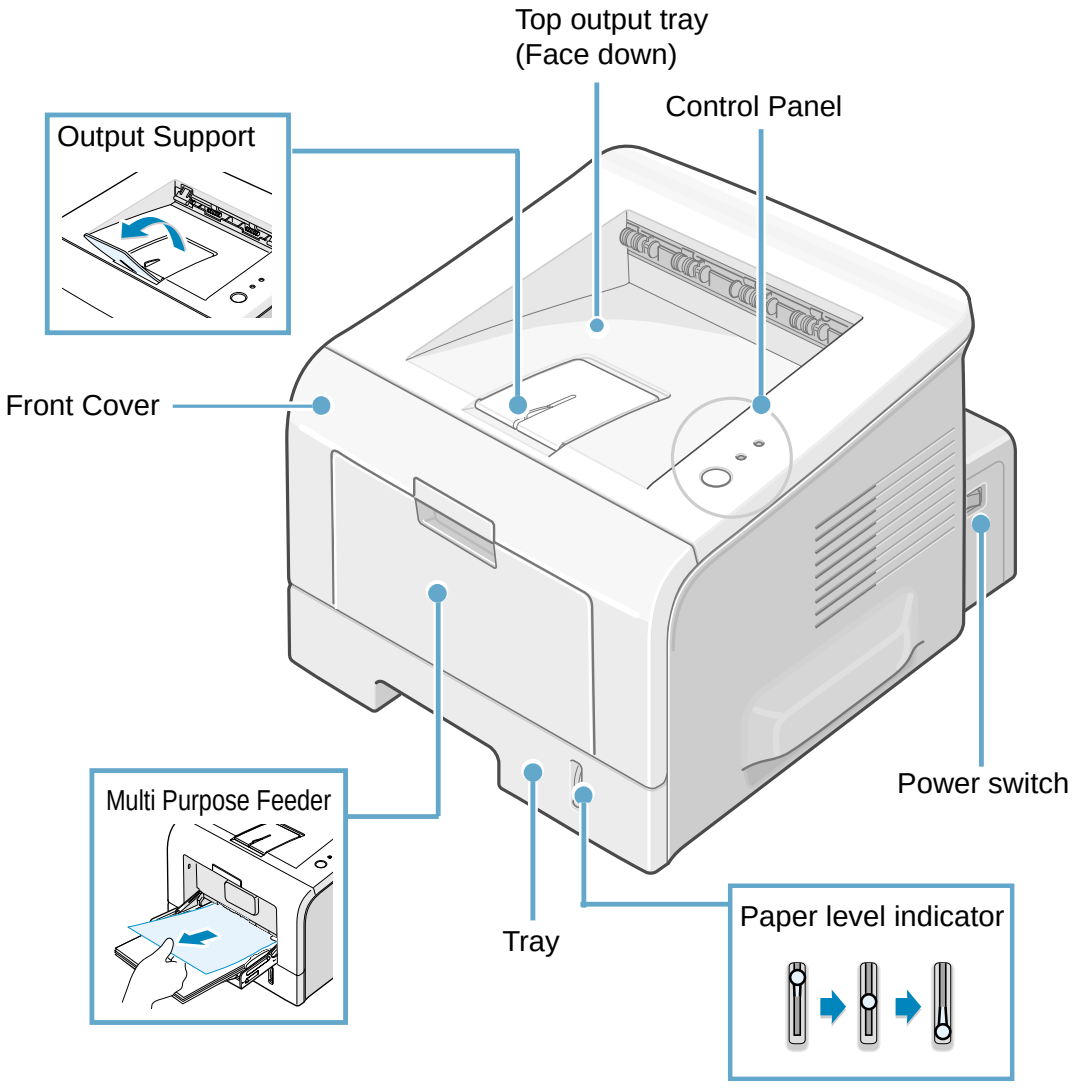
4. Summary of Product

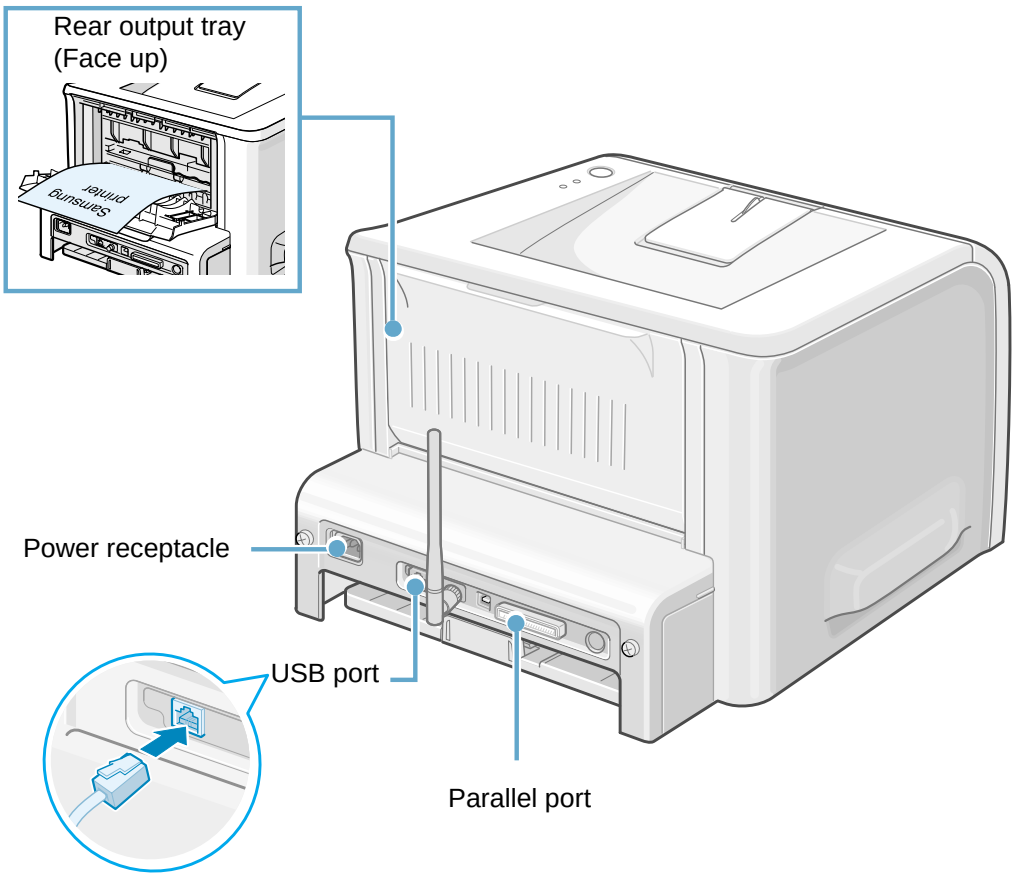
This chapter describes the functions and operating principals of the main components.

4.1 Printer Components

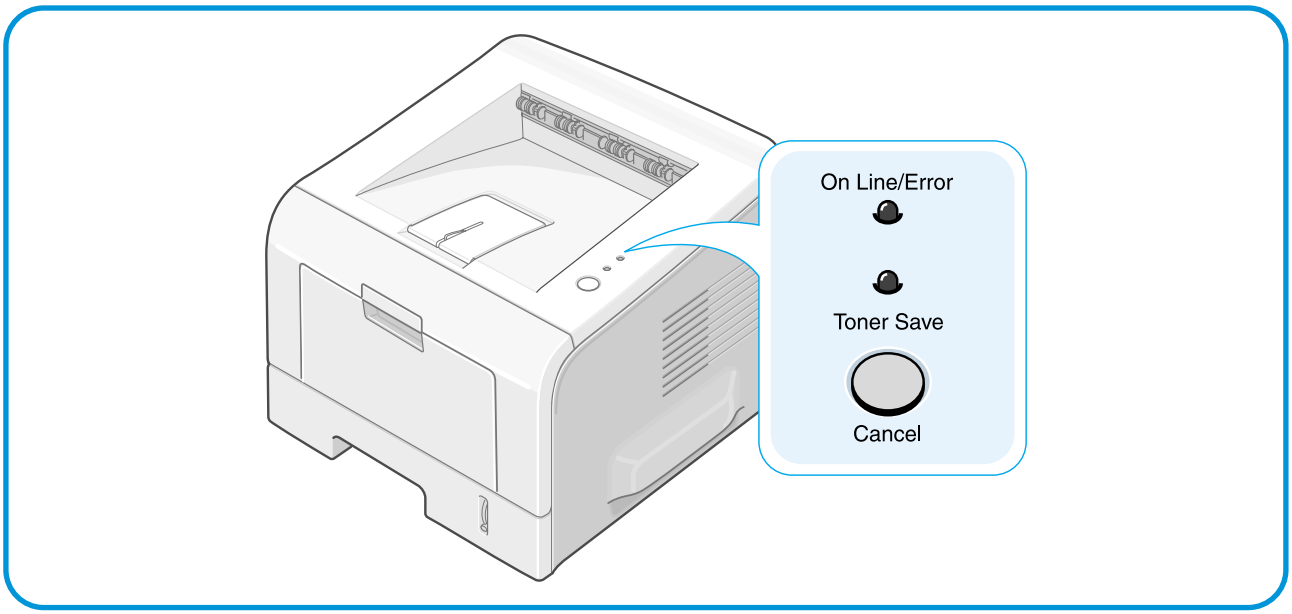
4.1.1 Front View



4.1.2 Rear View



4.1.3 Control Panel



1) On Line/Error and Toner Save LEDs

LED	Description
On Line/Error	If the On Line/Error light is green the printer is ready to print.
	If the On Line/Error light is red the printer is experiencing an error such as jammed paper, cover open or empty toner cartridge.
	If you press the Cancel button while the printer is receiving data the On Line/Error LED blinks red to cancel printing.
	In Manual Feed mode if there is no paper in the Manual Feeder the On Line/Error LED blinks red. Load paper into the Manual Feeder and the LED stops blinking.
	If the printer is receiving data, the On Line/Error LED slowly blinks green. If the printer is printing the received data, the On Line/Error LED blinks green quickly.
Toner Save	If you press the Cancel button in Ready mode this LED is on and the Toner Save mode is enabled. If you press this button once again this LED is off and the Toner Save mode is disabled.
On Line/Error Toner Save	If the On Line/Error and Toner Save LEDs blink at the same time your system has experienced an internal problems. Refer to Section 6.6

2) Cancel button

Printing demo page	In Ready mode press and hold this button for about 2 seconds until all LEDs blink slowly and release.
Printing configuration sheet	In Ready mode press and hold this button for about 6 seconds until all LEDs blink quickly and release.
Cleaning inside printer	In Ready mode press and hold this button for about 10 seconds until all LEDs turn on and release. After cleaning the printer one cleaning sheet is printed.
Canceling print job	Press this button during printing. The On Line/Error LED blinks while the print job is cleared from both the printer and the computer and then return to Ready mode. This may take some time depending on the size of the print job. In Manual Feed mode it is not possible to cancel the print job by pressing this button.
Toner Save mode on/off	In Ready mode, press this button to turn the Toner Save mode on or off.

4.2 System Construction

4.2.1 Summary

The ML2250 consists of the following main functional components

1) The Firmware
This controls the whole printing process

2) The Print Engine consisting of

a) Engine frame

b) Paper feed mechanism
The paper mechanism cosists of a 250sheet main cassette, multi-purpose paper tray, pickup rollers, friction pads and feed rollers. Together with sensors in the feed path these serve to control paper registration and guide the paper through the Image transfer, image development, image fusing and exit assemblies. The paper path has an anti-static connection to earth to eliminate paper feed problems due to static charge on the paper.

c) Main drive mechanism
The main drive is a Bi-polar 2 phase motor. It drives the OPC, Paper Pick-up and paper feed rollers using a gear train mechanism

d) Image development unit
Using a Laser Scanning Unit (LSU) this section of the mechanism creates the image on the OPC drum (part of the integrated toner cartridge).

e) Image transfer unit
The function of the this unit uses High Voltages supplied by the HVPS to move the image from the developer unit onto paper.

f) Image fusing unit
The function of this unit is to permanently fix the toner image onto the paper. This is achieved usibg a temperature controlled heating unit (the fuser).

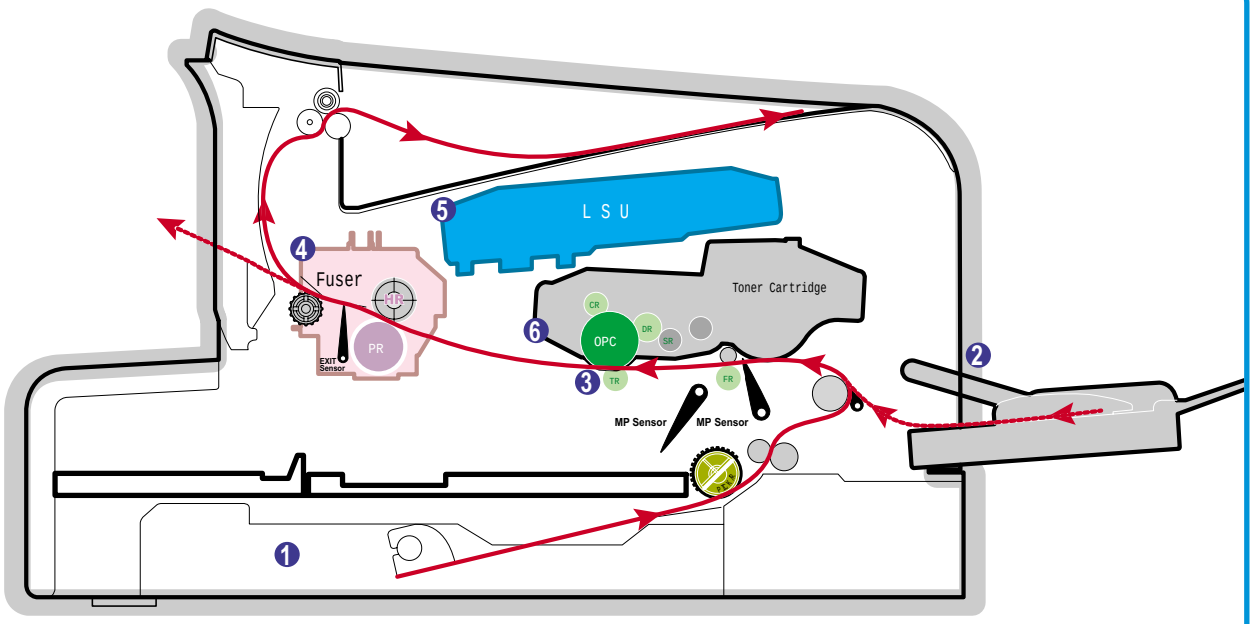
g) Electronics PBA including

i) Main control board consisting of
(1) Main processor Asic (166MHz SPGPm)
(2) Memory parts (Flash Rom containing the control program and DRAM for working memory)
(3) Engine interface parts (motor control, fuser control, HVPS control, sensors etc)
(4) PC Interface (USB , Parallel, Network – wired and wireless)
(5) Bus, DMA and I/O handling

ii) Operators panel

iii) PC Interface

4.2.2 System Layout



1. Cassette
2. Manual Feeder
3. Transfer Roller
4. Fuser
5. LSU(Laser Scan Unit)
6. Toner Cartridge

4.2.3 Paper Feed

This consists of the standard cassette, an optional cassette, an MP tray for supplying different types of media (envelopes, labels, special paper) and other parts related to the movement of paper through the printer.

1) Paper separation method
Individual sheets are separated in the cassette using the 'friction pad' method. When paper feeds into the machine it passes over a spring loaded friction pad that separates the sheets of paper.

2) Paper cassette
The paper cassette uses a 'centre loading' method There are no paper size sensors. Instead a software process is used to detect the size of the first sheet of paper as it is fed through the machine. Both the rear and side paper guides are adjustable to cater for various paper sizes.
There is a 'Paper Empty' sensor which detects the presence of paper (Capacity: 250 sheets).
There is an indicator flag on the front of the cassette which indicates the amount of paper remaining.

3) Pick-up roller
The pickup roller is used to pick-up and feed paper into the printer. It also is used to remove any static charge on the paper.

4) MP tray
The Multi-purpose tray is used to hold non-standard paper sizes and special media (envelopes, transparencies etc.). There is an MP paper empty sensor. It uses a friction pad method to ensure paper separation and can hold a maximum of 50 sheets of paper or envelopes.

5) SCF (Second Cassette Feeder)
The optional second cassette unit is identical to the main cassette and has a capacity of 250 sheets.

4.2.4 Transfer Ass'y

Toner is transferred from the OPC drum onto the paper using a PTL (Pre-transfer Lamp) and a transfer roller. The PTL shines light onto the OPC, this reduces the electrical charge on the surface of the OPC surface and improves the efficiency of the transfer.
The transfer roller transfers toner from the OPC drum to the paper.
Life span: Print over 60,000 sheets (at 15~30ºC)

4.2.5 Driver Ass'y

Power is provided to the paper drive assembly under the control of the main PWA. The main motor powers the paper feed, toner cartridge, fuser unit and all pick-up, feed and exit rollers.

4.2.6 Fuser

There are two methods of fusing toner onto the paper: the existing heat lamp process and the Q-PID process developed by Samsung. ML2250 export models, both 110V and 220V, use the heat lamp process.

This consists of a heat lamp, heat roller, pressure roller, thermistor and thermostat. By use of heat and pressure toner is caused to melt and adhere to the paper surface in order to complete the printing process.

4.2.6.1 Thermistor and Thermostat

The thermistor is used to detect the temperature of the heating unit and feeds this information into the main processor
If the heat lamp becomes too hot the Thermostat cuts off the power to the lamp in order to prevent over-heating and any potential fire hazard is removed.

4.2.6.2 Heat roller

The heat roller transfers the heat from the heat lamp to the paper. The surface of the heat roller is coated with Teflon so that toner does not stick to the surface.

4.2.6.3 Pressure roller

A pressure roller mounted under the heat roller is made of a silicon resin and the surface is also coated with Teflon. When a paper passes between the heat roller and the pressure roller the toner powder is meted and adheres to the surface of the paper permanently.

4.2.6.4 Safety features

To prevent overheating
- 1st protection device: Hardware cuts off when overheated
- 2nd protection device: Software cuts off when overheated
- 3rd protection device: Thermostat cuts off mains power to the lamp.

Safety device
- Fuser power is cut off when the front cover is opened
- LSU power is cut off when the front cover is opened
- The temperature of the fuser cover's surface is maintained at less than 80ºC to protect the user and a caution label is attached where the customer can see it easily when the rear cover is opened.

4.2.7 LSU (Laser Scanner Unit)

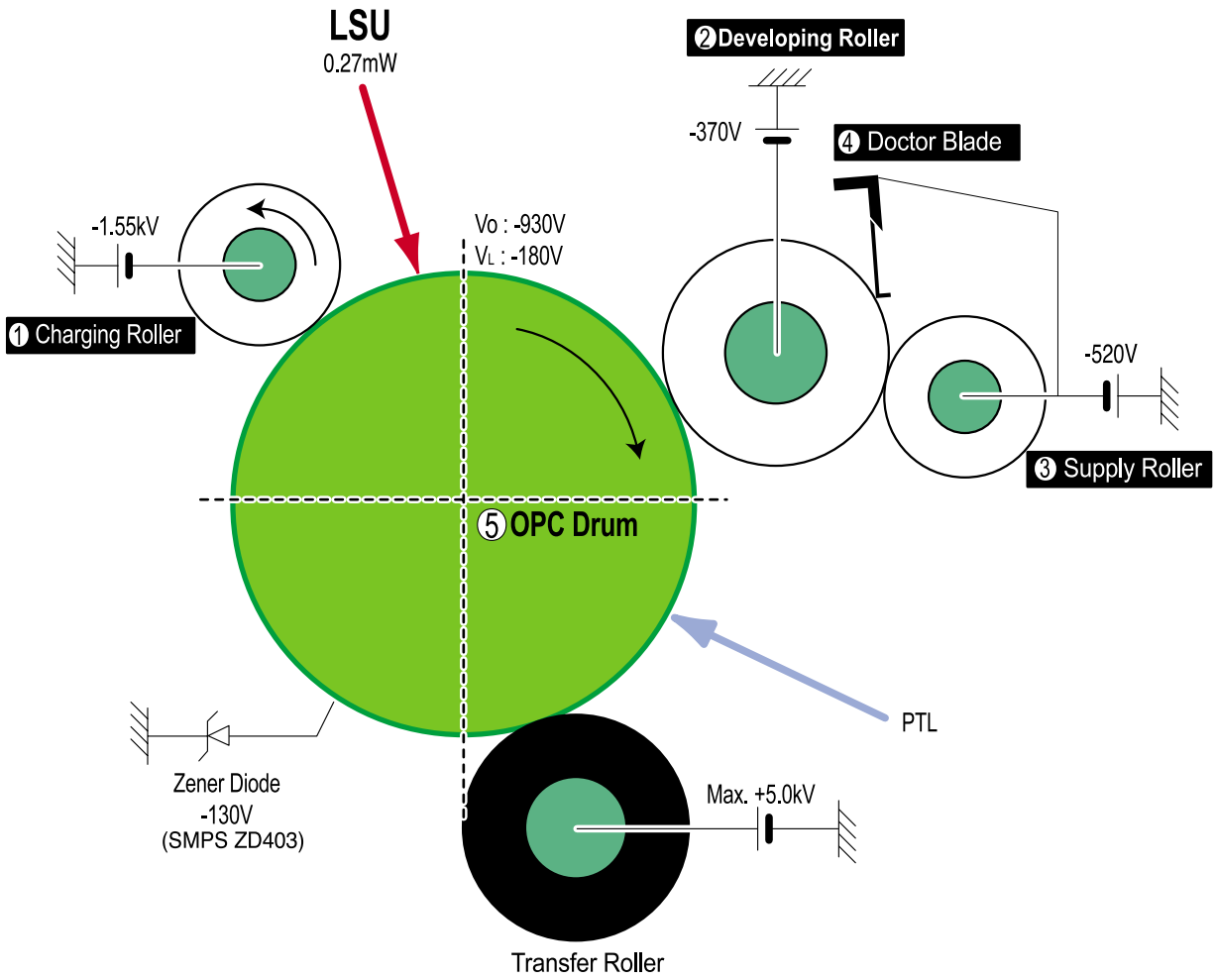
This is the core of the laser printer. It converts the video data received from the computer into an electrostatic latent image on the surface of the OPC drum. This is achieved by controlling the laser beam and exposing the surface of the OPC drum to the laser light. A rotating polygon mirror reflects the laser light onto the OPC and each side of the mirror is one scan line. The OPC drum turns as the paper feeds to scan the image down the page.

The /HSYNC signal is created when the laser beam from LSU reaches the end of the polygon mirror and this signal is sent to the controller. The controller detects the /HSYNC signal to adjust the vertical line of the image on paper. In other words after the /HSYNC signal is detected the image data is sent to the LSU to adjust the left margin on the paper.

4.2.8 Toner Cartridge

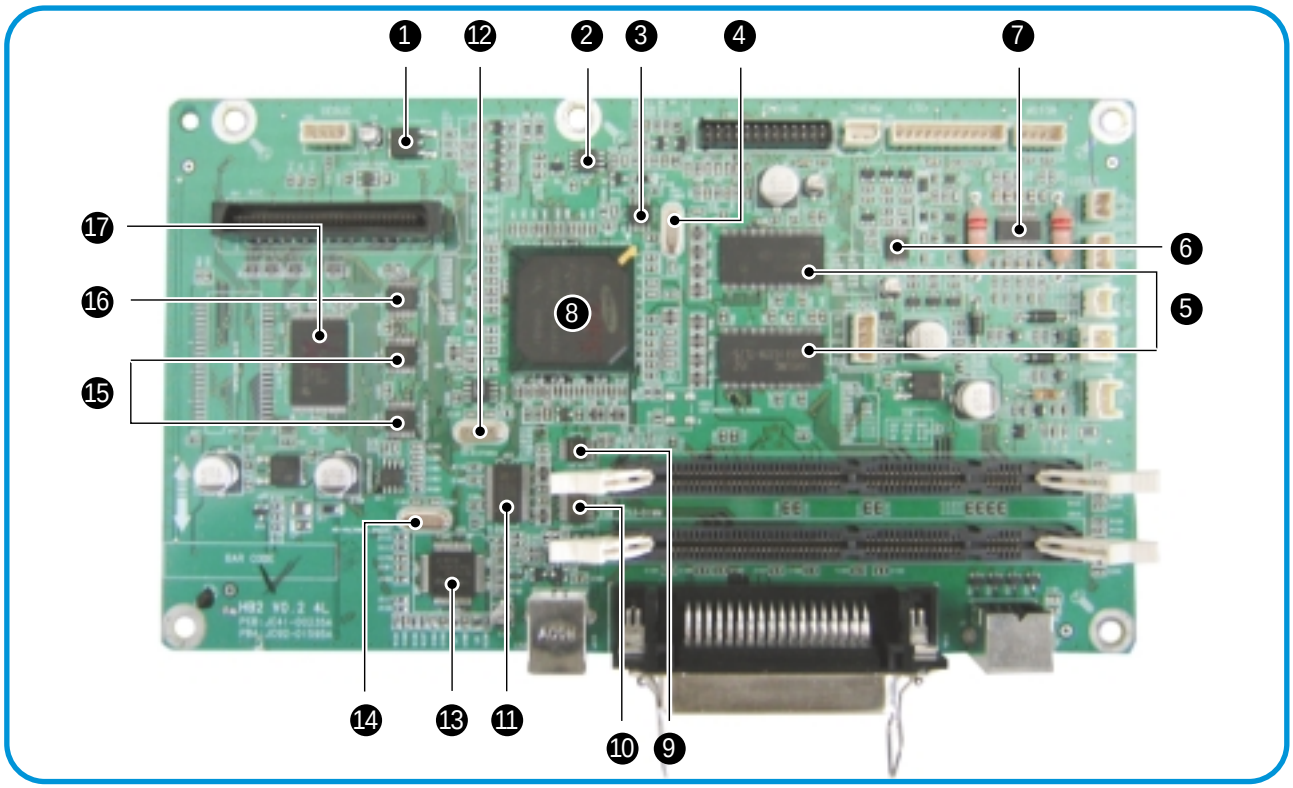
The toner cartridge is an integral unit containing the OPC unit and toner unit. The OPC unit consists of the OPC drum and charging roller, and the toner cartridge unit consists of the toner, supply roller, developing roller, and blade (Doctor blade)

- Developing Method: Non magnetic 1 element contacting method
- Toner: Non magnetic 1 element shatter type toner
- The life span of toner: 5,000 sheets (ISO19752 standard)
- Toner remaining amount detecting sensor: No
- OPC Cleaning: Film OPC using an electro-static cleaning process.
- Management of waste toner: Collected using an electro-static process and retained within the toner cartridge
  --> no waste toner to dispose of.
- OPC Drum protecting Shutter: No.
- Classifying device for toner cartridge: ID is classified by interruption of the frame channel.



4.3 Main PBA(SPL Model)

The Engine Board and Controller Board have been integrated into a single PBA. This consists of the CPU and printer control functions. The CPU functions as the bus controller, I/O handler, motor driver and PC interface. The main board sends the Current Image Video data to the LSU and manages the Electrophotographic printing process. Circuits on the PBA drive include the main motor (paper feed, cartridge, fuser), clutch driver, pre-transfer lamp driver, heat-lamp driver and fan driver.
The signals from the paper feed jam sensor and paper empty sensor are inputted to the main board from the power supply PBA..



1	LOW DROP FIXED AND ADJUSTABLE POSITIVE VOLTAGE REGULATORS(LD1117DT) U1
2	LOW POWER DUAL BIPOLAR COMPARATORS(LM393D) U2
3	SPREAD SPECTRUM CLOCK GENERATOR(CY25811) U4
4	CPU X-TAL(12MHz) OSC1
5	SDRAM(K4S641632H) U6, U15
6	LOW VOLTAGE HEX INVERTER WITH 5V TOLERANT SCHMITT TRIGGER INPUTS(74LCX14) U7
7	MOTOR DRIVER(A3977SLP) U9
8	GRAPHIC PROCESSOR ASIC(SPGPM) U11
9	LOW VOLTAGE HEX INVERTER WITH 5V TOLERANT SCHMITT TRIGGER INPUTS(74LCX14) U24
10	PARALLEL PORT SINGLE TERMINATION NETWORK(ST1284) U23
11	LOW VOLTAGE IEEE 161284 TRANSLATING TRANSCEIVER(161284) U22
12	VIDEO X-TAL(19.6MHz) OSC3
13	USB 2.0(NET2270) U25
14	USB X-TAL(30MHz) OSC4
15	LOW VOLTAGE OCTAL D-TYPE FLIP-FLOP(74LVX273) U14, U19
16	LOW VOLTAGE BIDIRECTIONAL TRANSCEIVER(74LCX245) U10
17	FLASH MEMOTY(29LV160DB) U13

4.3.1 ASIC (SPGPm)

• ARM946ES
  - 32-bit RISC embedded processor core
  - 16KB instruction cache and 16KB data cache
  - No Tightly Coupled Memory
  - Memory Protection Unit &CP15 control program
• Dual bus architecture for bus traffic distribution
  - AMBA High performance Bus (AHB)
  - System Bus with SDRAM
• IEEE1284 compliant parallel port interface
• Printer Video Controller for LBP engines
• Graphic Execution Unit for Banding support of Printer Languages
• Printer Video Controller for LBP engines
  - PVC : Printer Video Controller without RET Algorithm
  - HPVC : Printer Video Controller with RET algorithm
    (Line Memory & Lookup Table Memory : 512 x 8 , 4096 x 16)
• Engine Controller
  - Motor Control Unit
  - Motor Speed Lookup Table Memory (128 x 16 x 2)
  - Pulse Width Modulation Unit
  - 4 Channels are supported
  - ADC Interface Unit
  - 3 ADC Channels are available
  - ADC Core (ADC8MUX8)maximum clock frequency :3 MHz
• USB 2.0 Interface
• Package : 272 pins PBGA
• Power : 1.8V(Core), 3.3V(IO) power operation
• Speed : 166MHz core(ARM946ES)operation,60MHz bus operation

4.3.2 Memory

The ML2250 has Flash ROM and DRAM memory units. There are 2 SODIMM sockets to enable extra DRAm or Flash ROM (Postscript Option) to be fitted.

On Domestic 9Korean) models additional Mask ROM is also fitted: to store domestic Fonts such as PCL Font and KS5895, KSSM etc.
  - Capacity :16MByte
  - Access Time :100nsec

4.3.3 Flash Memory

It stores the system program, this can be updated by downloading the system program through the PC Interface. In export models PCL fonts are also sred in the flash memory.
• Capacity :2M Byte
• Access Time :70 nsec

4.3.4 SDRAM

Used as Swath buffer, System working memory area, etc. when printing.
• Capacity: 16MByte (Export) / 32MByte (Domestic), expandable up to 144Mbyte (Export) /160MByte (Domestic)
• Optional Additional DIMM : 16MB / 32MB / 64MB /128MB
• Type : SDRAM 100MHz/133MHz , 16bit

4.3.5 Sensor Input Circuit

4.3.5.1. Paper Empty Sensing
The Paper Empty sensor (Photo Interrupter) on the engine board is monitored by the CPU. When the cassette is empty the printer flashes the red ERROR LED.

4.3.5.2. MP Sensing
Presence of paper in the MP tray is detected by operation of the MP Sensor (Photo Interrupter) on the frame. The CPU monitors this sensor to recognize paper in the MP, and paper is fed from MP if there is paper present.

4.3.5.3. Paper Feeding
When paper passes the actuator on the feed sensor, it is detected by the Photo interrupter. This is monitored by the CPU and this signal starts the process of creating the image after a certain delay time.
If the feed sensor is not detected within 1 sec. after paper is fed, a paper jam0 occurs. (Red ERROR LED is lit).

4.3.5.4. Toner Remain Sensing
The ML2250 does not have a toner sensor fitted

4.3.5.5. Paper Exit Sensing
This detects that paper exits cleanly from the set using an exit sensor on the engine board and actuator on the frame. The CPU detects the on/off time of the exit sensor and normal operation or jam status is reported.
If a Jam 2 error occurs the Red ERROR LED is lit.

4.3.5.6. Cover Open Sensing
The Cover open sensor is located on the power supply board. It is operated by a molded tab on the front cover. When the front cover is open the +24V and +5V supplies to the DC fan, solenoid, main motor, polygon motor part of LSU,
HVPS and LSU Laser diode are cut off.

4.3.5.7. DC FAN/Solenoid Driving Circuit
A fan driving circuit is controlled by the CPU via a transistor. It is automatically turned off when a machine enters sleep mode.
There are two solenoids, these are driven by signals from the CPU (MP and paper pick-up).

4.3.5.8. Motor Driving Circuit
The main motor drives the paper feed, developing unit, Fuser and Exit ass'y. It is driven by software which controls the acceleration, constant speed and deceleration profiles. The Motor is driven using an A3977 driver IC.

4.3.5.9 Transfer

The charging voltage, developing voltage and the transfer voltage are controlled by PWM (Pulse Width Modulation). Each output voltage is changeable according to the PWM duty cycle. The transfer voltage used when the paper passes the transfer roller is decided by environment recognition. The resistance value of the transfer roller changes due to the surrounding environment in the room or within the set, this change in resistance in turn changes the value of the voltage due to loading. This voltage is fed back into the set through the A/D converter. Based on this fed back value the PWM cycle is changed to maintain the required transfer voltage

4.3.5.10 Fusing

The temperature of the heat roller's surface is detected according to the resistance value of the thermistor. The thermistor resistance is measured using the A/D converter and thus the CPU can determine the temperature of the heat roller. The AC power is controlled by comparing the target temperature to the value from the thermistor. If the value from the thermistor is out of the controlling range while controlling the fusing process, the error stated in the table occurs. (For the domestic model, the Q-PID method has been applied.)

• Error Type

Error	Description	DCU	LED Display
OPEN HEAT ERROR	-When warming up it has been lower than 68°C for more than 28 seconds	60	All LED blinking
LOW HEAT ERROR	-Standby It has been lower than 80°C for more than 10 seconds -Printing Up to 2 consecutive pages : It has been lower than 145°C For more than 4 seconds. From 3 consecutive pages : It has been 25°C lower than the fixed fusing temperature for more than 4 seconds. It has been higher than 220˚C over 3 seconds	62	All LED blinking
OVER HEAT ERROR	It has been higher than 220°C for more than 3 seconds	68	All LED blinking

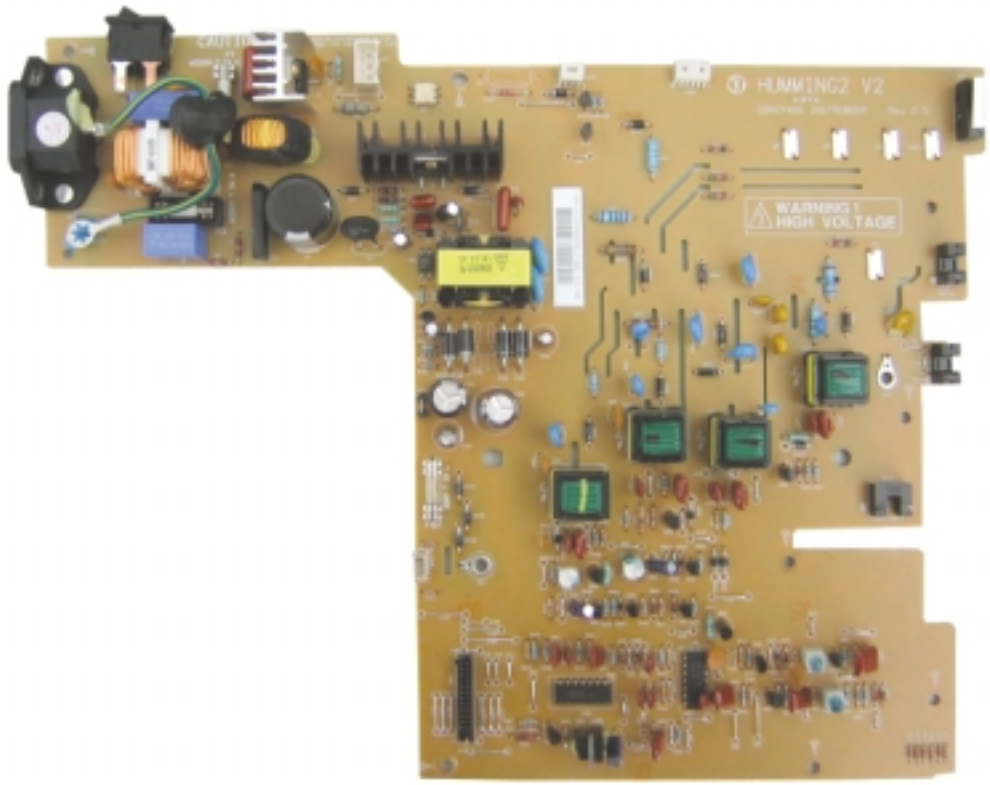
4.3.5.10 LSU

The LSU consists of the LD (Laser Diode) and the polygon motor control. When the printing signal occurs, the LD is turned on and the polygon motor is enabled. When the light sensor detects the beam, Hsync occurs. When the polygon motor speed becomes a normal, LReady occurs. If these two conditions are satisfied the LSU is judged to be ready. If the two conditions are not satisfied, the error shown in the table below occurs.

Error Type	Description	DCU Display Value
Polygon Motor Error	When the polygon motor speed doesn't become steady	95
Hsync Error	The polygon motor speed is steady but the Hsync is not generated	96

4.4 SMPS & HVPS

The SMPS and HVPS are on one integrated board.
The SMPS supplies the DC power to the system. It takes either 110V or 220V and outputs the +5V and +24VS supplies to the main and other PBAs.
The HVPS creates the high voltage of THV/MHV/Supply/Dev and supplies it to the toner cartridge. The CPU is used to modify some of these voltage settings to provide the ideal voltages to create the image.
The HVPS part uses the 24V and outputs the high voltage for THV/MHV/BIAS and the outputted high voltage is supplied to the toner, OPC cartridge and transfer roller.



4.4.1 HVPS (High Voltage Power Supply)

1) Transfer High Voltage (THV+)

- Input Voltage : 24 V DC ± 15%
- Output Voltage : MAX +5.0KV ± 5 %,(Duty Variable, no loading)
  -1.2KV ±15% (when cleaning,200 MΩ)
- Output Voltage Trigger : 6.5 *u*A
- Input contrast of the Voltage stability degree :under ± 5 % (fluctuating input 21.6V~26.4V)
  Loading contrast : ± 5 % or less
- Output Voltage Rise Time : 100 ms Max
- Output Voltage Fall Time : 100 ms Max
- Transfer voltage range as environment varies : +650 V(Duty 10%) ~ 5 KV (Duty 90%)
- Environment Recognition : THV-PWM ACTIVE is a transfer active signal. It detects the resistance of the transfer roller / OPC combination by applying the THV voltage (fixed value) and then measuring the OPC voltage. This allows the resistance to be determined. The resistance is affected by changes in temperature and humidity. A lookup table in the control program is then used to enable the THV voltage to be adjusted to compensate for the environmental conditions.
- Output Voltage Control Method : Transfer Output Voltage is output and controlled by changing the Duty cycle of the THV PWM Signal. 10% Duty :+650V,90% Duty : +5KV±5%

2) Charge Voltage (MHV)

- Input Voltage : 24 V DC ± 15%
- Output Voltage : -1.3KV ~-1.8KV DC ± 50V
- Output Voltage Rise Time : 50 ms Max
- Output Voltage Fall Time : 50 ms Max
- Output Loading range : 30 MΩ ~1000 MΩ
- Output Control Signal (MHV-PWM): CPU is HV output when PWM is Low

3)Cleaning Voltage (THV-)

- The (+)Transfer Voltage is not output because the THV PWM is controlled with high.
- The (-)Transfer Voltage is output because the THV-Enable Signal is controlled with low
- The output fluctuation range is big because there is no Feedback control.

4) Developing Voltage (DEV)

- Input Voltage : 24 V DC ± 15%
- Output Voltage: -200V ~ -600V DC ±20V
- Output Voltage Fluctuation range: PWM Control
- Input contrast of the output stability degree :±5 % or less
  Loading contrast : ± 5 % or less
- Output Voltage Rise Time : 50 ms Max
- Output Voltage Fall Time : 50 ms Max
- Output Loading range : 10MΩ ~ 1000 MΩ
- Output Control Signal (BIAS-PWM) : the CPU output is HV output when PWM is low.

5) Supply

- Output Voltage :-400 V ~-800V DC ±50 V(ZENER using,DEV)
- Input contrast of the output stability degree :under ± 5%
  Loading contrast : ± 5% or less
- Output Voltage Rise Time : 50 ms Max
- Output Voltage Fall Time : 50 ms Max
- Output Loading range : 10 MΩ ~ 1000 MΩ
- Output Control Signal (BIAS-PWM) : the CPU is HV output when PWM is low.

4.4.2 SMPS(Switching Mode Power Supply)

It is the power source of entire system. It is assembled by an independent module, so it is possible to use for common use. It is mounted at the bottom of the set.
It is consisted of the AMPS part, which supplies the DC power for driving the system, and the AC heater control part, which supplies the power to fuser. SMPS has two output channels. Which are 3.3V and +24V.

1) AC Input

- Input Rated voltage : AC 220V ~ 240V AC 120V / AC 220V(EXP version)
- Input Voltage range : AC 198V ~ 264V AC 90V ~ 135V / AC 198V ~ 264V(EXP version)
- Rated Frequency : 50/60 Hz
- Frequency range : 47 ~ 63 Hz
- Input Current : Under 4.0A rms/2.0A rms
  (When the fuser lamp is off and input / output voltages are in range)

2) Rated Output Power

NO	Item	CH1	CH2	CH3	Remark
1	Channel name	+3.3V	+5V	+24.0V	
2	CONNECTOR PIN	CON 3 3.3V PIN: 3, 4 GND PIN: 5, 6	CON3 5V PIN : 8 GND PIN: 7	CON 3 24V PIN: 11, 12, 13 GND : 9. 10	
3	Rated output	3.3V ± 5% (3.2 ~ 3.4V)	+5V ± 5% (4.75 ~ 5.25V)	+24V ± 10% (21.6 ~ 26.4V)	
4	Maxi output current	1.0 A	0.14A	2.0 A	
5	Peak loading current	1.5 A	0.14A	2.5 A	1ms
6	Ripple noise voltage	Under 100mVp-p	100mVp-p	Under 500mVp-p	
7	Maximum output	3.3W	0.35W	48W	
8	Peak output	4.95W	0.7W	60W	1ms
9	Protection for loading shortage and overflowing current	-		-	

3) Consumption Power

NO	Item	CH1 (+3.3V)	CH2 (+5V)	CH3 (24V)	System
1	Stand-By	1.0 A	0.07A	0.4 A	AVG : 55 Wh
2	PRINTING	1.0 A	0.14A	2.0 A	AVG : 280 Wh

4.5 Engine F/W

4.5.1 Feeding

If feeding from the cassette the drive of the pickup roller is controlled by controlling the pick-up solenoid. The on/off of the solenoid is controlled by controlling the general output port or the external output port. If feeding from the manual feeder the set decides to feed the paper according to the operation of the manual sensor, and by driving the main motor, insert the paper in front of the feed sensor. When paper moves the occurrence of a paper jam is judged as below.

ITEM	Description
JAM 0	*IThis is an indcation that the leading edge of the paper doesn't pass the feed sensor. -After the picking up cycle paper does not enter the set because no paper is picked up. -After the picking up cycle paper enters the set but it does not reach the feed sensor in certain time due to slip, etc. -After the picking up cycle if the feed sensor is not on re-pick up. After re-picking up, if the feed sensor is not on after certain time, it is JAM 0. -Even though the paper reaches to the feed sensor, the feed sensor is not ON.
JAM 1	*This is an indication that the leading edge of the paper has already passes the feed sensor. -After the leading edge of the paper passes the feed sensor the trailing edge of the paper does not pass the feed sensor within a certain time. (The feed sensor cannot be OFF during this time) -After the leading edge of the paper passes the feed sensor the paper does not reach the exit sensor within a certain time. (The exit sensor cannot be ON during this time)
JAM 2	*The paper exists between the feed sensor and the exit sensor. -After the trailing edge of the paper passes the feed sensor the trailing edge of the paper does not pass the exit sensor within a certain time.

MEMO