A151/A152
SERVICE TRAINING
MANUAL

MAJOR DIFFERENCE BETWEEN THE FT3013/FT3213 AND FT3113/FT3313 COPIERS

The FT3013/FT3213 (A151 and A152) are developed based on the FT3113/FT3313 (A076 and A077).

The following table lists the major differences between the FT3013/FT3213 series and the FT3113/FT3313 series.

No.	ITEM	FT3013/FT3213	FT3113/FT3313
Overall			
1	Energy Saver Function	Newly added.	Not available.
2	Copy Paper Weight	The copy paper weight specification has been narrowed due to the changes in the paper feed mechanism.	
3	Operation Panel	10 independent number keys for faster and easier operation. The access to the SP modes have been changed due to this reason.	Quantity keys.
Around the Drum			
4	Pre-Transfer Lamp	The pre-transfer lamp has been removed. the same PTL for the FT3113/3313 series is available for the FT3013/3213 series as optional service equipment.	The PTL is installed.
		Due to this, the transfer corona adjustment standard has been changed.	
5	Cleaning Mechanism	Counter blade system.	Trailing system with brush.
		Setting powder should be applied on the blade and drum after servicing.	
6	Drum Drive Mechanism	The main motor directly drives the drum. The drum motor and the drum motor board have been removed.	An independent drum motor drives the drum.
7	Erase Mechanism	For the FT3013 copier, side erase is performed by the platen cover. (The FT3213 copier is the same as the FT3313)	
8	Development Drive Mechanism	The development clutch solenoid has been removed.	
Paper Feed			
9	Paper Feed Mechanism (Paper Tray)	Semicircular feed rollers and corner separator system.	FTR (Feed + Torque Roller) feed system with corner separators.
10	Paper Feed Mechanism (By-Pass feed table)	Auto feed mechanism is newly applied.	No auto feed.
11	Misfeed Indication	PE, J1 and J2.	J1, J2, and J3.
		Indication change only. The basic detection mechanism has not changed.	
Fusing			
12	Fusing Lamp Control	Fusing lamp control mechanism has changed to achieve stable temperature control of the hot roller.	

No.	ITEM	FT3013/FT3213	FT3113/FT3313
Copy Process Control			
13	Grid Voltage for Image Density Control	The grid voltage does not change whether the manual image density is selected or auto image density is selected (with the exception of SP34 setting).	The grid voltage is different depending on whether the image density is manually selected or the auto image density mode is used.
14	Exposure Lamp Voltage for Image Density Control	The V_l correction method has changed to prevent over applying of the exposure lamp voltage. A white reference plate has been added under the left scale supporting bracket.	The V_l correction is applied at set intervals.
15	Drum Temperature Correction	The drum temperature correcton has been eliminated.	
Optics			
16	Optics Thermistor and Cooling Fan	An optics thermistor has been added to monitor the optics temperature for the operation of the optics cooling fan motor for the FT3213 copiers. Since the cooling fan is not installed on the FT3013 copier, the optics thermistor monitors the optics temperature to prevent overheating in the optics cavity. However the copier may stop for some extra waiting time when the thermistor detects a certain high temperature condition.	The optics thermistor is not equipped. The optics cooling fan operates during the copy cycle.
Drum Cleaning			
17	Used toner Overflow Detection	Since the elimination of the PTL and the change of the QL, the used toner overflow detection cycle has been changed. 1. When the copy quantity reaches 80K copies. 2. When the number of toner end conditon reaches 9.	1. Same as the FT3013/3213. 2. When the number of toner end condition reaches 11.
Installation			
18	Developer	Developer is not equipped to the copier at the factory. A new pack is necessary when installing the copier.	
19	220-230V to 240V Conversion	The conversion for the exposure lamp is required. The conversion for the dc power supply board is not required.	The coversion for the exposure lamp and dc power supply board is required.
20	Key Counter	In order to install the optional key counter, some service parts need to be ordered.	
Document Feeder (A365)			
21	Installation	From the May production, to install the DF to the FT3213, the ADF interface unit and the two stud screws are an accessory of the DF.	The ADF interface unit and the two stud screws are installed on the FT3313.
Service Program Mode			
22	Sales Mode	The salesman mode has been eliminated.	Some SP modes can be accessed by the sales representatives.
Service Call			
23	E40	"Optics Thermistor Error" has been eliminated.	

No.	ITEM	FT3013/FT3213	FT3113/FT3313
Test Points			
24	Test Points	Some test points on the main control board have been eliminated.	
Replacement and Adjustment			
25	Transfer Corona Current Adjustment	The adjustment standard is DC -34.0 ± 0.5 μA	The adjustment standard is DC -20.0 ± 0.5 μA
26	Fusing Unit Removal	the fusing unit removal procedure has been modified to achieve faster servicing.	

MAJOR UNIQUE PARTS FOR THE FT3013/FT3213
(Compared with the FT3113/FT3313)

PM Parts

Parts Number	Description	Remarks
AD002044	Cleaning Blade	
	Cleaning Brush	eliminated
	Paper Feed Roller	eliminated
	Torque Roller	eliminated

Electrical Parts

Parts Number	Description	Remarks
A1515100	Main Board for FT3013	
A1525100	Main Board for FT3212	
AZ220019	DC Power Supply Board - 115V	
A1525660	AC Drive Board - 115V	
AZ320075	Power Pack - CC/G/B	
AZ320076	Power Pack - T/D	
A1515276	Erase Lamp for FT3013	
AX640056	Optics Cooling Fan Motor for FT3213	
AX640057	Exhaust Blower Motor	
A1525610	Quenching Lamp - 115V	
AW100028	Fusing Thermistor	
A1525120	Optics Control Board (Auto ID Sensor)	
A1525241	ID Sensor Board	
AW100033	Optics Thermistor	
A1535211	$4^{th}/5^{th}$ Mirror Drive Motor	
A1535213	Lens Drive Motor	
AW020075	Photointerrupter	
AX020078	Main Motor - 115V	
AX520023	Exposure Lamp - 97V/220W	
AG010049	Operation Panel Assembly for FT3013	
AG010051	Operation Panel Assembly for FT3213	

Consumables

The toner used by the FT3013/3213 is different from the FT3113/FT3313.

SECTION 1

OVERALL MACHINE INFORMATION

1. SPECIFICATIONS

Configuration: Desk top

Copy Process: Dry electrostatic transfer system

Original Type: Sheet/Book

Original Alignment: Left center

Original Size: Maximum: A3/11" x 17" (lengthwise) -- FT3213 copier
B4/10" x 14" (lengthwise) -- FT3013 copier

Copy Paper Size: Maximum: B4/10" x 14" (lengthwise)
Minimum:
Paper Tray: A5/5 1/2" x 8 1/2" (lengthwise)
Bypass Feed: A6/5 1/2" x 8 1/2" (lengthwise)

Copy Paper Weight: Paper tray feed -- 64 to 90 g/m^2 (17 to 24 lb)
Bypass feed -- 52 to 105 g/m^2 (14 to 28 lb)

Reproduction Ratios: 2 Enlargement and 3 Reduction (FT3213 copier only)

	A4 Version	Letter Version
Enlargement	141% 122%	129% 121%
Full size	100%	100%
Reduction	93% 82% 71%	93% 74% 65%

Zoom: From 61% to 141% in 1% steps
(FT3213 copier only)

Copying Speed: 13 copies/minute (A4/8 1/2" x 11" lengthwise)
10 copies/minute (B4/8 1/2" x 14")

Warm-Up Time: 30 seconds (at 20°C/68°F)

First Copy Time: 9 seconds (A4/8 1/2" x 11" lengthwise)

Copy Number Input: Number keys, 1 to 99

Manual Image Density: 7 steps

Toner Type: Type 320

Developer Type: Type 310

	Automatic Reset:
	1 minute standard setting; can also be set to 3 minutes or no automatic reset.
Energy Saver Function:	Automatic
Paper Capacity:	Paper tray -- 250 sheets Bypass feed table – 1 sheet
Toner Replenishment:	Cartridge exchange (320 g/cartridge)
Copy Tray Capacity:	100 sheets (B4/10" x 14" or smaller)
Power Source:	110V/ 60Hz/ 15A (for Taiwan) 115V/ 60Hz/ 15A (for North America) 220V -- 240V/ 50Hz/ 8A (for Europe) 220V/ 60Hz/ 8A (for Middle East) 220V/ 50Hz/ 8A (for Asia) (Refer to the serial number plate (rating plate) to determine the power source required by the machine.)

Power Consumption:

	Copier Only	With DF*
Maximum	1.4 kVA	1.5 kVA
Warm-up	620 VA (average)	640 VA (average)
Copy cycle	810 VA (average)	860 VA (average)
Ready	160 VA (average)	180 VA (average)

Noise Emission:

	Copier Only	With DF*
Maximum	58 db	60 db
Copy cycle	Less than 55 db	Less than 55 db
Ready	Less than 39 db	Less than 39 db

Dimensions:

	Width	Depth	Height
Copier with platen cover and copy tray	713 mm (28.1")	592 mm (23.3")	400 mm (15.7")
Copier with document feeder and copy tray	713 mm (28.1")	592 mm (23.3")	463 mm (18.2")

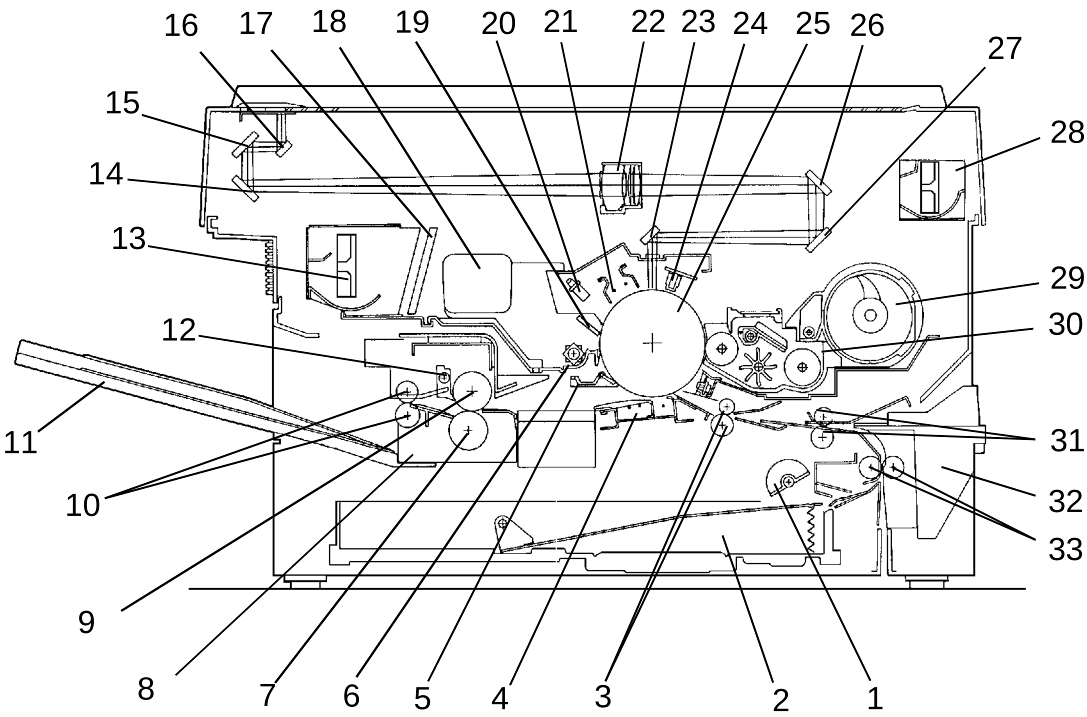
***NOTE:** The document feeder can be installed only on the FT3213 copier.

Weight:	Copier only: With DF:	43 kg (94.8 lb) 50 kg (110.2 lb)
Optional Equipment: (Sales items)	Document feeder (FT3213 copier only) Key counter	
Optional Equipment: (Service items)	Drum anti-condensation heater Optics anti-condensation heater Pre-transfer lamp Optics cooling fan (for FT3013 copier only)	

- Specifications are subject to change without notice.

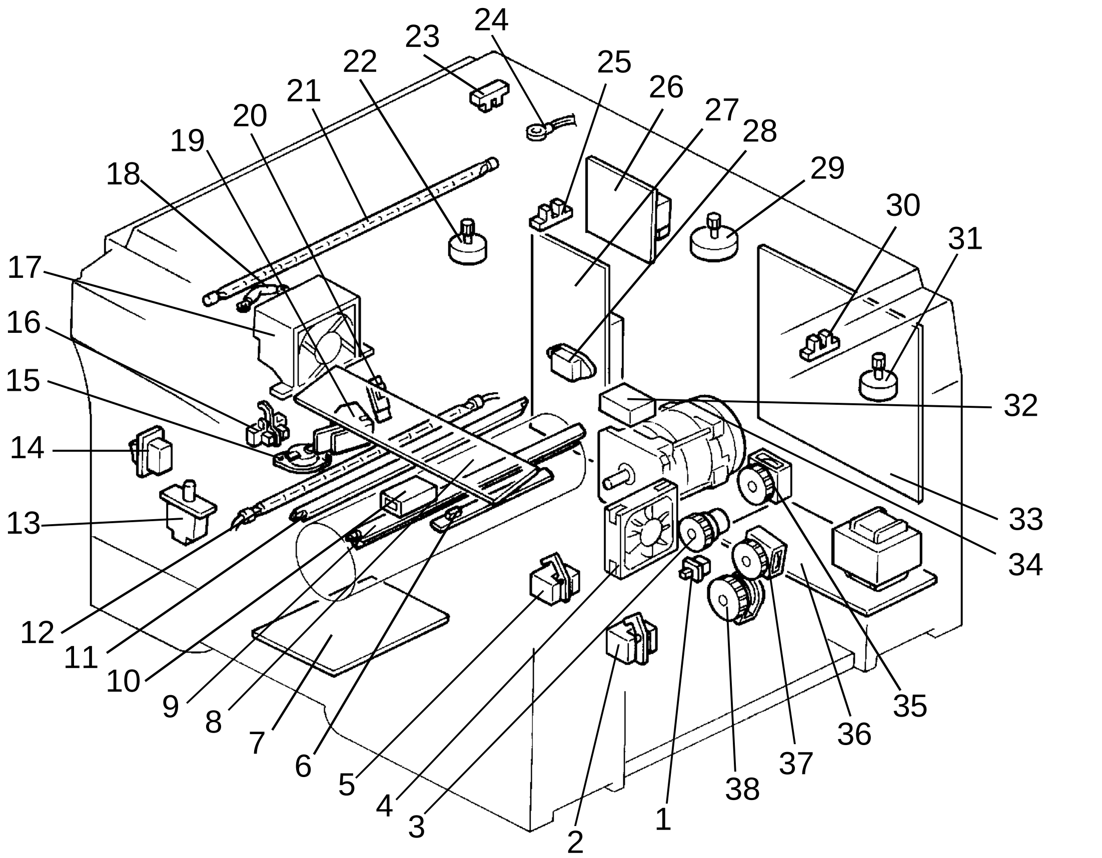
Model Designations:	A151 = FT3013 A152 = FT3213

2. MECHANICAL COMPONENT LAYOUT



1. Semicircular Feed Rollers
2. Paper Tray
3. Registration Rollers
4. Transfer and Separation Corona Unit
5. Pick-off Pawl
6. Cleaning Unit
7. Pressure Roller
8. Fusing Unit
9. Hot Roller
10. Exit Rollers
11. Copy Tray
12. Hot Roller Strippers
13. Exhaust Blower Motor
14. 3rd Mirror
15. 2nd Mirror
16. 1st Mirror
17. Ozone Filter
18. Used Toner Tank
19. Cleaning Blade
20. Quenching Lamp
21. Charge Corona Unit
22. Lens
23. 6th Mirror
24. Erase Lamp
25. Drum
26. 4th Mirror
27. 5th Mirror
28. Optics Cooling Fan Motor (FT3213 Copier only)
29. Toner Supply Unit
30. Development Unit
31. 2nd Relay Rollers
32. By-pass Feed Table
33. 1st Relay Rollers

3. ELECTRICAL COMPONENT LAYOUT



1. Paper Tray Switch
2. Relay Sensor
3. Registration Clutch
4. Optics Cooling Fan Motor (FT3213 only)
5. Registration Sensor
6. Image Density Sensor
7. Power Pack-TC/SC
8. Operation Panel Board
9. Erase Lamp
10. Total Counter
11. Quenching Lamp
12. Fusing Lamp
13. Front Cover Safety Switch
14. Main Switch
15. Fusing Thermoswitch
16. Exit Sensor
17. Exhaust Blower Motor
18. Optics Thermofuse
19. Auto Image Density Sensor
20. Fusing Thermistor
21. Exposure Lamp
22. Lens Motor (FT3213 copier only)
23. Scanner Home Position Sensor
24. Optics Thermistor
25. Lens Home Position Sensor (FT3213 copier only)
26. Power Pack-CC/Grid/Bias
27. AC Drive Board
28. Fusing Triac (115 V only)
29. Scanner Motor
30. 4th/5th Mirror Home Position Sensor (FT3213 copier only)
31. 4th/5th Mirror Motor (FT3213 copier only)
32. Main Motor Capacitor
33. Main Board
34. Main Motor
35. Toner Supply Clutch
36. DC Power Supply Board
37. Relay Roller Clutch
38. Paper Feed Clutch

4. ELECTRICAL COMPONENT DESCRIPTIONS

Motors

SYMBOL	NAME	FUNCTION	INDEX NO.
M1	Main Motor	Drives all the main unit components except for the optics unit and fans. (115/220–240 Vac [ac synchronous])	34
M2	Scanner Motor	Drives the scanners (1st and 2nd). (dc stepper)	29
M3	Lens Motor	Positions the lens according to the selected magnification. (dc stepper) … FT3213 copier only	22
M4	4th/5th Mirror Motor	Positions the 4th/5th mirrors according to the selected magnification. (dc stepper) … FT3213 copier only	31
M5	Optics Cooling Fan Motor	Prevents a build up of hot air in the optics cavity. (24 Vdc) … FT3213 copier only	4
M6	Exhaust Blower Motor	Removes heat from around the fusing unit and moves the ozone built up around the charge section to the ozone filter. (24 Vdc)	17

Magnetic Clutch

SYMBOL	NAME	FUNCTION	INDEX NO.
MC1	Registration Clutch	Drives the registration rollers.	3

Magnetic Spring Clutches

SYMBOL	NAME	FUNCTION	INDEX NO.
MSC1	Toner Supply Clutch	Drives the toner supply roller.	35
MSC2	Relay Roller Clutch	Drives the 1st and 2nd relay rollers.	37
MSC3	Paper Feed Clutch	Starts paper feed.	38

Switches

SYMBOL	NAME	FUNCTION	INDEX NO.
SW1	Main Switch	Supplies power to the copier.	14
SW2	Front Cover Safety Switch	Cuts the ac power line, when the front cover is open.	13
SW3	Paper Tray Switch	Detects when the paper tray is set.	1

Sensors

SYMBOL	NAME	FUNCTION	INDEX NO.
S1	Scanner Home Position Sensor	Informs the CPU when the 1st scanner is at the home position.	23
S2	Lens Home Position Sensor	Informs the CPU when the lens is at the home position (full size position). … FT3213 copier only	25
S3	4th/5th Mirror Home Position Sensor	Informs the CPU when 4th/5th mirrors assembly is at the home position (full size position). … FT3213 copier only	30
S4	Registration Sensor	1) Detects misfeeds. 2) Controls the relay roller clutch stop timing.	5
S5	Exit Sensor	Detects misfeeds.	16
S6	Relay Sensor	1) Detects when copy paper is set on the by-pass feed table. 2) Detects misfeeds.	2
S7	Image Density (ID) Sensor	Detects the density of the image on the drum to control the toner density.	6
S8	Auto Image Density Sensor (ADS)	Senses the background density of the original.	19

Printed Circuit Boards

SYMBOL	NAME	FUNCTION	INDEX NO.
PCB1	Main Board	Controls all copier functions both directly and through the other PCBs.	33
PCB2	AC Drive Board	Drives the main motor, exposure lamp, fusing lamp, and quenching lamp.	27
PCB3	DC Power Supply Board	Converts the wall outlet ac power input to +5 volts, +24 volts, and a zero cross signal.	36
PCB4	Operation Panel Board	Informs the CPU of the selected modes and displays the copier status and condition on the panel.	8

Lamps

SYMBOL	NAME	FUNCTION	INDEX NO.
L1	Exposure Lamp	Applies high intensity light to the original for exposure.	21
L2	Fusing Lamp	Provides heat to the hot roller.	12
L3	Quenching Lamp	Neutralizes any charge remaining on the drum surface after cleaning.	11
L4	Erase Lamp	Discharge the drum outside of the image area. Provides leading/trailing edge erase and side erase.	9

Power Packs

SYMBOL	NAME	FUNCTION	INDEX NO.
P1	Power Pack --CC/Grid/Bias	Provides high voltage for the charge corona, grid, and development roller.	26
P2	Power Pack --TC/SC	Provides high voltage for the transfer and separation corona.	7

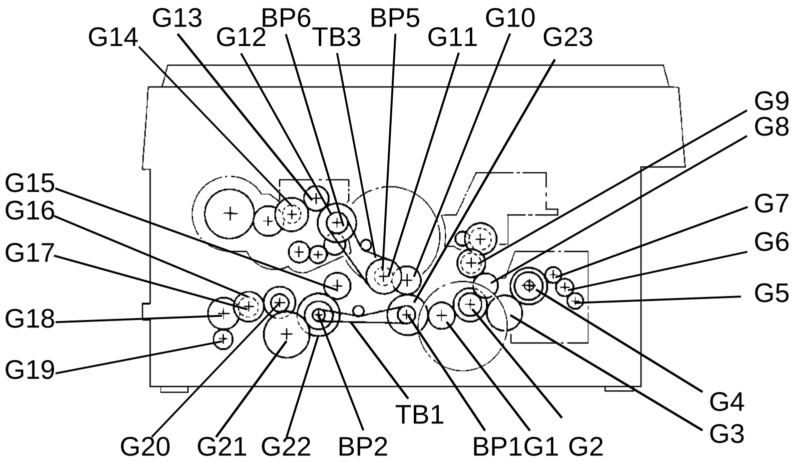
Counter

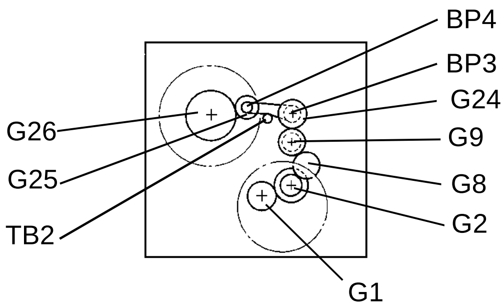
SYMBOL	NAME	FUNCTION	INDEX NO.
CO1	Total Counter	Keeps track of the total number of copies made.	10

Others

SYMBOL	NAME	FUNCTION	INDEX NO.
TH1	Fusing Thermistor	Monitors the fusing temperature.	20
TH2	Optics Thermistor	Monitors the optics temperature.	24
TS	Fusing Thermoswitch	Provides back-up overheat protection in the fusing unit.	15
TF	Optics Thermofuse	Provides back-up overheat protection around the exposure lamp.	18
C	Main Motor Capacitor	Start capacitor.	32
TR	Fusing Triac	Switches the fusing lamp on and off. (115 V only) Note: In the 220V-230V/240V version, the triac is built-in the ac drive board	28

5. DRIVE LAYOUT





G1: Main Motor Gear → G2: Relay Gear

G1: Main Motor Gear
↓
G23: Timing Belt Drive Gear → G10 Relay gear
↓
BP1: Timing Belt Pulley
↓
TB1: Timing Belt
↓
A

G10 Relay gear
↓
G11: Timing Belt Drive Gear
↓
BP5: Timing Belt Pulley
↓
TB3: Timing Belt
↓
Development Section
↓
BP6: Timing Belt Pulley
↓
G12: Development Gear → Development Unit
↓
G13: Relay Gear
↓
G14: Toner Supply CL Gear
↓
Toner Supply CL → Toner Supply Unit

G2: Relay Gear
↓
G8: Relay Gear
↓
G9: Relay Gear → **B**
↓
Cleaning Unit

G2: Relay Gear → G3: Fusing Drive Gear
↓
Fusing and Exit Unit
↓
G4: Hot Roller Gear
↓
G7: Relay Gear
↓
G6: Relay Gear
↓
G5: Exit Roller Gear

A

↓

Paper Feed Section

↓

BP2: Timing Belt Pulley

↓

G22: Relay Gear → (←) G15: Registration CL Gear → Registration CL → Registration Rollers

↓

Paper Feed Section

↓

G21: Paper Feed CL Gear → (←) G20: Relay Gear

↓

Paper Feed CL

↓

Feed Rollers

G15: Registration CL Gear

↓

Registration CL

↓

Registration Rollers

G20: Relay Gear

↓

G17: Relay Roller CL Gear

↓

Relay Roller CL

↓

G16: 2nd Relay Roller Gear

↓

2nd Relay Rollers

↓

G18: Relay Gear

↓

G19: 1st Relay Roller Gear

↓

1st Relay Rollers

B

↓

G24: Timing Belt Drive Gear

↓

BP3: Timing Belt Pulley

↓

TB2: Timing Belt

↓

BP4: Timing Belt Pulley

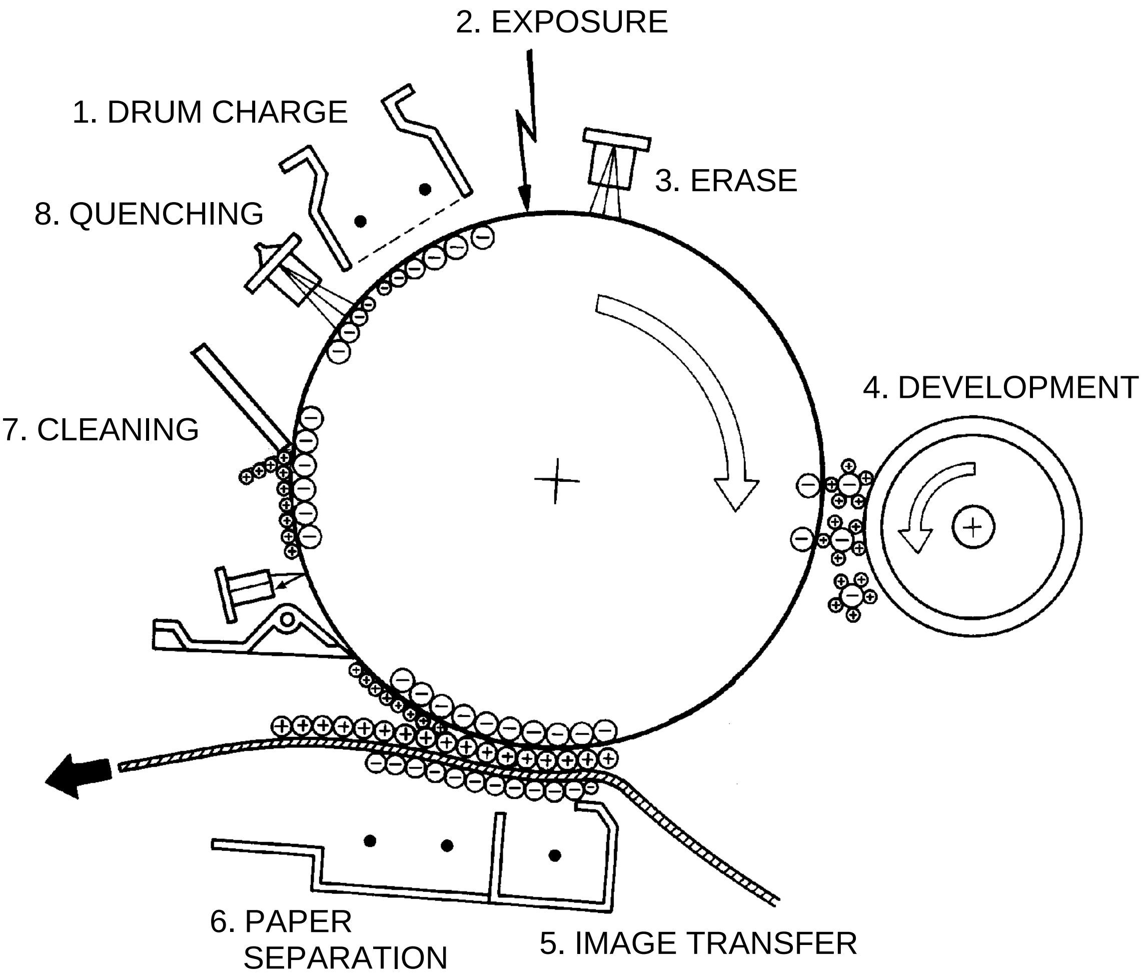
↓

G25: Relay Gear

↓

G26: Drum Drive Gear

6. COPY PROCESSES AROUND THE DRUM



1. DRUM CHARGE

In the dark, the charge corona unit gives a uniform negative charge to the organic photoconductive (OPC) drum. The charge remains on the surface of the drum because the OPC drum has a high electrical resistance in the dark.

2. EXPOSURE

An image of the original is reflected to the OPC drum surface via the optics assembly. The charge on the drum surface is dissipated in direct proportion to the intensity of the reflected light, thus producing an electrical latent image on the drum surface.

3. ERASE

The erase lamp illuminates the areas of the charged drum surface that will not be used for the copy image. The resistance of the drum in the illuminated areas drops and the charge on those areas dissipates.

4. DEVELOPMENT

Positively charged toner is attracted to the negatively charged areas of the drum, thus developing the latent image. (The positive triboelectric charge is caused by friction between the carrier and toner particles.)

5. IMAGE TRANSFER

Paper is fed to the drum surface at the proper time so as to align the copy paper and the developed image on the drum surface. Then, a strong negative charge is applied to the back side of the copy paper, producing an electrical force which pulls the toner particles from the drum surface to the copy paper. At the same time, the copy paper is electrically attracted to the drum surface.

6. PAPER SEPARATION

A strong ac corona discharge is applied to the back side of the copy paper, reducing the negative charge on the copy paper and breaking the electrical attraction between the paper and the drum. Then, the stiffness of the copy paper causes it to separate from the drum surface. The pick-off pawl help to separate the paper from the drum.

7. CLEANING

The cleaning blade removes any toner remaining on the drum.

8. QUENCHING

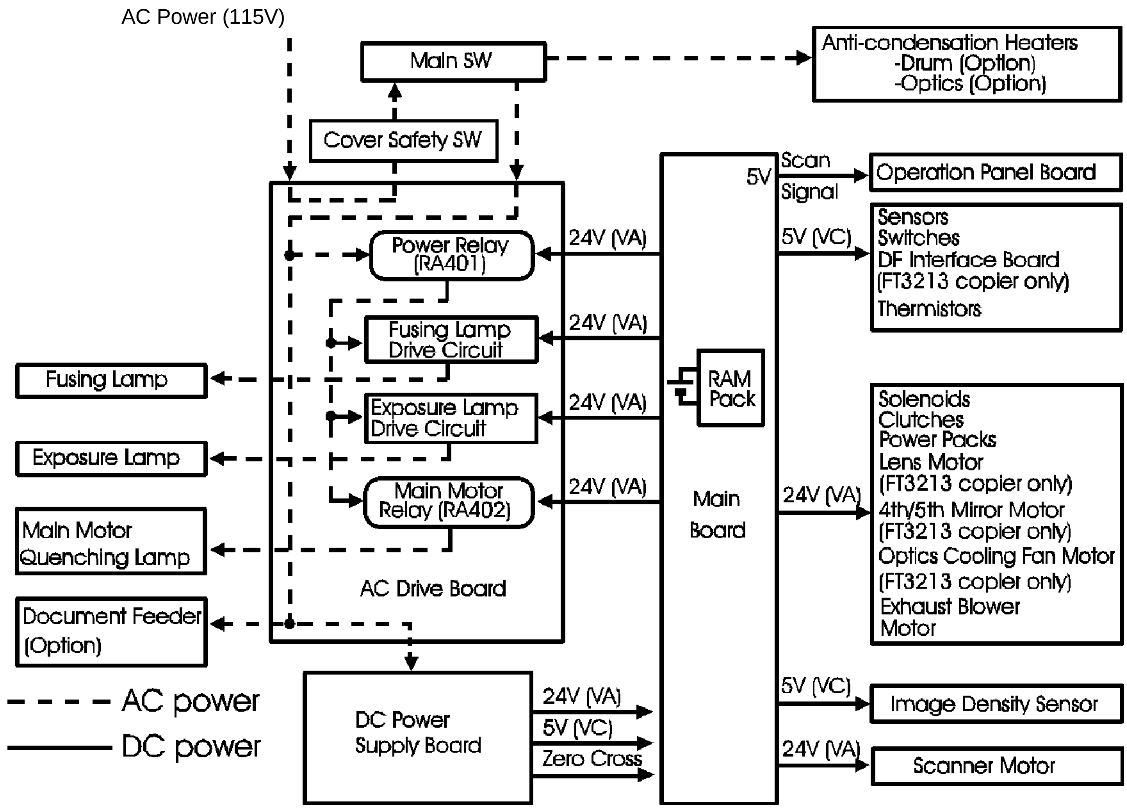
Light from the quenching lamp electrically neutralizes the surface of the drum.

7. COPY PROCESS CONTROL

	Grid Voltage	Exposure Lamp Voltage	Development Bias Voltage	Erase Lamp
Image Density Control	Standard image density grid voltage (–680 V) + Drum residual voltage (Vr) correction factor (SP67) + Auto image density level factor (SP34)	Base exposure lamp voltage (Manual or ADS mode) (SP48) + VL correction factor + Reproduction ratio correction factor (FT3213 copier only)	Base bias voltage factor (Manual or ADS mode [SP34]) + Image bias voltage adjustment factor (SP37) + Drum residual voltage (Vr) correction factor Note: Base bias voltage at manual ID level 7 can be adjusted by SP50	Depends on paper size and reproduction ratio
Toner Density Detection	Standard ID sensor grid voltage (–460 V) + Drum wear correction factor (SP57)	Same as image density control	Depends on ID sensor bias setting (SP33) Note: For initial 499 copies bias voltage is increased by –20 volts	ID sensor pattern erase (Vsg detection: Full erase)
Residual Voltage (Vr) Detection	Standard ID sensor grid voltage (–460 V) + Drum wear correction factor (SP57)	Same as image density control	0 Volts (Fixed)	Full erase (All LEDs ON)
Between Copies	0 Volts (Fixed)	Exposure lamp turns off	–160 Volts (Fixed) + Image bias voltage adjustment factor (SP37) + Drum residual voltage (Vr) correction factor	Full erase (All LEDs ON)

NOTE: The boxed items can be adjusted by SP mode.

8. POWER DISTRIBUTION



When this copier is plugged in and the main switch is turned off, ac power is supplied via the ac drive board to the optional anti-condensation heaters. When the front cover and/or the exit cover is open, the cover safety switch completely cuts off power to all ac and dc components. The RAM pack has a back up power supply (dc battery) for the service program mode data and misfeed job recovery.

When the main switch is turned on, the ac power supply to the anti-condensation heater is cut off and ac power is supplied to the ac drive board. The dc power supply board receives wall outlet ac power through the ac drive board.

The dc power supply board converts the wall outlet ac power input to +5 volts, +24 volts, and a zero cross signal, all of which are supplied to the main board.

The main board supplies dc power to all copier dc components. All sensors, switches, thermistors, and the DF interface board (option) operate on +5 volts. The operation panel operates on +5 volts supplied by the main board.

All other dc components including the power relay (RA401) and the main motor relay (RA402) operate on +24 volts.

When the main board receives power, it activates the power relay (RA401) which then supplies ac power to the fusing lamp drive circuit, and the exposure lamp drive circuit on the ac drive board. The fusing lamp drive circuit receives a trigger signal from the main board and the fusing lamp lights. The exposure lamp does not turn on until the main board sends a trigger pulse to the exposure lamp drive circuit.

When the Start key is pressed, the main board energizes the main motor relay (RA402). Then, the main motor and the quenching lamp turn on. When the main switch is turned off, power is cut off to the main board and to RA401, and the optional drum and optics anti-condensation heaters are turned on.

SECTION 2

DETAILED SECTION DESCRIPTIONS

1. DRUM

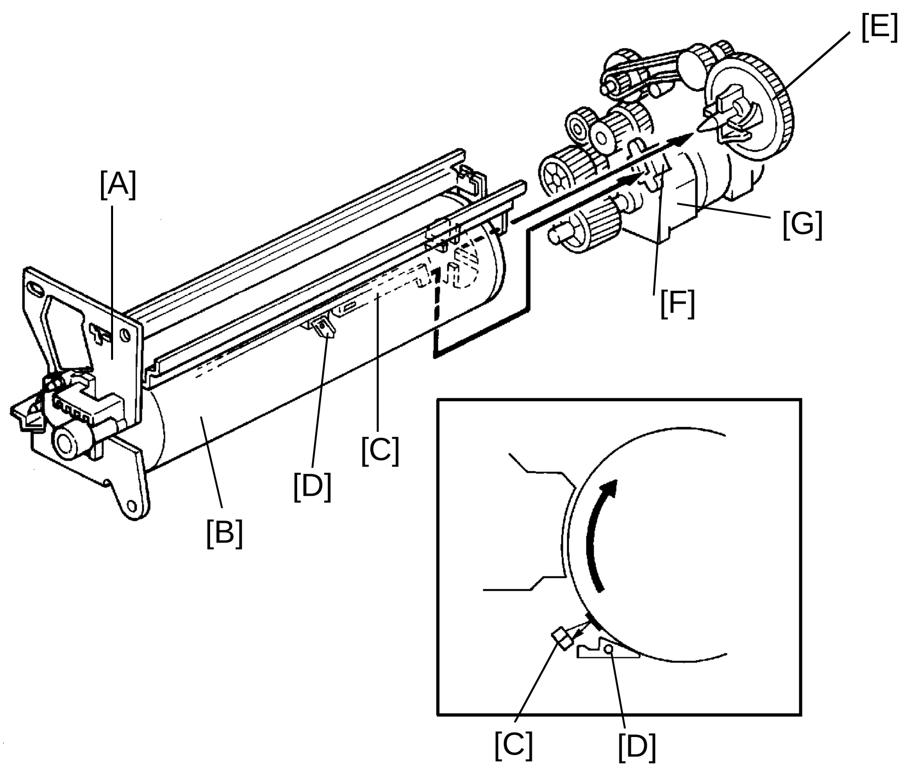
1.1 DRUM CHARACTERISTICS

An organic photoconductor (OPC) drum is used in this model.

The OPC drum has the characteristics of:

1. Being able to accept a high negative electrical charge in the dark. (The electrical resistance of a photoconductor is high in the absence of light.)
2. Dissipating the electrical charge when exposed to light. (Exposure to light greatly increases the conductivity of a photoconductor.)
3. Dissipating an amount of charge in direct proportion to the intensity of the light. That is, where stronger light is directed to the photoconductor surface, a smaller voltage remains on the drum.
4. Being less sensitive to changes in temperature (when compared to selenium F type drums).
5. During the drum’s life, drum residual voltage gradually increases and the photoconductive surface becomes worn.
   Therefore, some compensation for these characteristics is required.

1.2 DRUM UNIT



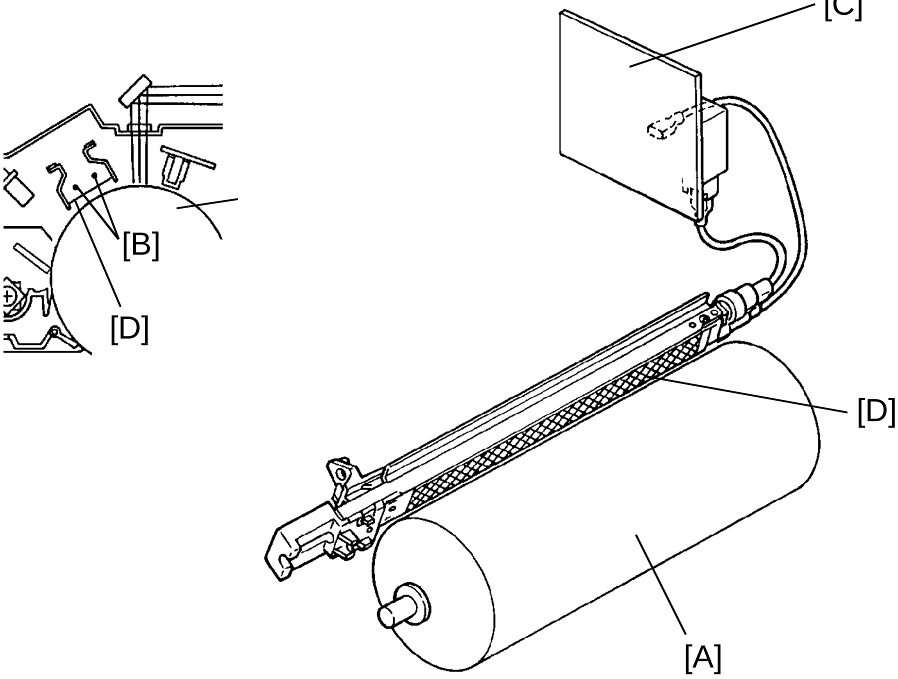
The drum unit [A] consists of an OPC drum [B], ID sensor board [C] and a pick-off pawl [D]. When the drum, the pick-off pawl, or the ID sensor is replaced or cleaned, the drum unit must be removed from the copier. Therefore, the drum has a coupling device which is connected to the drum drive gear [E]. The ID sensor connector [F] is used for the ID sensor.

The main motor provides rotation directly to the drum through a series of gears.

The pick-off pawl [D] is always in contact with the drum surface.

2. DRUM CHARGE

2.1 OVERVIEW



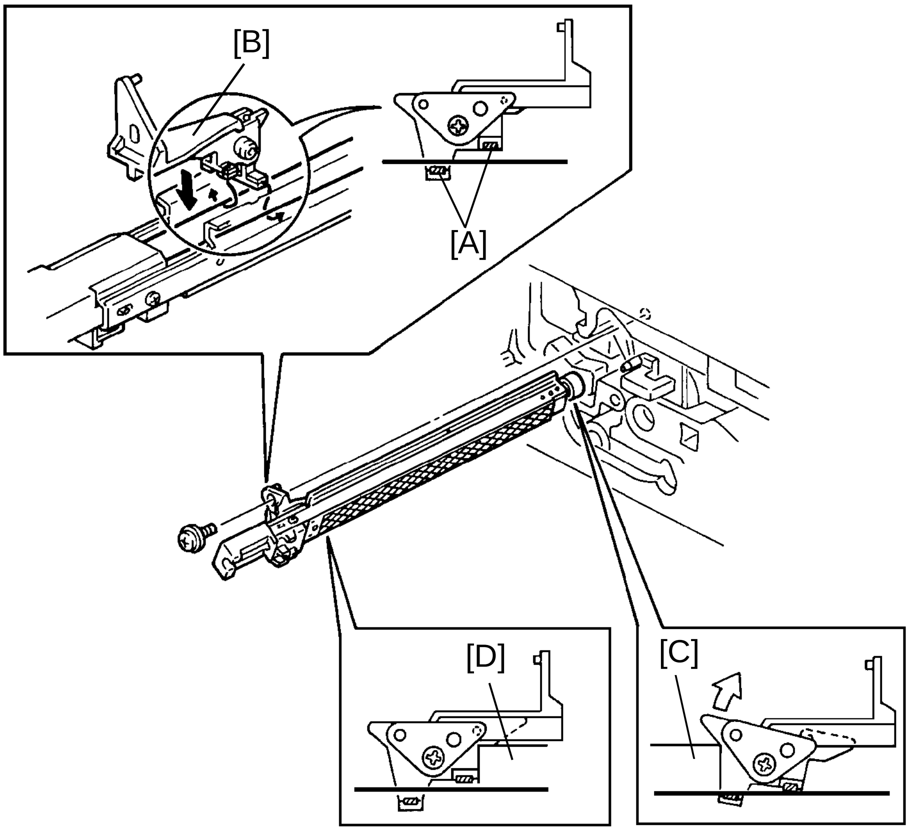
This copier uses a double wire scorotron and a highly sensitive OPC drum [A]. The corona wires [B] generate a corona of negative ions when the CC/Grid/Bias power pack [C] applies a high voltage. The CC/Grid/Bias power pack also applies a negative high voltage to a stainless steel grid plate [D]. This insures that the drum coating receives a uniform negative charge as it rotates past the corona unit.

The exhaust fan, located above the copy exit, causes a flow of air from the upper area of the development unit through the charge corona unit. This prevents an uneven build-up of negative ions that can cause uneven image density. The exhaust fan runs at half speed when in the stand-by condition and at full speed while copying.

The exhaust fan has an ozone filter (active carbon) which adsorbs ozone (O_3) generated by the charge corona. The ozone filter decreases in efficiency over time as it adsorbs ozone. The ozone filter should be replaced at every 80K copies.

The flow of air around the charge corona wires may deposit paper dust or toner particles on the corona wire. These particles may interfere with charging and cause low density bands on copies. To help prevent this, a wire cleaner cleans the corona wire when the operator slides the corona unit out and in.

2.2 CHARGE CORONA WIRE CLEANER MECHANISM



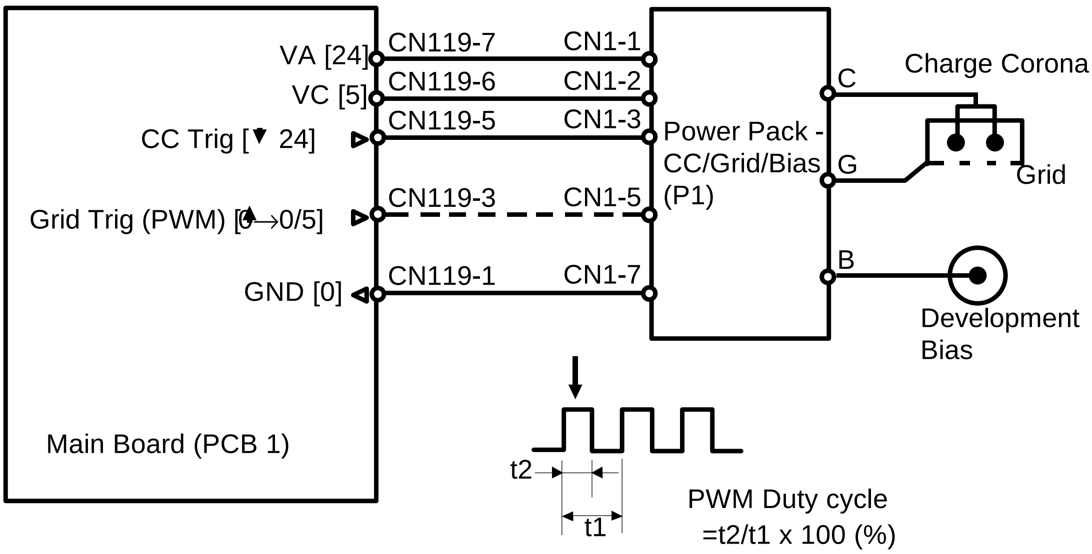
Pads [A] above and below the charge corona wires clean the wires as the charge unit is manually slid in and out.

The cleaner pad bracket [B] rotates when the charge unit is fully extended and the bracket is pulled up against the rear endblock [C]. This moves the pads against the corona wires (see illustration). If the charge unit is not fully extended, the pads do not touch the corona wires.

The pads move away from the wires when the charge unit is fully inserted and the cleaning bracket is pushed against the front endblock [D].

After copier installation the key operator should be instructed to use this mechanism when copies exhibit white streaks, (low image density bands).

2.3 CHARGE CORONA CIRCUIT



The main board supplies +24 volts to the CC/Grid/Bias power pack at CN1-1 as the power supply source. After the Start key is pressed the CPU drops CN1-3 from +24 volts to 0 volts. This energizes the charge corona circuit within the CC/Grid/Bias power pack, which applies a high negative voltage of approximately --7.0 K volts to the charge corona wires. The corona wires then generate a negative corona charge.

The grid plate limits the charge voltage to ensure that the charge does not fluctuate and that an even charge is applied to the drum surface.

The grid trigger pulse applied to CN1-5 is a pulse width modulated signal (PWM signal). This signal is not only a trigger signal, it also changes the voltage level of the grid. As the width of the pulse applied increases (see arrow in above illustration), the voltage of the grid also increases (becomes more negative).

2.4 GRID VOLTAGE CORRECTION

To maintain good copy quality over the drum's life, the grid voltage is changed due to the following:

- Drum residual voltage correction (Vr correction)
- Drum wear correction

2.4.1 Drum Residual Voltage Correction (Vr correction)

During the drum's life, the drum may fatigue electrically and residual voltage (Vr) on the drum may gradually increase. When this happens, the corona charged voltage on the drum is not discharged enough in the quenching and exposure processes. Even though development bias is applied during the development process, the background area of the original on the drum may still attract some toner. This may cause dirty background on copies. The Vr correction prevents this phenomenon as follows:

A pattern (Vr pattern) is developed on the drum every 1,000 copies and its reflectivity is detected by the ID sensor to measure the residual voltage. This is called residual voltage detection. (If the reflectivity is low, the residual voltage will be high.) When the Vr pattern is developed, all blocks of the erase lamp turn on, and the development bias voltage is 0 volt.

The CPU determines what level of Vr correction is necessary depending on the output (Vr ratio [L]) from the ID sensor.

$$L = \frac{Vrp}{Vsg} \times 100\ (\%)$$

Vrp: ID sensor output for Vr pattern
Vsg: ID sensor output for bare drum

The current Vr ratio is displayed by SP67.

The CPU increases the development bias voltage depending on the Vr ratio to prevent dirty background on copies, (See page 2-30 for more information.) The CPU also increases the grid voltage to ensure proper image density depending on the Vr ratio. (See page 2-8.)

2.4.2 Drum Wear Correction

During the drum's life, the photoconductive surface of the drum becomes worn by contact with the cleaning blade and developer on the development roller. This effects the ability of the drum to hold a charge. This characteristic especially affects the development of the ID sensor pattern. The ID sensor pattern developed on the drum becomes lighter causing higher toner concentration in the developer. The drum wear correction is made to prevent this phenomenon and is as follows:

The CPU keeps track of the drum's rotation time that corresponds to the wear of the photoconductive layer. The grid voltage for the toner density detection increases at a set interval. The grid voltage for the residual voltage (Vr) detection also increases at the same interval. (See page 2-9.) The drum rotation time is displayed by SP57.

2.5 GRID VOLTAGE FOR IMAGE DENSITY CONTROL

The main board controls the grid voltage for the copy image through the CC/Grid/Bias power pack. As the grid voltage for the image density control becomes less, the copy image becomes lighter and vice versa.

The grid voltage is based on the standard grid voltage and correction factors as follows:

Grid Voltage = Standard image density grid voltage (–680 volts [SP60 = 4])
+
Vr correction factor
+
Auto image density level factor (SP34)

2.5.1 Standard Image Density Grid Voltage

The standard image density grid voltage (SP60) is set at the factory and the setting is different for each machine. The setting of SP60 is described on the SP mode data sheet located inside the inner cover of the machine.

2.5.2 Drum Residual Voltage (Vr) Correction Factor

Vr ratio (L) (%) (SP67)	Change of grid voltage (volts)
100 to 84	±0
83 to 58	–40
57 to 41	–80
40 to 28	–120
27 to 0	–160

L = Vrp/Vsg x 100 (%)
Vrp: ID sensor output for Vr pattern
Vsg: ID sensor output for bare drum

During the drum's life, drum residual voltage (Vr) may gradually increase. Vr correction compensates for the residual voltage on the drum. The Vr correction is done every 1000 copies. The CPU increases the development bias voltage and the grid voltage. The above table shows how the grid voltage changes depending on the Vr ratio.

2.5.3 Auto Image Density Level Factor (SP34)

Auto image density level	Data (SP34)	Change of grid voltage (volts)
Normal	0 *	±0
Darker	1	–40
Lighter	2	±0

* Factory setting

The grid voltage and the exposure lamp voltage are constant regardless of the output from the auto image density sensor. Only the development bias voltage varies depending on the output from the auto image density sensor.

However, when the auto image density level data in SP34 is set to darker, the grid voltage is changed –40 volts as shown in the above table. When it is set to lighter, the grid voltage does not change, in this case the development bias voltage is corrected.

2.6 GRID VOLTAGE FOR TONER DENSITY DETECTION AND RESIDUAL VOLTAGE (Vr) DETECTION

The grid voltage is the same for both toner density detection and residual voltage correction.

Grid voltage = Standard ID sensor grid voltage (--460 volts [SP62=4])
+
Drum wear correction factor (SP57)

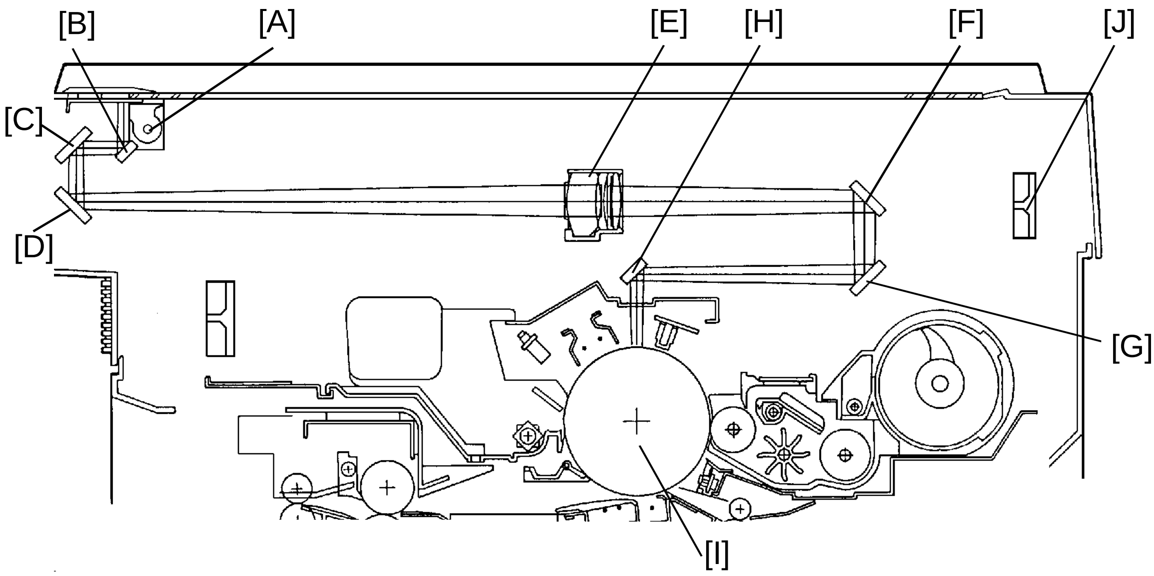
Drum Wear Correction Factor (SP57)

Main motor rotation time (SP57)	Change of grid voltage (volts)
0 to 2H	±0
2 to 65H	–20
65 to 112H	–40
112 to 157H	–60
More than 157H	–80

The grid voltage for toner density detection is the same as it is for the residual voltage (Vr) detection. However, the development bias voltage is different. (See pages 2-30 and 2-35.)

3. OPTICS

3.1 OVERVIEW



During the copy cycle, an image of the original is reflected onto the drum surface through the optics assembly as follows.

Light Path:

Exposure Lamp [A] → Original → First Mirror [B] → Second Mirror [C] → Third Mirror [D] → Lens [E] → Fourth Mirror [F]→ Fifth Mirror [G] → Sixth Mirror [H] → Drum [I]

This copier has six standard reproduction ratios (FT3213 copier only), three reduction ratios, two enlargement ratios, and full size. It also has a zoom function. The operator can change the reproduction ratio in one percent steps from 61% to 141%.

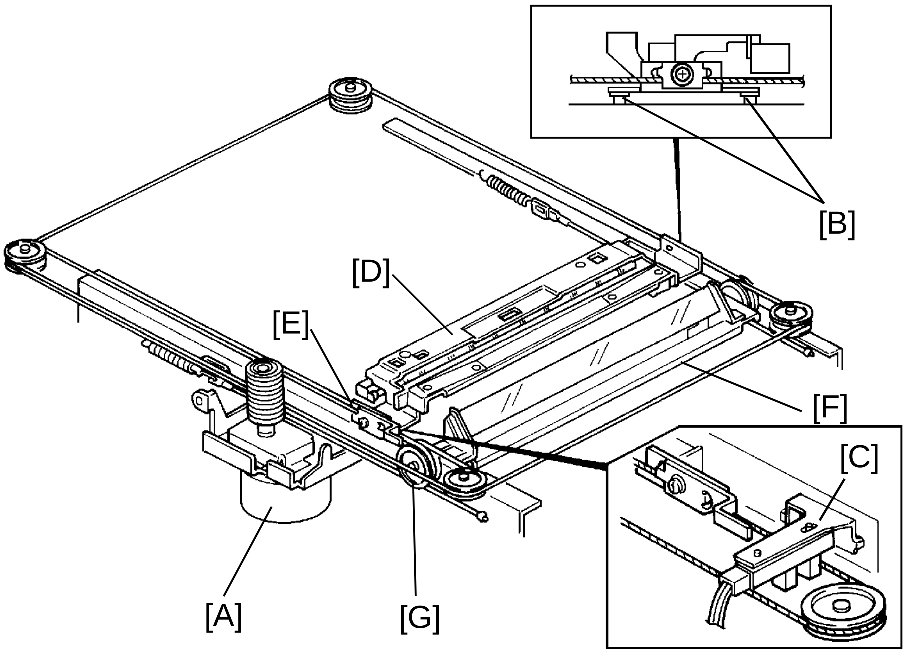
Stepper motors are used to change the positions of the lens and mirrors (FT3213 copier only). Separate motors are used because the wide range of reproduction ratios makes it mechanically difficult for one motor to position both the lens and mirrors. A stepper motor is also used to drive the scanner. This motor changes the scanner speed according to the reproduction ratio.

The CPU monitors the temperature around the optics cavity through a thermistor which is located at the upper left rear side of the copier frame. When the temperature reaches 45°C, the optics cooling fan [J] (FT3213 copier only) starts rotating to draw cool air into the optics cavity. However, the FT3013 copier is not equipped with a cooling fan. The machine will stop if the optics cavity overheats. (See page 6-52.) In this case, the Energy Saver indicator blinks and the Start key turns red.

The air flows from the right to the left, and exhausts through the vents in the left side of the upper cover. This fan operates until the temperature drops below 45°C.

The thermofuse provides back-up overheat protection. It opens at 128°C and removes ac power to the exposure lamp.

3.2 SCANNER DRIVE



3.2.1 1st and 2nd Scanner Drive Mechanism

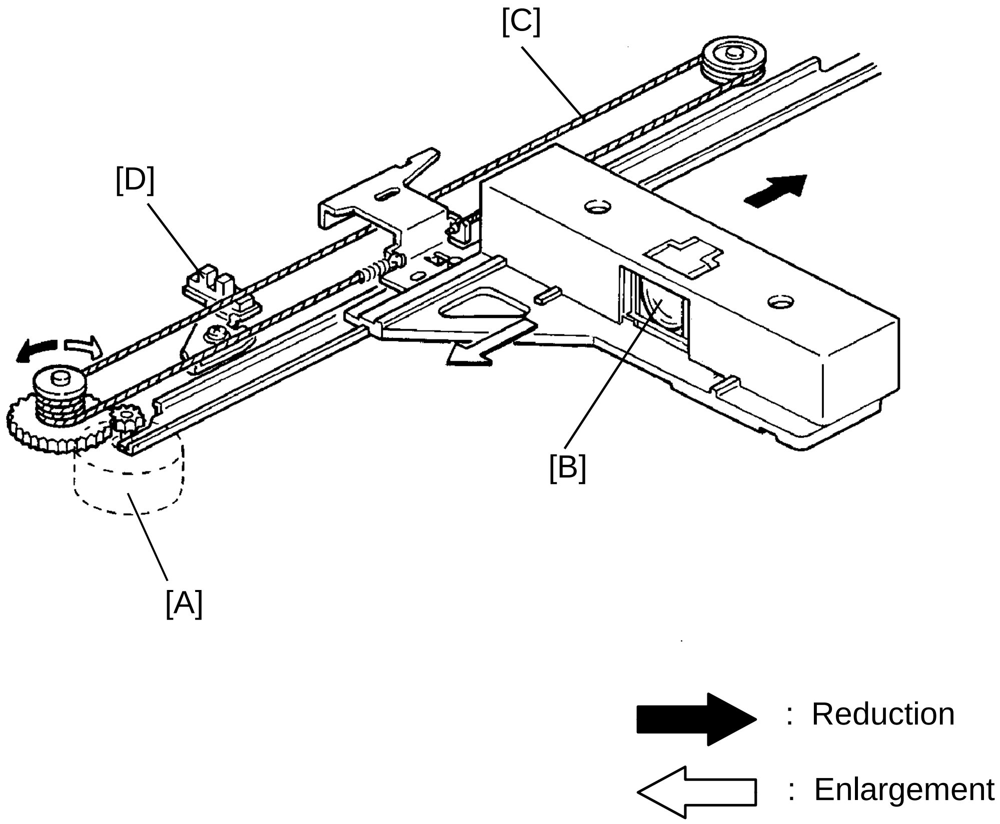
This model uses a stepper motor [A] to drive the scanners. Both ends of each scanner are driven to prevent skewing. The scanners have sliders [B], which ride on guide rails.

The scanner home position is detected by the home position sensor [C]. The scanner return position is determined by counting the scanner motor drive pulses.

The first scanner [D], which consists of the exposure lamp and the first mirror, is connected to the scanner drive wire by the wire clamps [E]. The second scanner [F], which consists of the second and third mirrors, is connected to the scanner drive wire by movable pulleys (the second scanner pulleys [G]). The pulleys move the second scanner at half the velocity of the first scanner. This maintains the focal distance between the original and the lens during scanning. This relationship can be expressed as:

V1r	= 2 (V2r) = VD/r
where r	= Reproduction ratio
V1r	= First scanner velocity (when the reproduction ratio is "r")
V2r	= Second scanner velocity (when the reproduction ratio is "r")
VD	= Drum peripheral velocity (100 mm/s)

3.3 LENS DRIVE (FT3213 copier only)

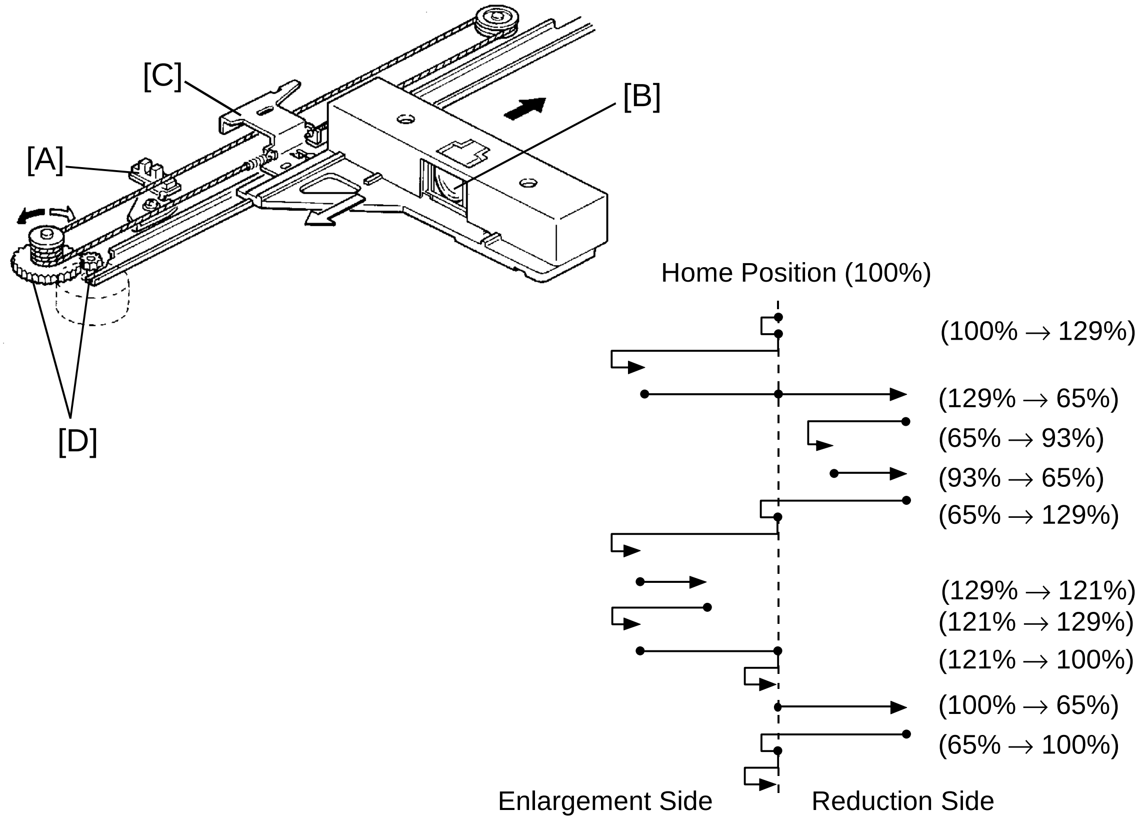


3.3.1 Lens Drive

The lens motor [A] (a stepper motor) changes the lens [B] position through the lens drive wire [C] in accordance with the selected reproduction ratio to provide the proper optical distance between the lens and the drum surface.

The rotation of the lens drive pulley moves the lens back and forth in discrete steps. The home position of the lens is detected by the home position sensor [D]. The main board keeps track of the lens position based on the number of pulses sent to the lens motor.

3.3.2 Lens Positioning



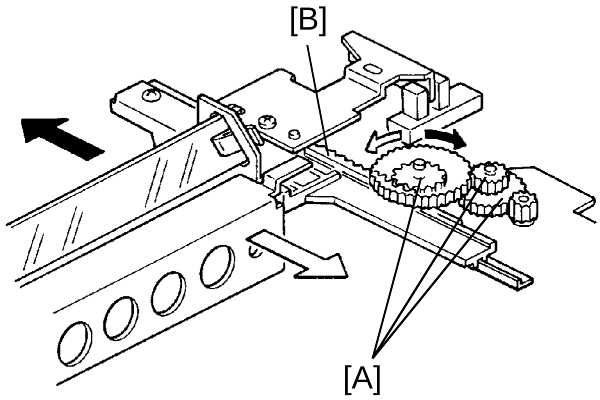
The lens home position sensor [A] informs the main board when the lens is at the full size position (home position). The main board determines the lens stop position in reduction and enlargement modes by counting the number of steps the motor makes with reference to the lens home position. When a new reproduction ratio is selected, the lens [B] moves directly to the selected magnification position.

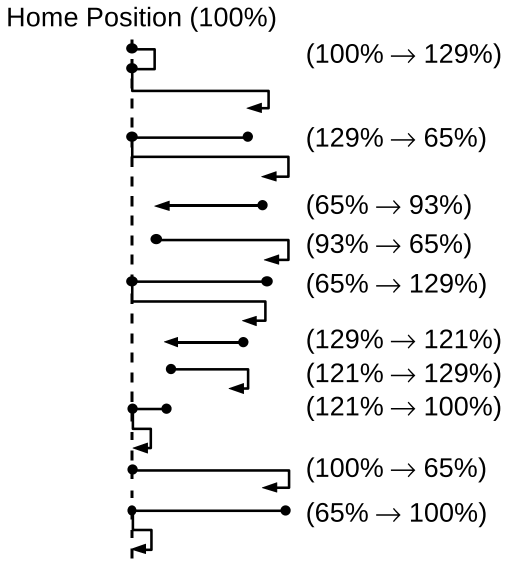
The lens home position is registered each time the lens starts from or passes through the lens home position sensor. As the lens moves from the enlargement side to the reduction side, the sensor registers the home position. This occurs when the actuator plate [C] enters the lens home position sensor.

A small vibration can be observed when the lens moves through home position from the reduction side to the enlargement side because the lens is going in the wrong direction to register the home position. The lens overshoots the home position by only one pulse before going back to register the home position.

The lens always stops while moving from left to right (as viewed from the front) to minimize the error caused by mechanical play in the drive gears [D].

3.4 4TH/5TH MIRROR DRIVE (FT3213 copier only)





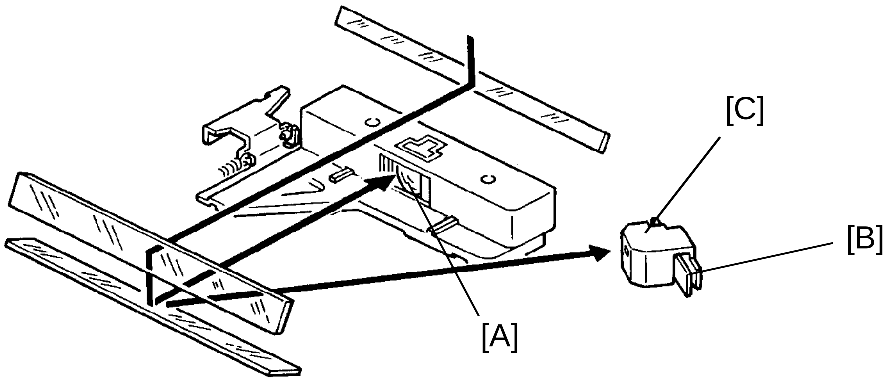
3.4.1 Drive

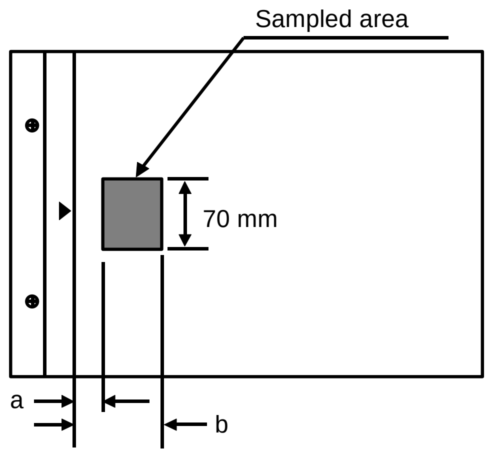
The 4th/5th mirror drive motor (a stepper motor) changes the 4th/5th mirror assembly position through the pinion gears [A] and the rack gear [B] in accordance with the selected reproduction ratio to provide the proper optical distance between the lens and drum surface.

3.4.2 Positioning

The positioning mechanism is similar to that of lens positioning, as shown in the above positioning chart. The 4th/5th mirror assembly always stops while moving from right to left (as viewed from the front).

3.5 AUTOMATIC IMAGE DENSITY SENSING





Light from the exposure lamp is reflected from the original and travels to the lens [A] via the mirrors. The auto ID sensor [B], a photodiode, is mounted on the upper front frame. The sensor cover [C] has a hole in it to allow light to fall directly onto the sensor. Sampling starts 10 millimeters from the leading edge of the original and continues for 50 millimeters from the leading edge of original in full size mode. The length of "a" and "b" will vary depending on the selected reproduction ratio (FT3213 copier only).

The lengths "a" and "b" in each reproduction ratio are calculated as follows:

$$a = \frac{10\text{ mm}}{\text{Reproduction Ratio (\%)}} \times 100 \qquad b = \frac{50\text{ mm}}{\text{Reproduction Ratio (\%)}} \times 100$$

The photosensor circuit converts the light intensity to a voltage. The detected voltage is amplified and sent to the main PCB where it is digitized. The CPU stores the digital value of each sampled point in RAM. It then computes the image density of the original from the maximum sampled value and changes the development bias accordingly. (See page 2-28 for details.) The exposure lamp voltage is constant regardless of the image density of the original.

3.6 EXPOSURE LAMP VOLTAGE CONTROL

The main board controls the exposure lamp voltage through the ac drive board. The exposure lamp voltage is based on the base lamp voltage and various correction factors. The method of control is different depending on whether the image density is manually selected or the auto image density mode is selected.

The exposure lamp voltage consists of the following factors:

Exposure lamp voltage = Base exposure lamp voltage
(Manual or auto image density mode)
+
V_L correction factor
+
Reproduction ratio correction factor
(FT3213 copier only)

3.6.1 Base Lamp Voltage In Manual Image Density Mode

Darker ⟷ Lighter

Manual ID Level	1	2	3	4	5	6	7
Exposure Lamp Data	Vo –4	Vo –4	Vo –2	Vo ±0	Vo+2	Vo+2	Vo+4

The above table shows changes in the exposure lamp data in the manual image density mode.

SP48 sets the exposure lamp data for level 4 (Vo) of manual image density mode. A value from 100 to 150 can be selected.

3.6.2 Base Lamp Voltage In Auto Image Density Mode

In the auto ID mode, the CPU selects the level 4 (Vo) exposure lamp data (SP48) regardless of the input from the auto image density sensor.

3.6.3 V_L Correction Factor

The light intensity may decrease because of dust accumulated on the optics parts. This may cause dirty background on copies. To compensate for this occurance, V_L correction is done as follows:

Whenever SP56 (ADS reference voltage adjustment) is performed, before sampling starts for the ADS adjustment, the auto ID sensor measures the amount of light reflected through the 1st, 2nd and 3rd mirrors from the white plate located under the left frame. The photosensor circuit converts this light intensity to a voltage. This voltage is then digitized and the CPU stores the digital value in memory as the **initial data** .

The copier utilizes a software counter for the V_L correction. At every 500 copies the machine measures the light intensity reflected from the white plate, "new" value is then compared with the initial data stored in memory.

If the measured voltage difference is equal to or more than 0.1 volts, +1 will be added to the exposure lamp data as the V_L correction factor.
If the difference is less than 0.1 volts, no correction will be applied.

The total increase for V_L correction cannot exceed +20. After cleaning the optics section, the following actions **must** be performed in order.

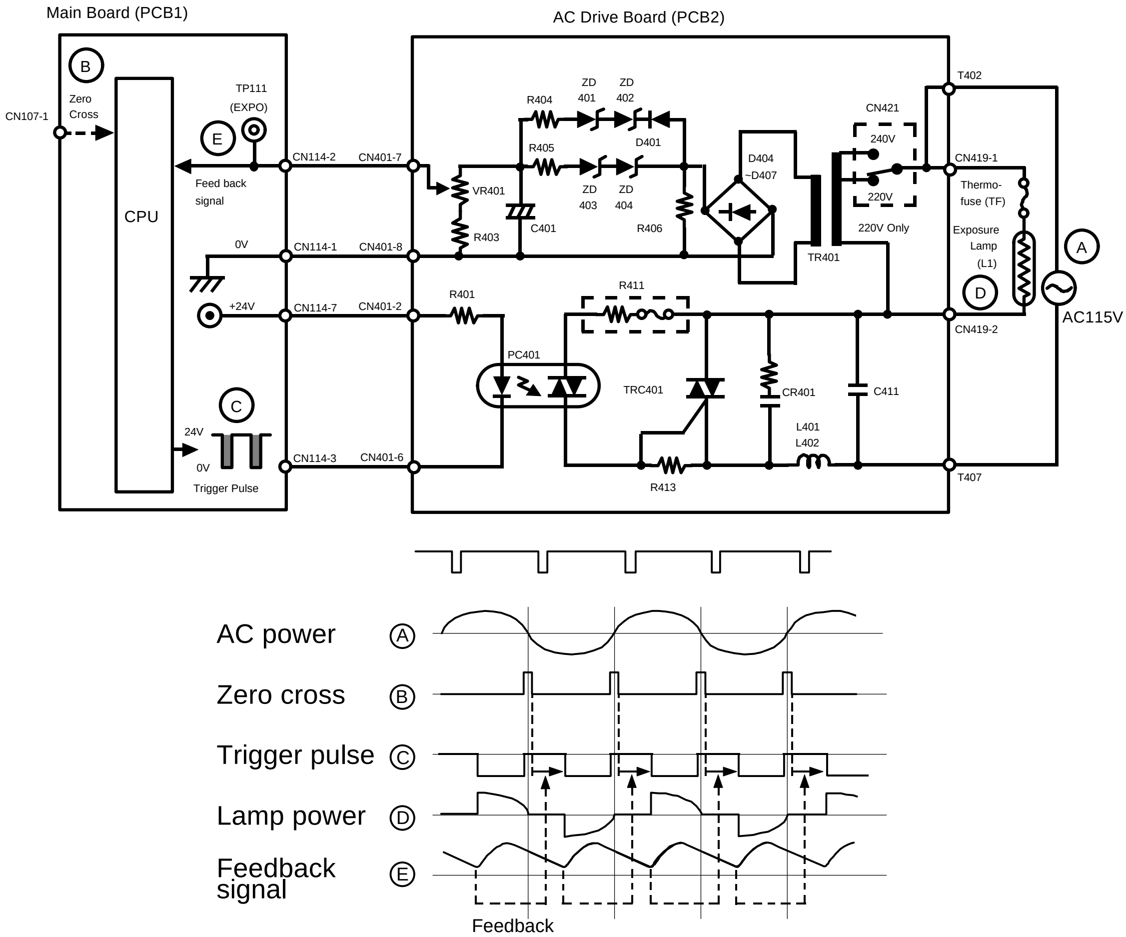
- SP95: Clear the exposure lamp data and the software counter by entering "1".
- SP48: Perform the light intensity adjustment.
- SP56: Perform the ADS adjustment (to store the new initial data and to adjust the ADS reference voltage.)

3.6.4 Reproduction Ratio Correction Factor (FT3213 copier only)

Reproduction ratio (%)	Change of exposure lamp data
61 and 62	+2
63 to 119	±0
120 to 129	+2
130 to 141	+4

The exposure lamp data is increased depending on the selected magnification ratio in order to compensate for the change in the concentration of light on the drum.

3.7 EXPOSURE LAMP CONTROL CIRCUIT



The main board sends lamp trigger (LOW signal) pulses to the ac drive board from CN114-3. PC401 activates TRC401, which provides ac power to the exposure lamp, at the lead edge of each trigger pulse.

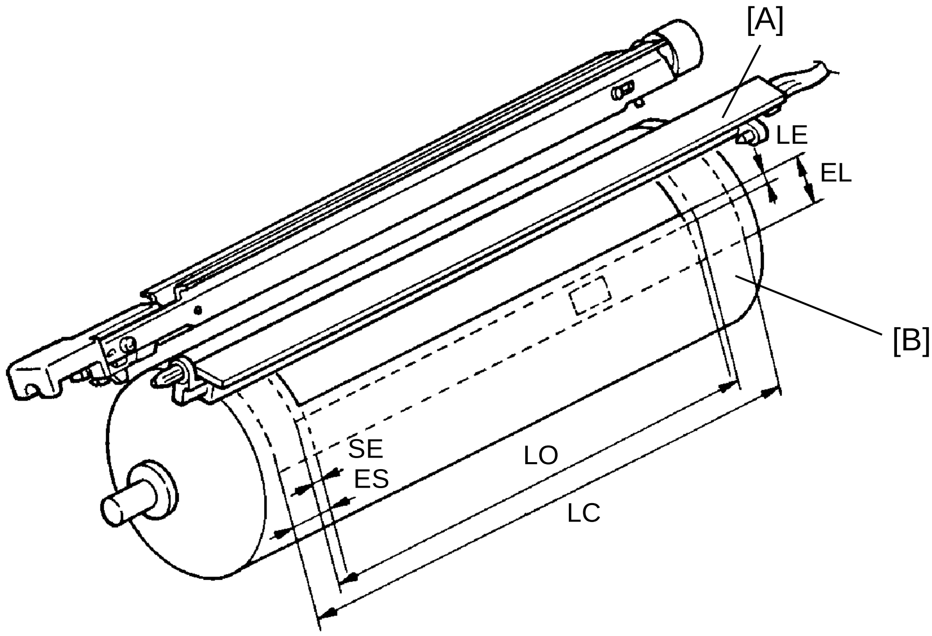
The voltage applied to the exposure lamp is also provided to the feedback circuit. The feedback circuit steps down (TR401), rectifies (D404 ~ 407), and smoothes (zener diodes and capacitors) the lamp voltage. The CPU monitors the lowest point of the smoothed wave (feedback signal), which is directly proportional to the actual lamp voltage.

The CPU changes the timing of the trigger pulses in response to the feedback voltage. If the lamp voltage is too low, the CPU sends the trigger pulses earlier so that more ac power is applied to the exposure lamp. This feedback control is performed instantly; so, the lamp voltage is always stable even under fluctuating ac power conditions.

The voltage applied to the exposure lamp can be changed with SP48 (Light Intensity Adjustment). The ADS voltage adjustment (SP56) must be done whenever the light intensity adjustment is done.

4. ERASE

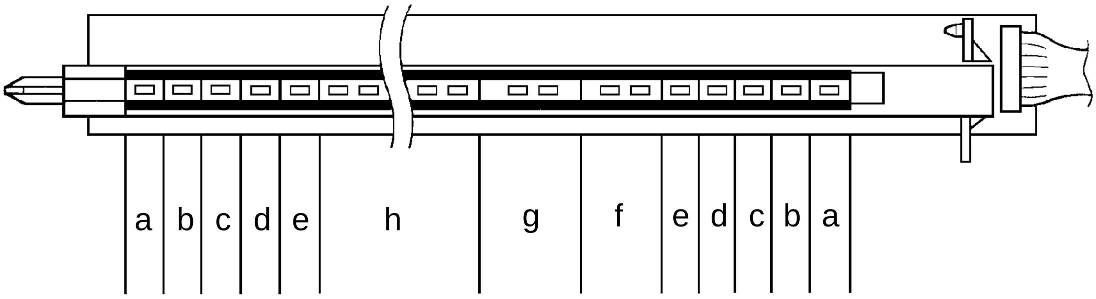
4.1 OVERVIEW



LE: Lead edge erase margin	2.5 ±1.5 mm
SE: Side erase margin	2.0 ±2.0 mm on each side; total of both sides 4 mm or less
LO: Original width	
LC: Charged width of drum	
EL: Lead edge erase	
ES: Side erase (FT3213 copier only)	

The erase lamp [A] consists of a single row of LEDs (29 LEDs) extending across the full width of the drum [B].

The erase lamp has the following functions: lead edge erase, side erase (FT3213 copier only), and trail edge erase.



4.1.1 Lead Edge Erase

The entire line of LEDs turn on when the main motor turns on. They stay on until the erase margin slightly overlaps the lead edge of the original image area on the drum (Lead Edge Erase Margin). This prevents the toner density sensor pattern from being developed every copy cycle and the shadow of the original edge from being developed on the paper. At this point, side erase starts (FT3213 copier only). The width of the lead edge erase margin can be adjusted using SP41.

During the toner density detection cycle (once every ten copy cycles), a block of erase lamps (labeled "g" above) turns off long enough for the sensor pattern to be developed.

The entire line of LEDs turn on when the residual voltage on the OPC drum is being detected (Vr detection).

4.1.2 Side Erase

Based on the combination of copy paper size and the reproduction ratio data, the LEDs turn on in blocks (labeled "a" – "g" above). This reduces toner consumption and drum cleaning load.

– FT3213 copier –

This machine has no sensors or switches to detect the copy paper size. Instead, the CPU measures the copy paper length using the registration sensor during the first copy cycle. Based on this length data, the CPU determines which copy paper size is used in the paper tray. (See page 2-49 for more information.)

The LEDs turn on in blocks as labeled "a" – "h" on the previous page.
In the full size copy mode, the CPU determines which blocks turn on based on the copy paper length data as follows:

Paper length	Paper size	Blocks ON
364 mm and 356 mm	B4, 10" x 14", 8 1/2" x 14", 8 1/4" x 14"	None
330 mm and 279 mm	8 1/2" x 13", 8 1/4" x 13" (F4), 8" x 13", 8 1/2" x 11"	a – b
297 mm, 267 mm, and 254 mm	A4R, 8" x 10 1/2", 8" x 10"	a – c
257 mm, 216 mm, and 210 mm	B5R, 5 1/2" x 8 1/2", A5R	a – e
For toner density detection cycles.		a – f, h
For residual voltage (Vr) detection cycles.		All

NOTE: Since the CPU cannot distinguish different paper widths, the CPU determines the size to be the larger standard width based on the measured length.
(EX: 10" x 14", 8 1/2" x 14" → The CPU recognizes as 10" x 14".)

In the reduction or enlargement copy mode, the CPU determines which blocks turn on based on the selected reproduction ratio as follows:

Reproduction ratio (%)	Blocks ON
83 to 99, 101 to 141	None
78 to 82	a
73 to 77	a to b
68 to 72	a to c
64 to 67	a to d
61 to 63	a to e

-- FT3013 copier –

Since this model has only two modes for the erase lamp, full erase mode (all blocks on) and toner density detection cycle mode (all blocks on except block "g"), side erasing is not performed by the erase lamp.
When making copies with the platen cover open condition, and the original and the copy paper is smaller than B4 (10" x 14"), the part without the original will be developed as a black image area on the drum.

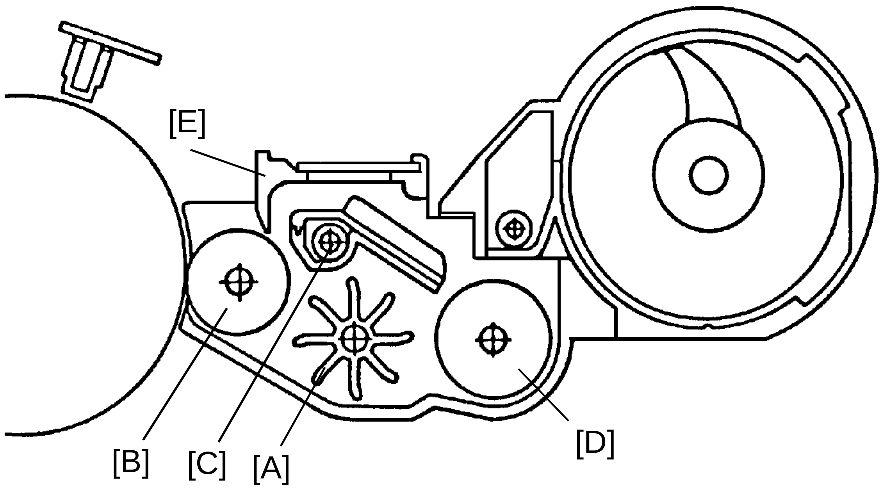
NOTE: If the customers makes copies without the platen cover closed frequently, the used toner tank may become full in a shorter period of time, than expected. For those customers, the toner tank must be checked and cleaned frequently.

4.1.3 Trailing Edge Erase

The entire line of LEDs turns on after the trailing edge of the latent image has passed. Therefore, a trailing erase margin cannot be observed on the copy. The LEDs stay on to erase the leading edge of the latent image in the next copy cycle. After the final copy, the erase lamps turn off at the same time as the main motor.

5. DEVELOPMENT

5.1 OVERVIEW



When the main motor turns on, the paddle roller [A], development roller [B], auger [C], and the agitator [D] start turning. The paddle roller picks up developer in its paddles and transports it to the development roller. Internal permanent magnets in the development roller attract the developer to the development roller sleeve.

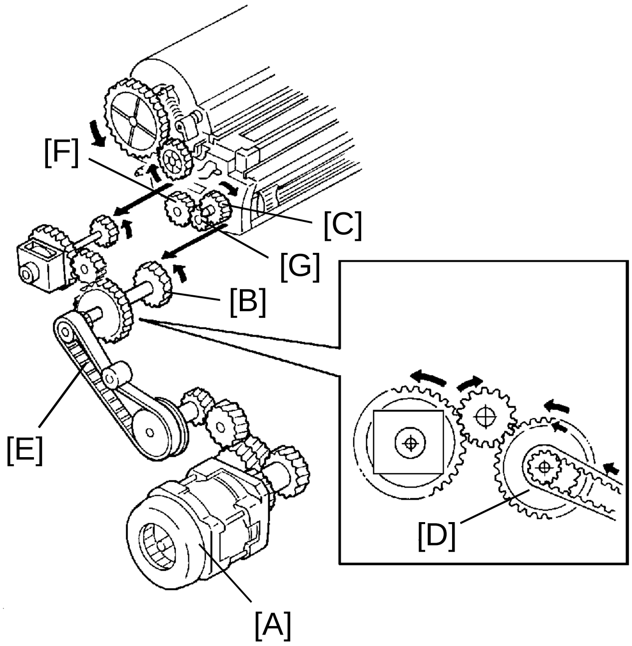
The turning sleeve of the development roller then carries the developer past the doctor blade [E]. The doctor blade trims the developer to the desired thickness and creates a developer backspill to the cross-mixing mechanism.

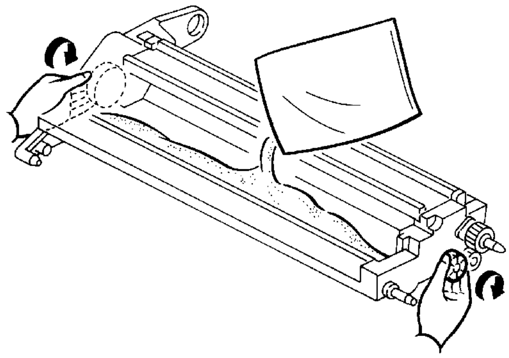
The development roller continues to turn, carrying the developer to the OPC drum. When the developer brush contacts the drum surface, the negatively charged areas of the drum surface attract and hold the positively charged toner. In this way, the latent image is developed.

The development roller is given a negative bias to prevent toner from being attracted to the non-image areas on the drum which may have a residual negative charge. The bias also controls image density.

After turning about 100 degrees more, the development roller releases the developer to the development unit. The developer is agitated by the paddle roller [A], agitator [D], and the cross-mixing mechanism.

5.2 DRIVE MECHANISM

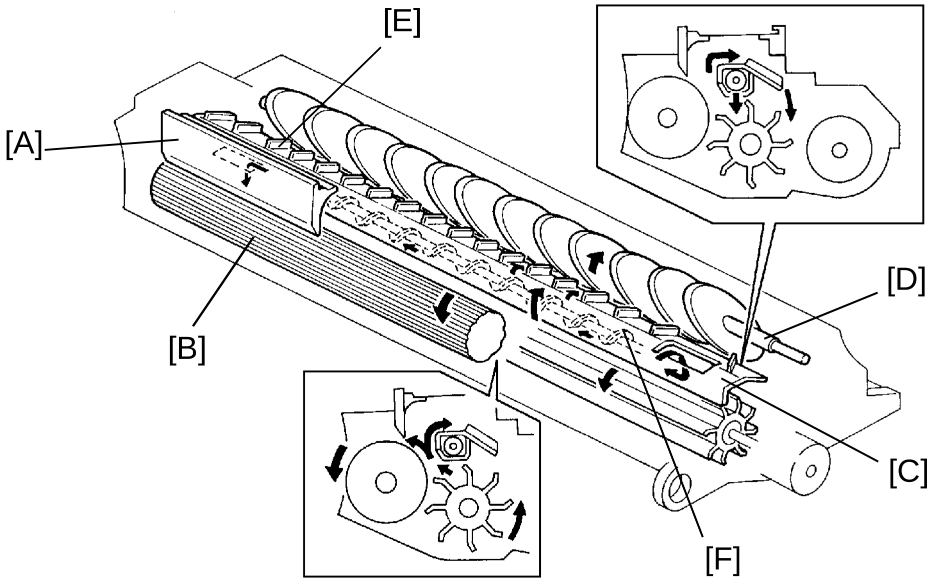




When the main motor [A] turns, the rotation is transmitted from the development drive gear [B] to the development roller gear [C] through the development gear [D], timing belt [E] and relay gears. The rotation is transmitted from the development roller gear to the paddle roller gear [F] through an idler gear [G].

NOTE: This copier is not equipped with a knob on the paddle roller shaft like some other machines. When installing new developer or manually rotating the development roller, always make sure to turn the gears in the direction shown above. Damage may occur to the copier if turned in the opposite direction.

5.3 CROSS-MIXING



This copier uses a standard cross-mixing mechanism to keep the toner and developer evenly mixed. It also helps agitate the developer to prevent developer clumps from forming and helps create the triboelectric charge.

The developer on the turning development roller is split into two parts by the doctor blade [A]. The developer that stays on the development roller [B] forms the magnetic brush and develops the latent image on the drum. The remaining developer that is trimmed off by the doctor blade goes to the backspill plate [C].

As the developer slides down the backspill plate to the agitator [D], the mixing vanes [E] move it slightly toward the rear of the unit. Part of the developer falls into the auger inlet and is transported to the front of the unit by the auger [F].

5.4 DEVELOPMENT BIAS FOR IMAGE DENSITY CONTROL

Image density is controlled by changing three items: (1) the amount of bias voltage applied to the development roller sleeve, (2) the amount of voltage applied to the exposure lamp, and (3) the amount of voltage applied to the grid plate.

Applying a bias voltage to the development sleeve reduces the potential between the development roller and the drum, thereby reducing the amount of toner transferred. As the bias voltage becomes greater, the copy image becomes lighter and vice versa.

The method of control is different depending on whether the image density is manually selected or the auto image density mode is used.

The development bias voltage applied to the development roller sleeve has the following factors:

Development bias voltage = Base bias voltage factor
(Manual or auto image density mode)
+
Image bias voltage adjustment factor (SP37)
+
Drum residual voltage (Vr) correction factor

The base bias voltage for non-image areas (between copies) is --160 volts. The above correction factors are also applied.

5.4.1 Base Bias Voltage Factor In Manual Image Density Mode

Darker ⟵⟶ Lighter

Manual ID Level	1	2	3	4	5	6	7
Base Bias Voltage (volts)	–120	–160	–160	–160	–160	–200	–240 *Note
Exposure Lamp Data	Vo –4	Vo –4	Vo –2	Vo ±0	Vo +2	Vo+2	Vo+4

Vo: Exposure Lamp Data for ID level 4 (SP48)

In manual ID mode, the base bias voltage depends on the manually selected ID level. The voltage applied at each ID level is shown in the above table. The base exposure lamp voltage also varies depending on the manual ID level also shown in the table above.

***Note:** The base bias voltage at ID level 7 can be changed using SP50 as follows.

Image density	Data (SP50)	Bias voltage (volts)
Normal	0	–240
Darker	1	–200
Lighter	2	–280
Lightest	3	–320

(Factory Setting: –240 volts)

5.4.2 Base Bias Voltage Factor In Automatic Image Density Mode

In auto image density mode, the base exposure lamp voltage is fixed at Vo (SP48). Image density is controlled by changing only the base bias voltage.

The base bias voltage depends on the background image density of the original, which is measured using the auto ID sensor. (See page 2-16 for more information.)

The CPU checks the voltage output from the automatic ID circuit. This circuit has a peak hold function. The peak hold voltage corresponds to the maximum reflectivity of the original. The CPU then determines the proper base bias level with reference to the peak hold voltage.

The table on the following page gives the base bias voltages at each ADS output level.

When the automatic density level is set to lighter by SP34, the base bias voltage shifts --40 volts as shown in the following table.

K	Base Bias Voltage (volts)	
	Normal or Darker (SP34 = 0 or 1)	Lighter (SP34 = 2)
$K \geq TL1$	–160	–200
$TL1 > K \geq TL2$	–200	–240
$TL2 > K \geq TL3$	–240	–280
$TL3 > K \geq TL4$	–280	–320
$TL4 > K \geq TL5$	–320	–360
$TL5 > K$	–360	–400

$$K = \frac{\text{ADS Output Voltage (Peak Hold Voltage)}}{\text{ADS Reference Voltage (SP56)}}$$

TL1 to TL5: Threshold level (See the following table.)

To maintain the correct image density, the exposure lamp data is incremented when the reproduction ratio is changed or when V_L correction is applied. This increment in the lamp data increases the intensity of light reflected from the original. Therefore, the auto ID sensor output voltage also changes. In order to maintain a constant voltage for the same original when the lamp data is incremented, the threshold levels are shifted up with each increment in the lamp data as shown in the following table.

Increase of exposure lamp data	+0 +1	+2 +3	+4 +5	+6 +7	+8 +9	+10 +11	+12 +13	+14 +15	+16 +17	+18 +19
TL1	0.80	0.85	0.90	0.95	1.00	1.05	1.11	1.16	1.20	1.23
TL2	0.75	0.80	0.84	0.88	0.92	0.97	1.01	1.06	1.11	1.16
TL3	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.99	1.03	1.08
TL4	0.61	0.65	0.69	0.73	0.77	0.81	0.84	0.88	0.92	0.96
TL5	0.29	0.31	0.33	0.35	0.37	0.38	0.40	0.42	0.44	0.46

5.4.3 Image Bias Voltage Adjustment Factor

Image Bias Adjustment (SP37)

Image density	Data (SP37)	Change of bias voltage (volts)
Normal	0	±0
Darkest	1	+40
Darker	2	+20
Lighter	3	–20
Lightest	4	–40

The image bias voltage can be changed by SP37 to adjust the image density level. The above table gives the image bias voltage for this SP mode setting. This adjustment should be done only if the exposure lamp voltage adjustment (SP48) fails to achieve the desired image density.

5.4.4 Drum Residual Voltage (Vr) Correction Factor

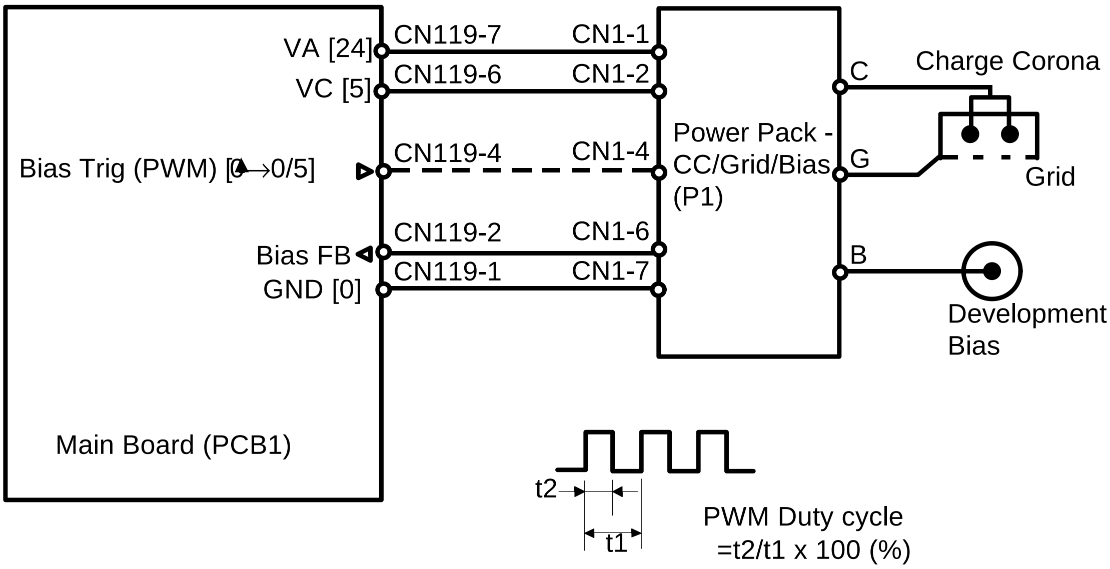
During the drum's life, drum residual voltage (Vr) will gradually increase. The Vr correction compensates for the residual voltage on the drum. The Vr correction is done every 1,000 copies. The following table shows how the development bias voltage changes depending on the Vr ratio.

Vr ratio (L) (%) (SP67)	Change of bias voltage (volts)
100 to 84	±0
83 to 58	–40
57 to 41	–80
40 to 28	–120
27 to 0	–160

L = Vrp/Vsg x 100 (%)
Vrp: ID sensor output for Vr correction pattern
Vsg: ID sensor output for bare drum

When the Vr correction is made (every 1,000 copies), all the LED's of the erase lamp turn on and the development bias becomes 0 volts so as to develop the Vr pattern.

5.5 DEVELOPMENT BIAS CIRCUIT

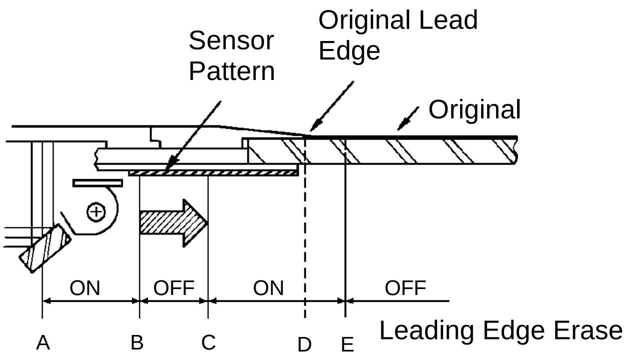


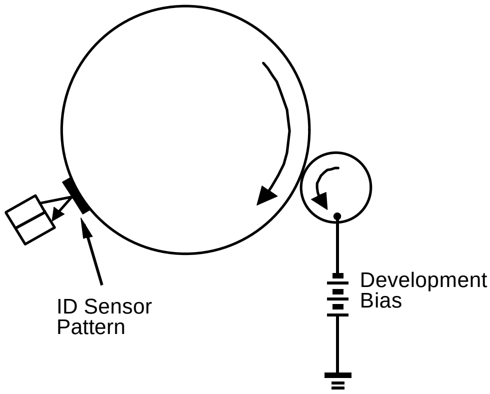
The main board supplies +24 volts to the CC/Grid/Bias power pack at CN1-1. When the Start key is pressed, the CPU starts sending the bias trigger pulses to CN1-4. This energizes the development bias circuit within the CC/Grid/Bias power pack, which applies a high negative voltage to the development roller. The development bias is applied whenever the drum is rotating except when the Vr pattern is developed.

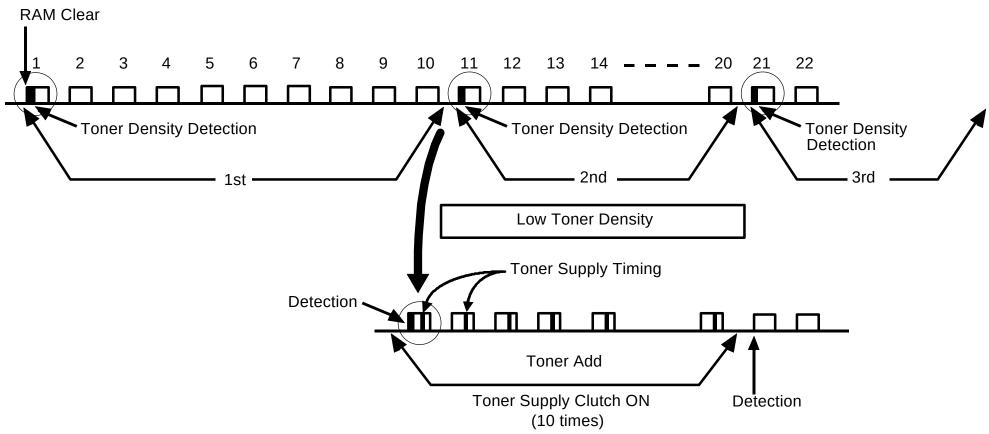
The bias trigger pulse applied to CN1-4 is a pulse width modulated signal (PWM signal). The width of the pulses controls the voltage level of the development roller. As the width of the trigger pulses increase, the voltage to the development roller also increases (becomes more negative). The CPU monitors the development bias voltage at CN119-2 and controls the width of the bias trigger pulses based on this feedback.

6. TONER DENSITY DETECTION & TONER SUPPLY

6.1 OVERVIEW







The CPU checks toner density by directly sensing the image density every 10 copy cycles. If the RAM is cleared (SP99), or a new RAM is installed, the CPU checks the image density at the beginning of the first copy cycle.

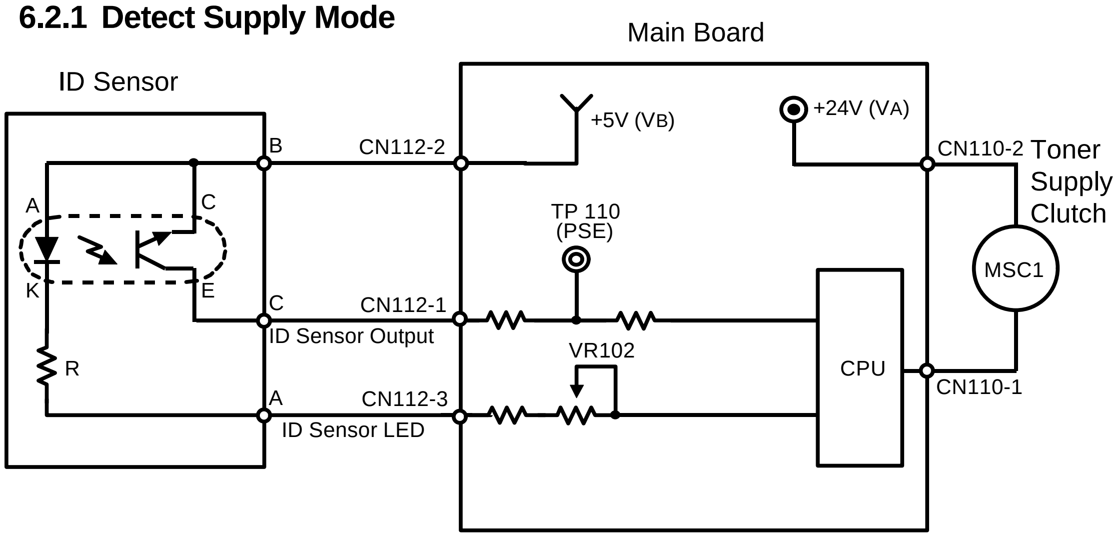
During the check cycles, the sensor pattern is exposed prior to the exposure of the original. After the sensor pattern is developed, its reflectivity is checked by the image density sensor (a photosensor). The CPU notes the reflectivity and if the reflected light is too strong, indicating a too low toner density condition, toner is added to the development unit.

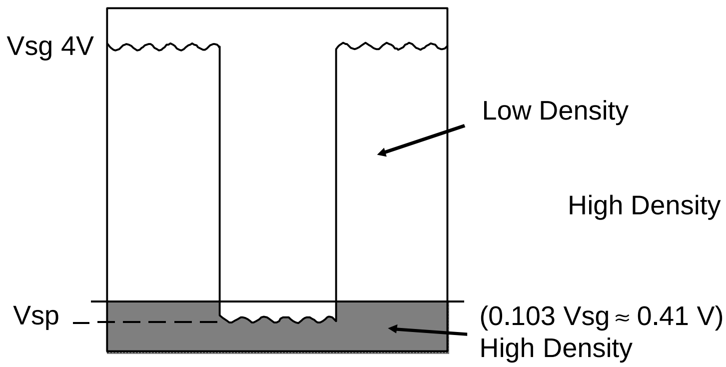
The toner is not added all at once. The CPU will energize the toner supply clutch for the proper amount of time in order to add a selected amount of toner over the next 10 cycles.

When the free run mode (DIP switch 101-1, ON) is selected, the CPU checks the toner density every copy cycle.

6.2 ID SENSOR FUNCTION

6.2.1 Detect Supply Mode





The image density sensor checks the density of the sensor pattern image once every 10 copy cycles. The CPU receives two voltage values directly from the sensor: the value for the bare drum (Vsg) and the value for the sensor pattern (Vsp). These two values are then compared to one another in order to determine whether more toner should be added.

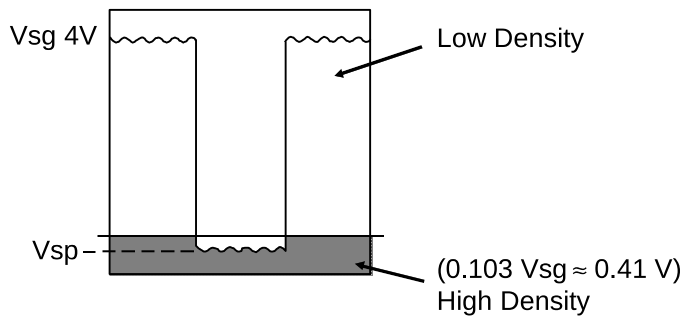
1. $\frac{Vsp}{Vsg} \times 100 < 10.3$ ..... No toner is added. (High density)
2. $\frac{Vsp}{Vsg} \times 100 \geq 10.3$ ..... Toner is added. (Low density)

When the image density is too low, the CPU activates the toner supply clutch to add toner over the next 10 copy cycles. The amount of toner added depends on the value of Vsp, the selected toner supply ratio (SP31), and ID sensor data. (See page 2-37 for more information.)

When SP35 is set to "1" (factory setting = "0"), the CPU changes the interval of the toner density detection from every 10 copies to every 5 copies.

6.2.2 Fixed Supply Mode

When SP30 is set to "1" (factory setting = "0"), the fixed supply mode is selected. In this case, a fixed amount of toner is added every copy cycle depending on the selected toner supply ratio (SP32) and the paper size in use. (See page 2-39 for more information.) However, the toner supply clutch is de-energized to prevent over-toning when Vsp is lower than 0.103 Vsg. (≈ 0.41 volts when Vsg = 4.0 volts).



6.3 ABNORMAL CONDITION IN TONER DENSITY DETECTION

If Vsg goes below 2.5 volts (LOW Vsg) or Vsp goes above 2.5 volts (HIGH Vsp) for 5 consecutive toner density detection cycles, the CPU determines that the toner density detection is abnormal. The CPU changes from the detect supply mode to the fixed supply mode. At the same time, either the auto ID indicator or the selected manual ID level starts blinking. The machine can be operated in this condition.

Abnormal Condition In Toner Density Detection

SP55 display		Conditions
Vsp	Vsg	
varies	0.00	Vsg ≤ 2.5 (LOW Vsg)
varies	5.00	Vsp ≥ 2.5 (HIGH Vsp)

6.4 DEVELOPMENT BIAS VOLTAGE FOR TONER DENSITY DETECTION

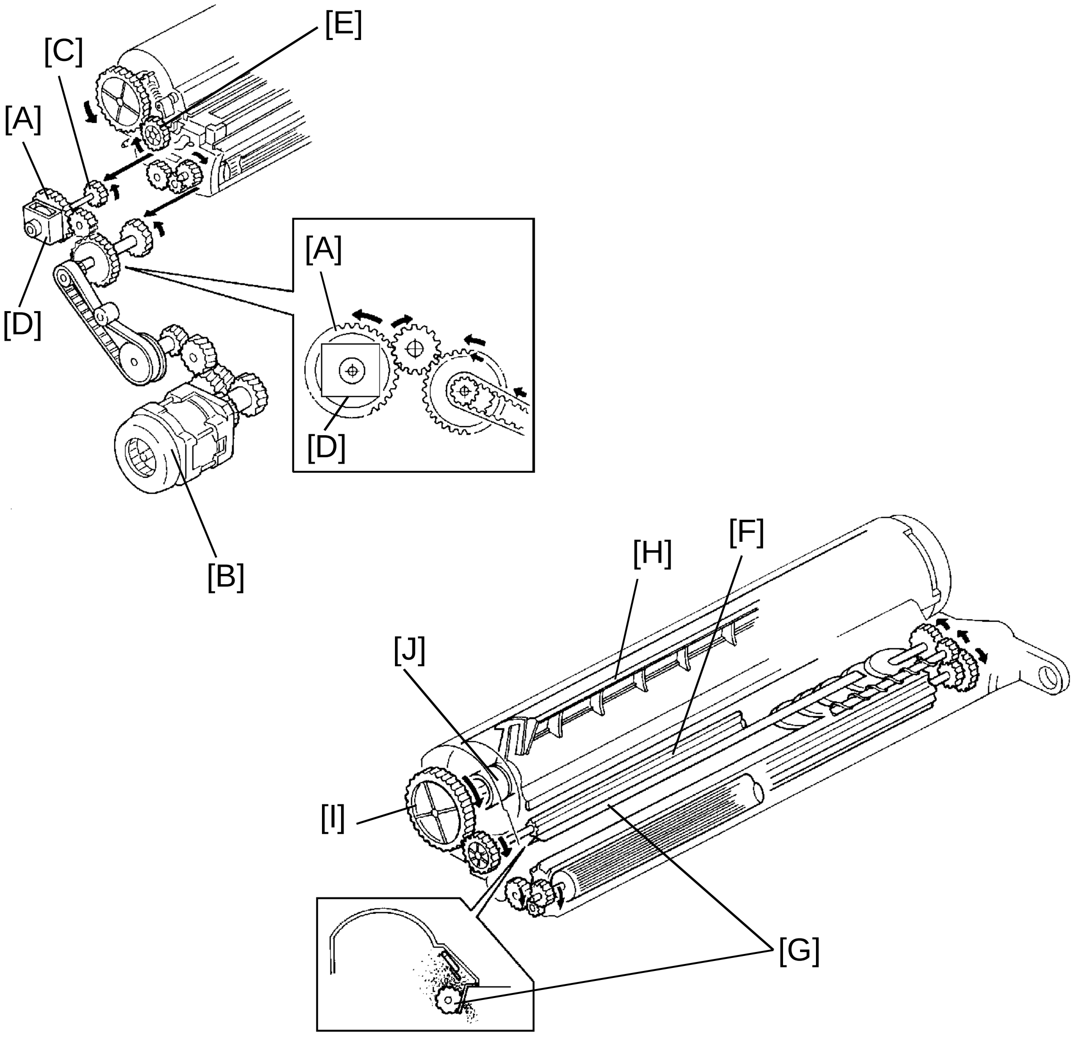
The development bias for toner density detection can be adjusted by SP33 in order to change the toner density level. The following table shows the development bias voltage corresponding to setting of SP33. This SP mode should be used only when the exposure lamp intensity adjustment (SP48) and the base bias adjustment (SP37) for copy image cannot achieve the desired image density.

Toner density	SP data (SP33)	Development bias voltage (volts)	
		0 to 499 copies	More than 500 copies
Normal	0	–240	–220
Low	1	–200	–180
High	2	–260	–240
Higher	3	–280	–260

After the developer initial setting (SP65) is performed, the triboelectric charge is still low. In this condition, the ID sensor pattern density is higher than it should be. This will cause the toner concentration in the developer to become too low.

To compensate for this occurance, the development bias voltage for the initial 499 copies is increased by –20 volts automatically as shown in the above table.

6.5 TONER SUPPLY AND AGITATOR DRIVE MECHANISM



The toner supply clutch gear [A] turns when the main motor [B] is on. The transmission of this rotation to the toner supply drive gear [C] is controlled by the toner supply clutch [D].

When the toner supply clutch energizes, the toner supply drive gear starts turning and drives the toner supply roller gear [E]. Toner catches in the grooves on the toner supply roller [F]. Then, as the grooves turn past the pin hole plate [G], the toner drops into the development unit through the pin holes.

The toner agitator [H] mechanism, which is contained in the toner cartridge, prevents toner from clumping. The toner agitator gear [I] turns whenever the toner supply clutch energizes. Rotation passes through the toner cartridge casing to the agitator junction [J].

6.6 TONER SUPPLY AMOUNT

This copier has two different ways of controlling the amount of toner supplied. Normally, the detect supply mode controls toner supply; however, a fixed supply mode also can be selected by SP30.

6.6.1 Detect Supply Mode (SP30 = 0)

The amount of toner supplied depends on the ID sensor data and the detect toner supply ratio data. The toner supply clutch on time in each copy cycle is calculated as follows:

Toner Supply Clutch ON Time = I x T (pulses)

Where : I = ID Sensor Data
T = Detect Toner Supply Ratio Data (SP31)

ID Sensor Data

Vsp/Vsg x 100 (Vsp, if Vsg = 4.0 volts)	Toner supply level (Toner supply ratio, SP31 = 0)	ID sensor data
0 to 10.3% (0 to 0.41 volts)	No toner supply (0%)	0
10.3 to 10.8% (0.41 to 0.43 volts)	1 (3.75%)	22
10.8 to 11.8% (0.43 to 0.47 volts)	2 (7.5%)	44
11.8 to 15.2% (0.47 to 0.61 volts)	3 (15%)	87
15.2 to 62.5% (0.61 to 2.5 volts) (See note below.)	4 (30%)	174 (Toner End level)
62.5 to more than 100% (2.5 to 5.0 volts)	Fixed supply mode	N/A (Abnormal Condition)

NOTE: If this condition is detected two times consecutively, the toner supply ratio rises to 60% (ID Sensor Data = 348), which is double that at toner supply level 4.

Detect Toner Supply Ratio Data (SP31)

Data (SP31)	Toner supply ratio at toner supply level 3	Toner supply ratio data
0	15%	2
1	7%	1
2	30%	4
3	60%	8

For example: Vsp = 0.45 volts, which means the toner supply level is "2" and the ID sensor data is 44.

The data of SP31 is set to "0".
The toner supply ratio is 15% and the toner supply data is 2.

Toner Supply Clutch ON Time
= I x T
= 44 x 2
= 88 (pulses)
= 352 (msec.) (1 pulse = 4.0 msec.)

6.6.2 Fixed Supply Mode (SP30 = 1)

The amount of toner supplied depends on the fixed toner supply ratio data and the paper size data. The toner supply clutch on time in each copy cycle is calculated as follows:

Toner Supply Clutch ON Time = T x P x 2 (pulses)

Where: T = Fixed Toner Supply Ratio Data (SP32)
P = Paper Size Data

Fixed Toner Supply Ratio Data (SP32)

Data (SP32)	Toner supply ratio	Toner supply ratio data
0	7.0%	2
1	3.5%	1
2	10.5%	3
3	14.0%	4

Paper Size Data

Paper size	Paper size data
B4	43
A4R	29
B5R	23
A5R	15
10" x 14", 81/2" x 14", 81/4" x 14"	43
81/2" x 13", 81/4" x 13" (F4), 8" x 13"	33
81/2" x 11", 8" x 101/2"	29
8" x 10"	27
51/2" x 81/2"	14

For example: The data of SP32 is set to "0".
The toner supply ratio is 7.0% and the toner supply data is 2.
Paper size is 8.5" x 11". The paper size data is 29.

Toner Supply Clutch ON Time
= T x P x 2
= 2 x 29 x 2
=116 (pulses)
= 464 (msec.) (1 pulse = 4.0 msec.)

6.7 TONER END CONDITION

The image density sensor is used to detect a toner end condition in both detect and fixed supply modes.

6.7.1 Near Toner End Condition

When the Vsp/Vsg x100 becomes greater than 15.2, the toner density detection cycle changes from every 10 copies to 5 copies. When this condition is detected again, the toner supply ratio becomes two times the amount of toner supply level 4 (Toner supply ratio = 60%, ID sensor data = 348). Then, when this condition is detected five times consecutively, the CPU determines that there is a near toner end condition and starts blinking the Add Toner indicator.

6.7.2 Toner End Condition

After the Add Toner indicator starts blinking (Near Toner End Condition), the operator can make 50 copies. If a new toner cartridge is not added within that 50 copy interval, copying is inhibited and a toner end condition is determined. In this condition, the Add Toner indicator lights and the Start indicator turns red.

Example: (Detect Mode)

Copy number	Toner density detection cycle	Vsp/Vsg x 100	Toner supply ratio (If SP31=0)	Indicator
1st~5th copies	1st copy	15.3	30%	
6th~10th copies	6th copy	15.3	60%	
11th~15th copies	11th copy	15.3	60%	
16st~20th copies	16th copy	15.3	60%	
21st~25th copies	21st copy	15.3	60%	Add Toner indicator starts blinking. (Near toner end condition)
• • • •	• • • •	• • • •	• • • •	Add Toner indicator blinks. (Near toner end condition)
71st copy	—	—	—	Add Toner indicator lights. (Toner end condition)

When the Vsp/Vsg x 100 becomes greater than 28.0 for two consecutive toner detection cycles, the CPU determines immediately that there is a toner end condition and copying is inhibited. This causes the Add Toner indicator to light and the Start indicator turns red.

Example: (Detect Mode)

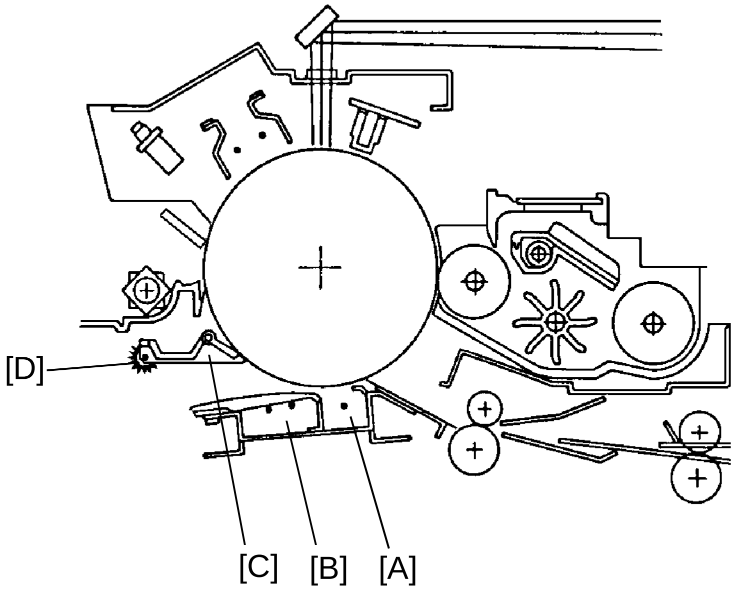
Copy number	Toner density detection cycle	Vsp/Vsg x 100	Toner supply ratio (If SP31=0)	Indicator
1st~5th copies	1st copy	18.3	30%	
6th~10th copies	6th copy	28.3	60%	
11th copy	11th copy	28.3	—	Add Toner indicator lights. (Toner end condition)

6.7.3 Toner End Recovery

After the toner cartridge is replaced and the front cover is closed, the CPU turns on the main motor, and turns on the toner supply clutch to supply toner to the development unit from the toner cartridge. Toner density is detected (Vsp and Vsg are monitored) during this period. When Vsp/Vsg x 100 becomes less than 15.2, the main motor is turned off and the toner end or near end condition is cleared.

If Vsp/Vsg x 100 stays greater than 15.2 (when the toner cartridge is not replaced), the toner end or near end condition is not cleared. If Vsp/Vsg x100 stays between 15.2 to 28.0, only one copy can be made. After the copy job the Add Toner indicator lights and copying is inhibited. If Vsp/Vsg x100 stays greater than 28.0, copying is inhibited. This prevents the customer from making copies with the toner end condition by opening and closing the front cover.

7. IMAGE TRANSFER & PAPER SEPARATION



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7.1 IMAGE TRANSFER

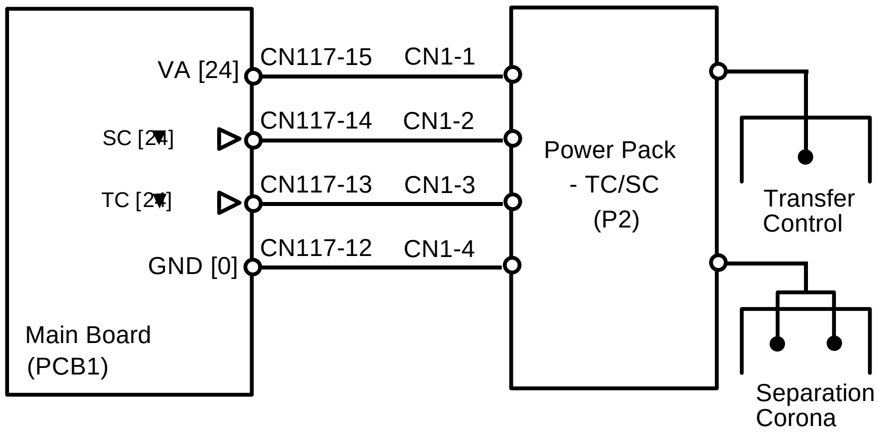
A high negative voltage (–5.0 kilovolts) is applied to the transfer corona wire [A], and the corona wire generates negative ions. These negative ions are applied to the back side of the copy paper. This negative charge forces the paper against the drum and attracts the positively charged toner onto the paper.

7.2 PAPER SEPARATION

After image transfer the copy paper must be separated from the drum. In order to break the attraction between the paper and the drum, the separation corona wire [B] applies an ac charge to the reverse side of the paper. The stiffness and weight of the paper then causes it to separate from the drum.

The negative charge on the paper (from the transfer corona) is not completely discharged until the paper is far enough from the drum that the toner will not be reattracted to the drum. The pick-off pawl [C] ensures that thin, low stiffness paper and upward curled paper separate completely. The spurs [D] prevent the unfused toner on the paper from being smeared by the pick-off pawl.

7.3 TRANSFER/SEPARATION CORONA CIRCUIT



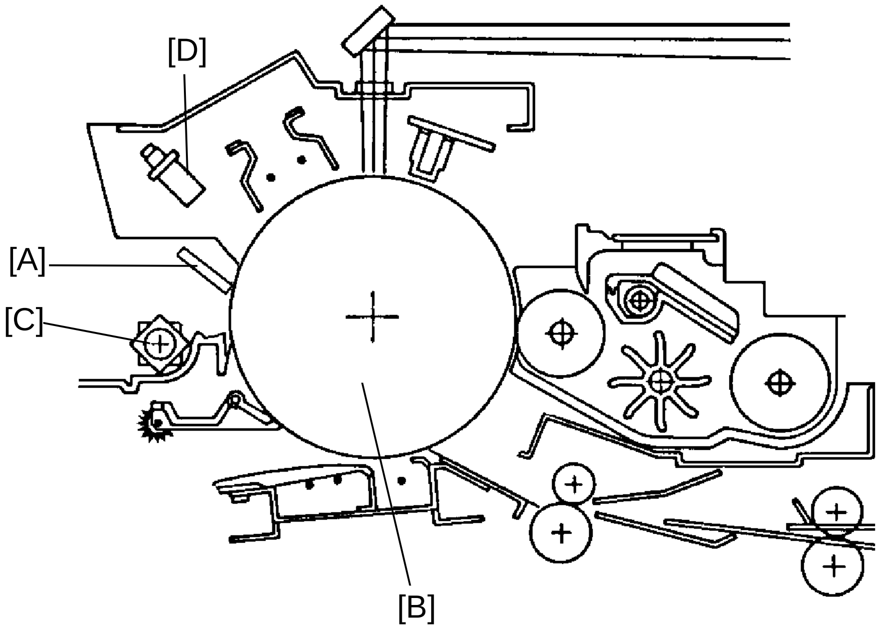
To apply the negative charge for the transfer corona, the main board outputs a LOW signal (CN117-13) shortly after the Start key is pressed.
To apply an ac charge for the separation corona, the main board also outputs a LOW signal (CN117-14) at about the same time.

The TC/SC power pack has a dc to dc converter and a dc to ac inverter. The dc to dc converter changes +24 volts to --5.0 kilovolts for the transfer corona. The inverter changes +24 volts to the 3.8 kilovolts ac (500 Hz) for the separation corona.

The separation corona circuit in the TC/SC power pack has a current leak detection circuit for safety. When this circuit detects that more than 3.0 milli-amperes is being supplied to the separation corona, the separation corona turns off immediately. When the main switch is turned off and on, or the front cover or the exit cover is opened and closed, this condition is cleared.

8. DRUM CLEANING

8.1 OVERVIEW



This copier uses the counter blade system for drum cleaning.
The cleaning blade [A] is angled against drum rotation. This counter blade system has the following advantages:

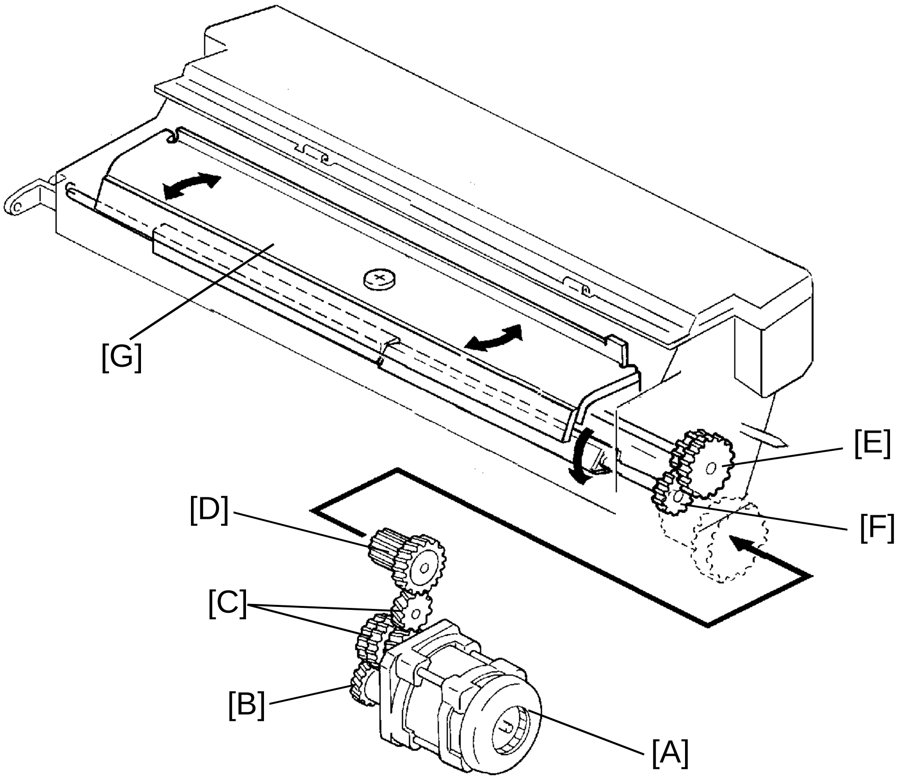
- Less wearing of the cleaning blade edge.
- High cleaning efficiency.

Due to the high efficiency of this counter blade system, this copier does not use a cleaning brush.

The removed toner falls into the cleaning unit. The toner collection roller [C] carries the used toner to the used toner tank. The quenching lamp [D], which consists of four small neon lamps, neutralizes any charge remaining on the drum in preparation for the next copy cycle.

The cleaning blade is always in contact with the drum. It releases when the release knob is pressed. This prevents the drum from being damaged when the cleaning unit is removed or installed.

8.2 DRIVE MECHANISM



The rotation of the main motor [A] is transmitted to the cleaning unit through the main motor gear [B], the relay gears [C], and the cleaning drive gear [D].

The gear [E] driven by the cleaning drive gear passes the rotation to the toner collection roller gear [F].

The cleaning blade [G] is mounted in the center of the blade and is tilted to apply even pressure.

8.3 USED TONER OVERFLOW DETECTION

The CPU uses the toner end counter and an overflow counter to detect the used toner overflow.

A used toner overflow condition is detected when either of the following conditions occur.

(1) When the overflow counter reaches 80K copies.
The overflow counter counts the total number of copies since the last time the toner end counter was cleared. When the overflow counter reaches 80K copies, the CPU starts to blink "E70" on the operation panel. An additional 250 copies can be made before the Start indicator turns red and copying is inhibited.

(2) When the number of toner end counter reaches 9.
When the number of the toner end counter reaches 9, the following number of copies can be made before the "E70" starts to blink.
This number is determined by the number in the overflow counter when the 9th toner end condition was detected.

N: Overflow Counter

$78K < N < 80K$	The remaining copies to reach 80K copies can be made.
$75K < N \leq 78K$	2K copies can be made
$50K < N \leq 75K$	3K copies can be made
$40K < N \leq 50K$	1K copies can be made
less than 40K	No copy

After the above number of copies is made, the CPU starts to blink "E70". Up to an additional 250 copies can be made after this. Then, the Start key turns red and copying is inhibited.

After disposing of the toner in the used toner tank, use SP83 to clear the toner end counter and overflow counter.

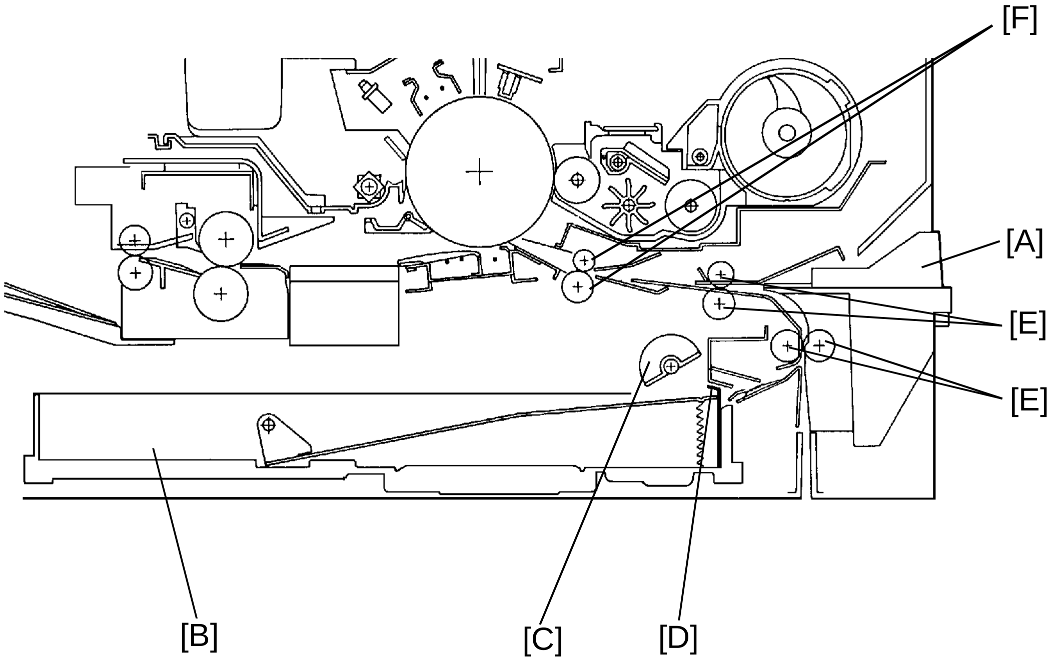
Toner end counter clear (SP83)

Data (SP83)	Memory counter
0	Not clear
1	Clear

SP58 shows the number in the toner end counter. When "1" is input in SP83, the data of SP58 is cleared. There is no SP mode to display the overflow counter.

9. PAPER FEED AND REGISTRATION

9.1 OVERVIEW



This copier has one paper feed station and a by-pass feed table [A].

The paper feed station uses a paper tray [B] which can hold 250 sheets. The by-pass feed table can hold only 1 sheet.

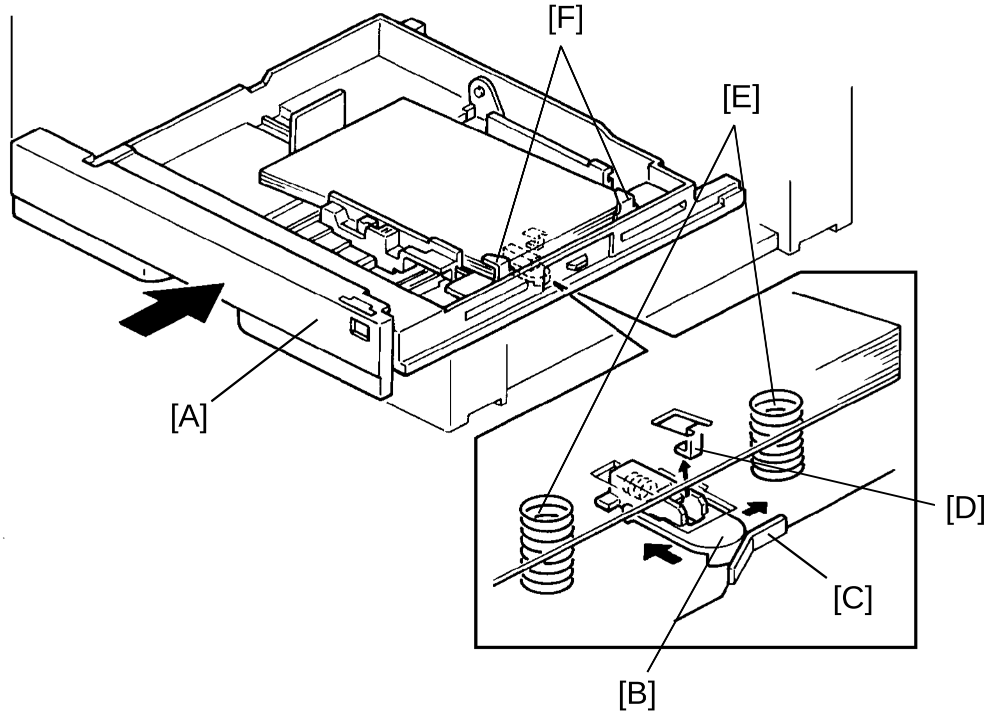
The paper tray uses a semicircular feed roller [C] and corner separator [D] system. The semicircular feed rollers (six rollers) make one rotation to drive the top sheet of paper to the relay rollers [E], which then feed the paper to the registration rollers [F].
The paper tray has two corner separators, which allow only one sheet to feed. They also serve to hold the paper stack.

When the paper tray is closed after the paper is loaded, the paper tray pushes the tray set switch. This informs the CPU that the paper tray is set.

An auto start system is used for the by-pass feed table. When copy paper is inserted into the by-pass table, paper will be fed into the copier automatically without having to press the Start key.

This machine has no sensors or switches to detect the paper size.

9.2 PAPER LIFT MECHANISM



When the paper tray [A] is closed after paper is loaded, the plate release slider [B], which is mounted on the bottom part of the paper tray, is pushed by the projection [C] of the copier frame and the release slider disengages the bottom plate hook [D]

Once the bottom plate hook is disengaged, the bottom plate is raised by the pressure springs [E] and the paper stack is pushed up to the corner separators [F]. This keeps the stack of paper at the correct height.

9.3 PAPER LENGTH DETECTION (Paper Feed Station)

The paper length is measured using the registration sensor and the determined paper size is stored in memory. The paper length measurement is performed only during the first copy after the following conditions:

1. When the main switch is turned on.
2. When the front cover is opened and closed.
3. When the paper tray is opened and closed.

The previous paper length is also cleared from memory by the above actions.

As shown in the following table, the CPU determines the size of the paper in the paper tray based on the period of time (paper length) it takes for the paper to pass the registration sensor.

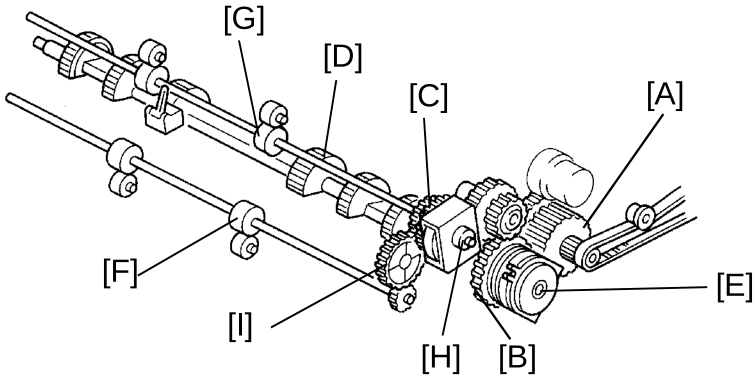
Paper length (mm)	Paper size
364	B4
356	10" x 14"
330	8 1/2" x 13"
297	A4R
279	8 1/2" x 11"
267	8" x 10 1/2"
257	B5R
254	8" x 10"
216	5 1/2" x 8 1/2"
210	A5R

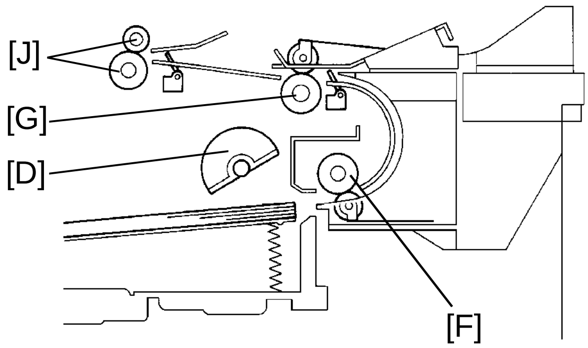
Since the CPU does not have the paper length in memory for the first copy cycle, the CPU controls the machine for the maximum paper size of B4 (257 mm x 364 mm).

From the second copy cycle on, the CPU controls the machine for the correct paper size based on the data stored during the first paper cycle.

Whenever the by-pass feed table is used, the CPU determines the paper size to be B4 (257 mm x 364 mm).

9.4 PAPER FEED DRIVE MECHANISM





Through a series of gears and a timing belt, main motor rotation is transmitted to the relay gear [A], paper feed clutch gear [B] and then the relay roller clutch gear [C].

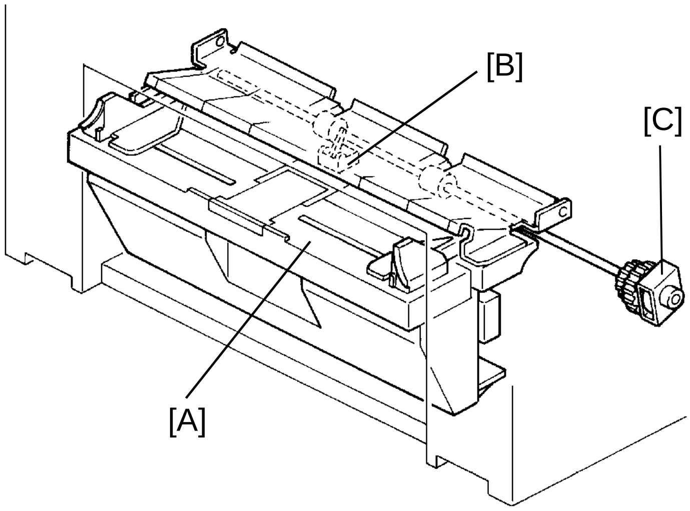
-- Feed rollers –

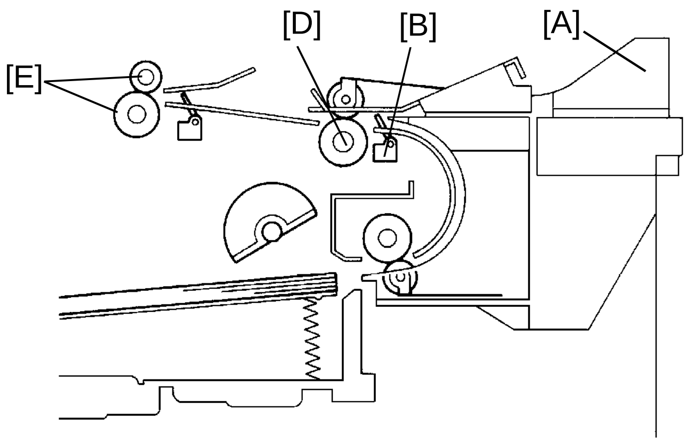
The paper feed clutch gear is secured on the shaft of the semicircular feed rollers [D]. The CPU energizes the paper feed clutch [E] after the Start key is pressed. At this time the semicircular feed rollers start rotating to feed the paper. The paper feed clutch stays on for 620 milliseconds to rotate the semicircular feed rollers for only one revolution. The leading edge of the copy paper reaches to the 1st relay rollers [F] when the paper feed clutch de-energizes.

-- 1st and 2nd relay rollers --

The relay roller clutch gear is secured on the shaft of the 2nd relay rollers [G]. The rotation timing for the 2nd relay rollers and the 1st relay rollers is controlled by the relay roller clutch [H]. The CPU energizes the relay roller clutch after the Start key is pressed (The same timing with the paper feed clutch). At this time, both the 1st and 2nd relay rollers start rotating. The drive is transmitted to the 1st relay rollers through a relay gear [I]. Paper is fed from the 1st and 2nd relay rollers to the registration rollers [J].

9.5 BY-PASS FEED TABLE (By-pass Auto Feed Mechanism)

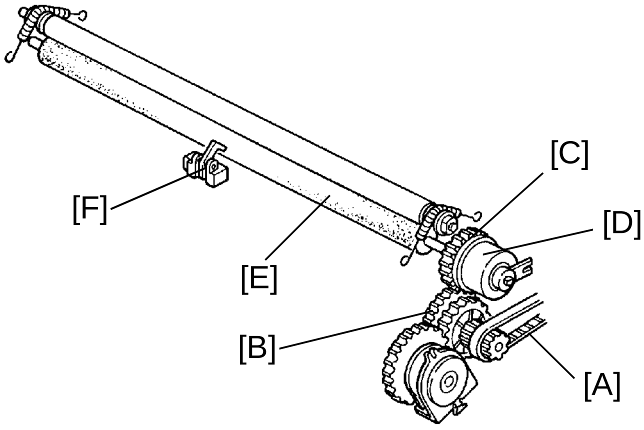


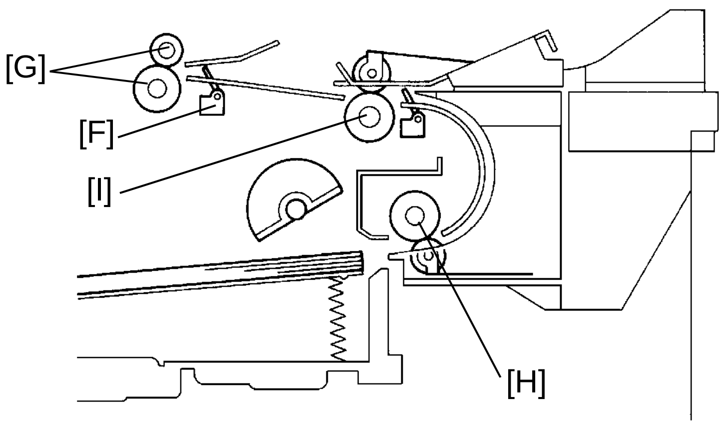


The by-pass feed table [A] can load only one sheet of paper.

When a sheet of copy paper is set in the by-pass feed table, the leading edge of the copy paper activates the relay sensor [B] which sends a low signal to the main board. The CPU energizes the relay roller clutch [C] after 500 milliseconds to feed the copy paper. Then, copy paper is fed from the 2nd relay rollers [D] to the registration rollers [E].

9.6 PAPER REGISTRATION





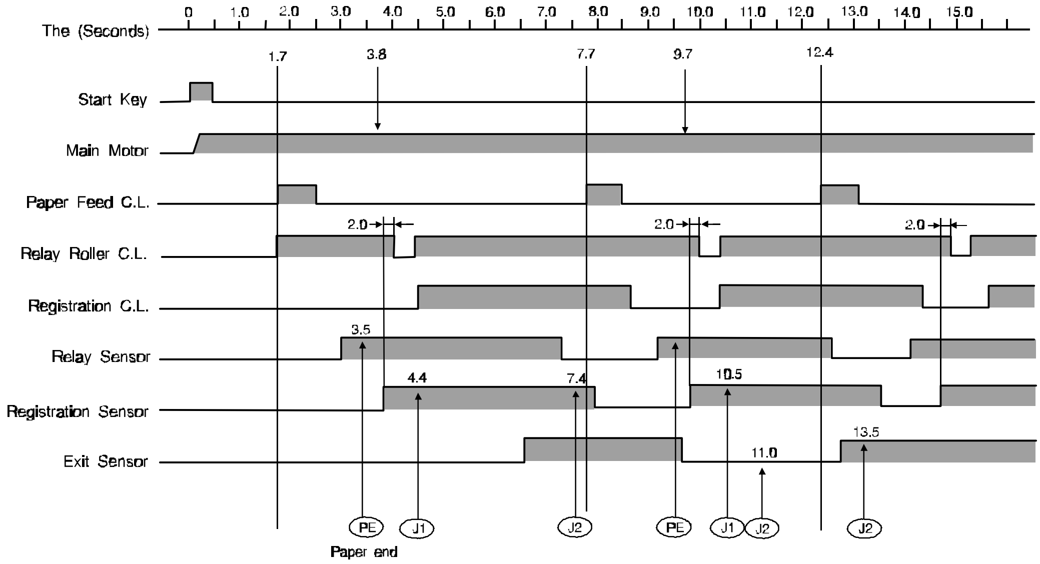
Main motor rotation is transmitted to the timing belt [A] through a series of gears. The timing belt rotates the relay gear [B] and then the registration roller clutch gear [C]. When the registration clutch [D] is energized, the rotation of the clutch gear is transmitted to the lower registration roller [E].

The registration sensor [F], which is positioned just before the registration rollers [G], control the relay roller clutch stop timing. The relay roller clutch stays on for 180 milliseconds after the leading edge of the paper actuates the registration sensor. The CPU then turns off the relay roller clutch. This delay allows time for the paper to press against the nip of the registration rollers and causes the paper to buckle slightly so as to correct any paper skew.

The CPU energizes the registration clutch and re-energizes the relay roller clutch at the proper time to align the paper with the image on the drum. The registration, 1st [H] and 2nd [I] relay rollers feed the paper to the image transfer section.

The registration sensor is also used for paper misfeed detection.

9.7 PAPER FEED AND MISFEED DETECTION TIMING



1st Copy = B4
2nd Copy = A4/8 1/2 "x 11"

The relay sensor, registration sensor and exit sensor are used for misfeed detection. If the CPU detects a misfeed, the Check Paper Path and the Misfeed Location Number (PE, J1, J2) indicators turn on.

When the main switch is turned on, the CPU checks these three sensors for initial misfeed.

During the copy cycle, the CPU performs three types of misfeed detection:

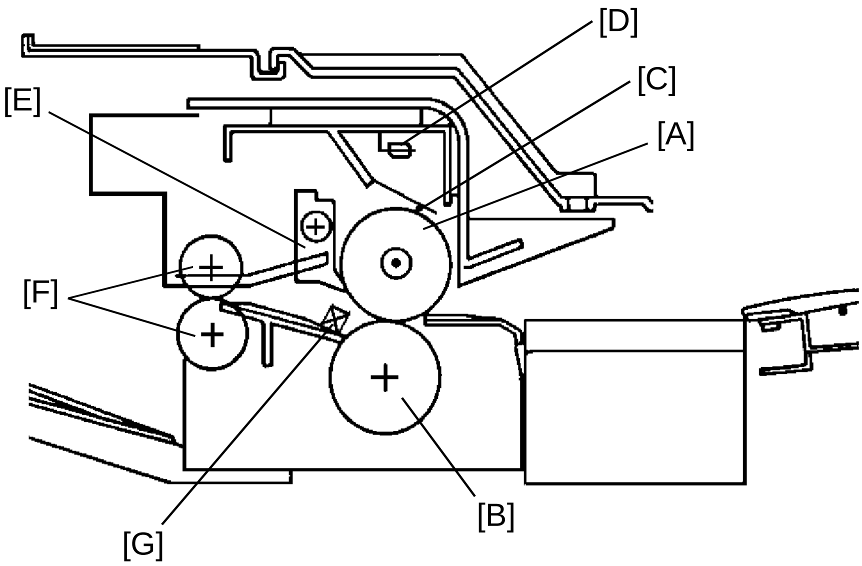
PE: Checks whether the relay sensor is actuated within 3.5 seconds after the Start key is pressed (only PE indicator turns on). This machine has no indicator or sensor to detect the paper end. The PE indicator is lit in the paper end condition as well.

J1: Checks whether the registration sensor is actuated within 4.4 seconds after the Start key is pressed. (J1 and Check Paper Path indicators turn on.)

J2: Checks whether the exit sensor is actuated within 7.4 seconds after the Start key is pressed, or whether the copy paper has passed through the exit sensor 4.24 seconds (B4 size) after the exit sensor has been actuated (3.57 seconds for A4/LT lengthwise).
(J2 and Check Paper Path indicators turn on.)

10. IMAGE FUSING

10.1 OVERVIEW

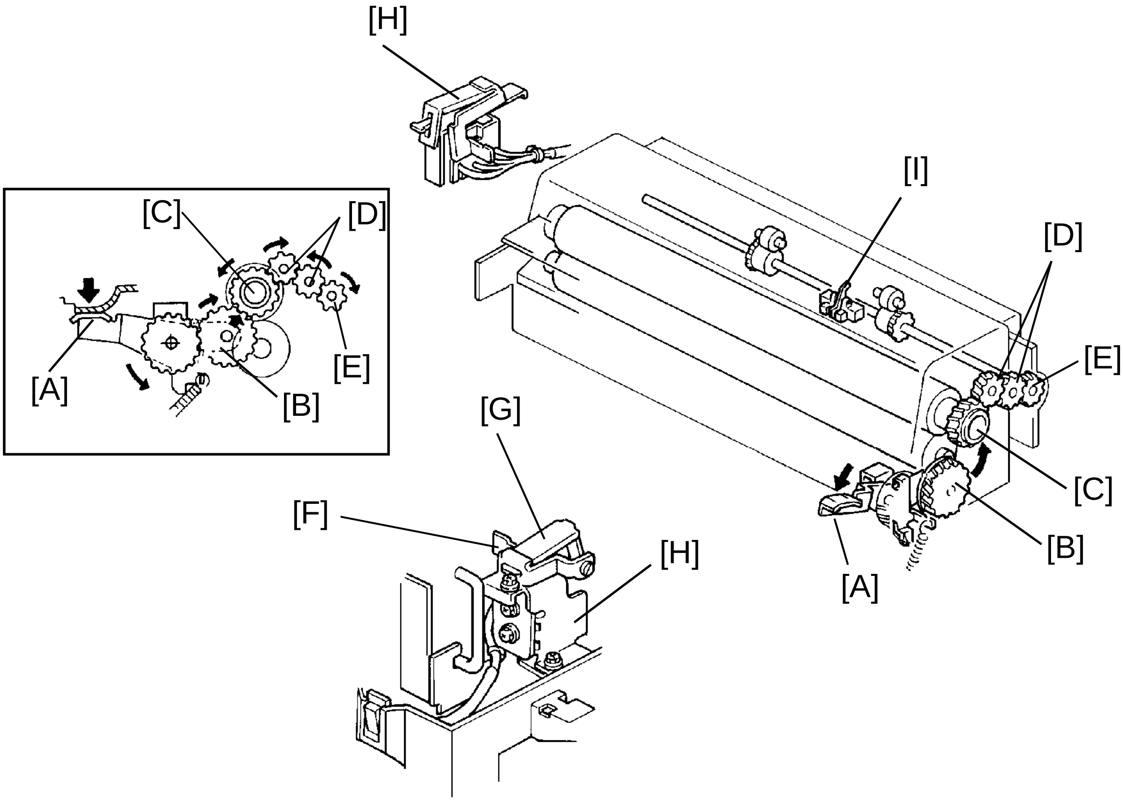


After the image is transferred, the copy paper enters the fusing unit. The image is fused to the copy paper by the process of heat and pressure through the use of a hot roller [A] and pressure roller [B].

The CPU monitors the hot roller’s surface temperature through a thermistor [C] which is in contact with the hot roller’s surface. A thermoswitch [D] protects the fusing unit from overheating.

The hot roller strippers [E] separate the copy paper from the hot roller and direct it to the exit rollers [F]. The exit sensor [G] monitors the movement of the copy paper through the fusing unit and acts as a misfeed detector. The exit rollers drive the copy paper to the copy tray.

10.2 FUSING DRIVE MECHANISM AND COVER SAFETY SWITCH



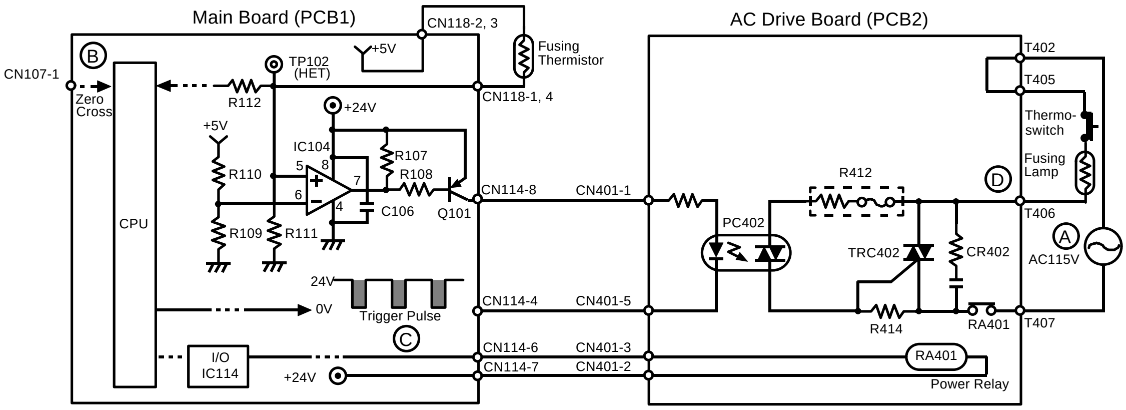
When the upper unit is closed the fusing engagement lever [A] is pressed down and an idler gear [B] engages with the hot roller gear [C]. Rotation passes from the hot roller gear through the idler gears [D] to the exit roller gear [E].

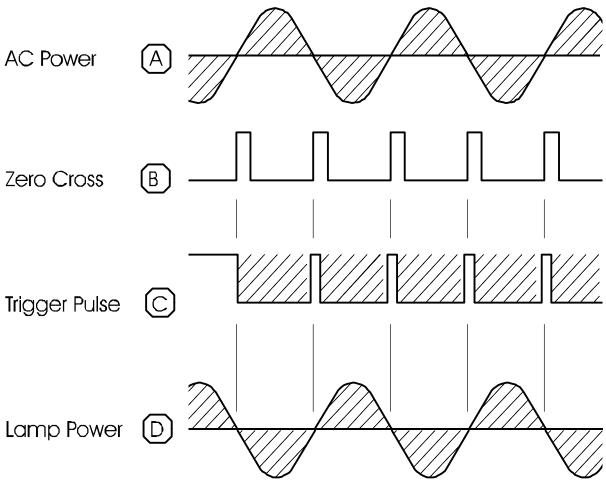
The fusing unit drive release mechanism automatically disengages fusing drive when the upper unit is opened. This allows the fusing rollers to rotate freely so that misfed paper can be easily removed.

When the exit cover and/or the front cover is opened, the switch lever [F] and/or the switch arm [G] release the cover safety switch [H] to remove all power from the copier.

The exit sensor [I] is used for paper misfeed detection.

10.3 FUSING LAMP CONTROL CIRCUIT



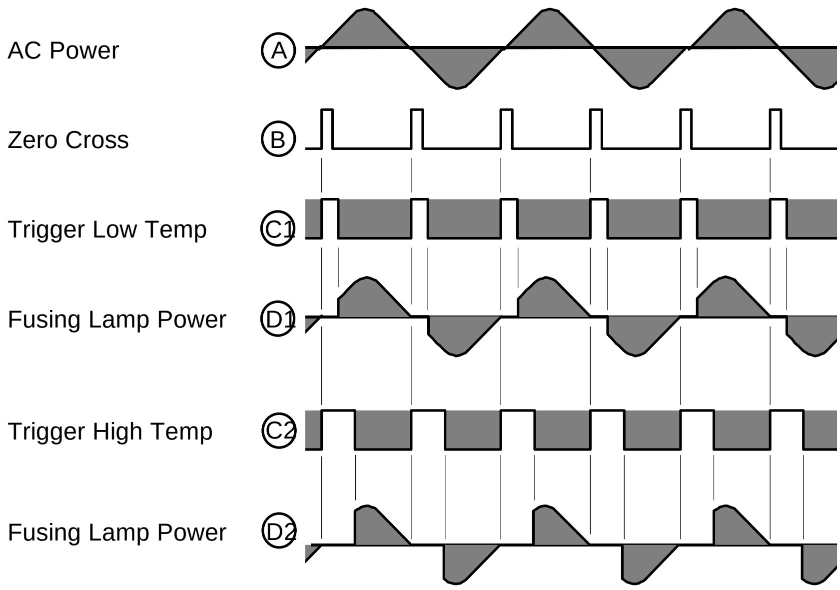


The main board monitors the fusing temperature through a thermistor. It also uses the zero cross signal generated by the dc power supply board to accurately control the applied power.

Normally, the voltage applied to the lamp is a full ac waveform. However, through SP29, fusing power can be phase controlled. (Normally, phase control is used only if the customer has a problem with electrical noise or interference.)

When the main switch is turned on, the main board starts to output a trigger pulse (C), which has the same timing as the zero cross signal (B), to the ac drive board. This trigger pulse allows maximum ac power to be applied to the fusing lamp. When the operating temperature is reached, the CPU stops outputting the trigger pulse (trigger goes HIGH) and the fusing lamp turns off.

10.3.1 Phase Control Mode



The main board sends the fusing lamp trigger pulse (LOW active) (C) to the ac drive board. PC402 activates TRC402, which provides ac power to the fusing lamp at the trailing edge of each trigger pulse. The trigger pulse goes HIGH when the main board receives the zero cross signal.

The amount of time that power is applied to the fusing lamp (D) depends on the temperature of the hot roller.

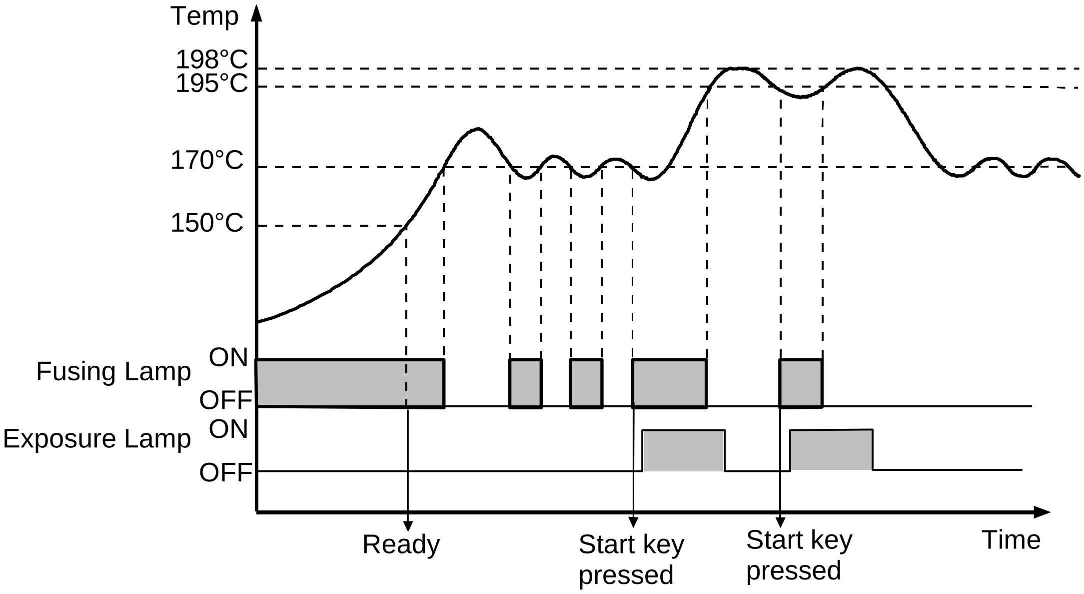
The trigger pulse (LOW part) is wider (C1) when the hot roller temperature is lower, and it is narrower (C2) when the hot roller is near the operating temperature.

10.3.2 Overheat Protection

IC104 and Q101 form an overheat protection circuit. When the fusing lamp is controlled within the normal range, pin 7 of IC104 stays LOW; therefore, Q101 stays on, allowing PC402 to operate. If the hot roller temperature reaches 240°C, the resistance of the thermistor becomes too low. At that time, pin 7 of IC104 becomes HIGH, turning off Q101 and stopping PC402. At the same time "E53" lights on the operation panel and the power relay (RA401) turns off.

Even if the thermistor overheat protection fails, a thermoswitch is installed in series with the fusing lamp that will prevent the fusing unit from excessively overheating. If the thermoswitch temperature reaches 170°C, the thermoswitch opens, removing power from the fusing lamp.

10.4 FUSING LAMP CONTROL



When the main switch is turned on, the CPU starts sending a trigger pulse to turn on the fusing lamp.

When the fusing temperature reaches 150°C, the Start indicator turns green (ready temperature). When the fusing temperature reaches 170°C (stand-by temperature), the CPU stops sending the trigger pulse and the fusing lamp turns off. The fusing lamp is turned on and off to keep the hot roller surface at the stand-by temperature of 170°C.

When the Start key is pressed, the fusing lamp is turned on to heat the hot roller up to the operation temperature of 195°C. (The operation temperature can be changed by setting the maximum temperature in SP79.)

To prevent any copy image problems caused by the exposure lamp intensity fluctuation, the fusing lamp (900W) does not turn on while the exposure lamp is on, even if the fusing temperature drops below 195°C.

10.5 ENERGY SAVER FUNCTION

When the copier is not in use, the energy saver function reduces the power consumption by decreasing the fusing temperature. The energy Saver indicator turns on and all the other indicators turn off.

For this copier, the energy saver function cannot be entered manually. To access this function, SP78 (Auto Energy Saver Mode) must be set to "1". And since this function is applied at the time when the machine enters the auto reset, SP15 (Auto Reset Time) must be set to "0" or "1" as well.

The energy saving ratio can be selected by SP86 as shown in the following table.

SP data (SP86)	Target benefit of power saving	Fusing temperature	Warm-up time
0	approx. Δ56%	approx. 60°C	approx. 25 sec.
1	approx. Δ47%	approx. 90°C	approx. 19 sec.
2	approx. Δ37%	approx. 120°C	approx. 12 sec.
3	approx. Δ25%	approx. 150°C	approx. 5 sec.

NOTE: The energy saving ratio in the above table are standard values measured in laboratory tests under controlled conditions. The actual ratios will vary depending on environmental conditions, copy modes, power supply conditions, and measurement instruments.

The greater the energy saving ratio is, the longer the wait time until the copier returns to the ready condition.

The copier exits the energy saver mode upon the following actions.

1. Pressing any key except the Start key.
2. Setting copy paper on the by-pass feed table.
3. Opening the optional DF or setting an original on it. (FT3213 only)
4. Opening and closing the front cover.
5. Turning the main switch OFF/ON.

SECTION 3

DOCUMENT FEEDER

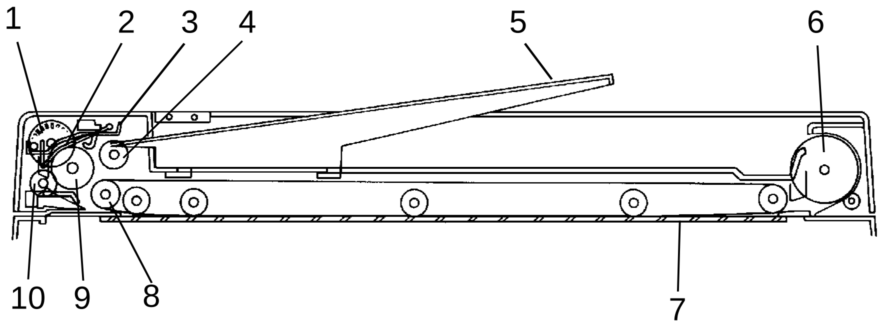
1. SPECIFICATIONS

Original Size:	Maximum: A3 or 11" x 17" Minimum: A5 Lengthwise or 5 1/2" x 8 1/2"
Original Weight:	53 to 105 g/m^2 (14 to 28 lb)
Original Feed:	Automatic Feed - ADF mode
Original Tray Capacity:	30 sheets - 80 g/m^2 (20 lb)
Original Set:	Face up - First sheet on top
Original Transport:	One flat belt
Copying Speed:	13 copies/minute (A4 lengthwise or 8 1/2" x 11" lengthwise)
Power Consumption:	35 W
Dimensions (W x D x H):	590 x 443 x 100 mm (23.3" x 17.5" x 4.0")
Weight:	Approximately 7 kg (15.5 lb)

- Specifications are subject to change without notice.
- The document feeder (DF40) can only be installed on the FT3213
- Only DF40 document feeders from S/N A296-4-05-0001 have the necessary accessory parts for installation on to the FT3213. These accessory parts include (1) ADF Interface Bracket Assy. P/N A3650661 & (2) Shoulder screws P/N A0771361.

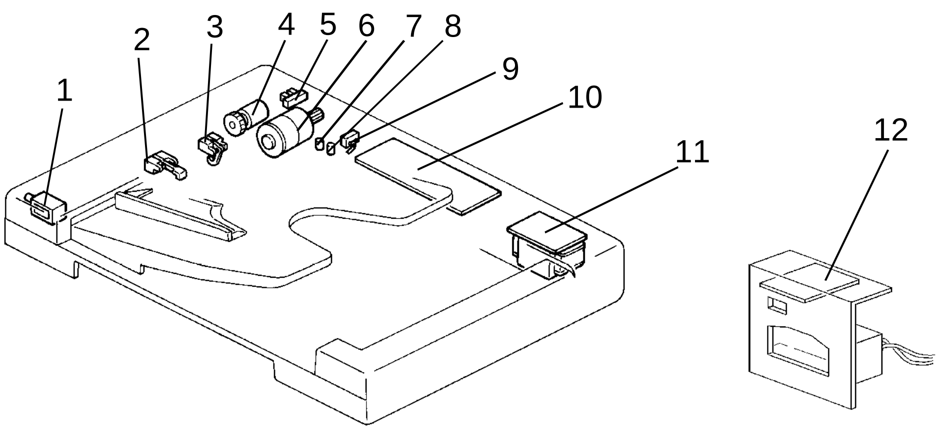
2. COMPONENT LAYOUT

2.1 MECHANICAL COMPONENTS



1. Pulse Generator Disk
2. Friction Belt
3. Pick-up Lever
4. Pick-up Roller
5. Original Table
6. Exit Roller
7. Transport Belt
8. Transport Belt Roller
9. Feed Roller
10. Relay Roller

2.2 ELECTRICAL COMPONENTS

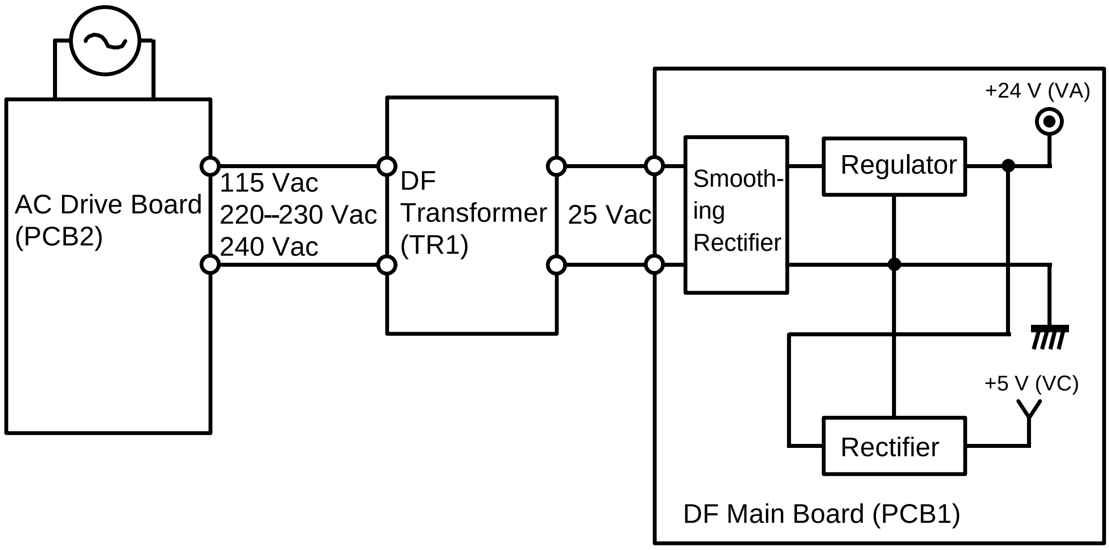


1. Pick-up Solenoid
2. Registration Sensor
3. Original Set Sensor
4. Feed Clutch
5. Pulse Generator Sensor
6. DF Motor
7. Insert Original Indicator
8. Original Misfeed Indicator
9. Lift Switch
10. DF Main Board
11. DF Transformer
12. DF Interface Board

3. ELECTRICAL COMPONENT DESCRIPTIONS

SYMBOL	NAME	FUNCTION	LOCATION
Motor			
M1	DF	Drives all the document feeder components.	6
Solenoid			
SOL1	Pick-up Solenoid	Energizes to press the pick-up lever against the stack of originals in preparation for original feed-in.	1
Clutch			
CL1	Feed Clutch	Turns on to transmit main motor rotation to the feed roller.	4
Switch			
SW1	Lift Switch	Informs the CPU when the DF is lifted and also serves as the misfeed reset switch for the DF.	9
Sensors			
S1	Pulse Generator Sensor	Supplies timing pulse to the DF main board.	5
S2	Original Set Sensor	Informs the copier CPU that originals have been placed and causes the Insert Original indicator to go out.	3
S3	Registration Sensor	Sets original stop timing and checks for original misfeeds.	2
Printed Circuit Board			
PCB1	DF Main Board	Controls all DF functions.	10
PCB2	DF Interface Board	Interfaces between the copier main board and the DF.	12
Transformer			
TR1	DF Transformer	Steps down the wall voltage to 25 volts ac.	11
LEDs			
LED1	Original Misfeed Indicator	Turns on when an original is misfed.	8
LED2	Insert Original Indicator	Turns off when the originals are inserted into the original table.	7

4. POWER DISTRIBUTION



The document feeder uses two dc power levels: +24 volts, and +5 volts.

When the main switch is turned on, the DF transformer receives the wall outlet ac power through the ac drive board and outputs 25 volts ac to the DF main board. Then, the dc power supply circuit on the DF main board converts the 25 volts ac input to +24 volts and +5 volts.

The +24 volts is used by the DF motor, the pick-up solenoid, and the feed clutch. The +5 volts is used by other electrical components.

5. BASIC OPERATION

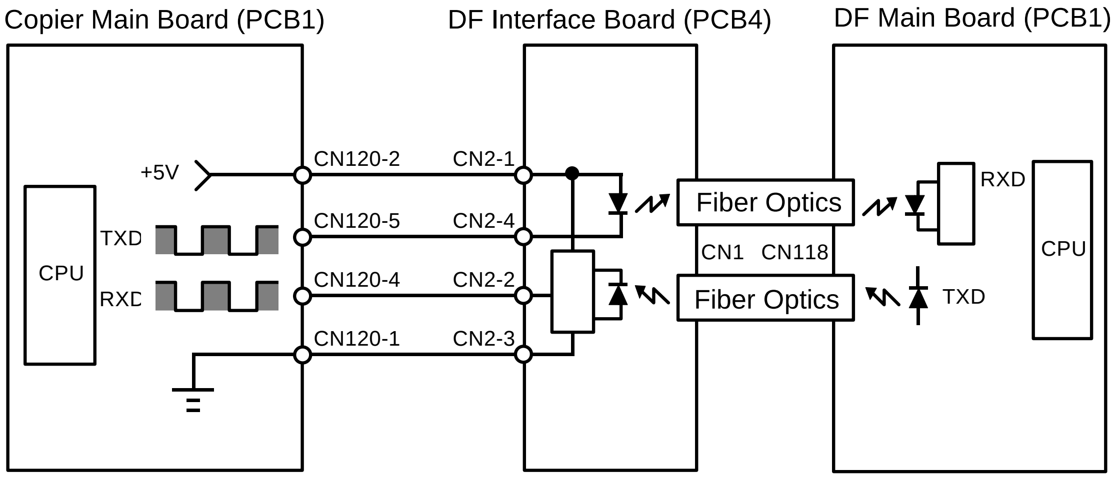
When the main switch is turned on, the DF CPU sends the "DF installed" signal to the copier CPU. Receiving this signal, the copier CPU recognizes that the document feeder is installed and sends the "DF confirmed" signal to the DF CPU.

When originals are placed on the original table, the Insert Original indicator turns off and the DF CPU sends the "original set" signal to the copier CPU to inform it that the originals have been set.

When the Start key is pressed, the copier CPU sends the "feed-in" signal to the document feeder. On receipt of this signal, the DF CPU energizes the DF motor, the pick-up solenoid, and the feed clutch to feed in the bottom sheet of the original stack onto the exposure glass. The pick-up solenoid, and the feed clutch remain energized until the original’s leading edge reaches the registration sensor. The DF motor turns off shortly after the original’s trailing edge passes the registration sensor. Then, the DF motor pauses and reverses for a moment to align the edge of the original with the scale.

The scanner starts, and the start timing does not depend on the progress of the original through the DF. When the scanner reaches the return position, the copier CPU sends the "original change" signal to the DF CPU in order to exchange the current original with the next original.

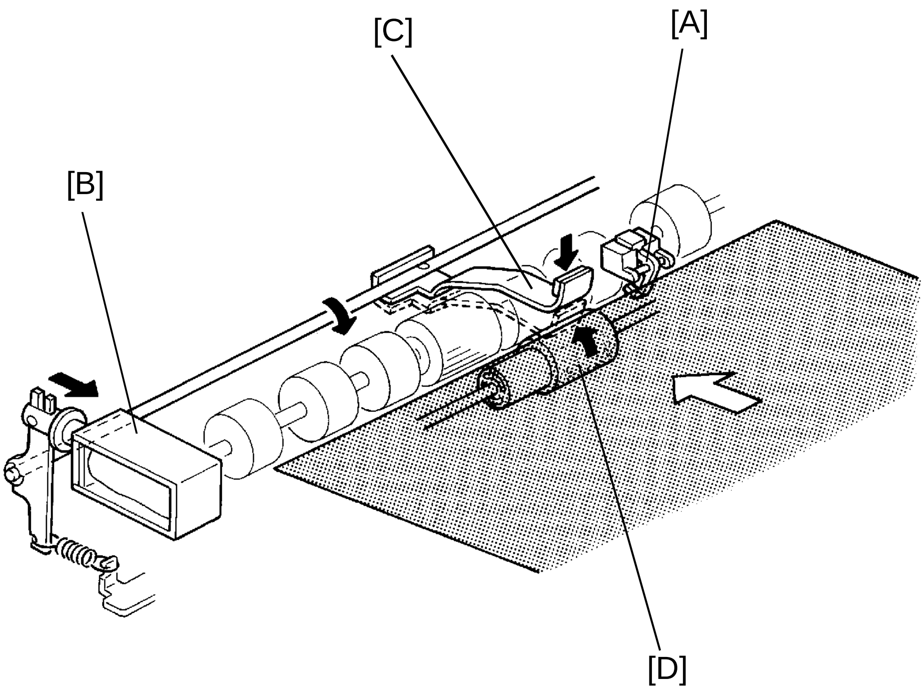
6. INTERFACE CIRCUIT



The copier CPU and the DF CPU communicate via the interface board using fiber optics. The interface board changes the optical signals to electrical signals (and vice versa).

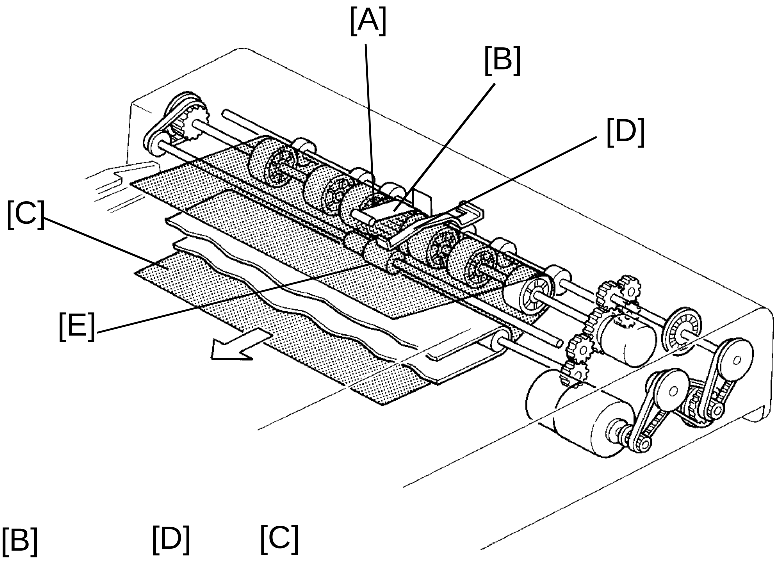
7. ORIGINAL FEED

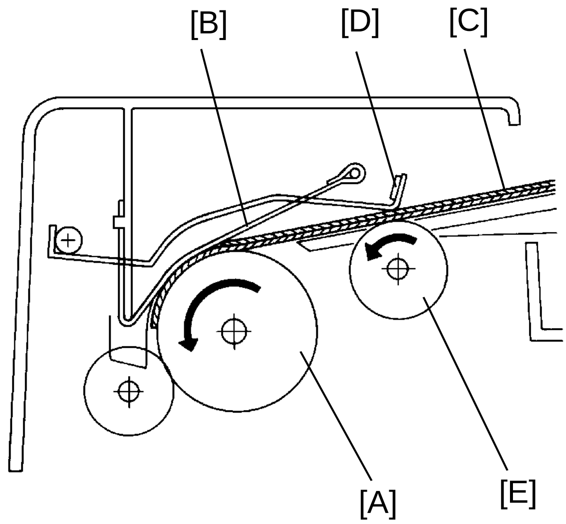
7.1 ORIGINAL PICK-UP MECHANISM



After setting the originals on the original table, the originals contact the feeler [A] of the original set sensor and cause the feeler to move out of the sensor. The DF CPU then sends the original set signal to the copier CPU to inform it that the document feeder will be used. When the Start key is pressed, the pick-up solenoid [B] is energized. The original stack is then pressed between the pick-up lever [C] and pick-up roller [D]. The rotation of the pick-up roller advances the bottom original.

7.2 ORIGINAL SEPARATION MECHANISM

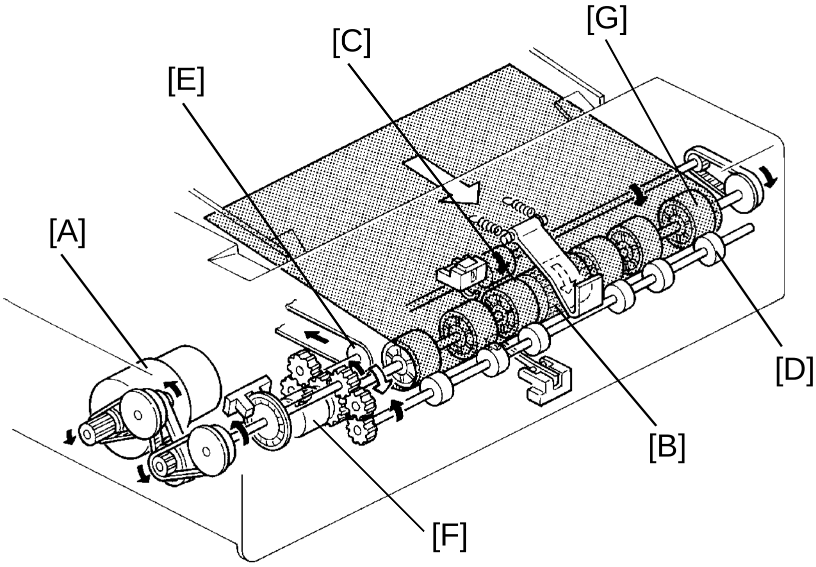




The feed roller [A] and the friction belt [B] are used to feed in and separate the originals [C]. Only the bottom original is fed because the friction belt prevents any other originals from feeding.

Original feed starts when the pick-up lever [D] presses the original stack and the rotation of the pick-up roller [E] advances the bottom original of the stack. The feed roller moves the original past the friction belt because the driving force of the feed roller is greater than the resistance of the friction belt. The friction belt prevents multiple feeds because the resistance of the friction belt is greater than the friction between original sheets.

7.3 ORIGINAL FEED-IN MECHANISM



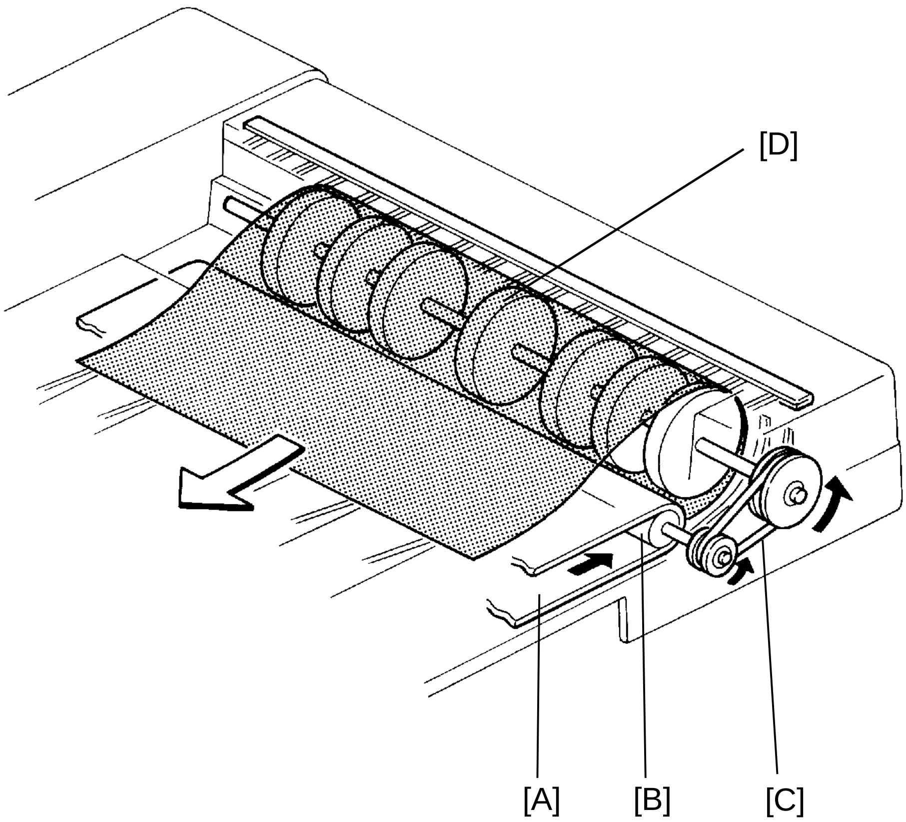
The DF motor [A] drives the feed roller [B], the pick-up roller [C], the relay rollers [D], and the transport belt roller [E] via timing belts and a gear train. The feed roller and the pick-up roller are controlled by the feed clutch [F], but the relay rollers and the transport roller are directly driven by the DF motor. The idler rollers [G] on the feed roller shaft are free from the shaft.

When the Start key is pressed, the DF motor is energized and the relay rollers and transport belt roller start turning. 100 milliseconds after the DF motor starts turning, the pick-up solenoid and the feed clutch is energized. The pick-up and feed rollers then start turning and carry the original between the relay rollers and the idler rollers. The pick-up solenoid and the feed clutch are de-energized when the original's leading edge passes through the registration sensor.

The DF motor remains energized to deliver the original to the exposure glass until a certain number of pulses (10 to 25 pulses) after the original's trailing edge passes through the registration sensor. Then, the DF motor pauses and reverses for 15 pulses to align the edge of the original with the scale.

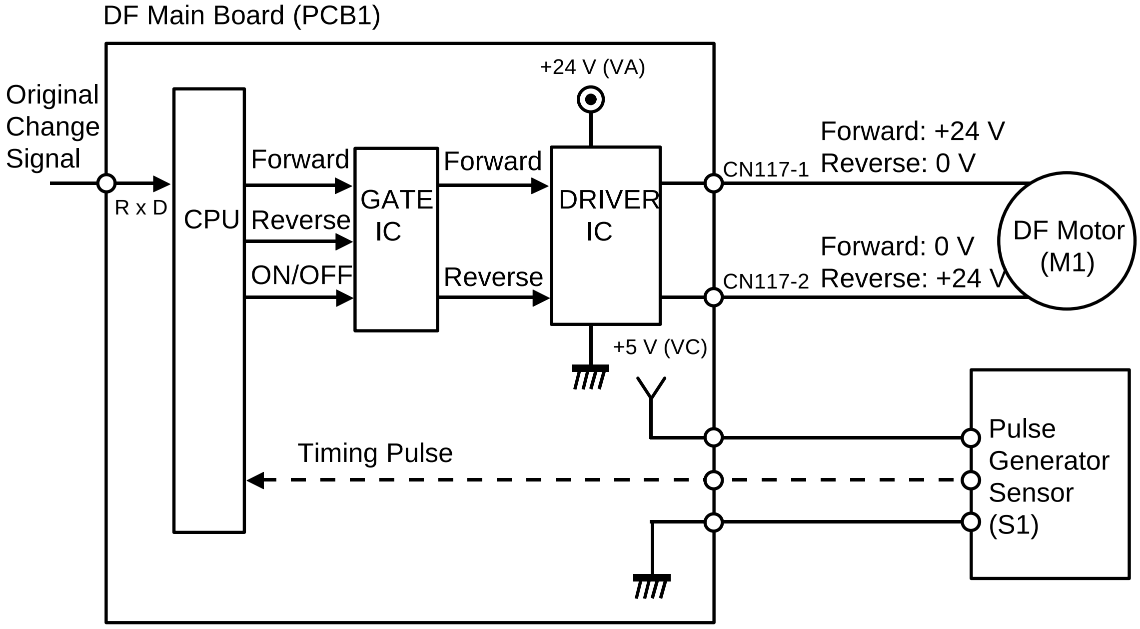
To feed the second original, the DF motor starts rotating when the scanner reaches the return position. (The copier CPU sends the original change signal to the DF CPU.) At this time, the transport belt starts carrying the first original on the exposure glass to the exit roller. The timing for when the pick-up solenoid and the feed clutch are energized for the second original depends on the length of the first original detected by the registration sensor.

7.4 ORIGINAL FEED-OUT MECHANISM



The exit rollers are driven by the DF motor through a gear train, the transport belt roller, the transport belt [A], the transport belt idler roller [B], and the exit roller drive belt [C]. When the DF CPU receives the original change signal from the copier CPU, the DF motor starts turning. Simultaneously, the transport belt carries the original to the exit rollers [D] and the exit rollers take over the original feed-out.

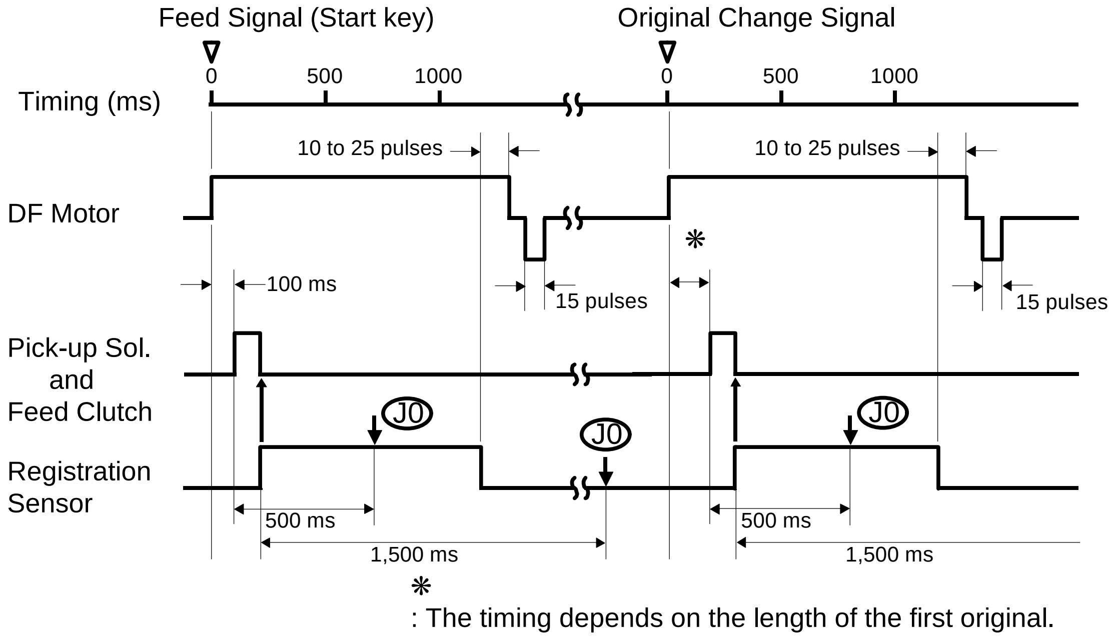
7.5 DF MOTOR CIRCUIT



A 24 volt dc motor is used as the DF motor. When the CPU receives the feed signal from the copier, the CPU outputs the ON signal and the Forward signal to the gate IC. On receipt of the forward signal from the gate IC, the driver IC outputs 24 volts to CN117-1 and 0 volts to CN117-2. This causes the DF motor to start turning in the forward direction.

Within 10 to 25 pulses after the original's trailing edge passes through the registration sensor, the CPU stops sending the ON signal and the Forward signal. The DF motor stops turning. Then the CPU outputs the ON signal and the reverse signal for 15 pulses. Then the driver IC outputs 0 volts to CN117-1 and +24 volts to CN117-2 to reverse the DF motor.

7.6 ORIGINAL FEED AND MISFEED DETECTION TIMING



The above chart shows the original feed timing for the original size of A4 or 8.5" x 11" lengthwise and the detection timing.

The registration sensor is used for a misfeed detection. If the DF CPU detects that a misfeed exists, the DF CPU lights the Original Misfeed indicator and sends the original misfeed signal to the copier CPU. Then the copier CPU lights the check paper path and the Misfeed Location Number (JO) on the operation panel. When the main switch is turned on, the DF CPU checks the registration sensor output for the initial original misfeed. During the original feed-in, the DF CPU performs two kinds of original misfeed detections:

1. Whether the registration sensor is actuated within 500 milliseconds after the pick-up solenoid and the feed clutch turn on.
2. Whether the original has passed through the registration sensor 1,500 milliseconds after the registration sensor has been actuated.