

# Electronics

Rapid advances in information technology has made possible the arrival of a full-scale ubiquitous information society where communication can be done freely anytime, anywhere, and with anyone. Hitachi offers system solutions incorporating advanced technologies in areas such as semiconductors, electronic displays, and device fabrication/analysis equipment to contribute to the creation of a comfortable environment for the lifestyles in the new era.



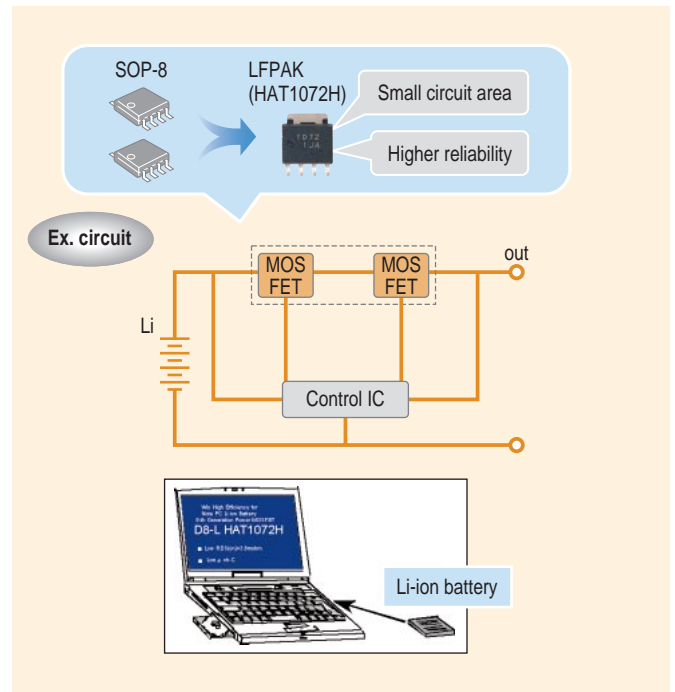
## 8th-generation P-channel Power MOSFET

Hitachi has developed an 8th-generation P-channel power MOSFET —HAT1072H — with 40% less RDS (on) in comparison with a conventional MOSFET. It can be applied as a power-management switch in portable products or a protection switch for a battery.

The chip package is an LFAK\* type which is a small and thin SMD (surface mounted device) with SOP8 (small outline package) compatible footprint. The chip performance is 3.6 mΩ typ. [RDS (on) with -30 V (VDSS)]. This performance is the highest among power management switch. Using this chip, designers can reduce the number of parts and size of products, and improve energy efficiency.

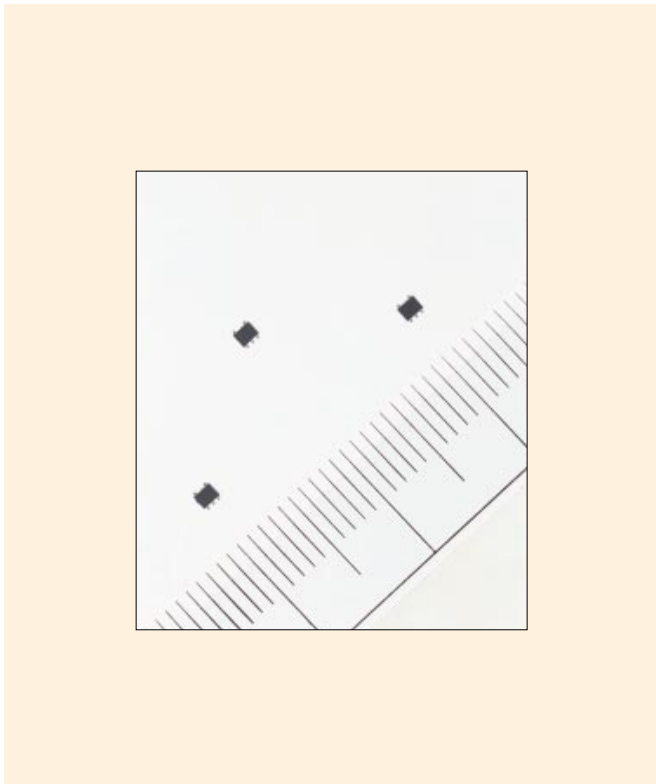
Hitachi plans to increase voltage or package line-up.

\* LFAK: Hitachi package code



A protection switch for a Li-ion battery for a notebook PC

## Ultra-high-speed Unilogic “HD74ALVC1G Series”



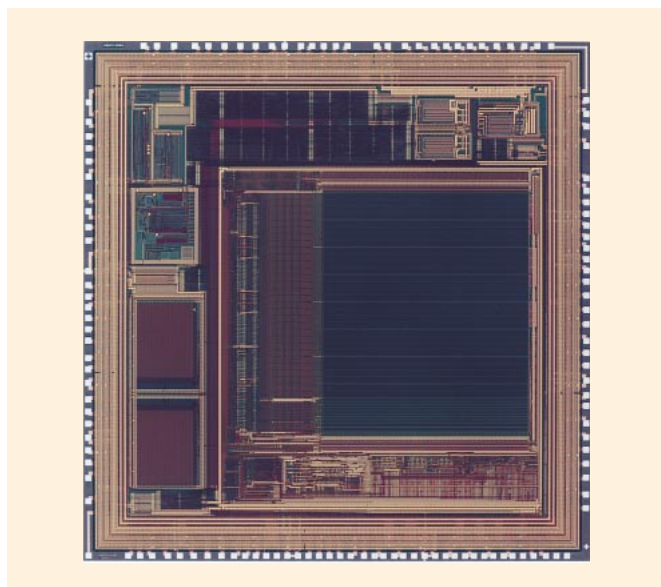
Packaged in the ultra small package “VSON-5” [1.6 × 1.6 × 0.55 (mm)], lead pitch [0.5 (mm)]

In recent years, mobile equipment such as mobile phones, digital still cameras, and notebook PC's require ever smaller logic IC's with package size and higher operation speed. To meet this requirement, we have developed the “HD74ALVC1G Series,” which has an ultra-high-speed 1-gate logic in an ultra-small package.

We fabricated the series by applying the 0.35-μm process. The chip has a very high data-transfer speed (3.0 ns; max. at V<sub>CC</sub>=3.3 V), which is useful for high-end equipment to compensate ASIC or add buffer without decreasing system performance. The chip installed in an ultra-small-package, “VSON-5,” is both compact and easy to handle (in a standard with 0.5-mm pin pitch). The series can handle 1.2 to 3.6 V V<sub>CC</sub>, so it is suitable for the current trend toward lower voltage operation of the CPU and memory for saving system power in battery-driven equipment. The Ioff function prevents the leakage current (5 μA max.) when 0 to 3.6 V is applied to the input or output terminal at V<sub>CC</sub>=0 V, which is useful in applications such as partial-power-down ones. Its high-output drive capability of +/- 24 mA at V<sub>CC</sub>=3 V covers various needs of voltage drivability. The series has an input tolerant function which serves as 3.6 V to 1.2 V level shift for different voltage interfaces.

The ALVC1G unilogic series has 15 product line-up, such as gates, buffer, analog switch, and flip-flop to meet various requirements from customer applications. Including the ALVC1G series the whole unilogic line-up covers a total of 104 products from high-end to low-end applications.

## “H8/3069F” — A New-generation F-ZTAT Microcontroller

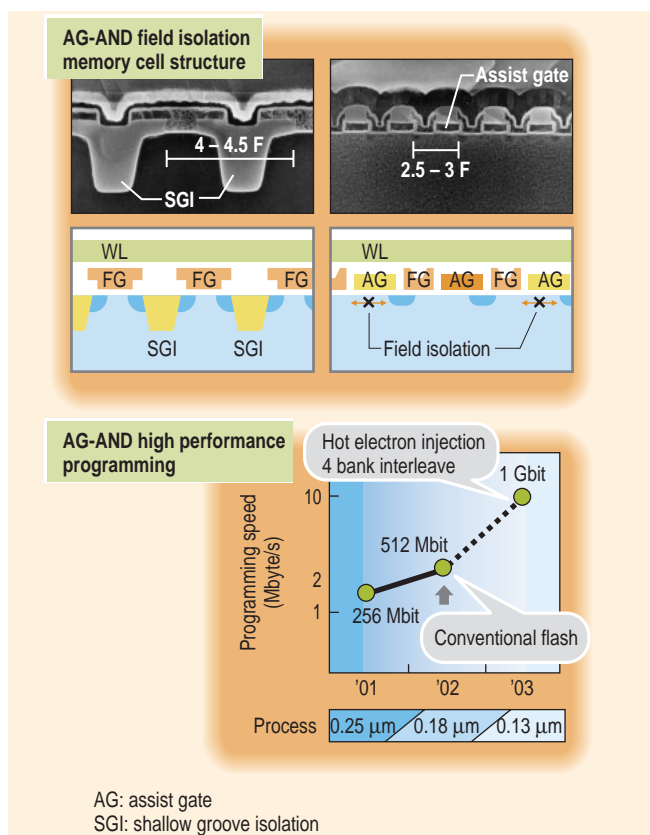


Chip photo of new-generation F-ZTAT microcontroller “H8/3069F”

A new-generation F-ZTAT (Flexible Zero Turnaround Time) microcontroller has been released under the concept, “being simple” and “customized.” Regarding “being simple,” a complicated erase/write function is built in the ROM and users can easily rewrite the flash memory. As for “customized,” the microcontroller has a flash memory for the boot, and the user can make an erase/write program suitable for the system. The H8/3069F incorporates a 512-kbyte flash memory, 16-kbyte RAM, and 8-kbyte flash memory for the boot mode.

## Hitachi’s Multi-level 0.13- $\mu\text{m}$ “AG-AND” Flash Memory

Hitachi has developed a 0.13- $\mu\text{m}$  CMOS assist-gate AND-type (AG-AND) flash memory with a multi-level cell technology. This 0.13- $\mu\text{m}$ -process AG-AND structure minimizes the cell unit size to 2.5 to 3 F (F=design rule) as compared with that of conventional 0.18- $\mu\text{m}$ -process shallow-groove isolation of 4 to 4.5 F. This architecture is more than 50% smaller than a conventional AND cell and produces high-speed programming performance of 10 Mbyte/s with hot-electron injection method and chip inside four-bank interleave programming method. The AG-AND cell design will form the basis of new gigabit-generation flash-memory chips, which can record large volumes of digital data at high speed. At this speed, one hour of CD-quality MP3 music (around 64 Mbyte) can be written to a flash card in approximately six seconds.



AG-AND field isolation memory cell structure and high performance programming

## PIN Secure MultiMediaCard with a User-authentication Function

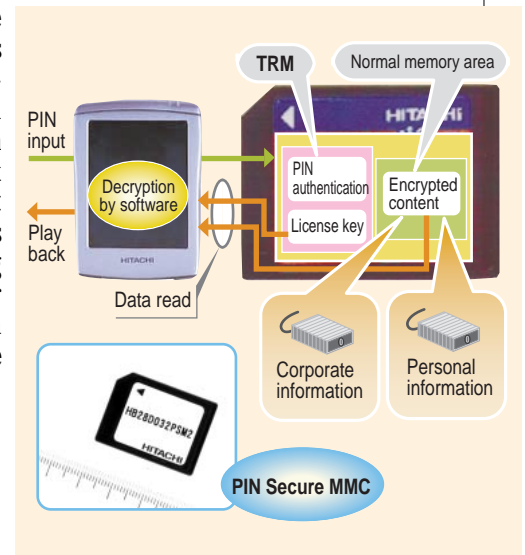
Hitachi has developed the PIN (personal identification number) Secure MultiMediaCard\* (PIN SecureMMC™), the industry's first flash card with a user-authentication function, as a recording media for confidential data such as personal information and corporate information.

This card features a user authentication function using PIN. Through this function, the license keys for recovering encrypted data can be accessed only after the user is authenticated by using the correct PIN input. In such way, confidential data can be protected from being obtained or modified by unauthorized personnel.

This card is based on the SecureMMC with content protection, which utilizes public key infrastructure (PKI) technology and a hardware tamper resistance module (TRM), for safeguarding the storage of secure data. In the PIN SecureMMC, protected data are stored in encrypted form and the license keys to decrypt that data and the PIN are stored in the TRM in the memory card. This procedure ensures strong security against data analysis by a third party. In addition, unlike the simple password lock/unlock function available on a standard memory card, the PIN user-authentication function can be applied to file-level data protection. These functions, such as PIN authentication and data encryption and decryption, can all be performed with this card and device software without requiring particular changes in hardware.

The card enables sales executives, medical professionals or gov-

ernment employees to safely acquire, store, transport, and view confidential information such as strategy plans, volume pricing data, patient records or government statistics. Its new functions ensure that data security will not be compromised if the memory card or the PDA is lost or stolen. The PIN SecureMMC is upwardly compatible with standard MultiMediaCards in the same compact size, i.e. 32 × 24 × 1.4 mm. It will thus address the growing security needs for data protection in a variety of mobile devices.



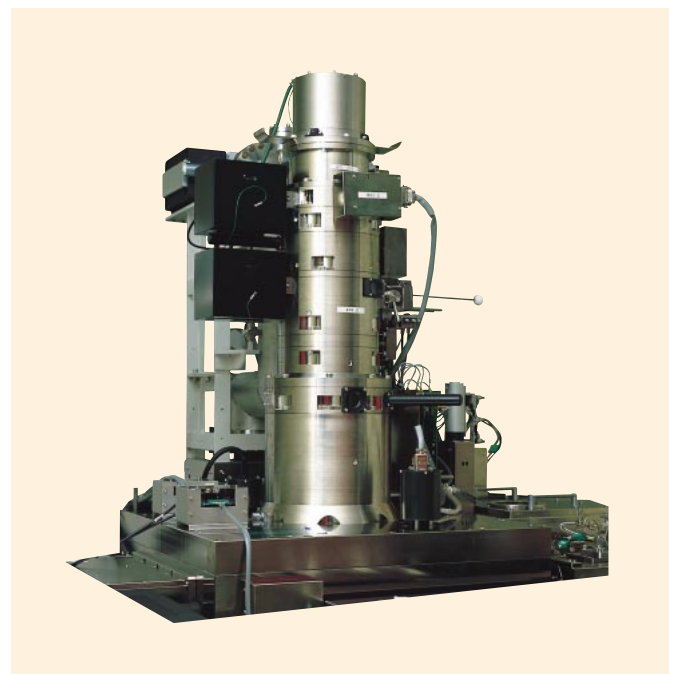
PIN Secure MultiMediaCard

## High-performance Electron-beam Mask Writer "HL-950M"

Rapid advances of semiconductor devices requires an advanced reticle to fabricate them. And the mask writer is expected to meet this demand. Accordingly, the HL-950M was developed as a tool for making reticles for the 150-nm technical node and below.

The system utilizes several new technologies, such as a high-precision electron optical column, a low distribution stage, and highly stabilized temperature control, in order to produce an advanced reticle. To delineate patterns on a reticle, a variable-shaped beam with 50-kV acceleration and a continuously moving stage are applied. Maximum beam-current density is 10 A/cm<sup>2</sup> and maximum beam size is 2 by 2 μm. The tool has a three-stage deflection system for writing patterns with high accuracy. It uses new dual digital control circuit for the writing procedure and data preparation simultaneously; as a result, system throughput is higher and huge volume data can be handled. The pattern address grid is reduced to 2.5 nm from 10 nm to increase pattern fidelity. The system can handle 5- to 7-inch reticles with an automatic plate-loading system.

A part of this work was performed under the management of ASET (Association of Super-Advanced Electronics Technologies) in the METI (Ministry of Economy, Trade and Industry)'s R&D program supported by NEDO (New Energy and Industrial Technology Development Organization).



A newly developed electron optical column for HL-950M

## Etching Tool for 300-mm-wafer Mass Production

The new series of etching tools were developed for mass production of 300-mm wafer. This tool provides high-precision and high-uniformity etching performance for various semiconductor materials, such as gate, metal, and dielectric, in the 0.10- $\mu\text{m}$  geometries generation and beyond.

Main features:

(1) High-precision and low-damage process

The use of UHF-ECR (ultra-high-frequency electron cyclotron resonance) plasma-generation technology allows stable plasma generation in the low-pressure/middle-density plasma region.

(2) High-uniformity and high-selectivity etching performance

Distribution of reactive gas is controlled by optimizing the aspect design of the reactive-gas-supply region and reaction chamber, allowing uniform deposit distribution on the wafer surface.

(3) Multi-chamber configuration with high reliability

The multi-chamber configuration which has been extensively used in mass production lines is adopted as the base frame.



*UHF-ECR plasma-etching system for 300-mm-wafer mass production  
This multi-chamber configuration consists of two etching chambers and two ashing chambers (optional).*

## Wafer Inspection Review Support System

Applying this system to wafer inspection provides enhanced yields in the manufacture of semiconductor products of the next generation.

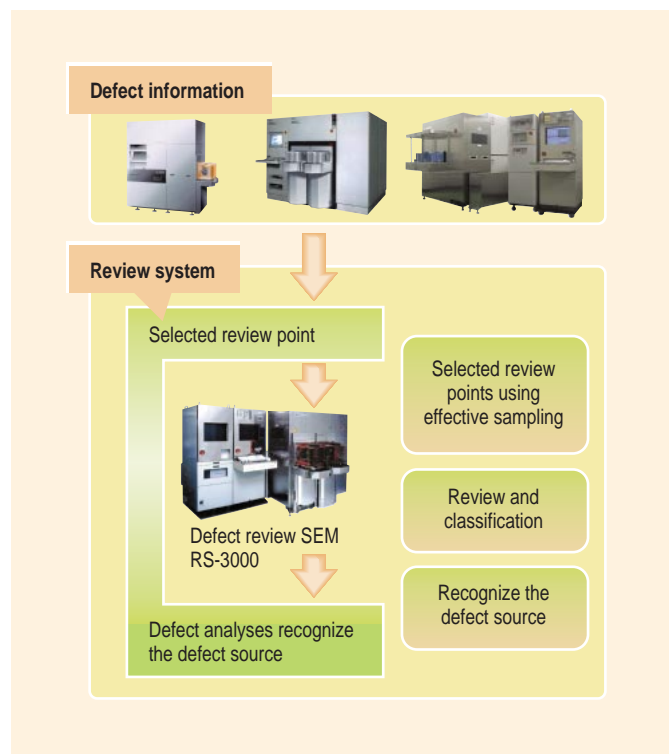
Recently, the need for reviewing defects by inspection tools is greatly increasing. Greater difficulty in reviewing the number, form, and quantity of defects accompanies the introduction of the latest reviewing technology.

The RI-1000 automatically classifies defects and this distills the defects which are identified by inspection tools so that an efficient process of reviewing defects is possible.

(1) E-sampling classifies defects by their kinds into groups to select the defects that must be reviewed automatically.

(2) Avoids operator-to-operator variations in technical performance.

(3) Yield analysis takes less time.



*Defect review support system recognizing the origins of defects*

## Advanced CD-measurement SEMs — Sub-100-nm Process Qualification —

The Hitachi S-9260 and S-9360 Advanced CD-Measurement SEMs have been developed for the sub-100-nm process control of semiconductor devices. They are 200/300 mm, ArF photo-resist and other charge sensitive wafer compatible. Both SEMs have a new automated column-alignment function and a new built-in Hitachi real-time process monitor, which keeps track of process conditions at all times. These new features make the S-9260 and S-9360 the best available CD-SEMs for a wide range of applications. Both instruments are not only suitable for R&D but also for next-generation mass-production tools for the semiconductor industry.

Unique features:

- (1) Automated and self-diagnostic functions keep the S-9260/9360 at the peak of performance and stability at all times. The automated beam and stigmator column-alignment function frees the operator from complicated time-consuming work, eliminating problems associated with alignments. Operating conditions of the S-9260/9360 are monitored by the self-diagnostic function at all times.
- (2) The new Hitachi real-time process monitor, with the latest software and automation features, improves processing yield by allowing any fluctuations in the process to be continuously monitored.

- (3) Improved hardware and software performance of the S-9260/9360 provides excellent measurement repeatability of 2 nm (3 sigma) and high sample throughput.



CD-measurement SEM for the sub-100-nm process control of semiconductor devices

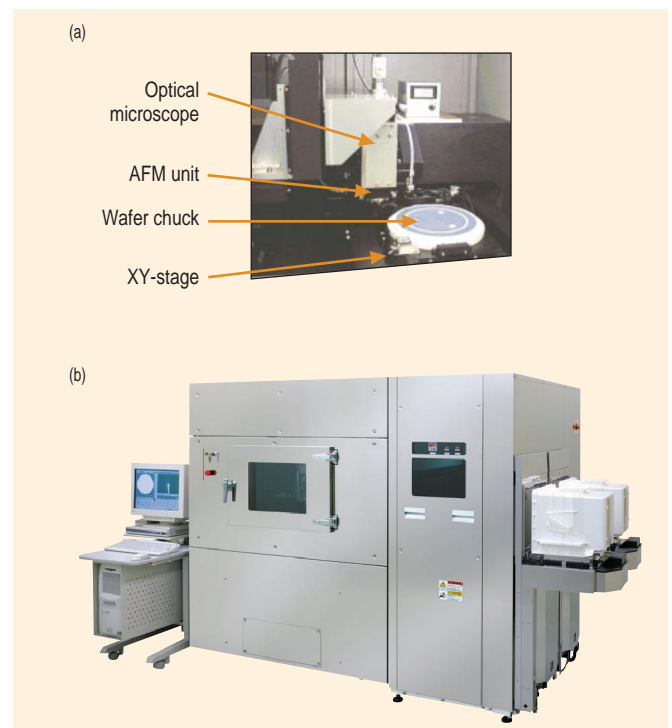
## Atomic Force Microscope (AFM) for Semiconductor Process Evaluation

Integration in semiconductors has advanced from two dimensions to three dimensions. Complex fabrications with a deep groove and multi-layer deposition and the change of (various) metallic materials used for wiring make evaluation of several processes with a conventional tool difficult.

Hitachi's AFM (atomic force microscope) using a new measuring method called "Step in" can clarify that it is possible not only to apply the CMP (chemical-mechanical polishing) process to wide scanning but also to observe steep structures such as dry-etched shallow-trench isolation.

Features:

- (1) Wide area scan (25.6 mm square) in one operation
  - (2)  $5 \times 1,000,000\times$  magnification with 0.1-nm resolution in Z direction
  - (3) Effective data without compensating raw data
  - (4) Applicable wafer size: 300 mm $\phi$
  - (5) Automation capability (GEM300)
- (Fabricated by Hitachi Kenki Finetech Co., Ltd.)

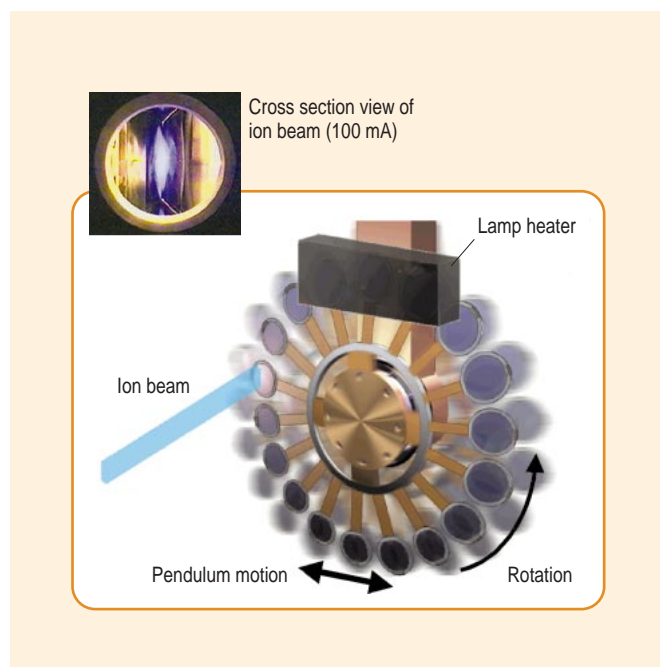


(a) Main measuring units and (b) current model, WA1300C

## High-current Ion Implanter for 300-mm-Diameter SIMOX Wafer Production

SIMOX (separation by implanted oxygen)-SOI (silicon on insulator) technology will be the best solution for the high-performance fabrication of SOI-CMOS devices on 300-mm wafers, since an SOI-CMOS device requires 20- to 100-nm order SOI. Hitachi High-Technologies Corporation has developed the SIMOX ion implanter for 300-mm diameter wafers, which fully supports the production of devices of the above type.

The unique design features of the previous model for use with 200-mm wafers have been maintained in the SIMOX implanter. The ion source provides a high 100-mA-class current; this, along with the stability and long operational lifetime of the device achieves a reliable system that has a high throughput. The mechanical scanning method, which combines pendular and rotational motion, as is shown in the figure, has been enhanced to provide for highly uniform implantation of  $\pm 1\%$  in 300-mm wafers. Hitachi's clean-space technology ensures levels of particle contamination that are low enough for the production of high-quality wafers. Hitachi's advanced SIMOX ion implanter is thus very useful for 100-mA class ion implantation, yielding volume production of high-quality of 300-mm SIMOX wafers.



Structure of the mechanical scanning method

## 43-cm (17-inch) SXGA TFT-LCD Module for Monitor Use

The demand for LCD (liquid crystal display) monitors is increasing steadily, because of the advantages of compact size, low power consumption, and less strain on the human eye. In addition, the trend in the PC market is creating a demand for larger display size and higher resolution.

To meet this market trend, Hitachi has produced a 43-cm (17-inch) diagonal SXGA TFT-LCD module that uses high-performance Super-IPS (In-Plane Switching) technologies such as (1) a TFT array with a high aperture structure, (2) a new color filter with high color saturation, (3) a driver IC with a large number of output terminals, and (4) a high-efficiency direct back-light.

Main specifications:

- (1) Number of pixels: 1,280 (horizontal)  $\times$  1,024 (vertical)
- (2) Brightness: 200 cd/m<sup>2</sup>
- (3) Color saturation: accordance with EBU
- (4) Viewing angle: over 170 degrees (upper and lower sides, left and right sides)
- (5) External dimensions: 374 (width)  $\times$  301 (height)  $\times$  25.5 (thickness) mm
- (6) Weight: 1,400 g



A sample image displayed on 43-cm (17-inch) SXGA TFT-LCD module

## 38-cm (15-inch) UXGA TFT-LCD Module for Notebook PCs

The LCDs used in PCs are gradually being converted from 36 cm (14 inch) to 38 cm (15 inch). High quality images comparable to a photograph as well as large sized screen are also now required. Accordingly, Hitachi has produced a 38-cm (15-inch) XGA\* and SXGA+ TFT color LCD module.

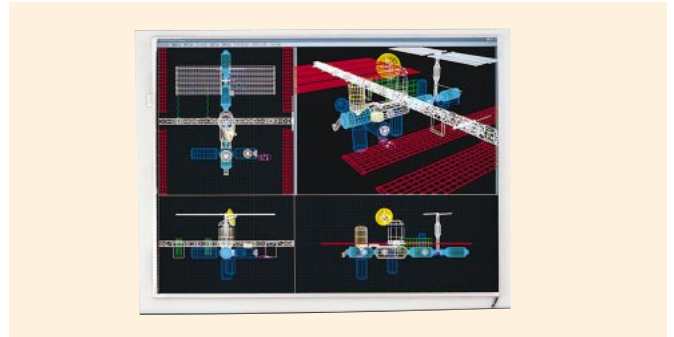
Hitachi has developed a 38-cm (15-inch) UXGA TFT color LCD module with over twice the resolution but with the same dimensions as the current module.

Main specifications:

- (1) Number of pixels: 1,600 (horizontal) × 1,200 (perpendicular)
- (2) Brightness: 150 cd/m<sup>2</sup>
- (3) Overall dimensions: 315 (width) × 240 (height) × 6.5 (thickness) mm
- (4) Weight: 575 g

- (5) Power consumption: 6.0 W

\* XGA is a trademark of International Business Machines Corp. in the U.S.



Sample images displayed on 38-cm (15-inch) UXGA TFT-LCD module

## 8.9-cm (3.5-inch) Transflective-type TFT-LCD for PDAs

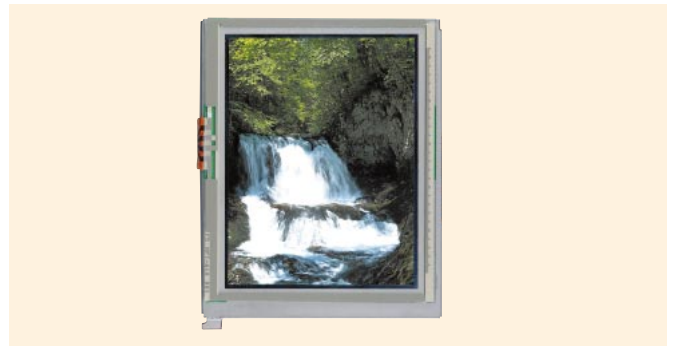
The expanding market for portable PDAs (personal digital assistants) used for schedule management or e-mailing is creating a demand for a display device with higher resolution and larger screen size.

Accordingly, Hitachi has developed an 8.9-cm (3.5-inch) transflective-type TFT (thin film transistor) color LCD module for this market. Its newly developed color filter produces higher color saturation, and its new optical design results in 260 k color expression.

Main specifications:

- (1) Number of pixels: 240 (horizontal) × 320 (vertical)
- (2) Color saturation: 40% (at backlight on)
- (3) Contrast ratio: ≥ 40 : 1 (at backlight on)

- (4) Brightness: 60 cd/m<sup>2</sup>



Transflective-type TFT-LCD

## 2.3-cm (0.9-inch) SXGA+ LCOS LCD Module for a Projector

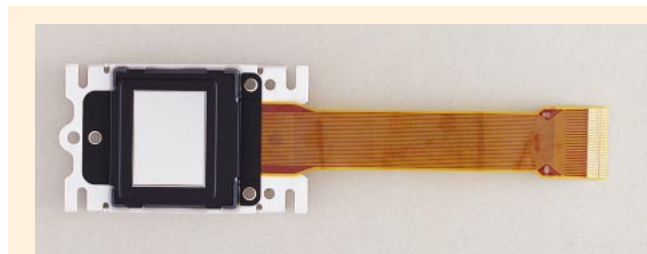
The growing market for LCD projectors used as presentation tools is creating a demand for higher resolution and higher brightness images and support for moving images.

Hitachi has developed a reflective-type LCD module utilizing 2.3-cm (0.9-inch) SXGA+ LCOS (liquid crystal on silicon). Based on a twisted nematic liquid crystal in a large-size TFT (thin film transistor) and ECB (electrically controlled birefringence) mode,

this LCD module produces high contrast ratio and quick response time. Its high quality images without stripe noise make it suitable for wide use ranging from presentations to home theater.

Main specifications:

- (1) Number of pixels: 1,365 (horizontal) × 1,024 (vertical)
- (2) Contrast ratio: ≥ 1,000 : 1
- (3) Response time: 8 ms (tr+tf, 40°C)



External view of 2.3-cm (0.9-inch) SXGA+ LCOS LCD module for a projector (left) and its structure (right)

