# The Interpreter

*An analysis of news, issues and trends affecting the computer industry*

## Keyboards become the latest computer peripheral

### *Trend toward detached, intelligent keyboards opens doors for manufacturers*

**Sarah Glazer,** Senior Editor

A few years ago, keyboards were typical computer components. They shared a case with a monitor or processor, wired in like other parts. But that's not so anymore. Today, many keyboards come from a factory in their own cases. They're ready to plug into a computer or monitor and contain their own printed-circuit boards. Keyboard suppliers are now tapping this intelligence to build in extras such as interfaces for mice or for voice recognition, and some suppliers are starting to sell directly to end users and system integrators.

"Awareness of keyboards becoming peripherals is just starting to grow," reports Mark Tiddens, corporate marketing manager of Key Tronic Corp., Spokane, Wash., the leading independent U.S. manufacturer of computer keyboards. "The only thing a keyboard doesn't have is an RS232 interface." Because it is virtually the only part of a computer that isn't shrinking, a keyboard is the logical place to put an interface for a mouse, a voice-recognition device or an optical character reader.

The trend toward enhanced keyboards is one reason manufacturers are changing their marketing rule of selling only to OEMs. Another reason is that OEMs themselves are changing the rules by unbundling their products. IBM Corp.'s announcement last summer that it would sell its PC keyboard (which it makes at its own keyboard plant) separately opened the door to a spate of plug-compatible keyboards from independent manufacturers.

"Selling to end users is a whole new business for us," Tiddens acknowledges. Key Tronic conducts its end-user business through advertising and distributors. An unexpected bonus from developing products for end users was gaining new OEM contracts—to supply keyboards to PC-compatible manufacturers, including Compaq Computer Corp., Columbia Data Products Inc., Eagle Computer Inc. and Corona Data Systems Inc. Tiddens reports that shipments to end users and OEMs of "standard" items—plug-compatible keyboards for the IBM PC and the Apple II, among others—represent 20 percent of Key Tronic's total units shipped. Tiddens also expects to start selling directly to

system integrators. "This market is totally new to us," he admits. "We're just now developing relationships with system integrators and software houses."

Independent suppliers are accustomed to working with small customers because most big computer companies rely on captive suppliers for their keyboards. One widely publicized recent exception is IBM, which is buying keyboards for its PCjr from independent manufacturer Advanced Input Devices (AID) Inc., Coeur d'Alene, Idaho. The non-captive market for full-travel keyboards (including those used in equipment other than computers) totaled almost $195 million in 1982, estimates Venture Development Corp. (VDC), a Wellesley, Mass., research organization.

**SHIPMENTS OF FULL-TRAVEL DIN AND NON-DIN STANDARD KEYBOARDS**



SOURCE: VENTURE DEVELOPMENT CORP.
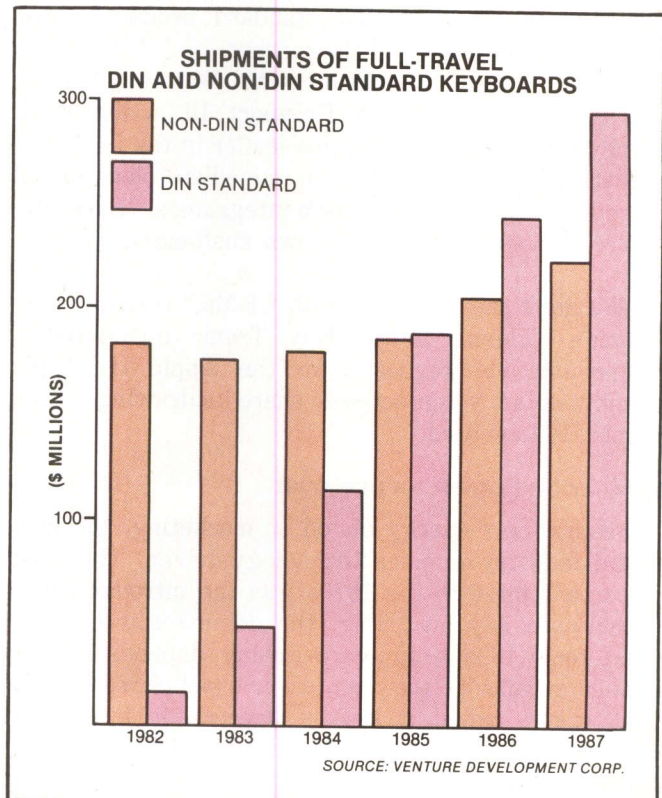
**Low-profile keyboards,** *particularly in demand for word processing and data entry, conform with German Deutsche Industrie Norm (DIN) standards for user comfort and safety. Because most new full-travel keyboards meet these requirements, research organization Venture Development predicts DIN-standard keyboards will lead in this market segment by 1986.*

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As keyboards become more uniform, they move closer to being true peripherals, believes marketing manager James Wieser of the Cortron division of Illinois Tool Works Inc., another keyboard supplier beginning to sell to end users. Not long ago, each OEM wanted its keyboard to be unique. Wieser reports that Cortron may develop a family of standard products, although its only current off-the-shelf keyboard is an IBM PC-compatible. He attributes today's move to-

*Because it is virtually the only part of a computer that isn't shrinking, a keyboard is the logical place to put an interface for a mouse, a voice-recognition device or an optical character reader.*

ward standardization to the IBM PC's popularity: "The IBM PC keyboard is the closest thing to a standard in our industry." Although Wieser believes keyboard manufacturing will remain overwhelmingly a custom business, he predicts that standard products could account for 20 percent of the market.

Skeptical of this prediction is Ed Waters, planning manager for Micro Switch, Freeport, Ill., a division of Honeywell Inc. and a longtime leader in the keyboard industry. Micro Switch has no immediate plans to sell directly to end users or system integrators. "Basically, you're competing with your own customers," Waters says.

"We don't see a conflict with OEMs," counters Key Tronic's Tiddens. When Key Tronic introduced a plug-compatible keyboard for the Apple II, Apple Computer Inc. volunteered to share its drawings of the Apple IIe keyboard.

### New technologies reduce cost

Despite new energy aimed at marketing, the keyboard industry remains technology-driven. The most important force in the 1970s was the introduction of capacitance key switching, the dominant technology used today. Capacitance switching depends on the change in capacity between two charged plates or pads that occurs when a key is depressed. It quickly outpaced more expensive, magnet-based technologies, including Hall-effect, inductive-core and reed switching —all still used in applications requiring keyboards with particularly long lifetimes.

Capacitance keyboards will remain the industry leader for the next five years, predicts VDC. Used mostly in computers and business machines for high-

speed data entry, full-travel capacitance keyboards "give the feel people are used to and are reliable enough to last the lifetime of the product," reports VDC analyst Lisa DiRocco. Full-travel keys mimic the feel of popular electric typewriter keyboards, while less expensive "micromotion" keys and flat panels give an unfamiliar feel.

Key Tronic's development of the first capacitance keyboard catapulted it to first place among independent keyboard suppliers. Although other suppliers have since developed capacitance products, Key Tronic estimates that it made 80 percent of the capacitance keyboards sold to domestic manufacturers in 1982 and that capacitance keyboards represented one-third of that year's non-captive domestic market. The company's fiscal 1983 revenues of $80.5 million were more
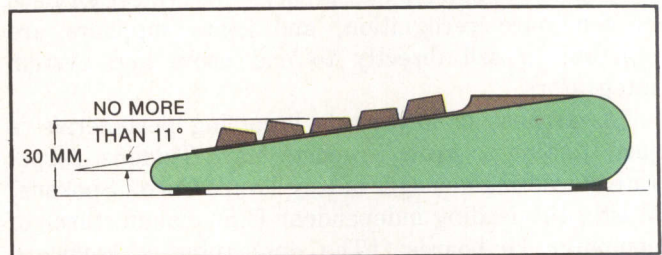


**A low-profile keyboard conforms to DIN standards** *that limit the distance between the home row of keys and the tabletop. German researchers found that this measurement and the angle of the key rows are crucial in preventing operator fatigue.*
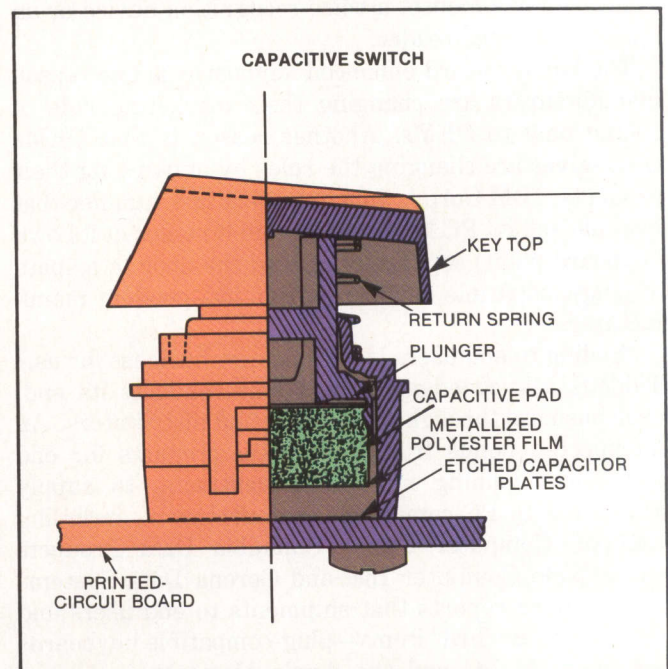


**In capacitive-switch technology,** *the capacity between two charged plates or pads changes as a key is depressed. (Courtesy of Key Tronic Corp.)*

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than twice the $35 million that Key Tronic's Tiddens estimates for its closest rival, Micro Switch.

Today, two new contenders threaten the supremacy of capacitance switching: membrane and conductive-rubber technologies. Although keyboards based on these technologies are less expensive than capacitance keyboards, both have problems ranging from unreliability to unacceptable feel.

## Horror stories haunt membrane technology

Membrane key panels usually consist of two layers of polyester film traced with silver ink, separated by a spacer sheet that has holes in contact areas. Primarily used in flat panels for instrument, appliance and game controls, membranes fully seal a control panel, which is especially useful in industrial, medical and other harsh-environment applications. A conventional key set can also press down the top membrane, bringing these keyboards into the high-duty data-entry arena. Although developers heralded membranes as the low-cost



CONDUCTIVE RUBBER

BUTTON
FRAME
CONDUCTIVE ELASTOMER
PRINTED-CIRCUIT BOARD
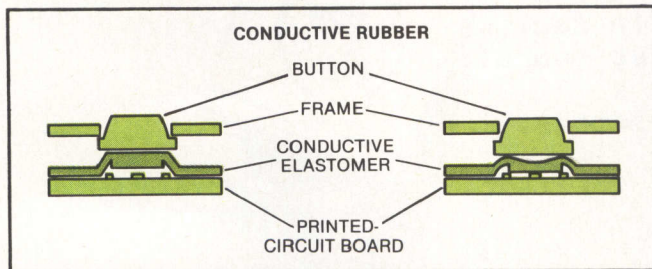
**Conductive-rubber switch technolgy** *uses a molded sheet of rubber that forms a dome beneath each key. When a key is depressed, the dome collapses and makes contact with the circuit below it. The dome then pops up again.*
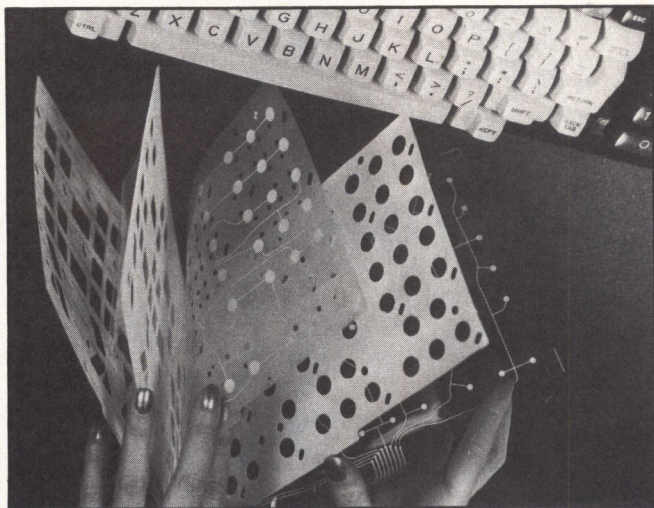


**Membrane-switch technology** *uses a plastic sandwich that contains a spacer sheet with holes for the contact areas. Although many membrane keyboards are flat panels, they can also be actuated by full-travel keys. (Courtesy of Micro Switch)*

keyboard of the future, persistent problems muted their praise.

"Horror stories," is how AID president John Overby describes the industry's problems with membrane keyboards. Although AID is developing a membrane keyboard, the project is taking a back seat to current products. Overby says the most disturbing problem about membrane keyboards is "latent failure," in which

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the units become unreliable two or three years after delivery. He claims that many of AID's customers for its micromotion keyboards are former users of membrane keyboards who "are getting burned on reliability and are coming in to do a retrofit."

"We don't claim [our membrane keyboards have]as high a life as Hall-effect keyboards," says Micro Switch's Waters. The Micro Switch full-travel membrane keyboard is actuated by capacitance key switches. He rates Micro Switch's membrane keyboard at 30 million actuations compared with 100 million actuations for the life cycle of a Hall-effect keyboard. A typical capacitance keyboard is rated at 100 million actuations.

Key Tronic also manufactures a membrane keyboard, which it rates at 50 million actuations. Key Tronic's Tiddens admits that, in two years, the keyboard attracted only one significant customer: Gavilan Computer Corp. Because a membrane keyboard doesn't require a printed-circuit board, it is particularly useful in equipment without detached keyboards, such as portable computers.

"The membrane keyboard has a problem now with market acceptance," says Craig Stout, president of Maxi Switch, Minneapolis, which is developing a membrane keyboard. "Customers are perceptive about the problems, and they're gun-shy." Although Stout believes membrane technology holds advantages, particularly in price, that will be tapped in the future, he says Maxi Switch will not bring its membrane keyboard to market yet.

Another technology that promises reduced cost is conductive-rubber switching. The technology, especially popular in Japan, is not new. But recently developed materials have for the first time made its use viable for high-end applications. To produce a conductive-rubber keyboard, manufacturers mold a sheet of conductive

## Controversy surrounds IBM PCjr keyboard

"It's not a typeable keyboard. I've typed on the PCjr keyboard, and it's really tiring," claims Mark Tiddens, marketing manager for Key Tronic Corp., Spokane, Wash. For one thing, the 3 ounces of force needed to depress a key is much higher than the 2 ounces Tiddens claims is required for minimum fatigue. For another, the keyboard is so flat that "your fingers just won't stay on the keys" and keep slipping off the home row, he reports.

That's not what IBM Corp. found when it performed "extensive tests" on the keyboard with a cross section of users ranging from high-speed typists to people who had no experience in using keyboards, insists John Overby, president of Advanced Input Devices (AID) Inc., the Coeur d'Alene, Idaho, company that manufactures the PCjr keyboard. In a test that included 29 keyboards, the top two choices were the IBM PC and PCjr keyboards, he claims.

IBM's desire for a changeable bezel overlay for the key legends dictated the unusual rectangular ("Chicklet") key shape on the PCjr keyboard, Overby says. The PCjr keyboard is a modified version of an earlier AID design called the Ergokey. "It's a particularly good idea for the education market or even for the business market where people want to change the overlay to match different software," Overby maintains.

Tiddens concedes that IBM may well be committed to the bezel keyboard for the educational market, but he believes IBM will introduce another, more standard keyboard for the business market. "I think IBM is just fooling the whole world in its direction on the PCjr," he speculates. "I don't think it was intended for the home market." Overby refuses to comment on future AID products, but he does not deny that other PCjr keyboards might be in the works.

Whether or not IBM offers alternative keyboards, other suppliers will. They include Key Tronic, Maxi Switch, Minneapolis, and the Cortron division of Illinois Tool Works Inc., Elmhurst, Ill. The very fact that the original keyboard is not standard "provides a good opportunity for many keyboard manufacturers to market an emulation with the same key tops as their



**The rectangular shape of keys for the IBM PCjr** *(lower keyboard) allows enough room between rows to accommodate a bezel template, explains John Overby, president of Advanced Input Devices, which manufactures the keyboard. The flexibility provided by changeable templates is particularly useful in the education market, he says.*

existing lines," says Cortron marketing manager James Wieser.

Wieser predicts that plug-compatible keyboards will also omit another controversial feature of the PCjr keyboard: the infrared link that connects the keyboard to the computer. Instead of using a cable, the keyboard emits infrared signals that a receptor on the computer decodes. Craig Stout, president of Maxi Switch, calls the infrared link a "neat gimmick," but he believes it will be used primarily for games because interference problems make it impossible to use more than one PCjr per room. He expects a conventional cable connection to be a feature of most plug-compatibles: "Someone who's going to invest more dollars in the PCjr is doing it for serious keyboard use."

A third controversy surrounding the PCjr keyboard is its price. IBM surprised the computer industry by buying keyboards from an independent supplier. It's the first time the giant, said to have the world's biggest

keyboard-manufacturing capacity, has used an independent source.

Key Tronic's Tiddens claims IBM wanted to pay as little as $12 to $15 per keyboard—far below the price of a keyboard based on the dominant capacitance-switching technology. AID uses a conductive-rubber switching technology that requires fewer parts than a capacitance keyboard but is considered more reliable than the industry's other inexpensive alternative, the membrane keyboard. But the PCjr keyboard's estimated price of $26, says Tiddens, "is almost enough for a capacitance keyboard."

Overby maintains that a comparable capacitance keyboard would cost closer to $50 and that his company's keyboard beat even membrane products in price. Far from being worried about competition from plug-compatible keyboards, Overby reports that AID plans to double its production capacity from 5,000 to 10,000 keyboards a day and expects to have "the world's largest keyboard capacity" within a year.

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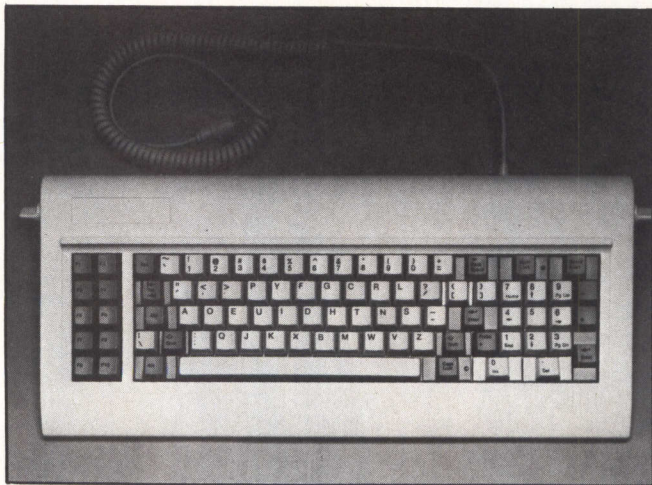


**Using the Dvorak keyboard,** *which puts the most-used keys on the home row, makes a high-speed typist as much as 40 percent more efficient than when using the more common QWERTY keyboard, says Craig Stout, president of Maxi Switch. "The Dvorak keyboard is a trend for the future," he maintains. (Courtesy of Maxi Switch)*

rubber so it forms a dome under each key. When a key is pressed, the dome collapses to close a circuit and then pops up again.

Older materials, usually silicon-based elastomers, tend to degrade before reaching 30 million actuations. As a result, they are useful only for equipment such as calculators. However, new materials, such as Japanese-developed non-silicon elastomers, overcome this problem. AID rates the conductive-rubber keyboard it makes for the IBM PCjr at 69 million actuations. Another advantage AID's Overby cites for the company's conductive-rubber keyboard is that the enclosure is an integral part of the keyboard, eliminating 250 parts. "The simplicity is where the major cost breakthrough is," Overby maintains.

However, a problem for the conductive-rubber keyboard is its feel: an excessive amount of force is required to depress the keys. "It doesn't have the feel people like—that secretaries are used to," claims VDC's DiRocco. Suppliers have been unable to improve the feel, she maintains. If conductive-rubber keyboards do find acceptance in high-end applications, she warns that U.S. suppliers may face increased competition from Japan: "That's the biggest technology in the East, and a lot of Japanese vendors are waiting to jump in."

## Suppliers move overseas

Because manufacturing switches, key tops and enclosures can differ slightly for each customer, most keyboard suppliers are vertically integrated and have complex manufacturing capability. Therefore, keeping manufacturing and assembly costs down is a major concern for suppliers. As a result, some have opened plants outside the United States.

Building offshore plants also helps keyboard makers fend off Japanese competition. That's the main reason Key Tronic recently opened a plant in Taiwan, says the company's Far East sales manager, Buck Zietzel. "We saw so many of our customers going to Taiwan to assemble," he reports. "We couldn't let the Japanese take over their keyboard needs and use that as a

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*Capacitance keyboards will remain the industry leader for the next five years, predicts Venture Development.*

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stepping stone to take over our market share." Most computer manufacturers use only one source for keyboards, Zietzel explains, because even when made to the same specifications, different suppliers' products have a noticeably different feel. If an OEM finds using Japanese keyboards for offshore assembly plants attractive enough, the company might easily turn to the Japanese supplier for all its keyboard business.

Key Tronic's Taiwan plant serves only its Far East customers—it ships no products back to the United States, Zietzel declares. In fact, until the plant proves itself, the company plans to ship plastics to Taiwan from its Spokane operation. Although Zietzel believes the Far East venture will become more self-sufficient, he says it won't be vertically integrated but will instead be primarily an assembly operation. Micro Switch has also opened plants outside the United States. Micro Switch's Waters reports that the company's plants in Scotland and Japan supply only European and Far East customers, although its plant in Mexico augments its U.S. manufacturing capacity.

Supplying OEMs that have moved production or assembly overseas is a problem for a company without nearby facilities, admits Maxi Switch's Stout. Maxi Switch is currently shipping keyboards to the Orient for some customers and may open plants overseas, he says, although it has no immediate plans to do so.

Of more pressing concern to Stout is the overall direction of the keyboard industry. "If keyboards are becoming a peripheral, then the after-market business is going to become a major part for those keyboard manufacturers who want to pursue it," he asserts. And, when a keyboard routinely controls devices such as mice, optical character readers and voice-recognition devices, "frankly, you have a system," he comments. The question he asks about the keyboard industry is: "How soon is it going to become a systems business?" □