

World's thinnest A4 color LED MFP with automatic duplex-scanning and printing units equipped: MC361/561

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OKI Data Corporation has been expanding global sales of its MC360/MC560 models for the A4 Desk Top and A4 Small Work Group MFP segments. Now, new models are available that are even faster, smaller and more eco-friendly. This article introduces these newly developed MC361/MC561 models. The high-end MC561 model is shown in **Photo 1**.



Photo 1. World's Thinnest¹⁾ A4 Color LED MFP MC561

Target Market and Product Concept

(1) Target Market Trends

In general, group with fewer than 20 users sharing a printer is referred to as the Desk Top (DT) segment and group of 20 to 50 users the Small Work Group (SWG) segment. The shipment trend since 2005 of the two segments, which is OKI's target market, is shown **Figure 1**.

Due to the recession triggered by Lehman's collapse, sales of MFPs dropped slightly in 2009, but in 2010 recovered to the same level as in 2008. From 2011 onwards, the market is forecasted to grow significantly. The competition is expected to intensify as the market grows, so to clearly differentiate its products from others, OKI Data has developed products based on the concepts of "fast/compact", "easy operation" and "eco-friendly".

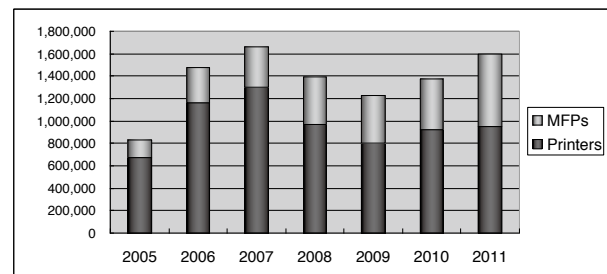


Figure 1. Worldwide Shipments for A4 Color DT/SWG Segments¹⁾

(2) Product Concept

The "fast/compact" concept was the primary focus in the development of the new MFPs. A high-speed auto duplex scanner unit, based on OKI's first scanner unit, and high-speed auto duplex printer unit are standard on the new models, but at a height of just 44.4 cm, they are the world's thinnest in their class. To emphasize this characteristic, the sales slogan "for high-speed double duplex, look to world's thinnest" was adopted.

To ensure "easy operation", the control panel is equipped with a large 3.5-inch LCD display and QWERTY keyboard (MC561). As more advanced functions are demanded from the MFPs, a method to easily access and manipulate those functions is an important user requirement.

"Eco-friendly" is a big trend worldwide, and OKI's products comply with Blue Angel, Energy Star and other international environmental standards. In developing the new MFPs, OKI developed its own ASIC (Green ASIC²⁾ IM) for use in the scanner unit. Not only has this contributed to high-quality image scanning, but helped achieve an energy consumption of less than 1.5 W during sleep mode.

(3) Product Specifications

MC361 and MC561 specifications are shown in **Table 1**.

¹⁾ Among color LED/laser MFPs with automatic duplex-copy capability (according to OKI's study, April 2011).

²⁾ Green ASIC is a registered trademark of Oki Data Corporation.

Table 1. Specifications

	MC361	MC561
Copy Speed (A4) Single-side Color / Black & White	20cpm / 24cpm	20cpm / 30cpm
First Copy Out Color / Black & White	17 sec / 12 sec	
Copy Scaling	25% to 400%	
Copy Density Adjustment	7-step (manual)	
Control Panel (3.5-inch LCD)	Yes	
Control Panel (QWERTY Keyboard)	No	Yes
Print Speed (A4) Single-side Color / Black & White	22ppm / 24ppm	26ppm / 30ppm
Print Resolution	600dpi	
Paper Capacity	250 sheets	
Multi-purpose Tray	100 sheets	
Size (W x D x H)	427mm x 509mm x 444mm	
Weight (including consumables)	29kg	

Key Technologies for Realizing Product Concepts

The key technologies for realizing the product concepts are described below in the order (1) Faster and Smaller, (2) Easy Operation, (3) Green ASIC IM Development, (4) MFP Firmware Functions and Layout.

(1) Faster and Smaller

The developmental goal was to lower the height of the product so it would not be obtrusive or sacrifice usability of the scanner unit when placed on the desktop²⁾. As a result, OKI was able to achieve the world's thinnest color MFPs in its class. The 44.4cm height of the new models is 20.1cm shorter than the previous MC560 and 7.7cm shorter than the MC360 (Figure 2).

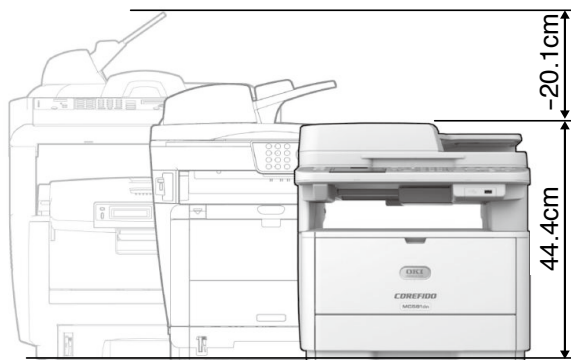


Figure 2. Height Comparison Between MC561 and Previous Models

1) Flatbed

The scanner unit, called flatbed, uses two rows of LED light source for 1200dpi resolution and a compact CIS module capable of high-speed scanning. This enabled

the unit to achieve a low profile and high scanning speed. Additionally, the height was suppressed by reducing the carriage frame of the scanning sensor to a minimum thickness that will maintain rigidity and integrating the scanner drive mechanism into the two scanner stays, which connect to the printer unit.

2) ADF (Automatic Document Feeder)

Higher speed and smaller size were achieved using a unique automatic duplex-scanning mechanism that first inverts the fed document. This reduces the path the document travels before being discharged by 20% when compared with the previous mechanism (Figure 3). Although there are two mechanisms to invert the original document during duplex scanning, a single motor controls both keeping the size small and lowering cost at the same time (Figure 4).

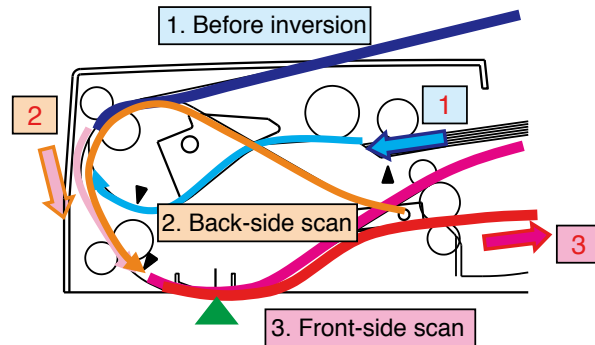


Figure 3. Document Path for Duplex Scanning



Figure 4. ADF Drive System

The feed mechanism used on previous models had documents slide atop the document tray requiring the tray to be angled at 35 degrees, and this contributed to equipment height. To reduce height, a combined pickup roller and shutter mechanism was adopted in the new models. Now at an angle of 8 degrees, the document tray is almost horizontal while still allowing smooth feeding of documents (Figure 5).

Pickup Roller and Shutter Mechanisms

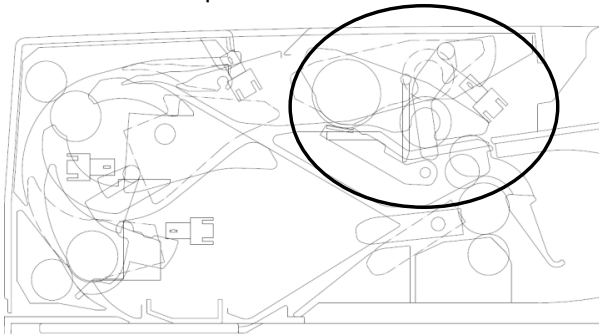


Figure 5. ADF Cross-section

(2) Easy Operation

1) Control Panel

To ensure easy operation, it is vital that the use of hard keys, selections from the hierarchical menu displayed on the LCD, and guidance features be well balanced in design. **Figure 6** shows the control panel of the MC561. The hard keys for the basic MFP functions are placed at the far left. To the right of those keys is a 3.5-inch black & white LCD panel with tilt feature, menu selection keys (directional button, OK key, Back key), numeric keypad, and Start buttons (color and black & white), respectively. This control arrangement allows the operation of the MFP to flow from left to right. The use of a wide LCD panel enables messages to be displayed without truncation.

Additionally, the MC561 has a panel at the far right that houses 16 one-touch keys to store FAX numbers. This panel can be opened to reveal a QWERTY keyboard that can be used to effortlessly enter names, addresses and passwords.



Figure 6. MC561 Control Panel

Other than to enter characters with the numeric keypad or QWERTY keyboard, the menus displayed on LCD panel for the various functions are controlled using the directional button and OK/Back keys.

To take full advantage of the MC561's rich features, numerous settings that spread across several screens may be required. Therefore, a screen configuration was devised to allow uniform key operations and make it possible to display on the limited screen space the current position in the screen hierarchy, icons and functions of the available keys (numeric keypad, OK key, Back key, Help key), and Help (description) screens, thus improving operability. **Figure 7** shows some examples of the screen display.

Job macro keys (hard keys) have been provided and can store up to ten commonly used complex settings. For example, settings required to make "black & white-4up-duplex-high definition scan-eliminate background" copies, or to make a 600dpi scan and storing the image as an encrypted PDF file to a specific folder in one's PC can be stored in the job macro keys. This allows the user to perform tasks in little as six steps.

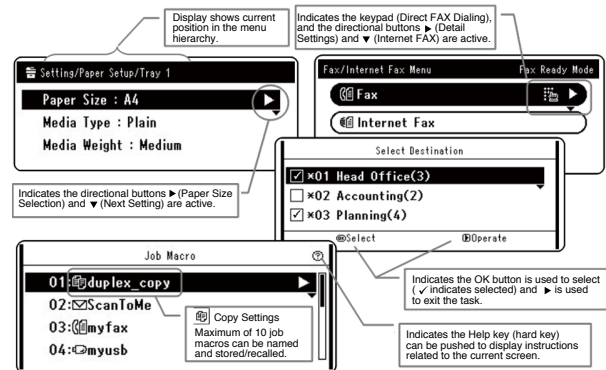


Figure 7. Examples of Control Panel Display

2) Flatbed

An opening has been provided at the back of the flatbed allowing a document bigger than A4 to be shifted back and scanned without the document obscuring the control panel (**Figure 8**).



Figure 8. Flatbed Pass-Through Opening for Larger Documents

(3) Green ASIC IM Development

Control of the MC361/MC561 series consists of the printer unit and scanner unit. The printer unit was developed based on the C530 printer, which utilized a control board with Green ASIC (Figure 9 left) at the core.

For the scanner unit, a control board was developed around the new Green ASIC IM (Figure 9 right).

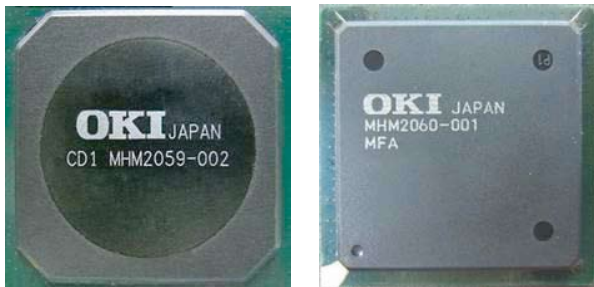


Figure 9. Green ASIC (Left) and Green ASIC IM (Right)

To increase scanning speed, the scanner image processing was hardware implemented into the Green ASIC IM. As a result, color document exchange speed^{*3)} of 20cpm and black & white document exchange speed of 30cpm were achieved. Control circuit required for the MFP is also built in.

Block diagram of the scanner control board with the new ASIC is shown in Figure 10.

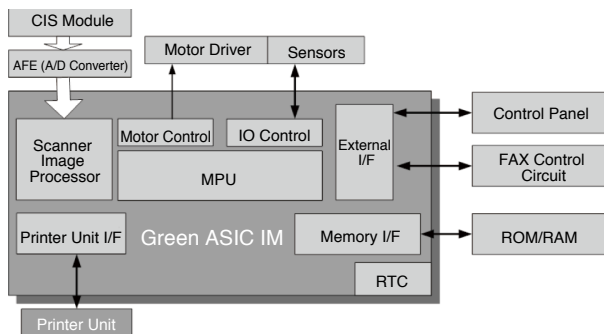


Figure 10. Block Diagram of Scanner Control Board

MPU (Micro Processor Unit) built into the Green ASIC IM performs mechanical control using inputs from sensors and parameter settings for image processing, motor control, AFE (Analog Front End) control and CIS (Contact Image Sensor) control. The same MPU controls the control panel and various interfaces, and it is designed to handle FAX transmission as well.

In order to handle the faster image processing, DDR2 memory was adopted to speed up memory interface. Consolidation of the scanner function into a single ASIC has paved the way for a low-cost, high-speed scanner control board.

Similar to the Green ASIC, power is only supplied to part of the ASIC during low power consumption state.

1) Scanning Technology

The document-scanning sensor in the MC361/MC561 utilizes a new color CIS module. The CIS module consists of the Red, Green, Blue LED light source and an integrated module housing both the rod lens array placed at the document width and CMOS image sensor. The mechanism in previous MFPs used a CCD (Charged Coupled Device) image sensor, cold cathode fluorescent light and lens that optically reduced the document when scanning. In contrast, the CIS module adopted for the new MFPs provides better color separation with the use of RGB LED light source, shorter warm-up time and improved scan resolution of fine lines and characters since scanning is done at the same size as the original document. Shadow effect considered a weakness of the CIS module when scanning such sources as books that lift up off the scanning surface is minimized using the LED2 light scheme. To cope with the speed of multi-channel scanning, image processing is performed in the new ASIC, thereby providing both high image quality and high-speed scanning. The example in Figure 11 shows how faithful the copy is to the original.

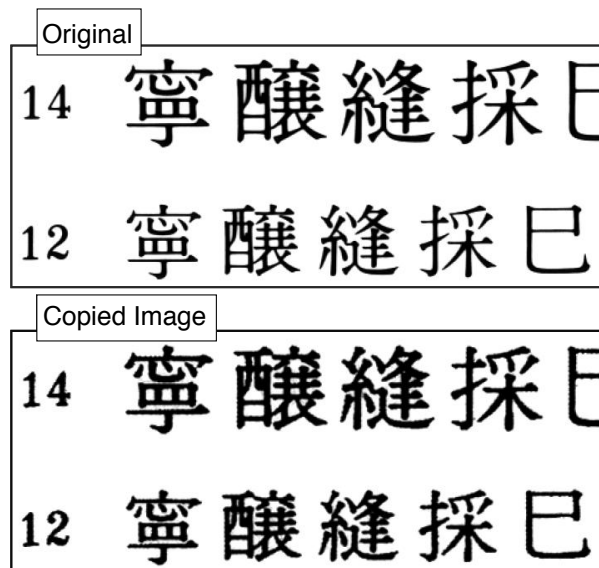


Figure 11. Image of Copied Characters

*3) Speed when documents in the ADF are copied one at a time in succession.

2) Sleep Mode

Similar to the C530 printer, sleep mode is provided. When there are no user operations, FAX or network access for a certain period, the MFP will enter the low power consuming sleep mode. In this mode, power is supplied to only a part of the control circuit keeping power consumption under 1.5W. Moreover, the MFP will wake from sleep mode in about three seconds saving the user from frustration when the MFP is set to enter sleep mode quickly.

(4) MFP Firmware Functions and Layout

It is common practice to port over as much as possible the control board and mechanisms developed for a printer product to the MFP's printer unit. The printer unit of the MC561 is commercialized in the C530 printer²⁾ (Figure 12).

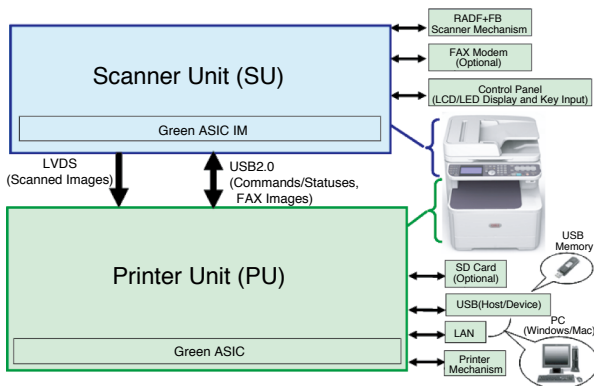


Figure 12. Scanner and Printer Unit Interfaces

1) Scanner and Printer Unit Interfaces

The scanner and printer units are connected using USB2.0 and LVDS interfaces.

USB2.0 interface is used to exchange synchronization commands/responses, device status notifications and FAX images (FAX transceiving function is implemented in the scanner unit) between the scanner and printer units.

LVDS interface transfers scanned and processed images from the scanner unit to the printer unit where the images can be printed (copy) or sent as data to a PC.

2) Process Flow during Copying and Scanning

When making copies or scans, the settings specified by the user on the control panel are passed from the scanner unit to the printer unit (via USB2.0). Following the specified settings, the printer unit sends scanning commands (via USB2.0) to the scanner unit's mechanism control and image processing modules, then receives the scanned images (via LVDS).

During copying, the printer unit will process the image received from the scanner unit according to the settings made on the control panel (for example color duplex-copies) before printing out the image.

If the scanned image is to be emailed, the printer unit will convert the received image into PDF format and attach it to an email for transmission to a mail server. At that time, the PDF file sent with email can be replicated and saved in the server using CIFS, FTP or HTTP file transfer protocol.

3) Rich Assortment of Features

Not only does the MC561 inherit rich assortment of features and multiple functions (parallel coping, scanning, faxing, printing possible) from the high-end MC860 (A3 MFP)³⁾, its memory usage has been reduced and enhancements made to individual functions. In addition to the aforementioned usability improvements, sleep mode and Green ASIC IM/Green ASIC supporting high-speed copy/scan processing, the following specific features are supported.

- Network scan (TWAIN) driver support
- Encryption and PDF conversion of scanned image
- Direct printing from USB memory
- Password protected encryption and printing authentication
- Long paper printing to maximum of 1320.8mm x 215.9mm
- Consolidated copying to combine several originals into a single page and ID copying to make a single-sided copy of a double-sided driver's license or other ID cards
- Enhanced FAX functions – Internet FAX (Simple Mode + DSN/MDN), DRD (Distinctive Ring Detection), Super G3 support, FAX forwarding, save received FAX image (PDF format), continual black & white printing (received FAX) without color toners, etc.
- Enhanced functions for billing logs and usage restriction of certain features depending on login information entered through the control panel (PIN or username/password) or attributes of the print job sent from a PC (source application, URL, PC host name, login name).

User authentication, usage restriction according to print job attributes and billing logs are effective in reducing TCO. Billing data can be periodically collected from an external billing server to analyze usage, create reports, check usage by an individual or department, and make charge allocations.

Summary

In addition to being “fast/compact”, “easy operation” and “eco-friendly”, the described color MFP is also low in cost. OKI will continue to respond to customer needs developing products in a timely manner. ◆◆

References

- 1) Report created by OKI Data based on IDC “Worldwide Quarterly Hardcopy Peripherals Tracker” CY2011Q2
- 2) Tsutomu Yamamoto, et al., “The Lowest Height A4 Color LED Printers: C300/C500 Series”, OKI Technical Review, October 2010/Issue 217 Vol. 77 No.2, pp.12-15
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[Glossary]

QWERTY keyboard

Keyboard with the most commonly used key layout. The name is derived from the first six letter keys appearing at the top-left of the keyboard.

MPU (Micro Processing Unit)

Semiconductor chip that performs arithmetic processing in computers. Also called microprocessor.

AFE (Analog Front End)

Semiconductor chip that converts the analog image signal from the CCD (Charge Coupled Devices) or CIS (Contact Image Sensor) scanning sensor to a digital signal.

CIFS (Common Internet File System)

Protocol for sharing computer files over a TCP/IP network.

FTP (File Transfer Protocol)

Protocol for transferring files over a TCP/IP network.

LVDS (Low Voltage Differential Signaling)

A standard for low-voltage differential signaling. Electrical signals with small amplitude and different polarity are transmitted, and the potential difference is used as data. Wiring is increased, but it is impervious to external noise.

HTTP (Hyper Text Transfer Protocol)

Protocol for transferring data between the Web server and Web browser.

Network Scan (TWAIN) driver

TWAIN (Technology Without an Interesting Name) is an interface specification for a PC application to accept images from a scanner, digital camera or other peripherals. When a TWAIN compliant driver (program) is installed, the PC can receive image inputs from peripherals connected via USB or TCP/IP network.

Internet FAX

System or service that uses the Internet instead of the telephone circuit to transmit FAX. Scanner images can be transmitted as email attachments.

DRD (Distinctive Ring Detection) support

There is a service that assigns multiple phone numbers to a single phone line, and a different ring tone is used for each number to distinguish the called number. DRD support allows the user to specify which ring tones to answer.

Super G3

International FAX standard. Original documents are scanned at 200dpi and compressed using MMR or JBIG algorithm before being transmitted at 33.6kbit/s. An A4-sized document can be transmitted in about three seconds.