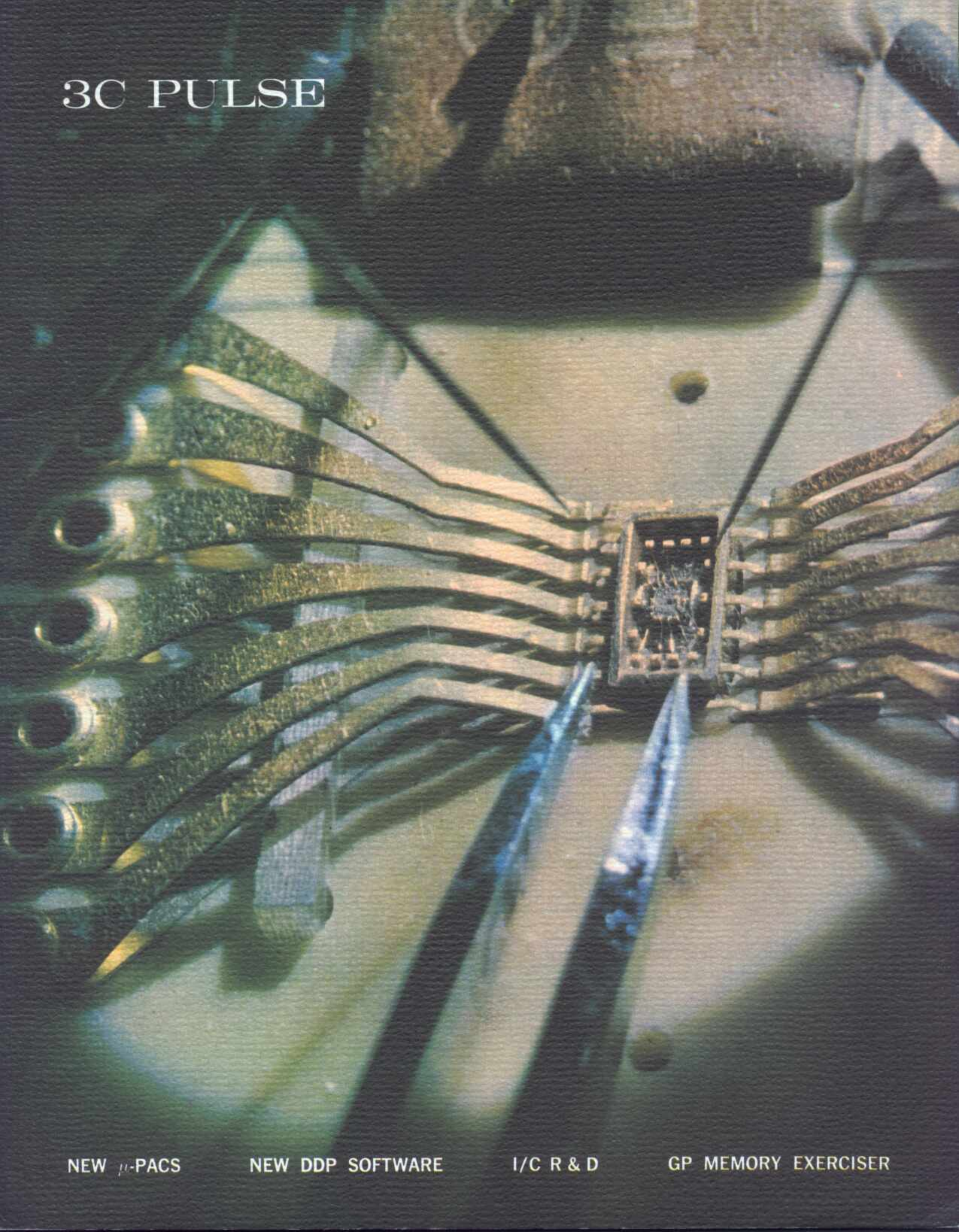
3C PULSE



NEW μ-PACS NEW DDP SOFTWARE I/C R & D GP MEMORY EXERCISER

INTEGRATED CIRCUIT TECHNOLOGY

(Text of an address given at the annual Computer Control Company, Inc., stockholders' meeting by T. P. Bothwell, Vice President, Engineering.)

Ladies and gentlemen, today I will take this opportunity to discuss with you briefly some of the more important development programs we have pursued here at Computer Control Company during the last three fiscal years.

You are all aware that 3C's business is highly technical and sensitive to technological progress, competitive pressures and innovations. In the digital electronics business, product life cycles are relatively short, seldom longer than five years. Our planning, staffing, and modes of operating must necessarily reflect this — short product lives require short development cycles and extremely careful planning and control. In our industry, typical R & D expenditures have ranged from 8% to 10% of corporate gross income. 3C's historical figure has averaged a little under 10%. For the past three years, it has been 8.7, 11.4, and 10.6% respectively.

These higher-than-normal rates of investment in R & D reflect a deliberate decision by 3C in response to the coincidence of two major external situations which have developed in our marketplace and environment. These situations were of the type which required planned and coordinated response on the part of the entire company and necessitated the undertaking of major development efforts.

The first of these was our preparation for the onset of integrated circuit technology and for 3C's exploitation of that technology. The second was related to our becoming a major factor in the small-scale, real-time computer business. 1965 represented the culmination of three years of activity in both. Major goals were:

- To establish 3C as a leading supplier in the digital equipment and computer industry
- To maintain our role as the leading supplier of digital logic modules
- To achieve technological leadership while optimizing economic return.

During 1965, all our newly developed products were developed with integrated circuits and the use of integrated circuits will characterize our new products for the forseeable future. We can further say that in 1965 our computer product line passed its adolescent stage and became recognized as a fully developed factor in the field of digital computer products. 1965, therefore, has been a year of transition for 3C.

Now let's take a look at what we have done in integrated circuit technology.

Evaluation and Application

In 1963, the company, in evaluating trends in the electronics industry, recognized that microcircuitry promised to play a significant role in the digital electronic equipment industry within the next several years. Several contenders led the microcircuit development parade and each was being touted as the probable source of the next manufacturing revolution. There were thin films, thick films, pellet components, ceramic circuits, flip-chips, and, most sophisticated, semiconductor integrated circuits.

(SPECIAL R & D REPORT CONTINUED ON PAGE 2.)

3C PULSE

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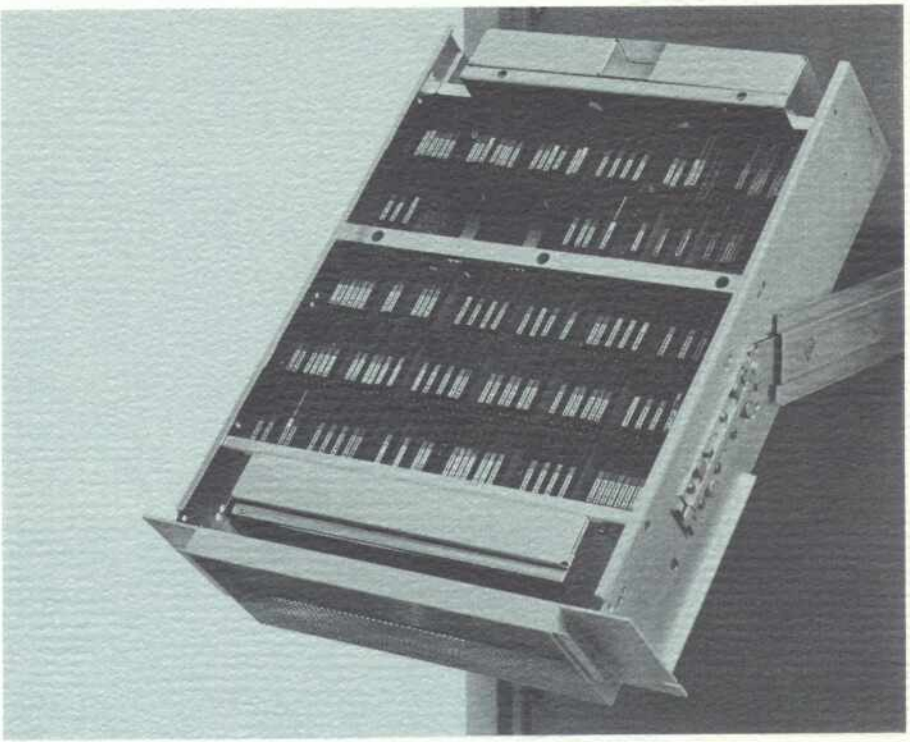
COVER: — Integrated circuit technology, from research to circuit modules to delivered hardware — acknowledged capability at 3C.

NEW HIGH DENSITY MOUNTING HARDWARE, MODULES, AND SYSTEM ACCESSORIES ADDED TO μ-PAC LINE



New mounting hardware that houses up to 240 3C μ-PACS™ in 5¼" of standard rack space, new logic circuits, and accessories have been introduced to complement 3C's μ-PAC monolithic integrated circuit module line.

3C introduced μ-PACS a year ago, after more than two years of in-house funded research and design, to offer price, size, and reliability advantages of integrated circuits in flexible building block logic packages. Since introduction, 3C circuit design engineers, computer/systems design engineers, and microelectronics engineers have continued development of μ-PACS in order to respond to industry demands.

High Density Hardware

The BT-332 Tilt Drawer mounting BLOC is designed to house 240 μ-PACS in only 5¼" of rack panel height without sacrificing accessibility to either PAC or wiring side. The front access drawer is mounted on slides to allow the BLOC to be pulled out clear of the mounting rack. For greater ease of access, the BLOC tilts down to expose the PAC side, or up to expose the wiring side. Several detents are provided to hold the BLOC in any desired position from horizontal to full vertical for convenient PAC replacement, testing, wiring or system trouble shooting.

The Model BT-332 features solderless-wrap connectors for maximum PAC density in a standard 19" relay rack. Built-in muffin fan cooling units are located at the front and rear of the assembly. Front panel space is available for systems instrumentation, controls, indicators, etc.

New μ-PACS

Four functional circuit PACS plus three auxiliary PACS are also added to the 3C μ-PAC line.

The Shift Register PAC, Model SR-335, contains 8 prewired integrated circuit shift register stages in the standard PAC. Up to 16 custom assembled stages can be specified by the user on this high density module.

Standard μ-PAC signals (+6 V and 0 V) are converted to negative logic levels of 0 to −25 volts at 60 ma per circuit with the new Negative Logic Level Driver PAC, Model LD-335. This PAC contains 8 identical circuits with common input voltage. Each circuit acts as a two-input AND gate followed by a level shifter.

The Non-Inverting Power Amplifier PAC, Model PN-335, contains six 3-input AND gates, each capable of driving up to 25 unit loads. Each gate contains two inverting amplifiers in series to give output like polarity to the input signal. Each gate has electrically common outputs to reduce load distribution current, and built-in, short-circuit protection.

The High Drive Lamp Driver PAC, Model LD-331, contains 8 independent microelectronic lamp driver circuits with discrete output transistors. Each driver is capable of switching 300 ma at up to 35 volts operating from standard μ-PAC signals.

The auxiliary PACS include the Test Point PAC, Model TP-330, which facilitates observation of waveform characteristics. The Blank PAC, Model BP-330, is a standard μ-PAC card with etched power and ground buses. It contains approximately 3.5 sq. in. for mounting special circuits. In addition, the Copper Clad PAC Kit, Model AS-330, contains a basic μ-PAC card with gold-plated fingers and 5.5 sq. in. of copper plate on each side for custom etching of interconnection patterns.

System Accessories

Unit Indicators, Model UI-110 and UI-330, are self-contained, transistorized indicators for displaying the state of any μ-PAC flip-flop, gate, or other logic unit. UI-110 is a neon indicator using +90 volt supply driven by standard μ-PAC signals. UI-330 is powered from +6 volts.

Mounting Panels, Models PM-330 and PM-331, are designed to adapt standard μ-PAC mounting hardware to 19" relay racks and to provide control panel space for system instrumentation, indicators, switches, etc. (Standard μ-BLOCS supplied in 5$^{11}/_{16}$" and 8$^{7}/_{16}$" widths which require mounting panels for rack installation.)

Custom Services

In addition, 3C has established a capability for producing special μ-PAC circuits to meet customer requirements. Complete laboratory and production facilities are available for continued research and development to solve unique integrated circuit problems.

General μ-PAC Background

μ-PACS, with typical noise rejection margin of 1.35 volts, are integrated circuits mounted on etched glass-impregnated epoxy cards.

With all important circuit inputs and outputs available at connector pins, traditional systems design is made possible. Design changes or system expansion are achieved simply by changing or adding modules or wires. Any 3C module can be replaced easily from a small inventory of spares.

μ-PAC circuits, operating from DC to 5 MHz utilize the NAND function, a method initially employed in 3C's S-PACS which became an industry standard, for positive logic. μ-PACS can also be used to directly implement the NOR function for negative logic, or AND-OR logic. 3C chose the NAND operation for positive logic for its μ-PAC family of digital modules because of the simplicity and usage symmetry made possible by the basic NAND gate circuits. All μ-PACS use static logic.

INTEGRATED CIRCUIT TECHNOLOGY

(From inside front cover)

Because of a basically simple manufacturing process, the semiconductor integrated circuit showed promise of substantially lower costs than those of similar items manufactured by any of the more conventional techniques. In 1963, this certainly wasn't the case; integrated circuits were selling at $100 apiece, and, by the pound, were slightly more precious than diamonds.

Our evaluation, however, convinced us that the path of integrated circuits was the only one of those considered which 3C should set up to pursue.

In trying to define just how micro-circuitry would develop and, more important, how 3C should respond to it, the limitations of our knowledge of the subject became clear. As a matter of fact, very limited information on the subject was available to anyone in the electronics industry at that point in time. Compounding this already complex situation were further problems. Many familiar modes of doing business would be modified. These included manufacturing processes, design trade-offs, and vendor relationships. Just how they would have to be modified was then hard to predict.

The problems were difficult but this much was clear: It was mandatory for 3C to have first-hand information about the characteristics of these devices, their strengths, their weaknesses, their best applications, and their cost. As a consequence, we resolved then to establish our Microelectronic Techniques Laboratory.

Microelectronic Techniques Laboratory

This lab was equipped and operating in October of 1963 and produced its first integrated circuit samples by the middle of 1964. The lab was set up on a modest footing. Its objectives were to be able to completely breadboard and develop working models of integrated circuits of types 3C might wish to manufacture or to have manufactured for us.

In late 1964, on the basis of significant progress in the Techniques Lab, and a dramatic price drop in the integrated circuit marketplace, 3C made the decision to develop an integrated circuit line of modular building blocks similar to the S-PACS which have been a mainstay of our business for many years. This decision was made after very careful study based primarily on economic and marketplace factors. It was our projection that, at the time such a product line would be introduced — and it was introduced in the spring of last year — the cost of the building blocks manufactured by this method would be substantially less than the cost of those manufactured with discrete resistor/capacitor components. The result was our μ-PAC digital logic module line.

In 1965, in addition to completing the development and introduction of the line of microelectronic modules, 3C made further progress by developing a complete line of new items of equipment employing μ-PACS, as basic building blocks. The ICM-40 memory (patent applied for) and DDP-124 computer are the first items in this line. We'll talk in more length about them in a few minutes.

Focusing now on some of the capabilities we have developed in our Microelectronic Techniques Lab, let's see how they have contributed to the development of our products.

(Incidentally, 3C's earliest venture into microelectronics was in the Mariner spacecraft computer program. For several years, we successfully built miniaturized, micro-power equipment for very-high-reliability operation in outer space between here and the planets Venus and Mars. That same 3C engineering team was responsible for the development of the μ-PAC line.)

The integrated circuit Techniques Lab was established to monitor developments in the industry, to experiment, and to develop integrated circuits to meet our specific requirements. On a very stringent budget, capabilities were established in photographic mask making, epitaxial growth, vacuum deposition, photolithographic processes, diffusion furnace processes, clean-room operations and micro-assembly. All of these are necessary in the manufacture of these rather sophisticated devices.

Since the integrated circuit is becoming so important to us, you might like to know how an integrated circuit comes to be what it is. The process for manufacturing an integrated circuit is similar to that long established for the manufacture of transistors and involves about 120 chemical, metallurgical, and photographic steps. We will mention the highlights of just a few of them. Our objective is to build a circuit in a silicon chip about 50 thousandths of an inch on a side and mounted on a flat-pack module.

The starting point in our process is a silicon wafer about 1 inch in diameter and 8 thousandths of an inch thick on which, by a so-called epitaxial growth process, we prepare a very pure surface layer of silicon. By a series of photographic and chemical steps, the embryonic integrated circuits are developed in the wafer. The photo-chemical portion of this process ends with a wafer on which are about 600 identical circuits. Each small square on this wafer, when projected microscopically, can be seen to contain a miniature reproduction of a circuit.

To give some idea of the degree of miniaturization possible through these processes, it would be possible to impose 17,500 such components on the surface of a 5-cent postage stamp. This is equivalent to putting 80 S-PACS on the same postage stamp. Our capabilities in this regard are comparable to the best currently in use by the semiconductor industry.

Returning to the wafer, we must next determine which circuits have the desired operating properties and which are to be rejected. Therefore, before any futher process steps, the circuit is tested with a miniature probe. The 14 fingers of this miniature probe are brought into contact with the individual circuits, a test is performed, and each circuit is determined to be good or bad and is so marked with a drop of ink. The wafer is then cut into individual circuit elements which are mounted and wired in the flat-pack. The last major step in the process is to weld the cover onto the pack.

It is worthy of note that the capabilities of our laboratory are such that, when a low-cost welder could not be procured to seal these packages, we developed a device for our own use. (See story on page seven.)

As further evidence of the capabilities of this laboratory and the quality of the work being performed there, we have recently been awarded an R & D contract for developing a method of packaging and connecting to the integrated circuit chip without the impediment of that relatively large can, eliminating the wire bonding operations involved in attaching the chip to the can. If successful, this would allow us to bring about another order of magnitude reduction in size and a substantial reduction in the cost of our manufactured computer and digital products.

Research Laboratory Benefits

By virtue of having the Techniques Lab as part of 3C's development program, we have achieved a number of advantages. First of all, six of the eight basic flat-packs now in the μ-PAC line were initiated and developed in this lab. Special designs were developed well in advance of the time when they could possibly have been available through normal procurement arrangements with the major semiconductor firms.

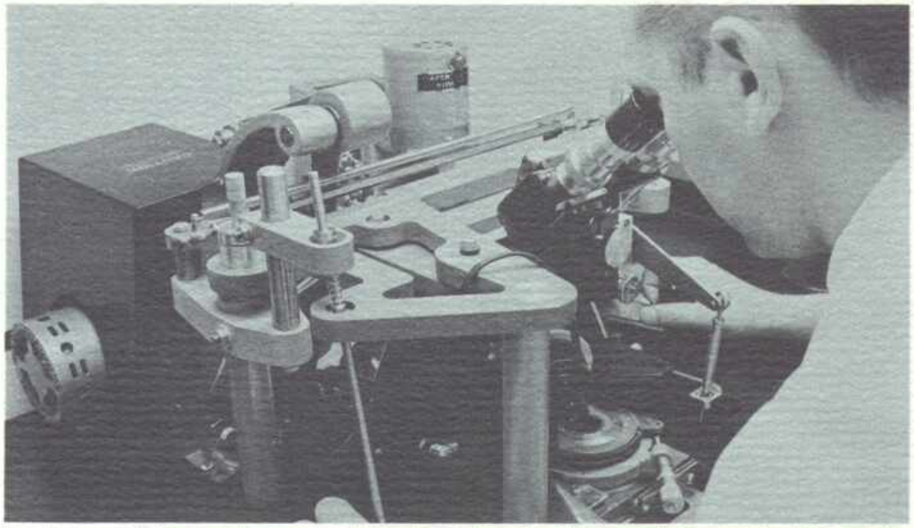
The inevitable mistakes, trade-offs, corrections, and compromises were simply and quickly handled within the company, giving rapid response and proprietary control. We have estimated that, in the development of the ICM-40 high-speed memory, as much as six months was saved because of the capabilities of this lab. In the technological life of a product today, six months is a long period of time.

Designs were chosen to be compatible with the manufacturing methods of the outside suppliers with whom we intended to work. With designs shown to be feasible and tested, we were able to bring multiple vendors into production on a single item, giving us the inherent cost advantages of multiple sources of supply. In addition, our knowledge of probable costs in the vendor shops has been of substantial value in optimizing our negotiations with the vendors. This has allowed us to rapidly procure custom circuits that are superior in performance while comparable in cost to those in the manufacturer's standard product lines.

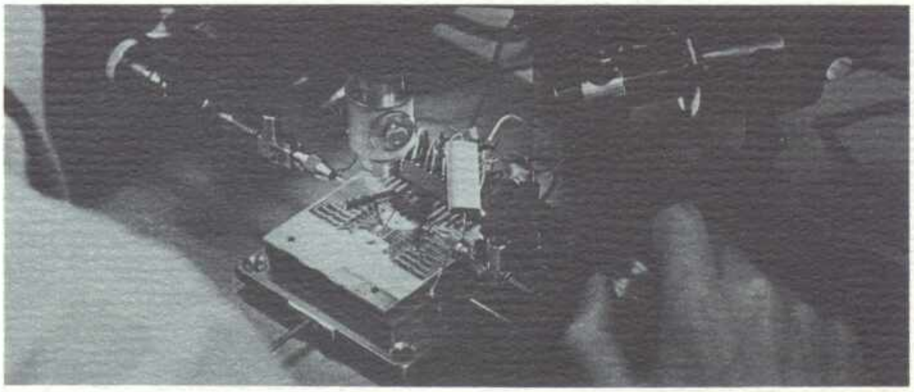
There is a good deal of debate in the industry right now as to when integrated circuits will be less expensive than standard components. For us, this cross over point has already arrived and the Techniques Lab has been instrumental in this. We are confidently predicting substantial price declines in our procurement costs for integrated circuits.

Sometimes, low-volume requirements are related to product cost or design breakthroughs. Because of the small-quantity production involved, semiconductor manufacturers are reluctant to make such types at any price. Therefore, another purpose which the Techniques Lab serves is the manufacture of integrated circuits of a limited-application type which may be required in quantities of only a few to a few hundred.

As to manufacturing high-volume integrated circuits ourselves, this has been considered but, at least for the present, the economics of make-or-buy indicate that our approach of contracting for the manufacture of these devices on the outside brings the greatest profit to 3C.



Precision registration equipment used in the fabrication of silicon monolithic circuits. This machine registers the patterns used in this process to 1/10,000 of an inch.



Electrical probing apparatus for integrated circuit tests. This equipment is used in evaluating circuit performance through studies of transient and steady-state signals on the silicon chip.

Techniques Lab management in front of high vacuum electron beam deposition system used in the fabrication of thin film devices. (Robert Baron, Director of Modular Products, left; Colin W. Knight, Manager of Techniques Lab, seated; T. Paul Bothwell, Vice President-Engineering, right).

(From page 3)

New Products in 1965

Moving from the Techniques Lab to the products introduced during 1965, the most basic were the μ-PACS. There are 31 types of integrated circuit modules, 3 power supplies, 7 μ-BLOCS, and accessories for connecting and solderless wiring. The μ-BLOCS are units for housing μ-PACS and power supplies. These items are sold for customers' use in building digital systems. μ-PACS range in price from $25 to about $130 each.

The next most basic product was the ICM-40 memory. Memory is an essential element of any computer. It is memory that differentiates a computer from most other electronic systems by allowing the computer to remember a sequence of instructions and to store data. The memory represents a large portion of the computer cost; consequently, skill in this subject is essential to our competitive position as a computer manufacturer.

The ICM-40 is noteworthy in many respects, only one of which is the fact that it is entirely built around integrated circuits. It also uses the basic structure of our μ-PAC product line. Another feature is its very high speed — 1 microsecond cycle time — while employing a very low cost magnetic core, an advantage that very few of our competitors have been able to achieve. Small physical size, a natural result of the integrated circuit design, contributed to achieving the operating speed of the memory. Memory speed is limited by wire length and reduced equipment size has naturally led to shorter wires, hence increased speed. The ICM-40 sells in the $10,000 to $20,000 price class.

The next major product introduced in 1965, also employing integrated circuits, was our DDP-124 computer. The 124 is a member of the 24-bit family of machines, and is compatible in program characteristics with them. It employs both the μ-PAC line for its logical functions and the ICM-40 as its memory.

Already, the computer industry in its relatively short life has been through one major revolution in manufacturing technology — the transition from vacuum tubes to transistors — and is now undergoing a second. We have been able to make this latest transition work for us; our integrated circuit computer represents more equipment for less money. The DDP-124 sells for a base price of approximately $65,000 and is a much more powerful computer than the slightly higher priced DDP-24, its conventional component predecessor.

Further, as a result of the substantially reduced physical dimensions made possible by the microcircuit techniques, the DDP-124 occupies barely one-third of the space which conventional components would require. And, but for the physical size of the typewriter, paper tape equipment, and similar components, the size reduction would be far more dramatic.

In the manufacture of all of the microcircuit products, provision has been made for the use of automatic wiring. The DDP-124 and ICM-40 memory will be manufactured by automatic wiring techniques.

General Purpose Computers

Let's turn our attention now to the other major developments in the establishment of a complete line of small, general purpose digital computers.

At the beginning of fiscal 1965, 3C had delivered only a single type of general purpose computer — its DDP-24. However, development was well under way at that time on two companion computers, the DDP-116 selling in the $30,000 price class and the DDP-224 in the $100,000 class. During 1965, both of these products were introduced to the market, complete programming packages were developed and delivered for them, and typical major digital systems were built around the DDP-224 and DDP-116.

Both the 116 and 224 were designed around our S-PACS and TCM-35 memories — all of conventional component construction.

A significant event of the last year involved the delivery of the two largest systems which 3C has ever installed. Their selling price totalled $1,500,000. Each was a shared-memory, dual DDP-224 system to control a NASA Lunar Excursion Module Simulator used to train astronauts for a portion of the moon flight.

The DDP-116, 224, and 124 have been extremely well received in their marketplace. If imitation is the highest form of flattery, then 3C has been widely flattered for its leadership in the 16-bit series computer.

In the area of peripheral devices, very substantial effort last year went into developing an OEM agreement with a major manufacturer for the supply of magnetic tape equipment and certain other peripheral devices to be used with 3C's standard computer product lines. We feel that this is a most important step in establishing the same level of reliability and quality for peripheral devices as 3C is accustomed to offer in equipment of its own manufacture.

Programming

The computer business requires that the manufacturer supply programs for his equipment. Programs tell a machine, by instructions, what to do. The importance of programming has been steadily on the increase throughout the life of the computer industry and represents an important element of 3C's development effort. During 1965, outstanding progress was made in our programming. Most significant was the completion of the development of all the required programs to go with our product computers. These include both operating programs for the equipment and test programs to determine correct operation and to help diagnose malfunctions.

Highlights include a FORTRAN IV compiler. FORTRAN is a so-called universal language used by mathematicians to converse more easily with computers.

In developing the assembler for our smallest computer, the DDP-116, a novel desectorizing technique was introduced which greatly simplifies programming a small computer.

A great deal of effort went into making our programming documentation more attractive and convenient for the customer. Typical programming documentation delivered with each standard DDP-116 computer includes seven loose-leaf manuals of program listings, three boxes of punched paper tapes, and, where needed, a box of punched cards.

We should also mention that an in-house computer facility has been established in support of our programming development facility. In it, both the DDP-116 and DDP-24 computers are used by company personnel for program generation, checkout, and in-house programming studies, as well as by customers as they may require.

Summary

In conclusion, we can say that we have made our commitment to employ the integrated circuit as an essential element of our modular and computer product future. Such a commitment will be an economic necessity in the next generation of equipments for both 3C and its competitors. We have taken this necessary step earlier than most of the industry and believe we have a significant competitive advantage as a result. Seldom does the opportunity for technological leadership coincide with the opportunity for strong profit position. Our "big three" of 1965, the μ-PAC modules, the ICM-40 memory and the DDP-124 computer, are each salable products, low-cost building blocks for other products, and each is technically avant-garde in its marketplace.

The Techniques Laboratory is committed to a continuing program of applied research and advanced development in the field of microelectronic devices, circuits, and applications. It is pursuing the comprehensive application of microelectronic technology by integrating skills ranging from solid state physics to systems engineering. 3C is contributing to many facets of microelectronic development including:

a. Novel active and passive device structures using silicon monolithic and evaporated thin film techniques.

b. Advanced process for the realization of silicon monolithic and evaporated thin film structures.

c. Sophisticated interconnection techniques for monolithic structures and complex, modular assemblies.

d. Multiple circuits, both digital and linear, which capitalize on advances in device and process technology.

e. Integration of microelectronic technology to subsystem and system levels.

In our computer business, we have established a line of small, control-oriented computers, complete with input-output peripherals and program packages, and have now introduced a next generation of equipment with the move to integrated circuits.

If 1965 was a year of transition, 1966 promises to be a year of consolidation. Major new product developments will follow the trails blazed by this year's "big three". We will continue to pursue advanced as well as current development efforts in the semiconductor integrated circuit, PAC, computer, memory areas, and experimental efforts in one or two areas new to us.

Our crystal ball tells us that the integrated circuit revolution is only beginning and, that over the next several years, innovations to product design and manufacturing concepts, even more dramatic than those we have seen thus far, are coming. We intend to continue to participate in the introduction of these new techniques and, in so doing, to turn these technological changes into 3C opportunities.

Thank you.

30-DAY DELIVERY QUOTED FOR DDP-116 COMPUTERS

New production facilities designed to meet increased demand have made possible 30-day delivery on DDP-116 general purpose computers, according to an announcement by Theodore W. Helweg, 3C Vice President of Marketing.

Helweg also announced installation of DDP-116's at selected 3C regional offices for equipment demonstration.

DDP-116 is a fast, low cost, and compact 16-bit word digital computer. Advanced software includes up to 134 subroutines in ASA FORTRAN IV library; is compatible with 3C DAP assembler and desectorizing loader. (Desectorizing, a unique feature of 3C's standard assembly program DAP-116, takes the DDP-116 a step beyond other small computer assembly programs by permitting efficient and maximum use of every location in memory without concern for the inherent addressing limitations found in all short word length computers. In many cases, it makes possible use of a 4K-word memory where an 8K-word memory would be necessary on a competitive machine.)

Standard DDP-116 specifications include 1.7 μsec cycle, expandable 4096-word memory and keyboard with paper tape I/O unit. A/D and D/A subsystems and a full line of peripheral equipment are available to extend the flexibility of DDP-116 in special purpose systems configurations.

The DDP-116 is designed for both open-shop scientific applications and real-time data processing, such as telemetry data reduction, nuclear instrumentation, simulation, and process control.

DDP-116 computers are now operational in over fifty installations. Companies such as Tridea Corporation, a subsidiary of Conductron Corporation; General Dynamics in Pomona, California; California Computer Products, Inc., as well as NASA's Marshall Space Flight Center, Huntsville, Alabama; Case Institute of Technology, and the High Energy Research Laboratory of Ohio State are utilizing 3C's DDP-116 general purpose digital computer for hybrid and other real-time control applications.

FIRST QUARTER EARNINGS AND SALES REPORTED

Benjamin Kessel, President of Computer Control Company, Inc., has announced sales and earnings for the company for the first fiscal quarter ending, January 28, 1966. Sales were $6,639,099 with earnings of $339,344, or 28.1 cents per share.

Starting with fiscal 1966 (calendar November 1, 1965), 3C adopted the practice of dividing its accounting year into four equal quarters, each having thirteen weeks. Comparative figures for the first quarter of 1965 are, therefore, not available.

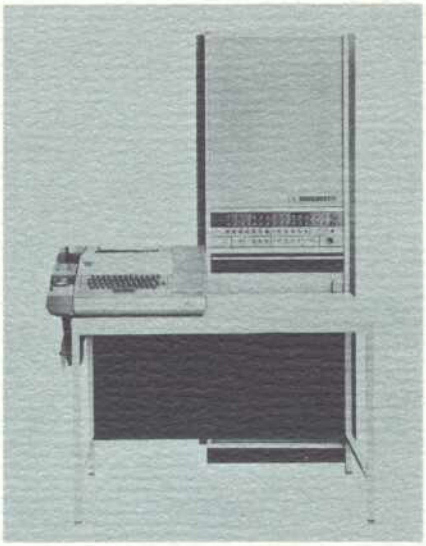
Kessel said, "First quarter earnings reflect a continuation of the satisfactory rate of shipments achieved in the final quarter of fiscal 1965 on new products in which the company invested heavily during the past two years. Continuing product development at a more normal rate this year is serving to extend these new product lines. Heavy marketing emphasis is being placed on volume sales to companies that incorporate 3C products, such as logic modules and computers, into their own systems and equipment. Results from our cost reduction program initiated last year also contributed to first quarter earnings."

Fiscal 1965

For the fiscal year ending October 30, 1965, sales were $23,773,232 with earnings of $388,123, or 32 cents per share. In fiscal 1964, sales were $19,049,683 and earnings were $525,907, or 44 cents per share.

Mr. Kessel said, "An unusually heavy concentration of new product introductions during the early part of the year, followed by high initial manufacturing costs, which are not unusual, plus limited shipping rates on new products, affected earnings adversely during the first two-thirds of the year. Favorable shipping rates and operating performance were achieved during the last third of the year and have continued into fiscal 1966."

New product activity during the entire year included the introduction of three new computers, the DDP-224, DDP-116, and the DDP-124. The DDP-124 is one of the first computers to feature monolithic integrated circuit construction. The company also introduced a new series of integrated circuit digital logic modules.



DDP - 116 COMPUTER USED TO CONTROL LINE TRACER

3C is furnishing DDP-116 general purpose digital computers to Tridea Corporation, a subsidiary of Conductron Corporation, South Pasadena, California. The DDP-116's will be used for on-line machine tool programming in conjunction with a Tridea developed automatic line tracer.

The 3C DDP-116's to be used by Tridea are low cost, 16-bit binary word general purpose digital computers which feature a comprehensive programming package, including a symbolic assembler, diagnostic, and utility routines. They are equipped with such options as a high-speed arithmetic unit, paper tape punch and SKS sense lines.

The Tridea automatic line tracer digitizes nondimensioned drawings of sheet metal parts. The output of the system is a finished numerical control punched tape suitable for control of N/C milling machines to produce parts whose drawing outlines were traced. The system eliminates many costly steps formerly necessary in translating drawing outlines to sheet metal form.

Two complete systems, each including a DDP-116, will be delivered by Tridea to McDonnell Aircraft in the Spring of 1966. Tridea is presently investigating the market for other similar applications in the aircraft, automotive, and garment industries.

The DDP-116 digital computer for machine tool control and programming is another example of the widespread on-line applications in which 3C computers are now being used.

RTM INCREASES SYSTEM EFFICIENCY

A new, general purpose real-time monitor (RTM) developed by 3C software specialists allows programmers to increase the efficiency of computer systems.

Real-time computer systems used in process control, communications, and other applications are usually idle about 40% of the time, due to the computational requirements during peak periods. The RTM allows programmers to make use of idle time for controlling additional real-time processes or for running free-time programs.

To present and potential users of real-time digital control systems, the monitor will mean not only greater machine utilization but greater justification for the use of computers.

The primary functions of RTM are: to schedule and control the execution of all application or free-time programs, to process all interrupt signals, and to control all input and output operations. The RTM is designed to operate with programs written in either FORTRAN IV or 3C's assembler language (DAP).

The RTM is designed to work on computer systems having at least 8,192 words of core memory, typewriter, paper tape reader and punch, or punched card reader and punch, plus memory lockout (including relocatable sector zero for 16-bit computers).

3C's DDP-116 low-cost, general purpose digital computer, will soon feature the RTM as standard software. The monitor will also be available for use on 3C's DDP-124 and DDP-224 computer systems.

INTERNATIONAL HEADQUARTERS

To spearhead participation in the fast growing international computer and digital product market, 3C international headquarters were opened in Paris in March. Two subsidiaries will also be in operation in Europe this year. Computer Control Company, Ltd., will open offices in London and Computer Control Company GmbH, will be located in Frankfurt.

3C recently signed an agreement with Tokyo-based Kyokuto Boeki Kaisha, Ltd., (KBK), to represent 3C in Japan for marketing, servicing, and installation of its computers and digital products. KBK is a leading Japanese engineering trading company and has been in business since 1947.

SSEC LICENSES NEW SEAM WELDER

In a joint announcement Benjamin Kessel, President of Computer Control Company, Inc., and Robert D. Richardson, President of Solid State Equipment Corporation, Philadelphia, Pa., disclosed the licensing of Solid State Equipment Corporation for exclusive manufacturing and marketing rights to 3C's Parallel Seam Welder. The newly developed equipment is specially designed for room temperature hermetic sealing of integrated circuit flat packages. The know-how and patent license granted Solid State Equipment will allow full commercialization of this advanced technique.

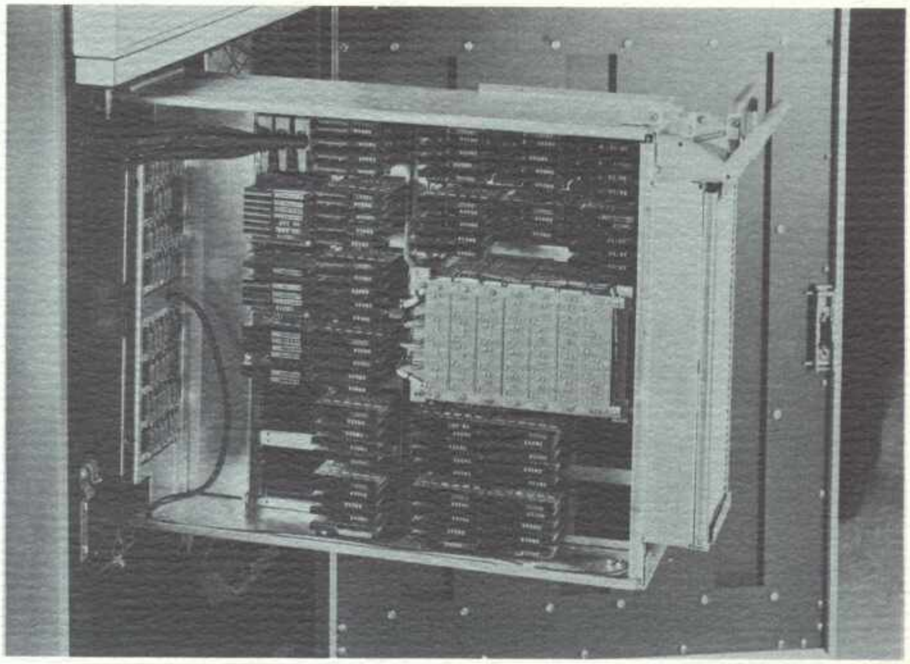
The transaction involves a long term royalty arrangement. In divesting itself of the manufacturing and marketing of the Parallel Seam Welder, 3C took another step in its long range plan to focus on its major, high volume product line of computers, logic modules, instruments, and core memories, as well as its special purpose digital system capabilities.

Kessel said, "The Parallel Seam Welder, now in use in 3C's Integrated Circuit Research Laboratory, was developed and constructed by 3C to fill a requirement for low cost, high yield, hermetic sealing of integrated circuit packages. Techniques for achieving this were not commercially available. We believe that we have made a significant contribution to the art of integrated circuit fabrication."

Richardson said, "Now hermetic sealing can be achieved at room temperatures with high yields using parallel seam welding techniques.

"Solid State Equipment Corporation, a new venture in the integrated circuit equipment marketplace, is moving rapidly to make the know-how and equipment available to fabricators of integrated circuits. Several medium and large sized manufacturers have been awarded contracts to produce principal portions of the Parallel Seam Welder to assure reasonable deliveries to the industry.

"For the first time, the integrated circuit industry has a hermetic seal packaging technique completely compatible with the requirements of complex integrated circuits of subsystem size. Parallel seam welding eases the way towards the marriage of thin film integrated circuits to monolithic integrated circuits, by eliminating the necessity of developing thin films that will stand the high sealing temperatures used in monolithic integrated circuit packaging."



NEW VERTICAL PACKAGING INTRODUCED FOR ICM-40

ICM-40, originally designed to mount horizontally, is now available with new hardware for vertical mounting in a standard 24″ deep x 19″ wide cabinet. In the vertical configuration, the memory module swings out, tilts and locks for easy access to the module side or the wiring side for testing module replacement, or inspection.

One μsec cycle time, 500 nsec access time, plus availability in capacities from 4K x 6 bits to 16K x 84 bits are some of the features of the ICM-40 core memory recently introduced by 3C in a 5¼″ high drawer configuration.

Because of its 5¼″ dimension, the ICM-40, which provides ¼ million bits of storage, can be interleaved with other vertical modules for more efficient packaging density without sacrificing accessibility at the front of the cabinet. For example, three vertical mounted ICM-40 units provide 4K x 84, 8K x 84, or 16K x 42 bit size memory capacity and at the same one μsec time as the horizontal unit.

ICM-40 was the first integrated circuit core memory series with operating speed of one microsecond full cycle and access time of less than 500 nanoseconds. The ICM-40 coincident current, random access core memory features price, size, and reliability advantages of 3C integrated circuits (μ-PACS) and is compatible with system designs utilizing discrete component logic.

Standard operating modes include clear/write, read/restore, and read/modify/write cycles. Output signals include memory busy, information available, and end-of-cycle. Hold address control input is available.

The new 3C integrated circuit core memory has an operating ambient temperature range of 0°C to +50°C. Its reliable operation over this range is ensured by use of all silicon microcircuitry.

Use of advanced design techniques for the new generation of 3C core memory products in no way diminishes the reputation of reliable storage devices which has been enjoyed by 3C since construction of its first fully transistorized memory system in 1958.

Power for the ICM-40 series comes from separate power supplies, each of which occupies 5¼ inches in a standard 19-inch rack, also available with vertical mounting hardware. Each power supply contains power failure sensing, non-volatile start-up/shut-down, over voltage, over load, and line transient protection.

Flexibility of the basic ICM-40 is augmented by a number of standard options. In addition to the standard random access mode of addressing, for example, the address register may be equipped for sequential addressing, address-out signals, and external count controls. Either two-zone or four-zone partitioning of the memory information register may be specified as a standard option, as may an external reset control for the information register.

NEW INSTRUMENT DIVISION FOR R & D EQUIPMENT

"To meet fast-growing markets for electronic testing devices, a new Instument Division is now in operation in Framingham," according to Benjamin Kessel, President of Computer Control Company, Inc.

Frank Dean, 3C Vice President, heads the new division. Under Dean's direction, key marketing and technical people are putting this activity into high gear.

Dean said, "Research and development organizations are prime users of our instrument products. Our equipment is employed in the development and test of all types of memories and memory elements — thin film, core, rod, plated wire, and others.

"We are manufacturing and marketing high-quality electronic test units to keep pace with the state of the art."

3C's instrument product line features:

High-speed, coincident current and word-organized memory exercisers.

5 and 20 MHz digital program generators.

Positive and negative current drivers.

Delay and width timing modules.

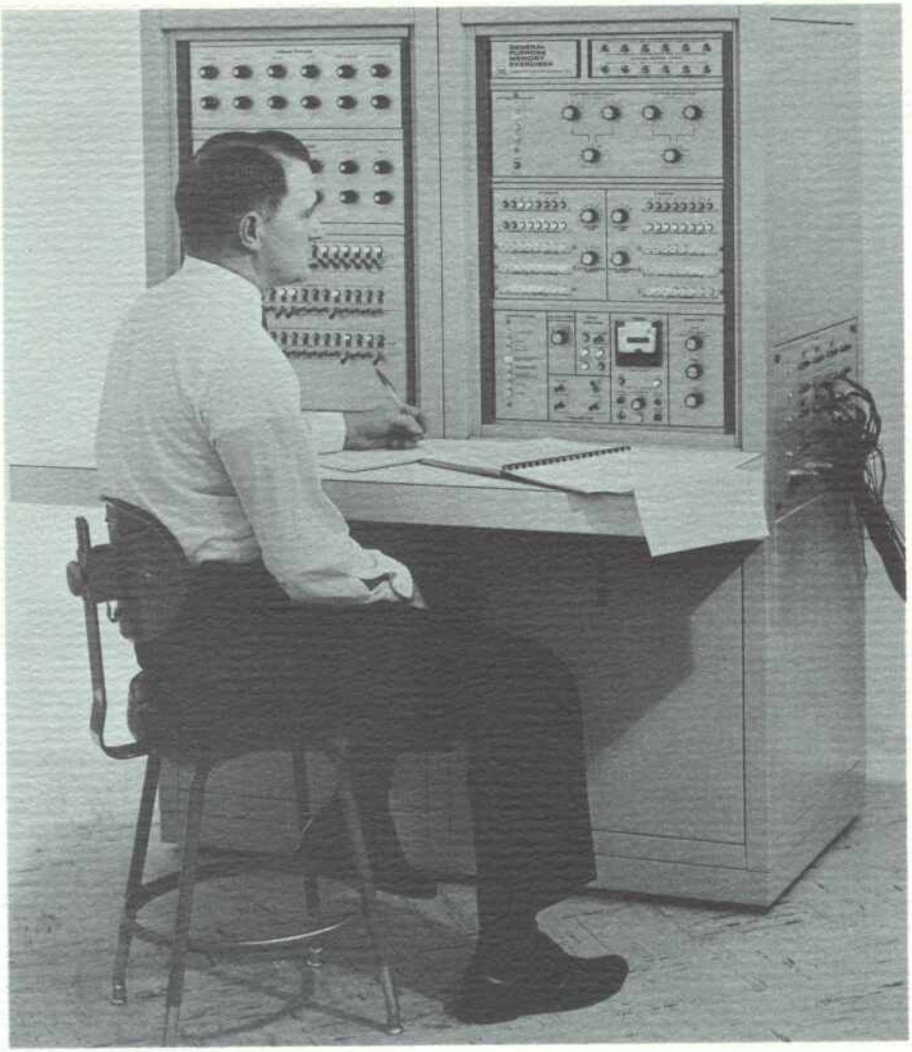
Formation of the Instrument Division is another step in expanding 3C's product mix — enabling the company to furnish "total customer requirements".

FIRST DDP-124 SHIPPED TO LINK

The first 3C DDP-124 high speed general purpose digital computer featuring monolithic integrated circuit construction has been shipped to the Link Group of General Precision, Inc., Riverdale, Maryland. The Link contract calls for a total of nine DDP-124 computers to be shipped by 3C within the next few months.

Link will use the DDP-124 computers as control elements for a new flight training simulator.

The new Link trainer will control four cockpits, representative of the T-28 aircraft, from a single computer-controlled system. It will be used by the U. S. Navy for instrument flight training. In addition, this new pilot training device is capable of simulating flying conditions of various aircraft, including carrier take-off and landing operations.



NEW MEMORY EXERCISER INTRODUCED BY 3C

The fastest, most versatile general purpose memory exerciser available today — 150 nsecs to 1.5 msecs cycle time — has been announced by Computer Control Company, Inc., Instrument Division.

3C Memory Exerciser, Model 3601, is a general purpose high speed test system designed to provide maximum versatility for development and test of present and future core memory systems. Reliability, speed, flexibility, and ease of operation are standard design features.

The all solid state Model 3601 Exerciser features a capacity of 65,536 addresses, word lengths up to 80 bits and ±6 volt output amplitude. Only 60 nsecs are required to generate address and data information, and 75 nsecs for error checking.

Eight operating modes and variable polarity and amplitude interface signals assure programming flexibility.

Operating modes are:

Load and Stop

Regenerate

Read · Modify · $\overline{\text{Write}}$

Buffer

Regenerate · $\overline{\text{Load}}$

Regenerate · $\overline{\text{Load,}}$ $\overline{\text{Regenerate}}$ · Load

Cycle Complement

Address Data Check

The unit also provides a means for selecting, adjusting and controlling addressing sequence, data pattern, operating modes, error checking, clock control, timing and interface signal levels. The 3C Exerciser utilizes H-PAC 20 MHz digital logic modules throughout. H-PACS, produced by 3C, are currently being used in a wide variety of high speed digital applications.

Delivery is 90 to 120 days; 150 days for custom-built units.

LATEST 3C TECHNICAL LITERATURE
AVAILABLE ON REQUEST

The following library of technical information documents 3C activities in the digital products and digital systems industry. To obtain copies, circle the corresponding number on the information request card.

CATALOG μ-PAC-2 details new 3C μ-PAC silicon monolithic integrated circuit digital logic modules. Revised edition includes new high density mounting hardware; lamp driver, logic level drive, power amplifier, and shift register μ-PACS; as well as new accessories and a custom system wiring capability. The new catalog features standard DC to 5 MHz μ-PACS, as well as mounting hardware, power supplies and module accessories. Technical description, specfications and logic diagrams for each PAC type are included along with loading rules and typical waveforms. Number 1

CATALOG S-3 details the full family of 3C S-PAC digital logic modules. More than 100 standard DC to 200 KHz, DC to 1 MHz, and DC to 5 MHz digital logic modules are described in addition to mounting hardware, power supplies and module accessories. The catalog contains technical descriptions, specifications, logic symbols and schematics. Also included are loading rules, typical waveforms and new mounting hardware. Number 2

CATALOG SIL-1 introduces SILICON S-PACS, 1 MHz digital logic modules, with full catalog information and specifications. Included are technical descriptions, schematics, loading rules, typical waveforms, mechanical packaging features, accessories, power supplies, and mounting hardware. Number 3

CATALOG H-2 describes the full spectrum of 20 MHz 3C H-PACS which offer new speed, new freedom from timing problems in complex systems configurations. Number 4

DDP-124 GENERAL PURPOSE DIGITAL COMPUTER — New brochure introduces first integrated circuit computer. Includes complete specifications, input-output options, peripheral equipment and software for the DDP-124. Number 5

DDP-116 GENERAL PURPOSE DIGITAL COMPUTER — Brochure describes general specifications, internal organization, command structure, input-output options, peripheral equipment, and software for the new DDP-116. Number 6

DDP-224 GENERAL PURPOSE DIGITAL COMPUTER — Brochure describes general specifications, input-output options, peripheral equipment and software for the DDP-224. Number 7

VAN MOUNTED DDP-24 GENERAL PURPOSE DIGITAL COMPUTER — Revised brochure describes general specifications, input-output options, peripheral equipment and software for the DDP-24 VM. Number 8

TYPICAL CAPABILITIES describes 3C's computers/systems application capabilities, including general purpose digital computers, logic modules, and special purpose systems design and construction. Number 9

ICM-40 INTEGRATED CIRCUIT CORE MEMORIES featuring cycle times of 1 μsec are detailed in Catalog ICM-40. Includes complete specifications on newest core memory series. Number 10

TCM-35 MAGNETIC CORE MEMORIES featuring cycle times of 1.4 to 2 μsecs are detailed in Catalog TCM-35. Series TCM-35 coincident current core memories are offered in word lengths up to 36 bits, word capacities up to 8192 (basic module). Number 11

TCM-32 MAGNETIC CORE MEMORIES designed to fill a wide range of word length capacities presented in Catalog TCM-32. TCM memories feature flexible component assembly for use with digital systems requiring high speed random access storage, or for buffering and high speed changing operations. Number 12

20 MHz DIGITAL PROGRAM GENERATORS featured in catalog DPG-2 are solid state, variable frequency, multichannel pulse train generators. Number 13

5 MHz DIGITAL PROGRAM GENERATORS featured in Catalog DPG-1 are designed specifically for applications where serial/parallel pulse patterns are required. Number 14

PULSE CURRENT GENERATORS featured in Catalog PCG-2 provide trigger control, delay, sync, width, output shaping, and output amplitude controls. Number 15

TIMING/POWER UNITS presented in Catalog TP-1 are designed to combine with other instruments to form completely self-contained negative or positive Pulse Current Generators. Number 16

POWER UNITS featuring new light weight modular instrument capabilities are introduced in Catalog P-1. Number 17.

GENERAL PURPOSE MEMORY EXERCISER, for development and production test operations, featuring 150 nsecs to 1.5 msecs cycle times with word lengths up to 80 bits, is detailed in Model 3601 Brochure. Number 18.

1965 Annual Report describes 3C's Fiscal 1965 activities and overall corporate capabilities. Number 19

FOR MORE INFORMATION ON TOPICS DISCUSSED IN PULSE, FILL OUT THE ATTACHED READER SERVICE CARD.

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