

日経エレクトロニクス
NIKKI ELECTRONICS

日経マイクロデバイス
NIKKI MICRODEVICES

ENERGY SAVING EPSON

1998.11



EPSON

Semiconductor Devices, Liquid Crystal Display Devices, and Crystal Devices
Focusing on Electronic Device Product Groups with Unique Features

“Energy Saving” is The Key Word Providing Customers With Products That Are Power Saving, Space Saving, and Time Saving

Low power consumption CMOS process cellular phone LSIs, D-TFD Liquid Crystal Display panels capable of acting as a digital interface, and crystal oscillators with two week turnaround
Seiko Epson electronic devices include products with features not available from other companies.
With Energy Saving as a key word, Seiko Epson provides customers with products that are power saving, space saving, and time saving.

“Japan’s electronic device business has entered a big structural reformation in the past year” says Saburo Kusama, Seiko Epson’s Vice President.

He also says, “Product development that merely expands the product area is insufficient in the already difficult electronic device business. As a manufacturer, we are entering an era when we have to ask, ‘How can we show our company’s unique features in a narrower range?’”

In the background lies a big industrial structural reformation, which is the shift to an information age. There is strong demand for “Features” and “Concepts” for items like performance, turnaround, and cost. These become the competitive force of a product, and surface in the

form of winning, losing, and reorganization.

Energy Savings That Aim for “Savings”

Within this big reformation, last year, “Energy Saving” was decided on as the keyword as a shared feature for both products and technology for the Electronic Device Marketing Division. Specifically, a fusion of power savings, space savings, and time savings is shown (Figure1).

This leads to customer cost reduction and savings in terms of resources, and this in turn contributes to reduced use of resources and better ecology for the end user. Our goal is “Creating Together and Producing Together” with our customers.

Specifically, Seiko Epson is offering not just an electronic device, but energy savings for the whole system and a total solution in terms of boards.

Power saving is the realization of power saving through things such as low power consumption and low voltage operation. In addition to power savings for the electronic device itself, this contributes to power savings at the board level and at the customer system level.

Space saving is the realization of smaller, lighter customer systems through fine processing, smaller, thinner, and lighter electronic devices, and using higher density mounting for the devices.

Time saving is the realization of shorter development and design time as well as quicker turnaround. Quicker turnaround for electronic devices contributes to shorter time for customer system design and manufacturing. With information equipment and multi-media equipment, faster development, trial production, and manufacturing are big issues for entering a system into the market in a timely fashion.

Specific examples of recent products include a cellular phone LSI combining a low power consumption CMOS process and a 32-bit RISC processor core, a low power consumption display drive LSI, a low power consumption D-TFD (Digital-Thin Film Diode) liquid crystal display panel that can act as a digital interface, and a programmable crystal oscillators with two week turnaround.

Selling Only Products With Unique Features

For some time now, Seiko Epson has been making a strong narrowing of focus on products. The basic concept is “selection and focus”. Vice President Kusama

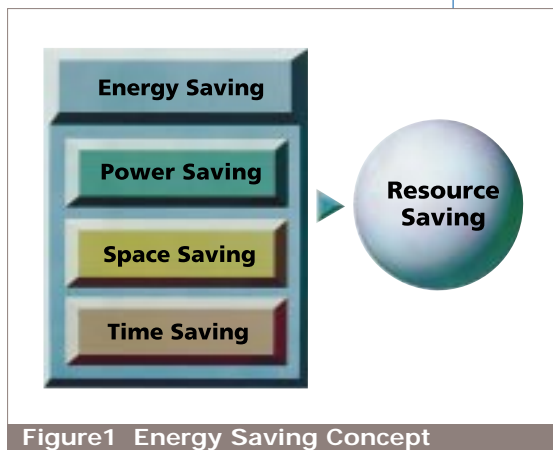


Figure1 Energy Saving Concept

explains, "No matter how good a technology or product is, we will not make it into a product if it does not have some unique feature or if it is the same as another company's product."

As a result, almost all products they put on to the market take the top position in terms of market share, or they aim for the top position. Mr. Kusama says, "In our company, employees study technology, and there are proposals for products which can be mass produced and which have high sales potential, but if a product doesn't have a 'unique feature,' we won't give it the go ahead. We tell some product managers that we'll pass their proposal if they can make the power consumption 1/10 of the current level."

In this way, product groups that have passed the tough inhouse selection process have this as a strength, and this becomes a reason for them to be supported by many customers. Mr. Kusama says, "For a final product to be competitive in the market, the performance of the devices used is important. This is because the performance of electronic equipment is affected by the performance of the electronic devices it contains. To make good products, you have to develop good devices. Having both the device and equipment have competitive ability demonstrates the strength of each item." The reason people are focusing on system LSIs is that they are what determine almost all functions and performance of a piece of equipment.

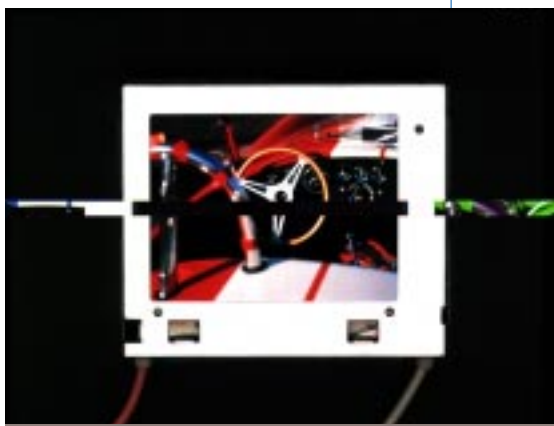


Figure2 LCD Aiming for Energy Savings

Mr. Kusama says, "Not only does the device itself have to have unique features and competitive ability, but now 'Creating Together and Producing Together' (collaboration) is more important than ever before." In this field, there has been talk for a long time about participation from the customer development stage, using joint development (design in/co-design). Seiko Epson has a great deal of experience doing joint tasks which cover the fields of software, hardware, mechanical systems, devices, and systems. Mr. Kusama says, "With our fast selling inkjet printer, the LSI design department engineers are involved in joint development for items such as color processing circuits."

Sales for the Electronic Device Marketing Division this period are sure to surpass those of last year. It is becoming difficult to achieve planned goals in the semiconductor field, but they say that they are meeting plan goals in the liquid crystal device and crystal device areas.

Aiming to Be a Company of Excellence The SE-21 Concept

Seiko Epson solidified the SE-21 concept at the end of 1995. Sales at that time were approximately 510 billion yen (March 1995). Making this one trillion yen in the year 2001, the plan is to make a 10% or greater increase in ordinary income from that period for all business divisions, with the goal of being an excellent company in the twenty-first century. At the same time, with "Selection and Focus" and "Spiral Up" as keywords, from the business structure perspective, Seiko Epson has



Mr. Saburo Kusama

Seiko Epson Corp.
Vice President
Chief Executive of
Electronic Device Business

"To create good products, manufacturers have to develop good devices."

set out a policy of attempting to realize an expanded scope and high earnings character.

Along with this, the company has consolidated its policies for each business division including information equipment, electronic devices, watches, etc. "Energy Saving" is the key word for the electronic device business. The Kyoto Conference of the Global Warming Prevention Conference was in December of 1997, so it can be said that, "We're a step ahead of the era," (Mr. Kusama).

The entire company has been involved in environmental issues from long ago. In 1988, the company declared a "challenge to make a fluoride-free company," and the company has indeed completely abolished chemicals such as chlorofluorocarbon and trichloroethane. In response to the policies of the Kyoto Conference, a policy was set in January of 1998 to reduce total energy consumed in the company by 60% (compared to 1997) by the year 2010. Mr. Kusama says, "Most of our energy is consumed in device manufacturing processes, and sales are expanding each year, so this is a tough goal to achieve for the manufacturing division. However, we can achieve it by using the knowhow we've accumulated so far. We have already reached the 20% reduction goals we were aiming for in the year 2000." Also, in March of 1998, Seiko Epson received ISO14001 certification for environmental control systems for all of its offices in Japan.

Semiconductor Business Focusing
On the "Portable" and "Display" Fields

"Energy Saving" and "Interface" Technology

We're focusing on portable information terminal and display fields based on low power consumption C-MOS technology developed using quartz watch. System LSI, processors, memory, etc. are prepared for portable information terminals.

Drivers, controllers, interfaces, etc. are prepared for display systems.

By focusing on fields that it excels in, Seiko Epson can create no. 1 products.



Mr. Kenji Kawagai

Seiko Epson Corp.
Semiconductor
Operations Division
IC Product Design
Department
General Manager

"By persistently refining our technology and knowhow and focusing on the 'portable' and 'display' fields, we create number 1 products."

Seiko Epson has confidence in its Energy Saving technology with its focus on low energy consumption. Of these technologies, "We've owned from early the dual gate C-MOS process" that exhibits a low voltage operation feature, "so this is a mature level manufacturing technology for us," says Mr. Kenji Kawagai, Semiconductor Operations Division, IC Product Design Department General Manager.

This technology has been cultivated using quartz watch, etc. There are many products and technologies that were jointly developed with the Watch Operations Division. This low power consumption technology has made contributions to portable equipment, including longer life for batteries and smaller, lighter equipments.

**Low Power Consumption
Realized Through Use of
Dual Gate C-MOS Processing**

The dual gate C-MOS process uses C-MOS

p-type areas and n-type areas as the same gate, and is a method which makes it easy to control threshold voltage V_{th} . There has particularly been improvement in p-type transistor control. When LSI made by fine process is used at low voltage, operation with higher speed and lower power consumption is easy.

In addition to this, even lower voltage operation is possible using SOI (Silicon On Insulator) technology. "Even battery-less quartz watch is now possible," says General Manager Kawagai. SOI has a structure where an Si monocrystalline layer is formed on an insulation layer. As parasitic capacity is reduced, operating speed can be faster and power supply voltage lowered. This technology (SIMOX) was developed by Nippon Telephone and Telegraph (NTT).

With dual gate C-MOS technology, a series of products using the 0.6 μ m process ranging from power supply voltage 0.5 V to 3V has been created (Figure3). "Inquiries are active even though the LSI price is

slightly high. This is because it is possible to reduce the cost for the overall system of the customer, for example to reduce one battery," says Mr. Kawagai.

**Seiko Epson Also Offers System LSIs
with Built In Processors**

"We are focusing on the 'portable' and 'display' fields. Our method is to 'select and focus'. Here, we're offering a total solution that combines low power consumption circuits and processor technology as well as interface technology," says Mr. Kawagai.

Items such as system LSIs and processors as well as memory are being prepared for portable equipment use. Also drivers, controllers, and interfaces are being prepared for display devices. Recently, in addition to the introduction of the SH microprocessor from Hitachi Ltd., Seiko Epson has also introduced the RISC processor core from England's ARM Ltd. A system has been created by which it is possible to offer system

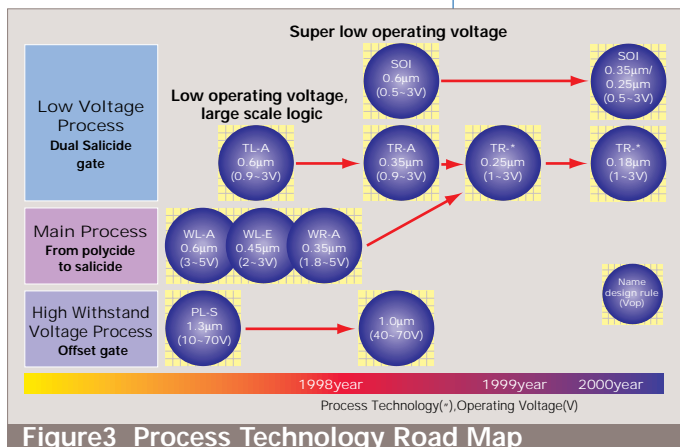


Figure3 Process Technology Road Map

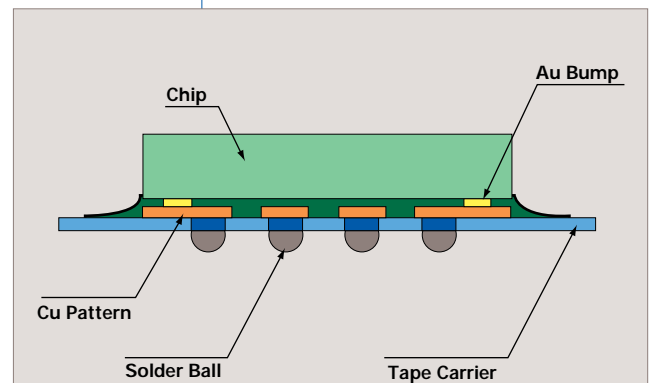


Figure4 New CSP for SRAM



LSIs for portable information equipment by combining low power consumption C-MOS technology and liquid crystal display driver technology.

Custom LSIs for cellular phones are already being acclaimed, because the component technology including low power consumption, display technology, and compact, light-weight technology as well as the technology and knowhow for combining these are already in place.

Seiko Epson has also a high market share for LSIs for pedometers and raising game. Until now, 4-bit microcomputers were used. This has changed to 8 bits with expansion of functions of these equipments, and by adding the SOI/C-MOS process, Seiko Epson is aiming for reducing to one tenth with its low power consumption.

Seiko Epson has SED1353/1354 as color display in drivers and controllers for liquid

crystal displays. The SED1354 has become the de facto standard (with color STN, a maximum of 4096 colors are displayed).

Furthermore, recently, low power consumption SRAMs for portable equipment have been developed. These are 4M bits and 2M bits models with operating voltage from 1.8V to 2.7V. The package is a thin type CSP of height 1 mm (Figure4), which has been developed making use of our bare chip assembly technology.

BTN Featuring High Contrast and D-TFD Capable Digital Interfaces Liquid Crystal Displays being pursued High Image Quality, Compact Size, and Low Power Consumption

Seiko Epson's liquid crystal displays are strived to achieve HCL. H means high Image quality and high density(and high resolution).C means compactness (thin type) and color solution, and L means low power consumption.

A high market share is held by low power consumption, high resolution poly-Si TFT and TFD for digital still camera monitors and projectors.

Seiko Epson has developed a D-TFD capable to interface by digital method for portable information terminals. BTN product will be available soon.

Our liquid crystal display(LCD)is currently specializing in, ①the portable equipment field (cellular phone, PDA, etc.), ②the compact monitor field(for digital camera monitors, car navigation systems, etc.), and ③the LCD projector field.

Seiko Epson also devolops driver and controller LSIs for displays, so is offering a total display system that combines compactness and low power consumption with high density assembly technology.

The concepts of Energy Saving, "selection and focus," and "creating together and producing together" are at work here as well.



Mr. Shoichi Iino, LD Technology Development Center General Manager, uses Figure5 to explain, "The basis for liquid crystal technology is 'HCL'. H represents High Image Quality and High Density, C represents Compact Design

and Color Solutions, and L represents Low Power Consumption."

A high market share is also held by high density products, examples being a 0.5 inches type (diagonal 1.3 cm) 180,000 pixel full color poly-Si TFT for view-finders and a 1.3 inches type (diagonal 3.4 cm) XGA poly-Si TFT for LCD projectors. By incorporating a LCD driver, these products become light and compact.

With high quality products, BTN liquid crystal featuring high contrast and a wide angle of view has been developed, and, "BTN reached the level to be put into market ,"

says Manager Iino. Mr. Iino adds,"Also, in the STN field, super passive LCDs realized the lowest power consumption in industry



Mr. Shoichi Iino
Seiko Epson Corp.
LD Technology Development Center
General Manager

"We're aiming to be number 1, with low power consumption."

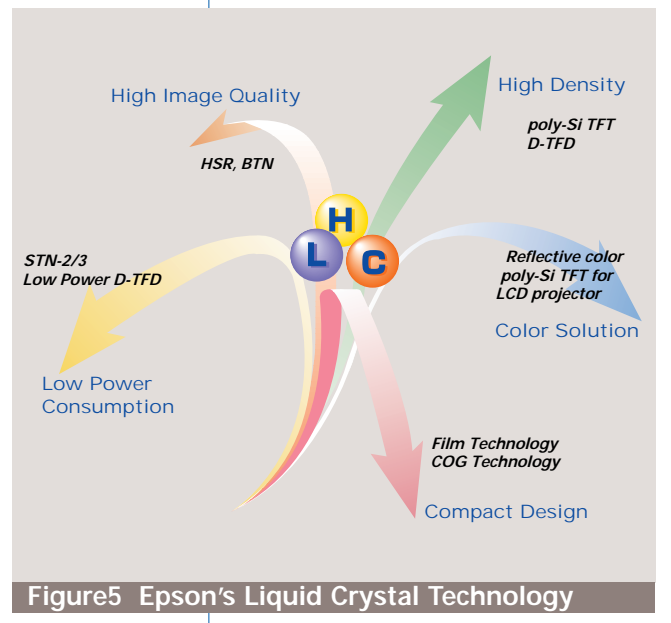


Figure5 Epson's Liquid Crystal Technology

and display close to white paper." Like with paper, it is possible to display black text on a white background, so there has been a good response for cellular phones and PDAs that display text.

As applications for these technologies, there are uses for things such as fashionable watches that display red on a metallic background, etc.

2.6 inches Type LCD with Low Power Consumption of 3 mW

The low power consumption product passive matrix type monochrome LCD TCM-A0822 rev.(currently shipping samples) is a 2.6 inches type (diagonal 6.8cm) with 320×200 pixels (pixel pitch is 0.18 mm) and 16 gray level display, and realizes a low power consumption of 3 mW at full pixel display. This is about one tenth as it was previously 25 mW to 30 mW.

Furthermore, display added a partial display function has been newly developed. This is a technology that allows only the area that needs to be displayed (e.g. icons, clock, calendar display) to be displayed, so that the average consumption power is a mere 0.5 mW. Since it is possible to display only the necessary area, it is possible to greatly extend the battery life. This is perfect for cellular phones and PDAs for which display screens are getting larger.

Seiko Epson is also developing a low power D-TFD (Digital Thin Film Diode) that can use a digital interface. It is estimated that passive level low power will be possible.

The D-TFD reflective type color LCD LF37SQR (Figure6) (development specifications) is a 3.7 inches type (diagonal 9.4 cm), 230,000 dots (320×3×240 dots), 260,000 color display with power consumption of 50 mW.



Figure6 D-TFD Reflective Type Color LCD

The D-TFD transmissive type color LCD LB18DC (development specifications) for digital still camera is a 1.8 inches type (diagonal 4.4cm), 110,000 dots (474×234 dots), 260,000 color display with power consumption of 400 mW (digital interface).

Aiming for Market Expansion Through Short Turnaround and Compound Products

Crystal Oscillators That Feature Compact Thin Package, Low Power Consumption, and Two Week Turnaround

Seiko Epson is aiming to expand the crystal device market. The company is exploring a new market by adding short turnaround time and compound products to compact, thin, light products with low power consumption.

Seiko Epson has already developing programmable crystal oscillator with two week turnaround and functional circuit blocks which have a crystal device, oscillating circuit and memory incorporated into one package.

The company has also developed a compact package of thickness 0.9 mm for crystal oscillator.



Mr. Kaname Miyazawa

Seiko Epson Corp.
Quartz Device
Operations Division
QD Design Engineering Department
General Manager

"We are incorporating circuits which are not in system LSIs. Smaller products are possible because crystal devices themselves are now compact."

The Quartz Device Operations Division manufactures products such as crystal unit, crystal oscillators, and RTCs (real time clock modules). Mr. Kaname Miyazawa, Quartz Device Operations Division QD Design Technology Department General Manager says, "Our goal is to increase the quartz device operations division's market share by pursuing Energy Saving together

with our customers based on power saving, space saving, and time saving."

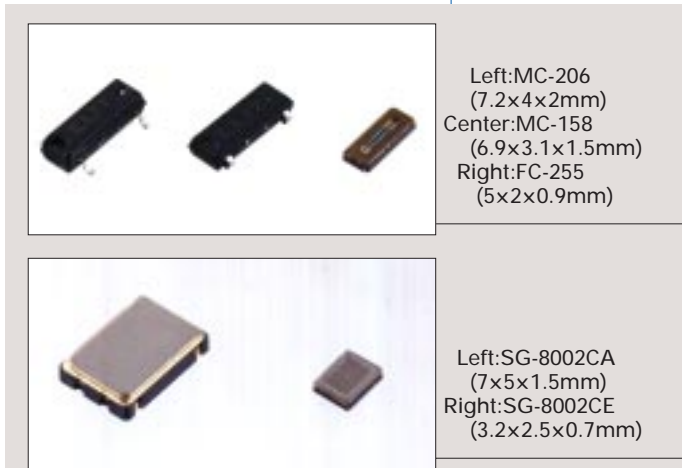
Power saving is the pursuit of low power consumption. The goal with crystal oscillators is to go from the current operating voltage of 2.7 V to 1.8 V, and with RTCs to go from the current 1.6 V to 0.9 V.

Space saving is the pursuit of compact, thin, lightweight package. A thin type

package crystal oscillator unit of thickness 0.9 mm has already been developed.

Time saving is the pursuit of quicker turnaround. This contributes to the design, development, and manufacturing of customer systems. Seiko Epson is already offering a programmable crystal oscillator with two week turn around.

Furthermore, "We want to expand the



Left:MC-206
(7.2×4×2mm)
Center:MC-158
(6.9×3.1×1.5mm)
Right:FC-255
(5×2×0.9mm)

Left:SG-8002CA
(7×5×1.5mm)
Right:SG-8002CE
(3.2×2.5×0.7mm)

Figure6 D-TFD Reflective Type Color LCD

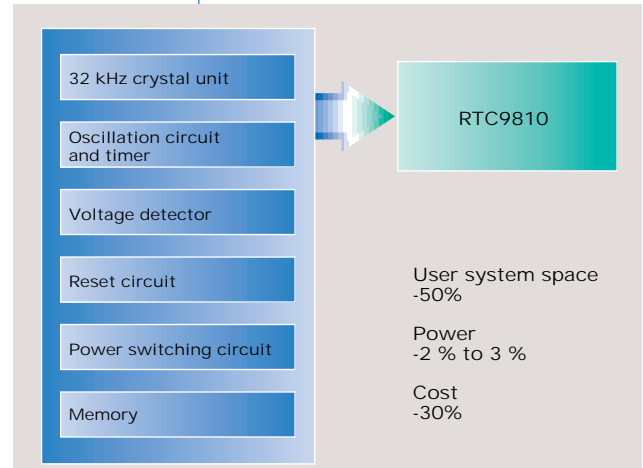


Figure6 D-TFD Reflective Type Color LCD

overall market for crystal devices by making advances with developing new functions and compound products,” says Manager Miyazawa. The company is developing items such as a high frequency circuit block with a crystal device, oscillation circuit, and memory all in one package.

Crystal Oscillator Targeting Turnaround Time of One Week

The high frequency programmable crystal oscillator SG-8000 series has a short turnaround time of two weeks. Recently, a full product line with packages from plastic to ceramic was completed.

Until now, for crystal oscillator, after receiving an order from a customer, the crystal oscillator was processed, assembled, and tested before shipping. It took four to five months from order to delivery. With this situation, it was impossible for items such as multi-media equipment to enter the market in a timely fashion.

In response, a crystal oscillator was developed that can obtain any frequency in a short time by incorporating a crystal oscillator that generates a reference, a PLL circuit, and PROM into a package, and by programming the frequency dividing ratio from the PROM writer. A desired frequency can be set from approximately 30,000 frequencies between oscillating frequency 1.0 MHz to 125 MHz, and a significantly short turnaround time was realized.

As a result, the customer’s flexibility in

designing was enhanced, and a significant reduction in development and manufacturing time is possible. At the beginning, turnaround time was six weeks, but this was shortened to two weeks thereafter. Recently, for issues such as completion of programming factories in the U.S., “We are aiming for one week turnaround,” says General Manager Miyazawa.

Package Persuing the Limit Size

Mr. Miyazawa says, “With cylinder package, we are pursuing the ultimate limit. Ceramic packages can be substituted for surface mount type plastic package with the built-in cylinder type package.” For example, with a crystal unit of oscillating frequency 32kHz, the company has developed a compact model with a reduction in diameter from 1.5 mm to 1.2 mm and further to 1.0 mm. This is oval cylinder. The AT oscillator was also made more compact with the diameter going 3.0 mm → 2.0 mm → 1.5 mm → 1.0 mm.

Seiko Epson is also pushing to make ceramic packages more compact. With the crystal unit, what has been 7.0 mm×5.0 mm×1.5 mm until now has been reduced to 3.2 mm×2.5 mm×0.7 mm.

Expanding the Market Through Compound Products

Seiko Epson is attempting to expand the crystal device market through sys-

tematizing as folloing : a high frequency circuit block is made by combining compound technology used for programmable crystal oscillator and crystal device miniaturizing technology. “By dealing with a part of the system such as an LSI, “savings” can be realized in terms of space, power, and cost of a user system. This is ‘System in QD’,” says Manager Miyazawa (QD : Quartz Devise. It is same as crystal device).

The company has already developed a product in module form that includes a 32 kHz crystal unit and oscillating circuit, timer, voltage detector, and memory (Figure7). This is for printers, and it was possible to reduce space by 50%, power by 2~3%, and cost by 30% through modulization (Figure8). Next, the Seiko Epson is considering tackling products such as clock circuits and I/O circuits for processors and ASIC, analog circuits, and high frequency circuits.

Seiko Epson Corporation
Electronic Devices Marketing Division
ED Sales Promotion Department

421-8 Hino, Hino City,
Tokyo 191-8501, JAPAN
TEL: +81-42-587-0222
E-mail: edevice@epson.co.jp
Home page: http://www.epson.co.jp

SEIKO EPSON CORPORATION

Electronic Devices Marketing Division

AMERICA	EPSON ELECTRONICS AMERICA, INC. HEADQUARTERS	1960 E. Grand Ave, El Segundo, CA 90245, U.S.A. Phone : +1-310-955-5300 Fax : +1-310-955-5400	
	SALES OFFICES	West	150 River Oaks Parkway, San Jose, CA 95134, U.S.A. Phone : +1-408-922-0200 Fax : +1-408-922-0238
		Central	1450 East American Lane Suite 1550, Schaumburg, IL 60173, U.S.A. Phone : +1-847-517-7667 Fax : +1-847-517-7601
			101 Virginia Street, Suite 290, Crystal Lake, IL 60014 Phone : +1-815-455-7630 Fax : +1-815-455-7633
		Northeast	301 Edgewater Place, Suite 120, Wakefield, MA 01880, U.S.A. Phone : +1-781-246-3600 Fax : +1-781-246-5443
	Southeast	4300 Six Forks Road, Suite 430, Raleigh, NC 27609, U.S.A. Phone : +1-919-781-7667 Fax : +1-919-781-6778	
		1700 Spinnaker Drive, Alptaretta, GA 30005 Phone : +1-770-754-4872 Fax : +1-770-753-0601	
EUROPE	EPSON EUROPE ELECTRONICS GmbH HEADQUARTERS	Riesstrasse 15, 80992 Muenchen, GERMANY Phone : +49- (0) 89-14005-0 Fax : +49- (0) 89-14005-110	
	GERMANY SALES OFFICE	Breidenbachstrasse 46, D-51373 Leverkusen, GERMANY Phone : +49- (0) 214-83070-0 Fax : +49- (0) 214-83070-10	
	UNITED KINGDOM UK BRANCH OFFICE	G6 Doncastle House, Doncastle Road, Bracknell, Berkshire RG12 8PE, ENGLAND Phone : +44- (0) 1344-381700 Fax : +44- (0) 1344-381701	
	FRANCE FRENCH BRANCH OFFICE	1 Avenue de l' Atlantique, LP 915 Les Conquerants, Z.A. de Courtaboeuf 2, F-91976 Les Ulis Cedex, FRANCE Phone : +33- (0) 1-64862350 Fax : +33- (0) 1-64862355	
ASIA	HONG KONG, CHINA EPSON HONG KONG LTD.	20/F., Harbour Centre, 25 Harbour Road, Wanchai, HONG KONG Phone : +852-2585-4600 Fax : +852-2827-4346 Telex : 65542 EPSCO HX	
	CHINA SHANGHAI EPSON ELECTRONICS CO., LTD.	4F, Bldg., 27, No. 69, Gui Jing Road, Caohejing, Shanghai, CHINA Phone : +86-21-6485-5552 Fax : +86-21-6485-0775	
	TAIWAN, R.O.C. EPSON TAIWAN TECHNOLOGY & TRADING LTD.	10F, No. 287, Nanking East Road, Sec. 3, Taipei, TAIWAN, R.O.C. Phone : +886- (0) 2-2717-7360 Fax : +886- (0) 2-2712-9164 Telex : 24444 EPSONTB	
	HSINCHU OFFICE	13F-3, No.295, Kuang-Fu Road, Sec. 2, HsinChu 300, TAIWAN, R.O.C. Phone : +886- (0) 3-573-9900 Fax : +886- (0) 3-573-9169	
	SINGAPORE EPSON SINGAPORE PTE., LTD.	No. 1 Temasek Avenue, #36-00, Millenia Tower, SINGAPORE 039192 Phone : +65-337-7911 Fax : +65-334-2716	
KOREA SEIKO EPSON CORPORATION KOREA OFFICE	10F, KLI 63 Bldg., 60 Yoido-Dong, Youngdeungpo-Ku, Seoul, 150-010, KOREA Phone : +82- (0) 2-784-6027 Fax : +82- (0) 2-767-3677		

Publication: SEIKO EPSON CORPORATION
Electronic Devices Marketing Division ED Sales Promotion Department
421-8, Hino Hino-shi, Tokyo 191-8501, JAPAN
Tel. +81-42-587-5291 Fax. +81-42-587-5266
Head Office: 3-3-5, Owa, Suwa-shi, Nagano-ken, 392-8502, JAPAN

Please refer to the electronic catalog of Epson's Device.

<http://www.epson.co.jp>