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The Q1/Lite Microcomputer System

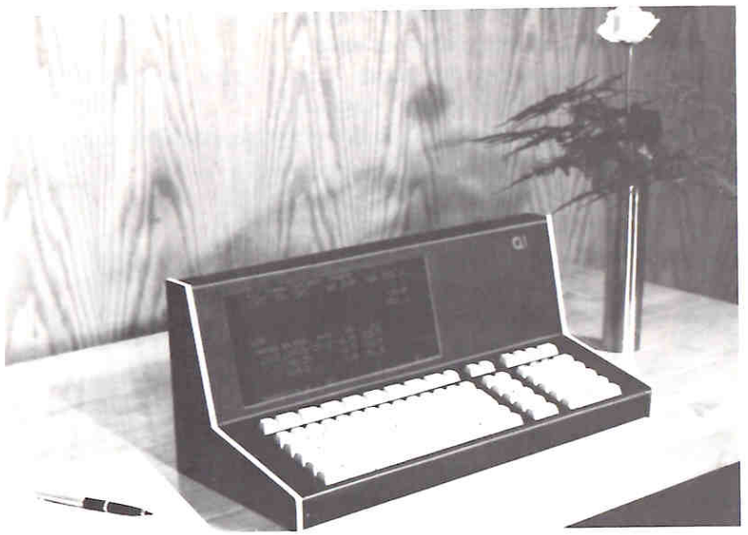
Q1 CORPORATION * 6 Dubon Court * Farmingdale, New York 11735

This document was keyed-in, revised, and typeset on the Q1/Lite
Q1 CORPORATION * 6 Dubon Court * Farmingdale, New York 11735

THE Q1/LITE MICROCOMPUTER SYSTEM

OCTOBER 1977

Q1/Lite, Standard Configuration



Q1/Lite, Independent Work Station

THE Q1/LITE MICROCOMPUTER SYSTEM

The proliferation of the microcomputer is rapidly transforming the computer industry. Q1 Corporation, the first company to develop, manufacture, and market microcomputer systems, has now introduced the Q1/Lite.

The Q1/Lite provides faster response at a lower cost than medium-scale computers, which presently represent the largest segment of the computer industry.

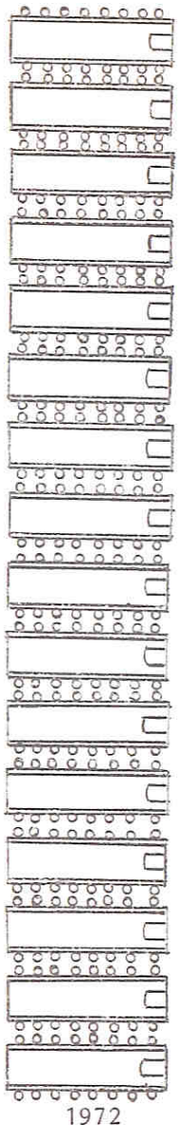
In addition, the Q1/Lite replaces a wide variety of data-processing equipment, including accounting machines, data-entry equipment, desk-top programmable scientific calculators, terminals, and word-processing machines. For this reason, the Company estimates that the potential market for the low-cost, multi-purpose microcomputer system is larger than any other segment of the computer industry.

The World's Most Popular Computer

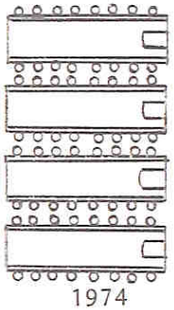
In 1972, for the first time, the entire Central Processing Unit of a computer was contained on a single silicon chip. This first-generation microprocessor became known as the 8008. At about the same time, the 1,024 bit semiconductor memory chip was introduced. Both the microprocessor and the memory component were implemented on silicon chips approximately 1/5" square in size.

Within two years, it became possible to quadruple the density of logic or memory elements per unit area. This led to the introduction, in 1974, of the 4,096 bit semiconductor memory chip, and the 8080 second-generation processor on a chip. At this stage of development, semiconductor memory technology surpassed the previously dominant magnetic core memory technology in cost-effectiveness.

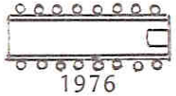
Since then, the 8080 microprocessor series has become, by far, the world's most popular computer. In 1976 alone, over 400,000 of the 8080 microprocessors were manufactured. This is more than the total number of computers previously manufactured in the quarter-century since the advent of the computer age.



1972
1st Generation



1974
2nd Generation



1976
3rd Generation

Three Generations of Microelectronic Technology: The Number of Integrated Circuit Components Used To Represent 16,384 Bits of Read-Write Memory

Third-Generation Microelectronic Technology

The Q1/Lite utilizes the 8800 third-generation microprocessor which contains, as subsets, the instruction sets of both the first-generation 8008 and second-generation 8080 microprocessors.

The Q1/Lite also utilizes third-generation semiconductor memory chips, each containing 16,384 bits, which represents a sixteen-fold increase of density compared with the 1,024 bit memory chips used in first-generation microcomputer systems.

This remarkable increase of density within the short span of four years has far-reaching effects on equipment size, reliability, and cost. While the 16K byte memory in the first-generation microcomputer required 128 chips, the third-generation microcomputer requires only 8. In terms of reliability, the number of welded connections for memory, for example, has similarly been reduced from 2,048 to 128, with a resulting 93% decrease in the probability of fault due to this factor.

Since the manufacturing cost per unit area of silicon chip has remained substantially unchanged during this period, there has also been a corresponding sixteen-fold decrease in the manufacturing cost per logic and memory element.

The Microcomputer: A Negative Cost Factor

The microcomputer, incorporated into a terminal with a display, printer, and external storage unit such as the flexible diskette drive, is now fast enough to perform control functions of the equipment and simultaneously process data at the point-of-use. By replacing more expensive mechanical, electrical, and electronic components, a microcomputer in this situation is a negative cost factor.

This major new development has irreversibly shifted the economics of processing data away from large, remote computers or locally-shared minicomputers and towards point-of-use microcomputer systems.

Operator Vs. Hardware Costs: A 2:1 Ratio

With the steady decline in the cost of computers, the human factor has emerged as the most expensive element in data-processing. For example, a computer which sells for $20,000, or rents for about $5,000 per year, is typically used by an operator, whose cost to the company is in excess of $10,000 per year in the United States. The operator, therefore, is now more than twice as expensive as the computer.

Given present trends, it can be expected that the cost of such a computer system will be reduced by 50% to $2,500 per year over the next five years, while the cost of the operator will go up by 50% to $15,000 per year. This 6:1 ratio in human vs. hardware costs is the critical factor which should determine the re-direction of present corporate policy in data-processing.

Q1/Lite at the Point-Of-Use:
Eliminating the Major Cost Factor in Data-Processing

Data-entry is now the most time-consuming, error-producing, and expensive factor in data-processing. This is readily understandable since in most cases, data is keyed in three times before it is fed into a computer system for processing. Typically, the data is:

1. Manually produced in the preparation of the source document.
2. Manually keyed into the data-entry device to record it in machine-readable form, as on punch cards and magnetic diskettes.
3. Manually re-entered for the purpose of verification.

Microcomputers are a negative cost factor in the design of data-entry equipment, and are now fast enough to process information at the time and place of data-entry. The Q1/Lite, which processes data and produces the required output documents, eliminates the need for conventional data-entry equipment.

Eliminating the Data-Entry Function

When a letter is typed on a word-processing machine, or a receipt is produced for a customer on a point-of-sale device, the required documents are produced, and the data is simultaneously recorded in machine-readable form. When data is recorded in machine-readable form in this manner as a by-product of the manual production of the source document, it is called Data-Capture. Data-capture eliminates the data-entry function, the manual re-keying of data to convert it into machine-readable form.

Elimination of the data-entry function also eliminates:

1. Virtually all discrepancies between the human-readable documents and machine-readable documents.
2. The substantial delay factor involved in batching source documents and transcribing them into machine-readable form.
3. Manual re-keying of data, the most expensive factor in data-processing.

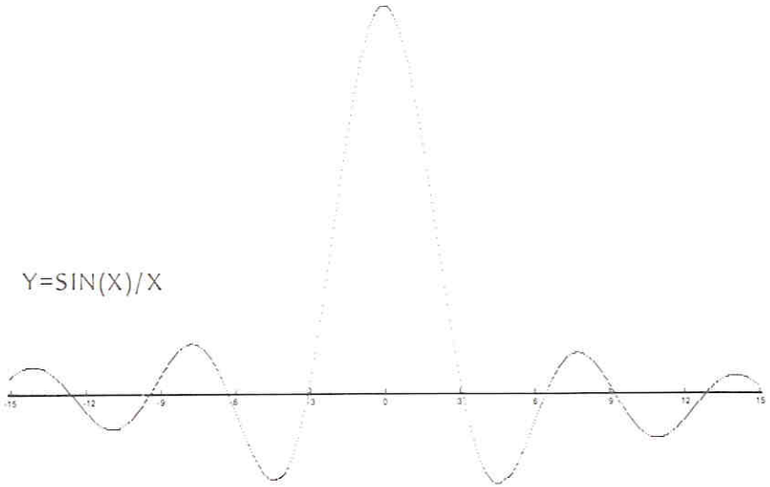
THE Q1 MULTI-PURPOSE APPROACH

Each module in the Q1/Lite has been specifically designed to meet multi-purpose requirements. For example, the diskettes utilized in the Q1/Lite replace magnetic cards often used on word-processing machines, magnetic tape cartridges used on desk-top scientific programmable calculators, and punch cards and paper tape used in other applications. It is now widely recognized that diskettes are superior to these other storage media in cost-effectiveness, capacity and speed.

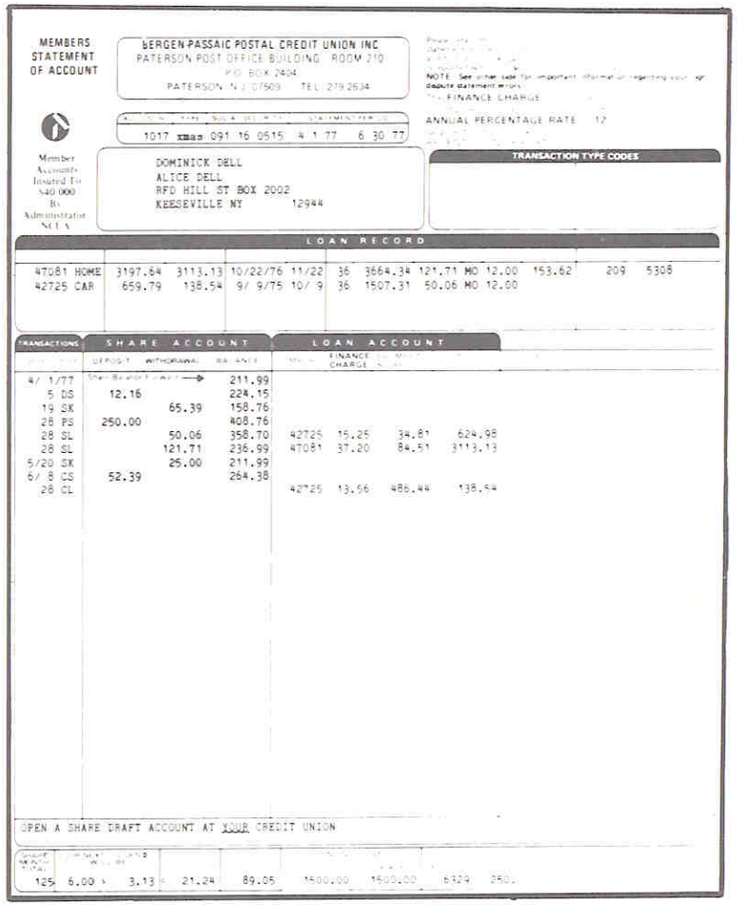
Another multi-purpose feature of the Q1/Lite is its high-level programming language. The Q1/Lite is the only microcomputer system which compiles and executes programs written in PL/1. Recent developments by Intel and other companies indicate that PL/1 will emerge as the dominant language of microcomputers.

Unlike COBOL or FORTRAN, PL/1 is suitable for a wide variety of business, scientific and text-processing applications. The use of PL/1 compared to the use of assembly language on the 8080 microprocessor, for example, results in a reduction of up to 90% in programming costs. This powerful programming language of the IBM 370 is available at the point-of-use with the Q1/Lite microcomputer system.

The Q1/Lite, in addition to performing most of the functions of remote, centralized computers, can perform accounting functions more effectively than accounting machines, word-processing functions more effectively than word-processing machines, and data-entry functions more effectively than data-entry equipment. Moreover, the Q1/Lite provides all of these functions at a lower cost. The low cost of the Q1/Lite results from its simplicity of design, its utilization of advanced technology, and its unique applicability to diverse markets.



Graph Computed and Produced on the Q1/Lite



MEMBERS STATEMENT OF ACCOUNT

BERGEN-PASSAIC POSTAL CREDIT UNION INC
PATERSON POST OFFICE BUILDING ROOM 210
P.O. BOX 2404
PATERSON, N.J. 07509 TEL. 279-2634

NOTE: See other side for important information regarding your statement.
** FINANCE CHARGE

1017 xmas 091 16 0515 4 1 77 6 30 77

ANNUAL PERCENTAGE RATE 12

DOMINICK DELL
ALICE DELL
RFD HILL ST BOX 2002
KEESEVILLE NY 12944

TRANSACTION TYPE CODES

LOAN RECORD

47081 HOME	3197.64	3113.13	10/22/76	11/22	36	3664.34	121.71 MO	12.00	153.62	209	5308	
42725 CAR	659.79	138.54	9/ 9/75	10/ 9	36	1507.31	50.06 MO	12.00				

TRANSACTIONS	SHARE ACCOUNT DEPOSIT	WITHDRAWAL	BALANCE	LOAN ACCOUNT FINANCE CHARGE			
4/ 1/77	Start Balance --->		211.99				
5 DS	12.16		224.15				
19 SK		65.39	158.76				
28 PS	250.00		408.76				
28 SL		50.06	358.70	42725	15.25	34.81	624.98
28 SL		121.71	236.99	47081	37.20	84.51	3113.13
5/20 SK		25.00	211.99				
6/ 8 CS	52.39		264.38				
28 CL				42725	13.56	486.44	138.54

OPEN A SHARE DRAFT ACCOUNT AT YOUR CREDIT UNION

125 6.00 3.13 21.24 89.05 1500.00 1500.00 6329 250.

Accounting Statement Produced on the Q1/Lite

July 18, 1977

Mr. Robert Lewis /B
President
National Insurance Company
767 Fifth Avenue
New York, New York 10022

Dear Mr. Lewis, /:

I enjoyed meeting you and your staff /with last week.

After detailed consultation with our systems analysts who attended the presentation, we have determined the configuration of Q1 equipment and programs required to most cost-effectively meet specifications of the /the National Insurance company. /CAP

I am enclosing a preliminary proposal for your comments. I will call you next week to discuss the proposal in more detail.

Sincerely,

Stephen Wilson
Vice President

Original Letter with Errors and Corrections

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Revised Letter

ADVANTAGES OF THE Q1 POINT-OF-USE, MULTI-PURPOSE APPROACH

Advantages of the Q1 Point-of-Use Approach

Fail-Soft Capability

When a locally-shared minicomputer breaks down, all of its connected terminals are also put out of service until the minicomputer can be repaired. By contrast, if a single Q1 Independent Work Station breaks down, all other work stations continue to operate.

Lower System Software Programming Costs

Since each Q1 Independent Work Station contains its own processor, application program, and operating system, there is no need for the complex multi-tasking required by a remote central computer or a locally-shared minicomputer.

Modular Growth

The initial cost of a locally-shared mincomputer is excessively high when only a few terminals are required. Typically, a minicomputer cannot effectively process data for more than 16 terminals. The low-cost, point-of-use microcomputer is the obvious solution when only a single or few work stations are required. Moreover, since each independent work station processes its own data, the computer used to control the access of the common data-base can be accessed by a significantly greater number of users than is possible with a locally-shared minicomputer.

Lower Cost

All of these advantages translate into increased profitability. By incorporating a microcomputer, equipment used to enter data costs less to manufacture, data-processing load can be increased without increasing costs, the cost of developing software is significantly lowered, and losses resulting from computer down-time are drastically reduced.

Advantages of the Q1 Multi-Purpose Approach

Fail-Soft Capability

Unlike a variety of limited-function machines which cannot replace each other upon breakdown, one Q1/Lite system can temporarily perform the functions of another, providing fail-soft capability.

Lower Application Programming Costs

With the decline in hardware costs, the relative cost of programming is steadily increasing. Since use of the Q1/Lite reduces the diversity of data-processing equipment and programming languages, it allows for far-reaching reductions in the cost of training programmers, programming, and documentation.

Lower Purchasing Costs

Typically, a large company can replace a variety of limited-purpose machines by the Q1/Lite. The resulting increase in volume discount is in the 15-20% range. This price advantage can be obtained, even though each department of a large company will use the Q1/Lite to meet its specific requirements.

For the smaller company, the Q1/Lite will normally be used for a variety of applications within a single office. This reduces the number of office machines required, and, therefore, substantially reduces costs.

Lower Maintenance Costs

Due to the remarkable simplicity of its design, the Q1/Lite, which replaces a variety of equipment, contains very few parts. This drastically reduces the cost of spare-parts, training of maintenance technicians, and documentation, and allows for an approximate 25% reduction in overall maintenance costs.

Greater Uniformity of External Storage Media

The Q1/Lite substantially eliminates the cost, time, and errors involved in converting machine-readable data from one external storage medium to another.

WORD-PROCESSING

Most business communications deal with words rather than numerical computation. The human element has become the major cost factor in information processing.

Typewriters

In letter writing, much of the typist's time is taken up with unnecessary repetition of previous work. For example, entire letters are frequently retyped in order to add, delete or correct a single word. The inability of the typewriter to automatically reproduce the unchanged portion of the letter makes the production of business letters on typewriters an extremely expensive operation.

Even when a letter is typed only once, without a single mistake, many data items keyed-in by the typist, such as the date, the name, title, company, and address of the recipient, and the salutation, name, and title of the sender are commonly redundant. In many cases, parts of the body of the letter, as well, consist of previously formulated paragraphs. For example, proposal writing, subscription renewal letters, investment reports, and a wide variety of legal documents contain relatively few totally new elements.

Communicating Typewriters

Teletypes, unlike typewriters, can automatically reproduce text which was keyed-in previously. However, the standard printing mechanisms of the teletypes in common use are totally unsuitable for word-processing applications. They have several basic limitations. The print line is too short (only 72 print

positions), the print speed is too slow (about 8 characters per second), and the character-set is too small (only 64 characters). This small character-set allows for representation of capital letters only, precluding such a teletype from use in all standard typing applications.

The teletype lacks three other key components: a microcomputer, a display, and a direct-access storage diskette. The absence of any of these severely reduces the productivity of the most expensive cost factor in this operation, the human operator.

Print Quality and Text Density

Standard typewriter and computer printers print 10 characters per inch and 6 lines per inch, or 60 characters per square inch. When 12 character per inch printing is used, the character density is increased to 72 characters per square inch. Proportional spacing of the same size characters produces an average of 15 characters per inch, or 90 characters per square inch.

The remarkable fact is that proportional spacing improves readability even as the character density is increased. Ninety characters per inch as against sixty characters represents a one-third reduction in the total cost of paper.

The Q1/Lite

The high print quality of the Q1 Printer/Composer allows for improved readability and a 50% increase in text-density over standard computer print-out. This text-density increase results in an economy factor of one-third in the costs of paper, copying, offset-printing, collating, mailing, and storage space.

The use of the Q1/Lite, instead of a typewriter, for letter writing in a business environment, roughly triples a typist's letter output. If we assume the annual cost of the typist to be $10,000, and the yearly cost of the Q1/Lite to be $5,000, the total annual cost of the operator and the system is $15,000. This typist with the Q1/Lite will produce an output equal to three typists working on typewriters, whose total yearly cost to the company is $30,000. As a result, the Q1/Lite cuts the costs of letter writing in half. Moreover, the Q1/Lite will pay for itself, even when used only two hours a day by a person in a position such as receptionist-typist.

ELECTRONIC MAIL AND THE Q1/LITE

It is now widely recognized that the processing, dissemination, and storage of the vast quantities of paper generated by government and industry leave no alternative but the use of computers to reduce the tremendous costs of human labor. For example, in an ever-increasing number of cases, the physical transportation of information by mail no longer meets present-day requirements.

Electronic mail, the transmission of information over communication lines, is now required. Naturally, electronic mail should allow for the data to be processed by computer. It is also important to provide for economic storage of data.

The point-of-use, multi-purpose microcomputer system, such as the Q1/Lite, is ideally suited for meeting these requirements of electronic mail.

Microfilm and Facsimile

In some cases, microfilm has been used to reduce the cost of paper, storage space, and dissemination of information. Facsimile has been used to scan, transmit, and record information from one location to another. However, neither microfilm nor facsimile are adequate for reducing the basic costs of storage space, transmission, and processing of data.

A page of text produced on a high-speed non-impact printer or a CRT phototypesetter contains alphabetic characters generated by a series of minute dots. Typically, the linear resolution will be either 100 or 200 dots per inch on a non-impact printer, and 800 dots per inch on a CRT phototypesetter. These three levels of resolution correspond to low, medium, and high print-quality.

A standard letter-size page, which is 8 1/2" by 11", with text recorded even at the low resolution of 100 dots per inch or 10,000 dots per square inch, contains a total of about one million dots. Likewise, when this single page of text is sent from one facsimile device with the same low resolution to another over communication lines, about one million dots have to be transmitted.

The 100 to 1 Ratio

It is significant to note that while microfilm reduces the size of the page, it does not reduce the quantity of recorded information. In other words, the recorded page on microfilm will contain about one million dots, like the printed page, but the dots will be smaller.

By contrast, only 8 bits or dots are typically used to represent a character in computers and their external storage devices, such as magnetic diskettes. Thus, more than 100 times as many dots or bits are required to represent a character on microfilm as on the standard computer code.

This 100 to 1 ratio in the number of dots or bits required also applies to the transmission of text by facsimile compared to transmitting the same text from one point-of-use microcomputer such as the Q1/Lite to another, where it is reproduced on a high-quality printer. This represents a 99% reduction in the quantity of information required to transmit a typical page of text.

Machine-Readability

Most important, microfilm, at best, has a brief abstract or only the title of a document in machine-readable form. Facsimile lacks even this minor machine-readable capability. For this reason, neither microfilm nor facsimile allow for full text information retrieval and processing performed by computers.

With the rapidly increasing use of microcomputer systems for word-processing, text in machine-readable form is produced as a standard by-product of the creation of documents. Similarly, in the modern printing and publishing industry, the text of newspapers, magazines, and books is obtained in machine-readable form as a standard by-product of typesetting.

With the expected proliferation of point-of-use microcomputer systems in the office environment, a substantial majority of the documents requiring communication and computer processing will also be automatically produced in machine-readable form.

In summary, the Q1/Lite provides for economic storage, and at least a 99% saving in the amount of information required to transmit text, when compared to facsimile or microfilm.

Moreover, data captured in machine-readable form on a point-of-use microcomputer, such as the Q1/Lite, can be further processed by computers, and this is a critical advantage over documents recorded on microfilm or transmitted by facsimile.

The introduction of the Q1/Lite makes electronic mail an immediate technological and economic reality.

THE DURABILITY OF THE Q1/LITE

The present transformation of the computer industry results primarily from the steady and rapid advances in semiconductor technology. This technology began with the invention of the transistor at Bell Telephone Laboratories in 1949, which ushered in the computer era.

Since the invention of the integrated semiconductor circuit in 1959, progress in semiconductors has been remarkably constant. The density per unit area has doubled on the average each year, while the manufacturing cost of the integrated circuit has remained substantially the same, resulting in an annual 50% reduction in the cost per circuit element.

Since 1960, the density per unit area has increased more than 100,000 times, reducing the cost per circuit element by the same factor.

The multitude of changes taking place in the computer industry are largely a product of this one central development.

As a result of this development, the Q1/Lite requires only a small number of semiconductor components. For example, 16,384 characters of internal read-write memory require only 8 integrated circuits. Since the number of components is already so small, the expected continued decrease in the number of memory components will have only a marginal effect on the system size and cost.

The durability of the Q1/Lite is reflected in its hardware, software, and system approach.

Hardware

The versatile Q1 System contains only a few modules: The alphanumeric keyboard for the operator to communicate to the system, the flat, digital display for the system to communicate to the operator, the printer for high-quality output documents, the flexible disk drives for direct access external storage, and the PL/1 compiler for programming of business, scientific and text-processing applications with a single, high-level programming language. In time, further changes in semiconductor technology will have little impact on these basic user-oriented components and on the total Q1 System.

Software

Following Q1 Corporation's lead, PL/1 is now emerging as the dominant language in the microcomputer field. This development imparts durability to PL/1 programs written for the Q1/Lite, compared to limited-purpose BASIC programming language, which is sometimes offered on small computers. Similarly, the Q1/Lite systems software is written with an instruction set that will be contained in future generations of Q1 equipment.

System Approach

The microelectronic revolution in semiconductor technology has made the computer and memory in the Q1/Lite so inexpensive that it is no longer economically justifiable to use locally-shared minicomputers or large, remote computers. The large computer, minicomputer, and point-of-use microcomputer are analogous to a large clock in the town square, a room clock on the wall, and a wristwatch on a person's hand. Just as wristwatches have proven to be the most convenient way to tell time, the microcomputer at the point-of-use is the most natural way to handle most data-processing applications. The Q1 system approach of putting computers at the point-of-use is the final realization fo the trend away from large, remote computers, providing a unique degree of product durability.

The wide diversity of computer products on the market today reflects the fact that most are designed to perform only a limited set of functions. Through an intensive systems development effort by the technical staff of Q1 Corporation, it was discovered that design improvements in such diverse equipment as small business computers, data-entry machines, accounting machines, desk-top programmable scientific calculators, terminals, and word-processing machines all pointed towards their convergence into a single system. This trend, which was pioneered by Q1 Corporation, is fundamental and irreversible.

Unlike the multi-purpose Q1/Lite, limited-purpose machines often have to be replaced by a new generation of limited-purpose equipment when application requirements change. As a result, the Q1/Lite has a product life equal to at least two generations of limited-purpose machines. With its hardware, software, and system approach, the Q1/Lite has achieved a qualitatively new level of durability.

SYSTEM DESCRIPTION

System Configuration

The Q1/Lite is available in either single or multi-station configuration.

Standard Single Station

The single station, which is the standard configuration of the Q1/Lite, consists of the alphanumeric keyboard and display, processor and memory, printer, and disk module.

The single station contains the 8800 processor, 7K bytes of Read-Only Memory used for the resident operating system, and a minimum of 16, 32, or 48K bytes of Read-Write Memory for the program and data.

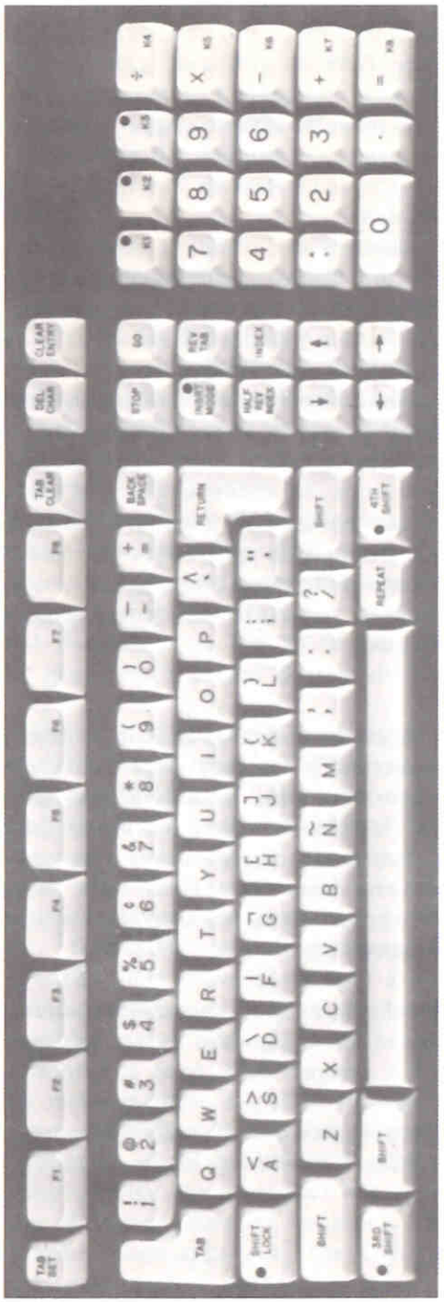
This single station can be used as a stand-alone system, or with the optional communication controller, communicate with a large centralized computer system and can contain a printer, the optional magnetic bubble memory module, and the communication controller.

Multi-Station

The trend toward distributed data-processing initially led to the use of minicomputers to process data for a number of terminals, and to provide access to disk drives containing a common data-base. However, the increased power and extremely low cost of microcomputers has now shifted the economics of processing data away from the shared-logic approach of minicomputers and towards the utilization of microcomputers at the point-of-use.

In the multi-station configuration, several independent work-stations are connected to a standard system by means of a multiplexor to share a common data-base or printer.

Each independent work-station contains a keyboard, display, central processing unit, Read-Write Memory, and a resident operating system.



Q1/Lite Keyboard

Keyboard

The Keyboard has three separate key sections:

1. An alphanumeric section
2. A numeric section
3. Function keys

The arrangement of alphanumeric keys on the Q1 Keyboard is similar to the Selectric keyboard layout. This makes it possible for a typist to use the Q1 Keyboard in word-processing applications with a minimum change in typing habits. The Q1 Keyboard, however, has two basic advantages over the Selectric Keyboard:

1. The Q1 Keyboard has four positions per key: lower case, upper case, third shift and fourth shift. The Selectric Keyboard has only two positions per key: lower case and upper case.

2. The Q1 Keyboard has 96 printable characters, while the Selectric Keyboard has only 86 printable characters. The additional 10 characters on the Q1 Keyboard can be entered, displayed, or printed by using the third shift.

The Q1 Keyboard was designed to meet a variety of language requirements. Codes associated with key positions can now be changed in accordance with the requirements of each language. This development is very important in ensuring that alphabetic data is sorted in the correct sequence.

Display

One of the unique features of the Q1/Lite is its compact, flat, digital display, which is a significant factor in making the system portable, unlike CRT-based equipment. This display was introduced as a standard feature of the Q1 System for word-processing and accounting at a time when none of IBM's word-processing machines, nor accounting machines produced by Burroughs, NCR, Nixdorf, Olivetti, and Phillips contained displays. Even now, there are no displays on teletypes and other printing terminals, nor on the majority of accounting and word-processing machines.

The display on the Q1/Lite makes possible:

1. Visual inspection, and when necessary, correction of keyed-in data by the operator.

2. Review by the operator of data retrieved from internal memory or external storage.

3. Prompting the operator, thus reducing the need for training and reliance on the operator's manual.

4. Reduction in the number of key strokes required to key-in data (e.g. by displaying data-types to be filled in by the operator.)

A state-of-the-art computer system such as the Q1/Lite performs word-processing operations, including line justification, pagination, and various other format-control functions automatically under program control. This frees the operator to concentrate on content-related operations, such as keying-in text, additions and deletions, and makes it unnecessary for the operator to examine and format the complete page on the display as it may be printed.

The standard print-line is 13.2 inches, and spacing is typically 12 characters per inch, or 158 characters per line. It is not economically feasible to design CRTs to display this line length, and, in fact, no word-processing machine on the market today displays the entire print-line.

As highlighted in a recent issue of Datamation entitled, "Word and Data Processing Converge," the trend toward distributed data-processing is causing the convergence of data-processing and word-processing equipment. Companies incorporating large displays into their word-processing systems are excluding themselves from participating in this fundamental trend.

In conjunction with the replacement of the 80 column punch card by the magnetic diskette, IBM has introduced a small display format for the 3740 data entry equipment, the System 32 small business computer, and the recent System 6 word processing equipment.

Q1 Corporation has found the 6-line, 40 character per line format to be the optimal size for the multi-purpose, point-of-use Q1/Lite Microcomputer System, offering larger displays as an option.

Q1 Printer/Composer

The Q1 Printer/Composer is a serial impact printer which prints 40 – 45 characters per second and produces print quality far superior to standard computer printers and office typewriters. It has horizontal spacing of 120 increments per inch, and vertical spacing of 48 increments per inch. It can print 10 or 12 characters per inch with regular spacing, and an average of 15 characters per inch with proportional spacing. By finely controlling word and character spacing, the printer justifies lines, without requiring time-consuming hyphenation decisions by the operator.

The versatile Q1 Printer/Composer is suitable for preparation of masters, which are used to make plates for offset printing. High print quality is further enhanced by the use of clay paper commonly used in cold-type composition in the printing industry. The program-controlled horizontal and vertical spacing makes the printer also suitable for plotting graphs. The printer can produce an original and five copies, and in data-processing applications, is often used with the optional forms-feed tractor to control fan-fold continuous forms.

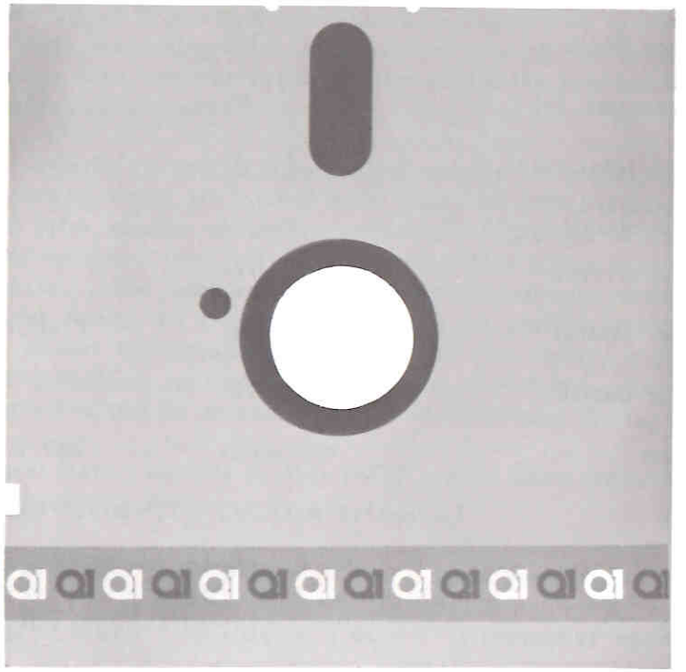
Several factors combine to make the Q1 printer into a composing or typesetting unit:

1. proportional spacing
2. the use of single-strike carbon ribbon
3. line justification

The Q1 Printer features the standard print line length of 13.2", accomodating forms up to 15" wide, and has a set of 96 printable characters. This printer is 7.5" high, 20" wide; and 13.5" deep, and can be housed along with the keyboard, display, computer, and its memory in one compact desk-top unit.

Another version of this printer, which generates characters in a 7x9 dot matrix, and prints at a speed of up to 200 cps, is optionally available.

	Printer/Composer	7x9 Dot Matrix
MODEL	Model P45	Model P200
Speed	45 cps	200 cps
Print-Line	13.2"	13.2
Paper Width	15"	15"
Characters Set	96	96
Pitch (char/inch)	10, 12, 15	10
Bidirectional Paper Feed	Yes	No
Line-Control	Fractional	Fractional
Form-Control	Yes	Yes
Power	100 Watts	290 Watts
Size	7.5"Hx17.5"Wx13.5"D	7.75"Hx17.5"Wx14"D
Operating Temperature	45°F – 105°F	39°F – 95°F
Storage Temperature	-20°F – 130°F	-20°F – 137°F
MTBF	500 Days	500 Days



Diskette Used on the Q1/Lite

Disk Modules

Like other modules of the Q1/Lite Computer System, the Flexible Disk Module was specifically designed to meet multi-purpose requirements. For example, the diskettes utilized in the Q1/Lite replace magnetic cards often used on word-processing machines, magnetic tape cartridges used on desk-top scientific programmable calculators, and punch cards and paper-tape used in other applications.

Disks provide direct-access external storage, efficient scratch-pad area, systems and application programs residence and make feasible processing of a single or several transactions at a time without the need of the delay involved in batch processing.

Flexible Disk Drives

MODEL	D160	D500	D1000
Capacity in K Bytes	160	500	1000
No. of Sides Used	1	1	2
Tracks Per Side	35	77	
Bytes per Track	4,608	8,316	
RPM	300	360	
Average Access Time	462 ms.	260 ms.	
Transfer (bytes/second)	31,200	62,500	
Drive Size	3.2"x5.7"x8"	4.7"x9.5"x14.2"	
Diskette Size	5.25"x5.25"	8"x8"	
Power	15 Watts	80 Watts	
Operating Temperature	40^{o} - 115^{o}F	40^{o} - 115^{o}F	
MTBF (power on hours)	8,000	8,000	

Rigid Disk Drive

Rigid Disk Drives

Rigid disk drives with 27 or 54 megabyte capacity are optionally available for data-base applications where higher speed and larger capacity are needed. The Disk Controller can presently support either one or two disk drives, and allows access to these drives, by up to 64 independent work-stations.

MODEL	D27M	D54M
Capacity (megabytes)	27	54
Tracks Per Platter	408	815
Bytes Per Track	13,440	
Recording Surfaces	5 plus 1 servo	
RPM	3,600	
Start/Stop Time	20 Seconds	
Transfer Rate	806K Bytes/Second	
Track to Track	6 ms. maximum	
Average Positioning	30 ms.	
Average Latency	8.3 ms.	
Dimensions	17.8"Wx8.5"Hx32"D	
Operating Temperature	60^{o} to 100^{o}F	
MTBF	2,500 Hours +	

Communications

For stand-alone applications, the Q1/Lite does not require communications capability. In a multi-station configuration, the optional Q1/Lite Communications Controller allows the independent work stations to transmit data at a rate exceeding 100K bits per second at a distance of 3,000 feet from each other or from the disk storage module. With the addition of the appropriate modem, data can also be transmitted over telephone lines.

The Q1/Lite can be programmed to handle both synchronous and asynchronous communication. In the asynchronous mode, the Communications Controller can transmit data at the rate of 50 to 19.2K baud. In the synchronous mode, the Communications Controller can handle the IBM bisynchronous line protocol.

The software to emulate the 2780 batch terminal is available. In data-entry applications, the Q1/Lite can communicate with the IBM 370 System in a bisynchronous mode, emulating IBM 3740 data-entry equipment. For electronic mail, there is also a software package to allow word-processing files to be sent as Western Union Mailgrams.

MAGNETIC BUBBLE MEMORY TECHNOLOGY

The Q1/Lite is the first computer system to be offered with magnetic bubble memory technology, which was originally used by NASA for information storage in spacecraft because of its ultra-reliability.

This solid-state technology is estimated to be 1,000 times as reliable as mechanical information storage devices, such as disks. Magnetic bubble memory also has the advantage of non-volatility. Unlike typical semiconductor read-write memories, data is retained even when the power is turned off.

The Q1/Lite basic system contains 88,000 characters of magnetic bubble memory. The average access time is 5 milliseconds, serial transfer rate is 50,000 bits per second, and parallel transfer rate will be 50,000 bytes per second. This non-volatile memory makes the Q1/Lite basic system uniquely suitable for applications such as data-entry, without requiring the optional flexible-disk external storage unit. Data can quickly be transferred, either daily or at the operator's convenience, to a local or remote external storage device. This is a significant advantage since magnetic diskettes are the most environmentally sensitive element in present-day microcomputer systems.

While other microcomputer systems require two disk drives in order to copy data from one mini-diskette to another, the Q1/Lite, because of its large storage capacity, requires only a single disk-drive to accomplish this task. Moreover, the ability to store this large volume of data in the solid-state electronic memory, instead of the mechanically-rotating diskette, increases processing speed.

In addition, PL/1 allows the use of both internal and external subroutines. Frequently used subroutines for a group of programs written in PL/1 or Assembler can be compiled separately and put into a library. These subroutines can be used by different programs by invoking the CALL Statement. Programs are available to maintain the PL/1 Library.

Subroutines within a program which are used frequently can be coded as an internal subroutine at the beginning of the program and its use will be confined to the same program.

The Q1/Lite utilizes a special technique to compile and execute PL/1 programs. As a result, the object program is extremely compact (the object program of about 800 PL/1 Statements takes approximately 16K bytes) and the compilation speed is very fast (at about 300 statements per minute). Instead of generating the machine code, the PL/1 compiler converts the programmer's PL/1 Statements into an intermediate code. At execution time, this intermediate code is executed by a PL/1 Interpreter which resides in the Read-Only-Memory and is part of the ROS (Read-Only Operating System). Because of the efficient algorithm employed, the PL/1 Interpreter occupies only 2K bytes.

Programming time with the use of PL/1 is far less than with the use of other languages. Moreover, PL/1 is suitable for "Block Structure" programming, providing better documentation and easier maintenance.

Resident Operating System

Certain routines, such as Input/Output Handling, Interrupt Services, are necessary for almost any program. Instead of having to load these routines from a secondary storage device whenever a machine is turned on, as with most computers, they are stored in the Read-Only Memory on the Q1/Lite. The Resident Operating System includes:

1. Input/Output Handling routines
2. Loader
3. Interrupt Services routine
4. PL/1 Intermediate Code Interpreter
5. Conversion routines for various data types
6. Decimal and Binary arithmetic operation

16K bytes of memory have been reserved for the Resident operating system. At the moment, only 7K bytes have been used, once again due to the efficient algorithm and coding. Unlike other systems where only part of the Random Access Memory is available for application programs, the Q1 Resident Operating System takes only 768 bytes for the Input/Output buffer, scratch area, processor stack, etc. The rest is available for the application program. The memory utilization rate for a 16K bytes system is as high as 95.2%.

The Input device (keyboard) and the Output device (printer) are driven on an interrupt basis handled by a routine in the Resident Operating System, making possible the simultaneous operation of the two devices.

SYSTEM UTILITIES

DISK Management

The Q1 DISK management program maintains the disk files. Files can be added, deleted, enlarged, reduced or renamed through a variety of simple commands. In addition, software write-protect can be set or reset on any file. Selected files or the entire disk can be copied by using this program.

The EDITOR

The EDITOR is a powerful tool for writing source programs. The statements of a source program can be examined or changed on the display. Through the various system control keys, lines can be located by direct access or by context search. In addition, lines can be added or deleted wherever necessary.

The FORM Program

While the EDITOR operates on source program files, the FORM program operates on data files. Constant information for operator lead-through can be displayed with scrolling capability. This program is primarily for file conversion and testing.

The SORT Program

This utility program sorts data files into ascending sequence according to a specified SORT key.

The PRINT Routine

A program to print an ASCII file (e.g. a source program which has been recorded by the EDITOR.)

The DUMP Routine

A program to dump the contents of data files in Hex code and ASCII.

The JOIN Routine

A program to join files together.

Q1 AND THE NEW COMPUTER MARKET

The point-of-use, multi-purpose microcomputer system has redefined the computer industry. Its potential market is larger than the market for any other computer product. Nevertheless, powerful economic conditions act to prevent major companies from entering this market.

The Polarization of Computer Size

In the last few years, there has been a major trend away from medium-scale computers, which still represent the largest, but steadily diminishing segment of the computer industry. These computers are being replaced by less expensive small computers on one end of the spectrum and by more expensive large-scale computers on the other.

Initially, the trend in small computers was to install minicomputers near the point-of-use to be shared by a number of operators through terminals. Minicomputers, however, are too expensive to be used by one or only several operators, and are normally not powerful enough to support more than 16 operators. These limitations have shifted the trend in small computers towards incorporating microcomputers in point-of-use equipment.

Data-processing functions previously performed by medium-scale computers and minicomputers are now being taken over by microcomputers and large-scale computers, leading to the polarization of computer size.

The End of the Minicomputer Era

Semiconductor companies produce microprocessor components and their memories in extremely high volume. These microprocessors are now as powerful as minicomputers at a small fraction of the manufacturing cost. Likewise, these semiconductor memories are far less expensive than magnetic-core memories used in minicomputers. Minicomputer companies lack the internal volume necessary to achieve lower cost through volume production.

The 8080 microprocessor is now replacing the minicomputer in distributed data-processing. In 1976 alone, 400,000 microprocessors of the 8080 series were produced by companies such as Advanced Micro Devices, Texas Instruments, and Intel. Significantly, no minicomputer company manufactures the 8080, the world's most popular computer.

The 8080 microprocessor is as powerful as Digital Equipment Corporation's PDP8/A minicomputer, which costs more than ten times as much to manufacture. DEC is now using the 8080 microprocessor rather than their own PDP8/A minicomputer in their LA180 Printing Terminal.

In 1976, DEC, the leading manufacturer of minicomputers, began offering a microcomputer version of its PDP-11 minicomputer. In 1977, DEC also introduced a microcomputer version of its PDP-8 minicomputer. This shift by DEC from its own minicomputers to microprocessors purchased from semiconductor companies was necessary in order to take advantage of the lower cost of microprocessors. It was also necessary to extend the useful life of these two lines of minicomputers, against the much more rapidly growing population of microcomputers, such as the 8080 series and the AMD 2900 series.

The popular 8-bit word-length is suitable for most point-of-use applications. When greater speed and direct addressing of larger memory are required, the 32-bit word-length is the next natural size. In contrast, the 16-bit word-length characteristic of minicomputers is at once too expensive for point-of-use applications, and insufficient for directly addressing memories of any significant size. For example, it is not feasible to execute programs in data arrays larger than the traditional 64K bytes.

The AMD 2900 microprocesseor is now being used by various companies such as Interdata and Honeywell to build 32-bit word-length computers. According to Interdata, their microcomputer-based Fortran Processing System can run comparable Fortran programs at half the speed of large-scale computers like the IBM System 370/158 or Univac 1108 at one-seventh the price.

The polarization of computer size and the shift from minicomputer companies to semiconductor companies for low-cost computers and their memories signals the end of the minicomputer era.

IBM's Predicament

For a quarter of a century, the name of IBM has been synonymous, in the public mind, with the computer industry. Now, the emergence of the 8080 processor as the world's most popular computer has placed IBM computers in the minority. IBM's share of the total number of computers in use is expected to continue to decline rapidly.

At present, IBM's installed equipment rental base is estimated to be in excess of $16 billion. Typically, after one year of rental, this equipment may be returned by the customer on 90-day notice.

As a general rule of thumb, computer prices go down at the rate of about 50% every five years. When the IBM 3033 processor was introduced, it was priced 40% below the System 370/168 with similar capacity.

This immediately made the System 370/168 much less cost-effective, and caused a customer rush to switch from their present equipment. It was reported that some customers were willing to pay $50,000 to $100,000 for early delivery, figuring that they would save an even greater amount in rental.

A System 370 customer who plans to upgrade the equipment has two basic choices: install the new processor with equivalent computing power at a reduced monthly rental, or install the new processor with increased computing power at about the same monthly rental. While the customer has these two choices, IBM does not.

If over a period of one year, the user community would shift from their existing equipment to the new processor family in order to obtain the reduced rental, it would result in losses to IBM of more than $6 billion in revenues in a single year. This is equivalent to wiping out IBM's profits for the last few years.

This predicament prevents IBM from introducing their new technology across the range of the System 370 product line. The 3033 processor is roughly equivalent to the System 370/168, of which there are only a few hundred world-wide.

Further, before introducing the 3033 processor, IBM took steps to induce customers to purchase, rather than rent, the System 370/168 by substantially reducing purchase price while increasing the cost of rental.

In recent years, IBM has introduced such equipment as the 3740 data-entry equipment, the System 32 small business computer, the MC/ST II word-processing equipment, and the 5100 desk-top computer. These products were designed with limited functions in order to minimize their impact on each other's markets, and on IBM's installed equipment base.

The limited-purpose nature of these IBM products is reflected in their programming languages and external storage media. The 5100 is offered with BASIC and APL, System 32 with RPG, the 3740 with Application Control Language, which has even more limited capacity than RPG, and the Magnetic Card Selectric II, which is not user programmable. COBOL, FORTRAN and PL/1, the main programming languages of the IBM/370, are not available with any of these machines.

For external storage, the 5100 uses a tape cartridge and is, therefore, unsuitable for applications requiring direct, rapid access to data, such as information retrieval, table look-up, or sorting. Similarly, the low storage capacity of the magnetic card available with the MC/ST II makes this word-processing machine unsuitable for applications such as machine retrieval or sorting of name and address files used in automatic letter writing. Moreover, the use of diverse external storage media, such as tape cartridge, magnetic cards, and magnetic diskettes on these IBM products presents a severe problem whenever data must be converted from one external storage medium to another.

In order to protect its enormous rental base, IBM has offered its customers either increased computing power rather than reduced cost, or additional limited-function equipment. This unusual situation should deter IBM from introducing a low-cost, multi-purpose microcomputer system.

Other Computer Companies

The larger computer companies have not, as yet, offered low-cost, multi-purpose microcomputer systems. These computer companies are deterred from entering this market because it is incompatible with their established product lines. With the exception of IBM, no computer company has sufficient internal volume requirements to competitively produce standard semicondutor components.

Semiconductor Companies

Semiconductor companies are manufacturing memories-on-boards as add-ons to IBM, DEC, and Data General computers and microprocessors-on-boards for other equipment manufacturers (OEM) who require these sub-system modules in small to moderate quantities. These semiconductor companies, which manufacture these standard components in extremely high volume, are now also marketing mass-produced consumer products such as electronic calculators, video games, citizen's band radios, and wrist-watches.

These semiconductor companies are unlikely to go into the microcomputer systems field, which requires customized application programming and customer support, and where the major cost-factor is in peripherals they do not manufacture, such as keyboards, displays, power supplies, printers, and disk drives.

Magnetic bubble memory technology, which is fundamentally different from semiconductor technology, is expected to be a greater cost factor than semiconductors in microcomputer systems. No major American semiconductor company, except Texas Instruments, manufactures magnetic bubble memory components. This is another factor which makes it uneconomical for semiconductor companies to enter the microcomputer systems field.

Q1 and the Microcomputer Industry

The computer industry has, thus far, failed to respond to the need for low-cost, multi-purpose systems. A similar situation occurred after the invention of the transistor at Bell Telephone Laboratories. Since the transistor performed the functions of the vacuum tube, it was expected that RCA and other leading companies in vacuum tube manufacturing would become the major force in the emerging transistor/semiconductor industry. The exact opposite occurred. The leaders of the vacuum tube industry were so committed to existing technology, that they failed to recognize the revolutionary impact of the transistor. As a result, new companies in the field such as Texas Instruments and Fairchild captured the leadership of this huge industry.

Low-cost, multi-purpose microcomputer systems will soon displace most of the presently used data-processing equipment. It is reasonable to expect that these microcomputer systems will be developed, manufactured and marketed by younger companies unburdened by commitments to previous technologies.

Q1 Corporation is now in the fortunate position of marketing a product which has mass market potential, with major potential competitors deterred from entering this market. With its technological leadership, Q1 Corporation looks forward to the challenge of meeting the enormous need for multi-purpose, point-of-use microcomputer systems.