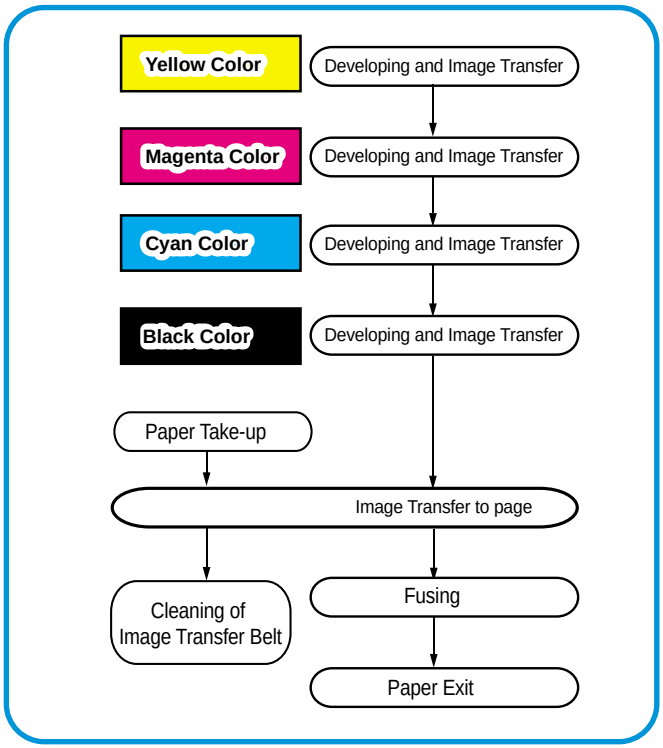
* Developing method: Non-magnetic, Mono-component developing system.
* Toner cartridge order: K, Y, M, C from top.
* Developing sequence: Y, M, C, K
* Life span: 7K(K) / 5K(C, M, Y)
* Power: DEVE motor (BLDC)
* Power transmission: Electric clutch
* Toner remaining: TRC sensor (see page 5-7) + Dot counting method

2) Developing state of color

The page image is built up from each of the 4 colors and transferred to the paper as described below.

> Developing sequence: Y, M, C, and K

1) A latent image containing only yellow toner is created on the OPC drum and then transferred onto the ITB.
2) A latent image containing only magenta toner is created on the OPC drum and then transferred onto the ITB to add to the yellow image already in the ITB.
3) A latent image containing only cyan toner is created on the OPC drum and then transferred onto the ITB, adding to the 2 colors already present on the ITB
4) A latent image containing only black toner is created on the OPC drum and then transferred onto the ITB, creating an image on the ITB consisting of the 4 colors.
5) The Image on the ITB is secondly transferred onto paper using the T2 transfer roller.
6) The image on the page is then fused and the paper is ejected into the output tray.



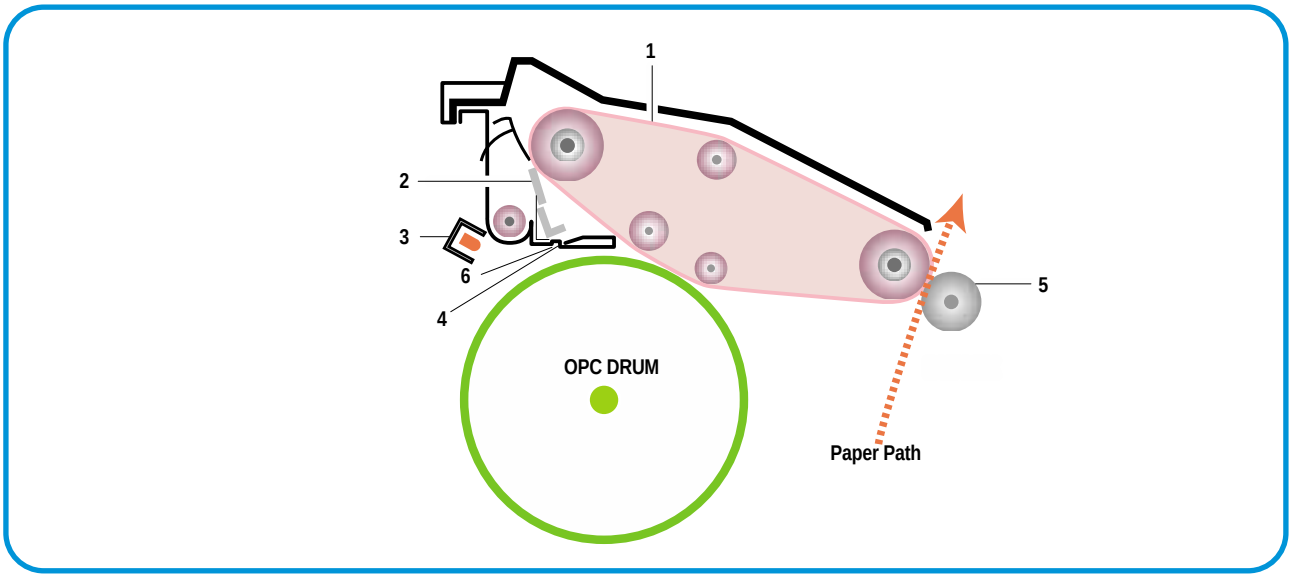
3) Toner cartridge empty detection

Software Dot count, Roller count + TRC Sensor

5.1.4 Image Transfer Section

The toner image formed on the OPC drum is transferred to the ITB (Image Transfer Belt), this is called the primary image transfer. When the final image has been built on the ITB it is transferred onto paper, this is called the secondary image transfer.

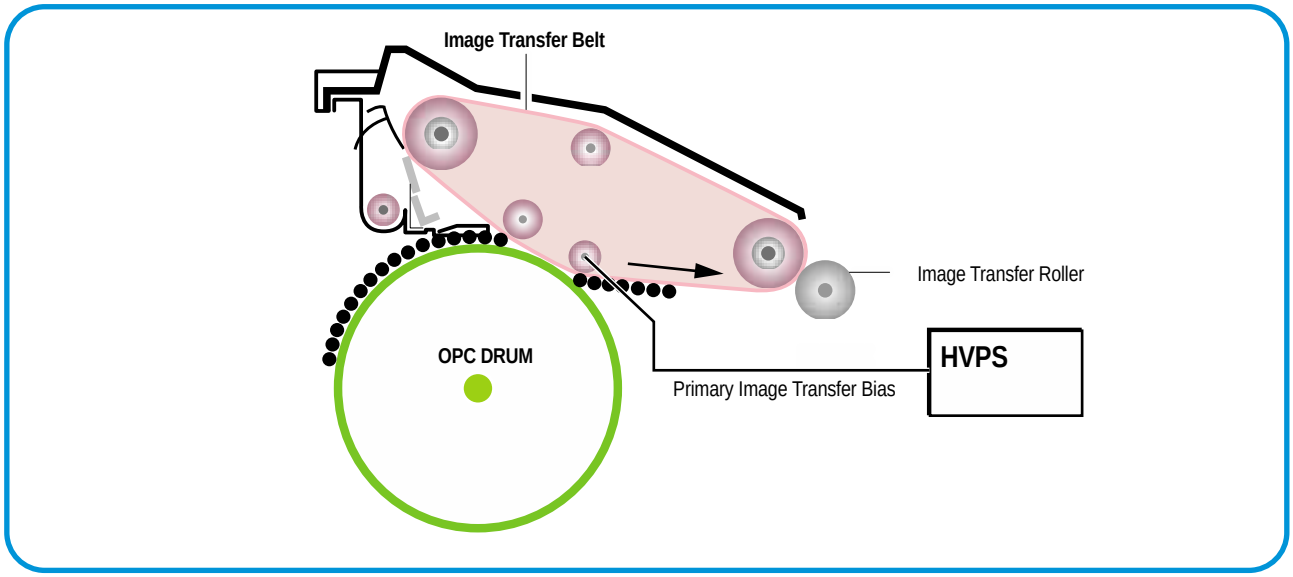
1) Structure



NO.	Name	Description
1.	Image Transfer Belt	Used to build up the 4 color image from the OPC drum. Colors are transferred in the order Y, M, C, K
2.	Image Transfer Belt cleaner	After the final image is transferred onto paper any waste toner is removed from the transfer belt using this cleaning blade
3.	PTL (Pre-Transfer Lamp)	Reduce the electric potential of OPC Drum surface before primary image transfer the image on the OPC Drum.
4.	CTD (Color Toner Density) sensor	This sensor is used by the engine to monitor the density of toner deposited on the OPC drum. It is also used as an indication of 'Toner Empty'
5.	Image Transfer Roller (T2 Roller)	This transfers the final toner image on the image transfer belt to paper.
6.	ITB Home Sensor	This sensor is used to ensure that each of the 4 color images starts at exactly the same point on the ITB. It works by detecting a fixed point on the belt.

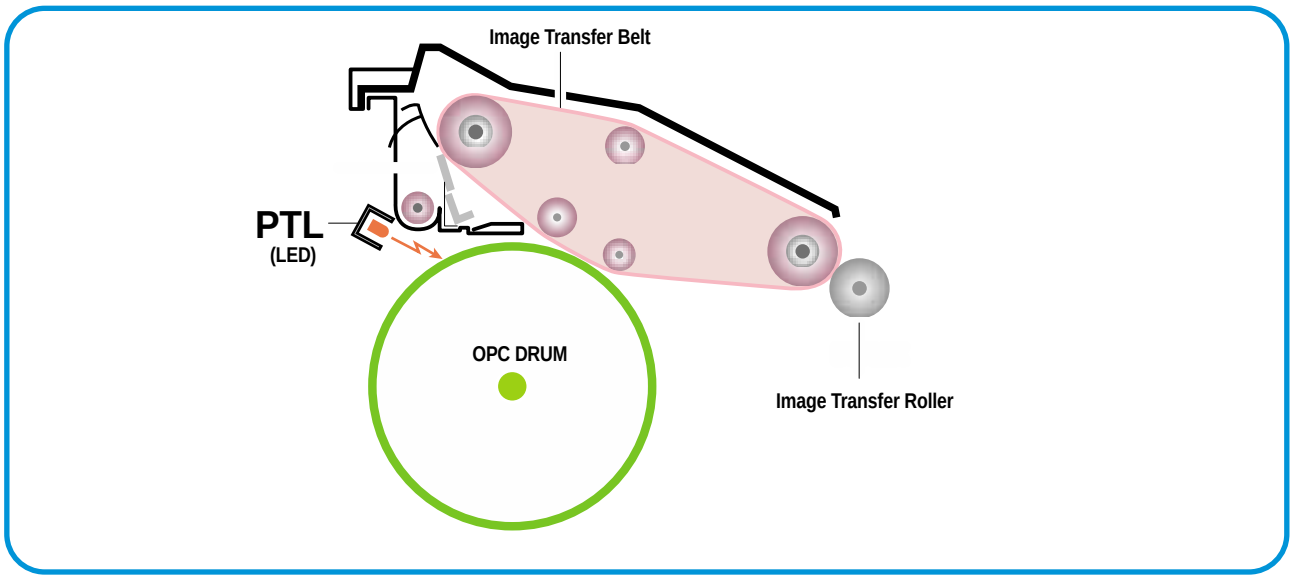
2) Primary Image Transfer

A colored page is split into 4 component color parts and developed one color at a time in turn on the OPC (in the order Y, M, C, K). The final image is built up on the ITB by transferring these separate color images from the OPC drum.



3) PTL (Pre-Transfer Lamp)

It is arrayed LED on PCB Board. Main function is improving the T1 utility factor by reducing the adhesive strength of OPC and Toner by irradiation on the OPC Drum formatted the image.



4) CTD (Color Toner Density) Sensor

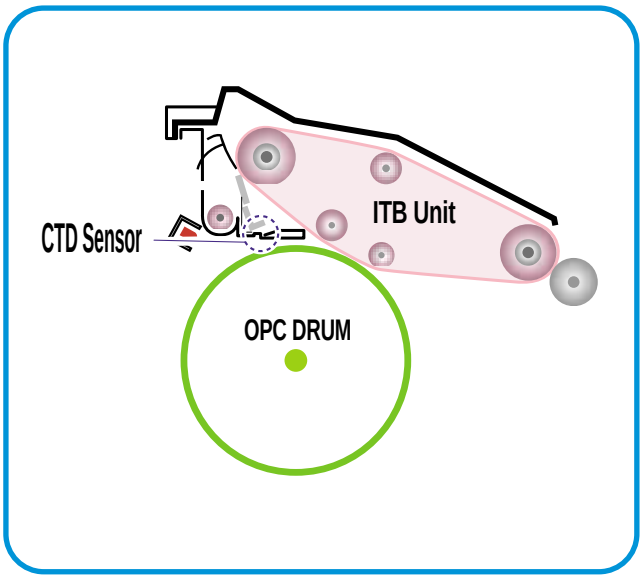
The CTD sensor detects density of toner of each of the 4 colors formed on OPC drum, and Main controller decides an optimum developer bias voltage value for printing.

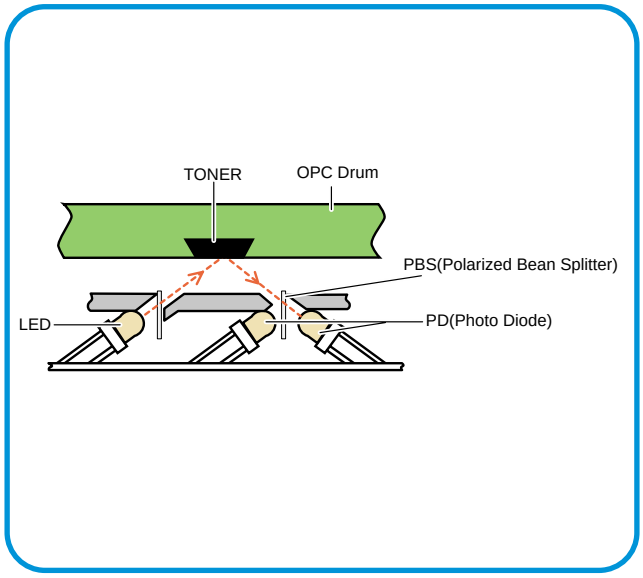
*** Structure:** An Infrared LED is used as a sending unit and PDs (Photo Diodes) are used as a receiving unit. A PBS (Polarized Beam Splitter) is used to separate transmitted light from the LED and reflected light from the OPC / toner surface.

*** Principal:** The OPC surface and toner have different light reflecting characteristics. The OPC surface produces a specular reflection whilst the toner produces a scattered reflection. By detecting this difference the amount of toner present on the OPC surface can be measured by the sensor.

*** Caution:** Be careful not to contaminate the surface of the CTD sensor, as this will cause problems with color reproduction and quality.

*** Process:** The TRC (Tone Reproduction Curve) control process is used at power on, after waking from sleep mode , after every 100 pages of printing, and after fitting a new toner cartridge or OPC drum to check the toner density transferred onto the OPC. Small patches of 6.25%, 25%, 37.5%, 50%, 62.5%, 75%, 87.5%, and 100% density for each of the 4 colors are deposited on the OPC drum surface and the CTD is used to detect how much toner is transferred. Based on an internal calibration curve the TCR control process adjusts the developer bias voltage to ensure that optimal toner transfer takes place.





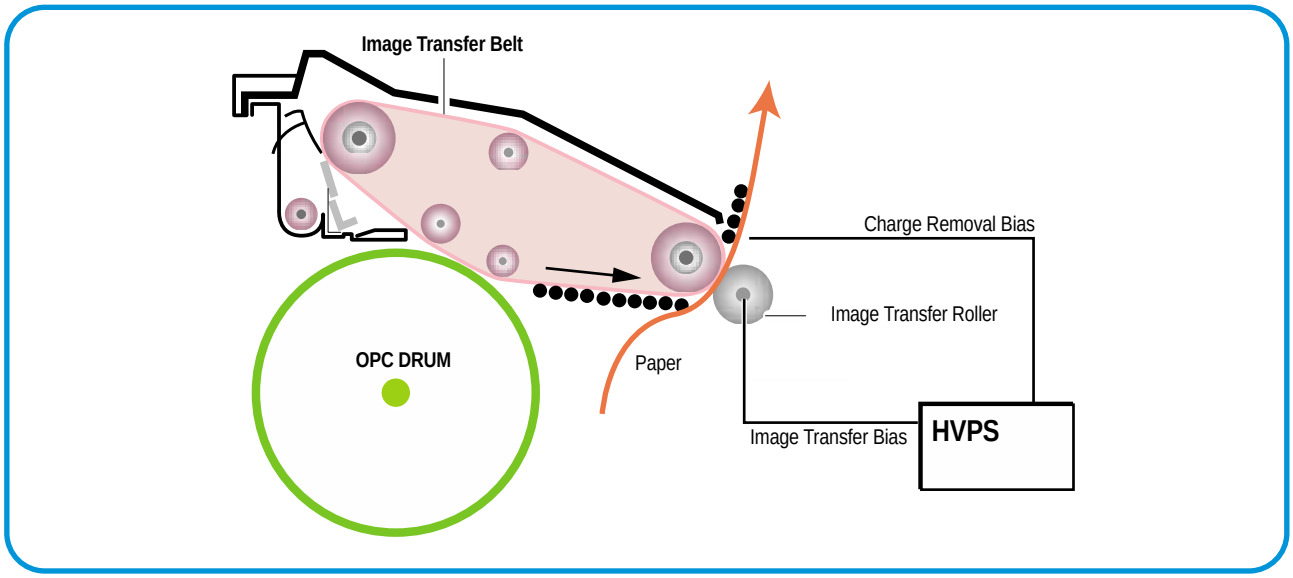
5) Secondary Image Transfer

The image is built up on the ITB (primary image transfer). This image is then transferred onto paper using the T2 transfer roller (roller transfer system) this process is known as the secondary image transfer.

* The HVPS applies the Image Transfer Bias voltage to the Image Transfer Roller (T2), this transfers the image from the belt onto the paper.
* When the image is to be transferred from the ITB to the paper the image transfer roller pressure contact solenoid is activated and this activates a cam which moves the T2 roller into contact with the belt.
*After the transfer has taken place any remaining charge on the paper is removed by applying a charge removal bias (generated in the HVPS) to a charge removal plate

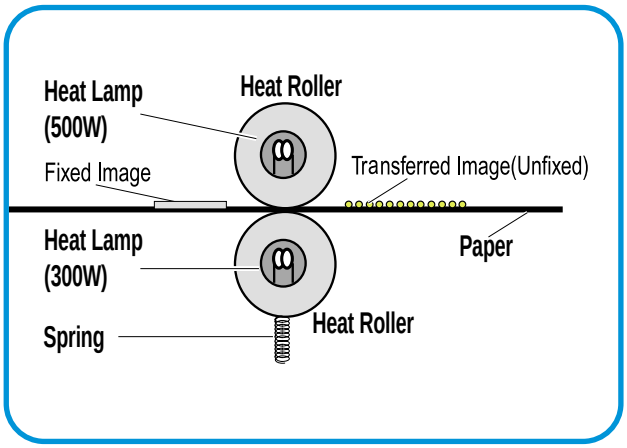
>Type

* Transfer method: Semi-conductive roller contact method
* Effective transferring range: 218mm (i.e. maximum image length)



5.1.5 Fuser (Fusing Section)

Toner that has been through the primary and secondary image transfer processes is fixed, semi-permanently, to the paper.
The fuser unit consists of heat lamps (2 ea), heat rollers (2 ea), thermistor, and thermostats (2 ea). It melts the toner onto the paper using pressure and high temperature to complete the printing process.



1) Thermostat (2pieces)

If the heat lamps or heat rollers overheat the thermostat turns off power to the lamps in the fuser unit to prevent fire. It is a temperature cut-off device.

2) Thermistor

The thermistor detects the temperature of the heat roller's surface, and feedbacks the information to the main processor which uses this information to control power to the fuser lamps in order to maintain the heat roller at a steady temperature.

3) Heat Roller (2pieces)

Halogen lamps are used to heat the heat rollers. The heat rollers have a special Teflon surface which ensures that any melted toner which comes into contact with the heat roller surface does not stick. Paper passes between the two rollers which evenly heat the paper from both sides to melt the toner and semi-permanently fix it to the paper.

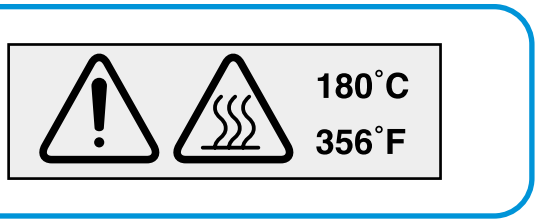
4) Safety Information

> Overheat protection

* 1st level protection: Print engine is stopped if overheat is detected
* 2nd level protection: Software turns off lamp power if overheat is detected.
* 3rd level protection: Thermostat turns off lamp power if overheat is detected.

> Protecting device

* Fuser unit power is turned off when the duplex cover or the toner cartridge door is open.
* This machine keeps the surface temperature of the fuser unit cover under 80°C, and it has a caution label attached inside the exit cover where it can be easily seen by the user.



5.1.6 Exit

After passing through the fuser paper is ejected into the paper exit tray. Any static electrical charge is removed by static discharge brushes.
When operating in duplex print mode, after printing the front side of the page, the paper exit roller reverses to feed the paper back into the machine in order to print the second side of the page.

5.1.7 Waste Toner Collection Process

Waste toner on the OPC drum and on the image transfer belt is collected into the waste toner tank.

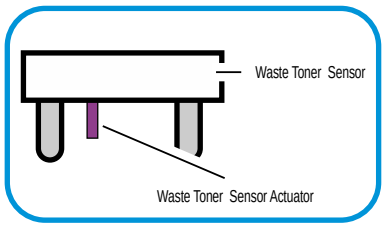
* After transferring the toner image on the OPC drum to the ITB, a cleaning blade scrapes waste toner from the OPC drum, and the waste toner is collected into a waste toner tank.
* An Image Transfer Belt cleaner scrapes waste toner from the image transfer belt, and the waste toner is collected into a waste toner tank.

1) Waste toner tank sensor

A waste toner sensor detects the presence of the waste toner tank and also detects if the tank is full. This is an On / Off detection. Do not operate the printer without a waste toner tank.

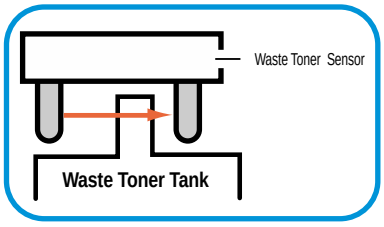
> No waste toner tank

When the waste toner tank is not installed the waste toner senor actuator blocks light from the senor LED.



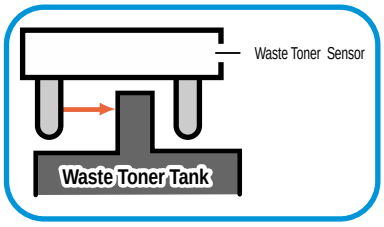
> A little waste toner

When the sensor LED light reaches the photo sensor passing through the waste toner tank this indicates that the tank is not full.



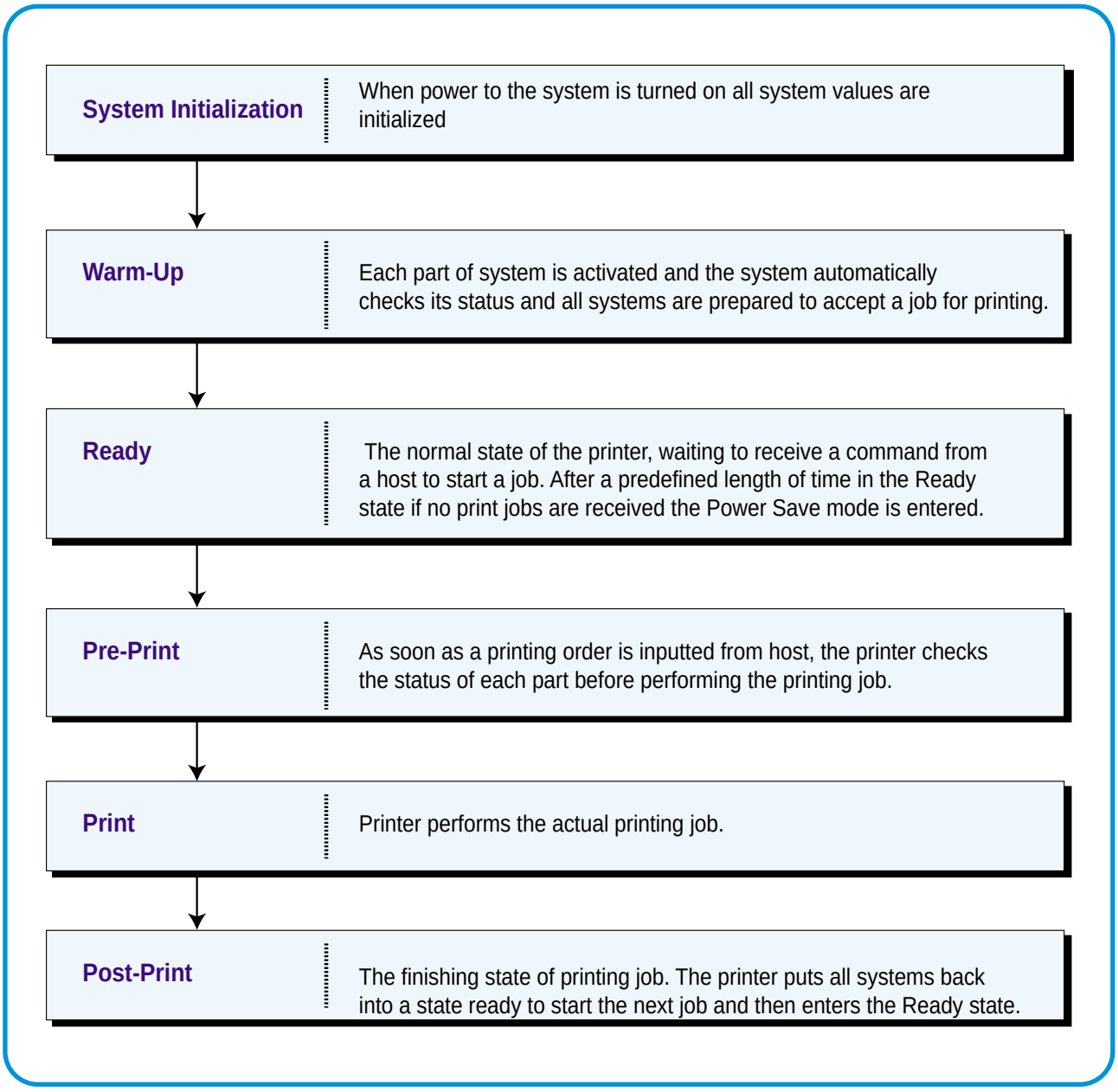
> Waste toner tank full

When the waste toner tank is full to the level of the waste toner sensor, the senor LED light is blocked by waste toner indicating that the tank is full.



5.2 Outline of Engine Firmware

The CLP 500/500N use 4 different colored toners (Yellow, Magenta, Cyan, Black) and it is a laser color printer. Engine firmware controls the print processes, driving the print engine, paper feed, developer, fuser, and paper discharge systems. It has both color and mono printing modes. The printer process sequence is as follows:



5.2.1 System Initialization

The system initialization process is carried out immediately after power on. The following tasks are performed.

1) Initialize ASIC (EPLD)
2) Initialize system variables
3) Initialize a virtual timer
4) Initialize fuser control
5) Initialize ADC
6) Set-up ITB HOME interrupt

5.2.2 Warm-Up

In the warm-up stage, the following tasks are performed.

1) Self Test

* System error check
* Cover open check
* Device (ITB, OPC, DEVE cartridge) check
* Heating error check
* Motion of motor and jam & paper empty check
* Check Feed and exit sensors. If paper is detected it is ejected. If the paper detection does not clear a jam recovery is carried out and the paper drive unit is instructed to drive for the maximum permitted paper length.

2) Heat Control

The heater control unit separately manages the temperature of the heat lamps.

* Target temperature (165°C)
* Temperature below 130°C - heat unit fully on,
* Temperature above 135°C temperature is controlled by reading the temperature value every 10msec.

3) TRC (Toner Reproduction Curve)

The TRC process (see page 5-7) is carried out and the developer bias voltage determined.

4) Cleaning

Transfer rollers, OPC and ITB are electrically and mechanically cleaned.

5.2.3 Ready

1) Host interface is monitored for print commands
2) Heat control
* Target temperature (165°C)
* Every 40 seconds, temperature value for the previous 250ms is read and a proportional control process is carried out

3) This is the standby mode entered after warm-up or after completing a print job.
4) System Error check
5) Power save state is entered after timeout

> Wakeup condition
* When a "wakeup" order is received
* When a cover is opened and then closed
* When the level of the paper empty sensor changes.

> Heat lamp is off

5.2.4 Pre-Print

This is the preparation stage before processing a printing job and after receiving a print command from a host.

1) Start LSU
* Run Scanning motor
* Check motor ready
* Turn LD on

2) Start BLDC motor, Eraser/PTL on
* Run main motor
* Check lock signal
* Run developer roll motor
* Check lock signal

3)Turn High Voltage On
* Charger on
* Developer high voltage off

4) Cleaning
* OPC cleaning (Mechanical motion)
* ITB cleaning

5) Jam check
6) Motor Unlock Check
7) Check and Set a High Voltage Condition (T1, T2, Charger)
8) Initialize Printing Parameters
* Paper size, copies, cassette ...
* Image pixels, image times, y-offset, x-offset
* Flags

9) Check Print mode
* Color print mode:
  - Except legal & OHP/Legal/OHP
  - Simplex/Duplex
* Mono pint mode: Simplex/Duplex/OHP

5.2.5 Print

After sensing the ITB home position the following tasks are performed,

Send Psync signal to controller -> Operates virtual timer for each color(Vdata) -> Forms latent image on OPC drum -> Supplies toner on OPC drum -> Transfers image to ITB (T1) -> Pickups a paper -> Transfers image to a paper (T2)

1)Check ITB Home (Treated by Home interrupt): It is designed to detect ITB HOME every 3 seconds.

a) ITB Home sensing
b) If a test mode is set up, a test pattern is printed.
c) A counter value is set up that addresses the timing to turn on page sync.
d) The virtual timer for each color (Y, M, C, and K) is set up
e) If Home is not detected every 3 seconds, an error is reported.

2)Paper path and print

a) Printing paper from cassette, MPT and SCT is picked up
b) Control paper path
 * Stop when the leading edge of a piece of paper reaches the feed sensor.
 * If the leading edge doesn't reach the feed sensor, it is an error.
 * While transferring the last color to the ITB, re-feed the paper.
 * Checks if the paper reaches the exit sensor in certain time. If it reaches too soon, or it doesn't reach, it is an error.
 * Checks that the paper passes the exit sensor or not.
c) Jam check
 * Check reaching time and passing time for the paper reaching and passing the feed and exit sensors. If time exceeds a certain time, it is an error.
d) Duplex control
 * After passing the exit sensor, the duplex clutch is operated to mechanically change the direction of the paper flow in order to print the other side.
e) Printing sequence and motion for each color
 * Use a virtual timer for printing the colors in sequence. (Yellow, Magenta, Cyan, Black)

> What is a Virtual Timer?

A virtual timer is a mathematical function for creating regular action at fixed time intervals. The standard setting is for a 5msc timer interrupt.

5.2.6 Post-Print

This is the last stage of the printing process. Its functions are described below.

a) Clean transfer rollers
b) Stop all virtual timers
c) Initialize parameters used in the printing process.
d) Stop motors