The Lowest Height A4 Color LED Printers: C300/C500 Series

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OKI Data has been expanding worldwide sales of its popular C3000 and C5000 series printers for the A4 desktop printer segment and A4 small workgroup segment. However, advancement in miniaturization and move toward ecological support has led to the development of new models.

This article introduces the newly developed C300 and C500 series printers. The model shown in **Photo 1** is the top-of-the-line C530dn printer.

Photo 1. C530dn: World's Lowest Height Color LED Printer

Product Concept and New Technologies

We are pioneers of the A4 color page-printer market having adopted the tandem single-pass method at an early stage. Although the competitors have recognized the advantages of the method and have since begun adopting the approach, we have been able to introduce new models with a clear concept and unique features.

Utilizing the features of the LED head, our core technology, we have developed products that enhance user convenience and designed with the concept of compactness, eco-friendliness and lower cost.

(1) Compactness

Our competitors are focused on minimizing the footprint of their products, and as a result, many printers on the market are vertically tall. However, these printers are very non-user-friendly. Not only will the printer's presence be oppressive when placed on the desktop, but reaching for the printed-paper on the top surface will also be difficult from a seated position. Furthermore, if the printer is used as a MFP engine, the scanner unit will be set on top of the printer making the resulting equipment even taller and harder to use.

LED head is itself compact, but it also has the advantage of compacting the entire printer design. We decided to adopt the LED head and make low height design the feature of our products.

In order to reduce printer height, component layout was reviewed eliminating vertical space wherever possible. The cross-section and paper path of the resulting printer is shown in **Figure 1**.
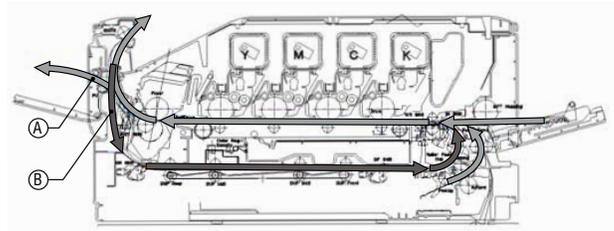

Figure 1. Printer Cross-section and Paper Path

Paper fed from the 1st tray passes between the drum unit and transfer belt unit then exits either through the face-up or face-down slots (arrow A). For duplex (two-sided) printing, the paper partially exits the face-down slot but is pulled back. The paper is then passed through between the transfer belt unit and 1st tray to be re-fed (arrow B). In order to hold down the height of the printer, transfer belt frame was reduced to the minimum thickness that will retain required rigidity, and a portion of it serves as part of the paper path for duplex printing.

Image drum unit was made more compact by integrating the four colors, and at the same time, ease of maintenance was improved. **Figure 2** shows the perspective view of the integrated image drum unit.

At 24.2cm, the C300 and C500 series printers are roughly 10cm lower in height compared with the previous

C5000 series making them the world's lowest-profile color page printers. **Figure 3** shows the comparison with the previous C5800 model.
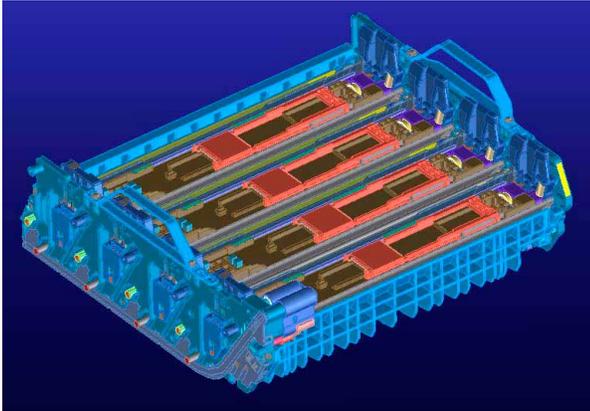

Figure 2. Integrated Image Drum Unit

Figure 3. Height Comparison Between C530dn and C5800

(2) Eco-friendliness

Users are concerned with reducing power consumption, so the need to include it in our design concept is strong. Reducing unnecessary power during standby mode is also a necessity from an environmental standpoint. In our new printers, power consumption during standby has been reduced to 0.9w. This low number outmatches similar class models from competitors whose standby power consumption is on average 7w.

Additionally, for the first time in our printers, Eco Mode is available, which cuts the power consumed when powering up from the Power Save Mode. Details of the Eco Mode are described below.

In a page printer that employs heat fusing, as print speed is increased, the fuser must also be heated to a higher temperature before printing is started. Temperature of 180-200 degrees Celsius is required to melt the toner. Majority of the power consumed by the page printer is for heating and maintaining fuser temperature.

However, for printing one or two pages, using a slower print speed and lower fuser temperature can actually

shortened the overall print time. Eco Mode was developed from this idea. The mode uses such information as the number of pages to be printed and the fuser temperature at the time of printing then automatically selects the best print speed to shorten print time while reducing power consumption. **Figure 4** shows the energy-saving benefit of Eco Mode when compared against Normal Mode. Comparing the energy usage after completion of two pages, Eco Mode was found to have used about 20% less energy.
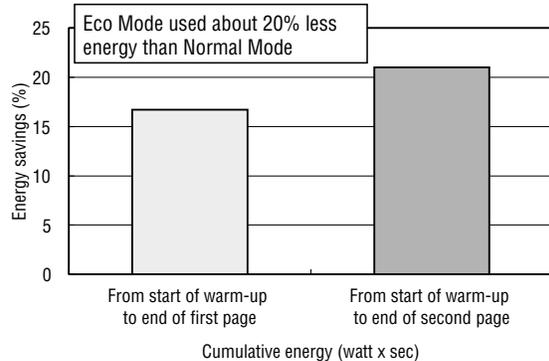

Figure 4. Energy-Saving Benefit of Eco Mode

The elapsed times after coming out of power save to end of warm-up and print completion of each page are presented in **Figure 5**. Even in terms of time, Eco Mode was able to beat Normal Mode when printing two pages.
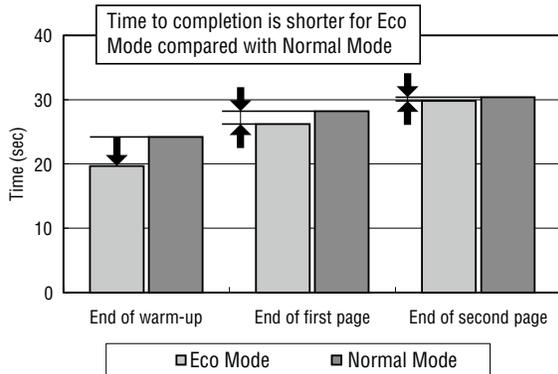

Figure 5. Time Comparison After Coming Out of Power Save

Although power consumption was reduced in support of the environment, printer performance has not been sacrificed. Print speeds of the C310/C330dn are 22ppm for color and 24ppm for monochrome, and speeds of the C510/C530dn are 26ppm for color and 30ppm for monochrome. These performance figures are the fastest in their class (domestic A4 color LED/laser printers retailing for less than 100,000 yen). In addition to being

the world's lowest-profile printers, they come with duplex printing standard putting the printers at the top of the class also in terms of product specification. The printers support longer length papers and printing on 1320mm sized paper is possible. They can also be used for such applications as POP.

(3) Technologies to lower cost

In an effort to lower cost, we conducted a review of the printers and looked at a variety of materials.

a) Improved LED head

We succeeded in developing a new LED array incorporating a multi-function LED element. Number of wirings and width of the chips were reduced. In addition, only a single power line was used for the LED mounting board. As a result, the number of board layers was cut approximately 50%. The aluminum head-holder used in previous models was replaced with a metal-resin composite. **Photo 2** is a view of the new LED head.


Photo 2. New LED Head

b) Downsized high-power board

Previous high-power boards were equipped with CPUs, but our new printers are controlled using low-power CPUs thus eliminating CPUs from the high-power boards. Size of the boards is also 40% smaller compared to past products contributing to a more compact design and lower cost. **Photo 3** shows the recently developed high-power board and high-power board from a previous model.

c) Improved image drum unit

One of the unique features of our processing technology is the contact method used between the OPC drum and developing roller. The method allows the fine dots of LED head to be accurately formed into the toner image, so the printed dots are clear and characters with precise contours can be printed. However, spacing between the developing roller and drum required adjustments, and with the older models, this was accomplished using an inter-
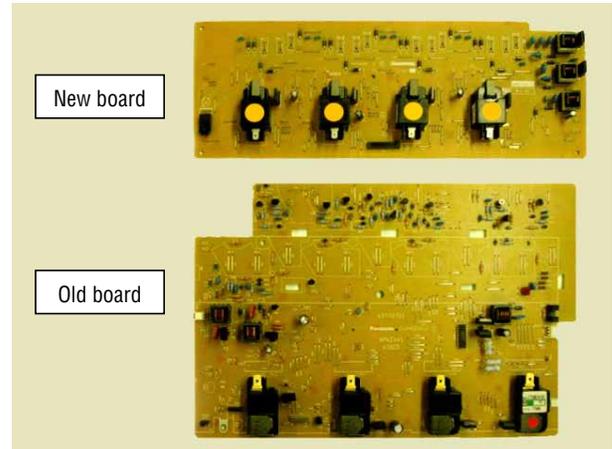

Photo 3. New and Old High-Power Boards

axis adjustment mechanism. In the new models, a spring is used to press the developing roller against the OPC drum. To drive the roller, one end is connected to a gear. Due to the reaction force of the gear, it was necessary to verify the left/right balance of the roller, but the use of the spring-type press has simplified the adjustment mechanism.

d) Improved toner cartridge

In order to ensure the handling ease of the toner cartridge and toner capacity, a sliding shutter was developed for the cartridge replacement port (upper arrow in **Figure 6**). Cartridge installation and open/close operations can be performed with a single touch. The shutter for the image drum unit's toner supply ports were also linked to open/close at the same time. Additionally, the waste toner box was integrated with the K-color cartridge eliminating the trouble of having to replace the waste toner box. The number of components was also reduced.
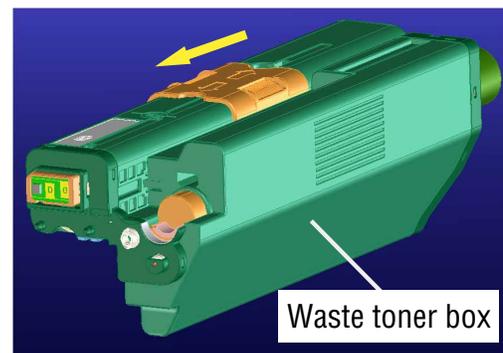
Figure 6. K-color Toner Cartridge

e) Improved transfer belt

Transfer belt is one of the expensive components in a color page printer. In developing the new printers, the material and manufacturing method of the belts were changed enabling cost reduction. Although the rotating method used in conventional manufacturing ensures even film thickness and required mirror finish, both material and manufacturing process have become expensive. The belt adopted for the new printers is manufactured by applying the inflation method on a general-purpose resin. Die gap, which is the inflation extrusion opening, was strictly controlled to achieve constant film thickness. For the surface mirror finish, thickness of the acrylic coating was precisely adjusted to set a region where poor cleaning and curling of the cleaning blade does not occur. Distribution of the belt's surface and volume resistivities were different from the belt material used in previous models. Therefore, surface and volume resistivities were determined by taking into consideration area where contamination to the OPC drum does not occur, range of favorable transfer control, prevention of discharge patterns on printing, and rate of resistivity change due to age. The relational diagram of these requirements is shown in **Figure 7**.
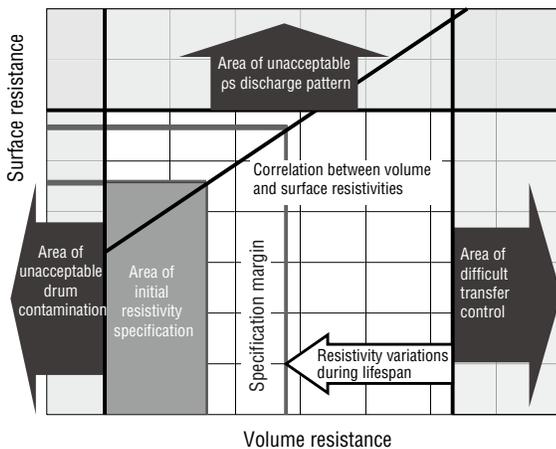
Figure 7. Favorable Range of Transfer Belt's Volume and Surface Resistivities

Specifications for the C300/C500 series are shown in **Table 1**.

Conclusion

In the latest round of product development, LED technology enabled us to create products that were compact, eco-friendly and low cost. OKI Data will continue to provide products that utilize the advantages of the LED head.   ◆◆

Table 1. C300/C500 Series Specifications

Model		C310dn/C330dn	C510dn/C530dn
Print Method		4-tandem LED	4-tandem LED
Print Speed	Color	22ppm	26ppm
	Monochrome	24ppm	30ppm
LED Head Resolution		600dpi	600dpi
Print Width		A4/Letter	A4/Letter
Auto Duplexing		Standard	Standard
Paper Capacity	1st Tray	250 sheets	250 sheets
	MPT	100 sheets	100 sheets
	2nd Tray	530 sheets (optional)	530 sheets (optional)
Power Consumption	In Use	480W avg.	540W avg.
	In Sleep Mode	-	Approx. 1.8W/0.9W
Dimensions (W x D x H)		410 x 504 x 242mm	410 x 504 x 242mm
Weight		Approx. 22kg	Approx. 22Kg
Interface		USB 2.0	USB 2.0
Network Interface		Standard	Standard

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【 Glossary 】

Small Work Group

Group of products used in an office with less than 30 people and capable of handling 30ppm.

Tandem Single-Pass Method

Method speeds up color printing by using a separate developing unit for each color.

MFP: Multi Function Printer

An office machine that incorporates printer, copier and scanner functionalities in a single device.

Power Save

State of low power consumption achieved by limiting power to certain areas during the non-printing phase.

POP: Point of Purchase

Long advertisements displayed in stores.

MPT: Multi Purpose Tray

Front-loading paper tray that supports irregular-sized and/or thick paper.