MICROCOMPUTERS AND THE SURVEYOR

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Having recently developed a comprehensive survey program for microcomputers, we have been invited to discuss these new systems and their application to the survey profession.

For any professional use a basic microcomputing system consists of a computer, an input device, an output device, and a storage medium. Common input devices include terminals, keyboards, card readers, etc. Output devices can include high speed peripheral printers, drum or flat-bed plotters, typewriters, and so on. For most business applications, the storage system consists of a dual drive floppy disk unit capable of high speed access to both program routines and data. Although cassette tape may be used for storage, it is not recommended for general office use due to its minimum storage capacity and slow operation.

The survey calculation system that we have developed utilizes hardware by Commodore Business Machines, consisting of a 32K computer, tractor feed printer and dual drive floppy disk. The computer itself uses a standard typewriter keyboard, a number pad, and an onboard 9" monchrome video screen (CRT).

The keyboard, in addition to all of the alphanumeric characters, contains a variety of graphic characters and cursor control keys such as clear, up, down, etc. With the 128 character set provided, it is possible to arrive at many types of visual displays, both on the printer and the CRT. If special characters are needed for any particular purpose, they can be created by program instruction.

Up to 1000 characters (25 lines of 40 characters each) can be displayed on the CRT. Each character occupies an 8 x 8 dot matrix. Under program control, the CRT plays many important roles in
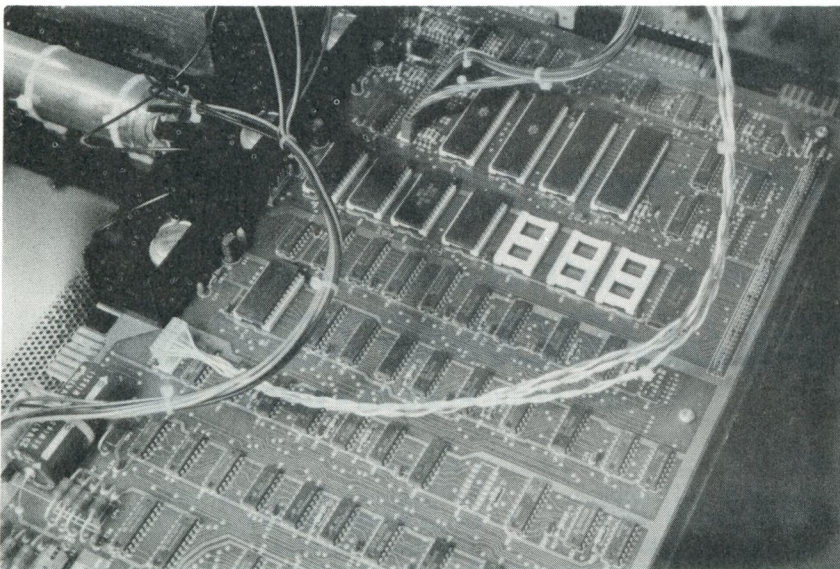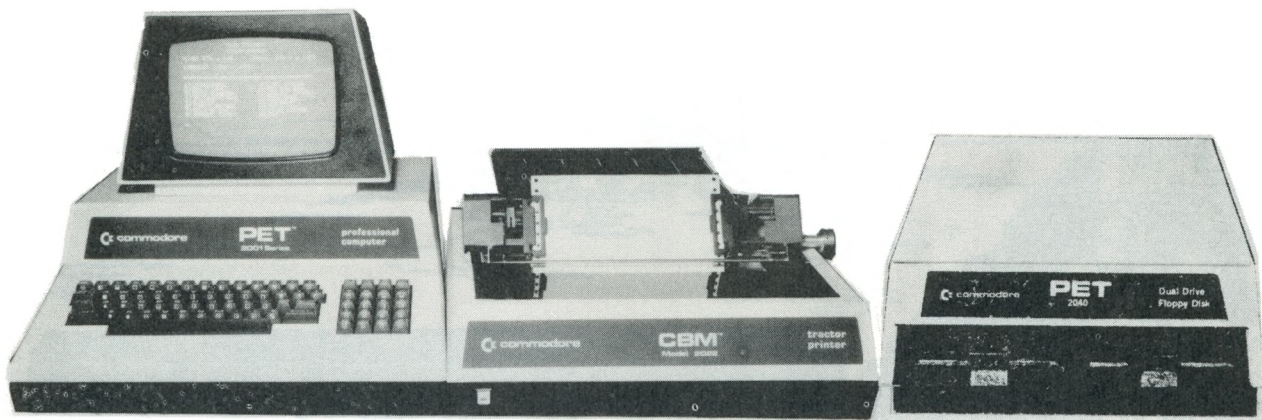
the use of a microcomputing system. It can offer choices as to how the operator of the system might wish to proceed and then guide him through his particular selection with the use of prompting messages. Again under program control, the user can list data or check solutions visually, without the necessity of having long printouts of miscellaneous intermediate results. With an appropriate word-processing program, the CRT acts as an editing device. This allows the user to type letters and descriptions onto the CRT, make any corrections, additions or deletions necessary, and proceed to store the result and/or print it out on company letterhead using the appropriate interface for his particular office typewriter.

The computer itself offers 32,000 bytes of user-available RAM (Random Access Memory). RAM is space allocated for the storage of program instructions

and data. RAM space is also used in the execution of program instructions. For example, in order to execute a command to branch to a calculation subroutine, the computer must remember the location of the branch, find the specified subroutine, and return to the program instruction following the branch. A complicated series of subroutines can be constructed where the first subroutine branches to another, which in turn branches to another, which in turn branches to another, and so on. In the Commodore computer, 23 levels of subroutine branching are possible.

The computer also contains 14K bytes of ROM (Read Only Memory). This memory contains the command instructions controlling the operating system of the computer. The command set contained in the ROM is activated as soon as the system is powered on. ROM controls such things as reading, interpreting, and executing program instructions as well as defining the character set as represented on the CRT and printer. A well designed ROM means smoother computer operation and little

or no downtime. Facility is provided in the Commodore computer for an additional 8K of ROM which can be used for permanent program storage. Access to ROM functions can only be obtained through the use of machine language programming.

The dual drive floppy disk adds approximately 340K bytes of storage capacity to the basic 32K computer. The disk drive unit uses industry standard 5¼" diskettes for program and data storage. Under program control, the disk drive transfers data to the computer's RAM and retrieves it as required.

The printer is a high speed, tractor feed unit, capable of printing 70 lines per minute with burst speeds of 150 characters per second. Print lines can contain up to 80 characters and standard computer paper sizes up to 10" in width may be used. As with the disk drive unit, the printer is an "intelligent" peripheral. It contains its own ROM and programmable RAM, providing the capability to be programmed to construct many different types of output format.

During the operation of the survey program, each new piece of data for storage is converted into a 5 byte binary number and stored in a previously determined vector array. This is much like a mailman depositing letters in a super high-rise apartment building mailroom. The computer places the first value encountered for storage in the upper left corner slot. Each successive new piece of data is placed in consecutive slots until the array is filled and capacity is reached. Unlike the mailman, the computer is much quicker about it and remembers in exactly which slot any given piece of data is stored. This eliminates the need to search the entire array for a specific value.

Although the system is capable of performing all typical survey calculations, it is deceptively simple to operate. This is because the computer is doing all the work. The survey program itself contains over 5000 multi-level program steps, with over 1000 logical testers.

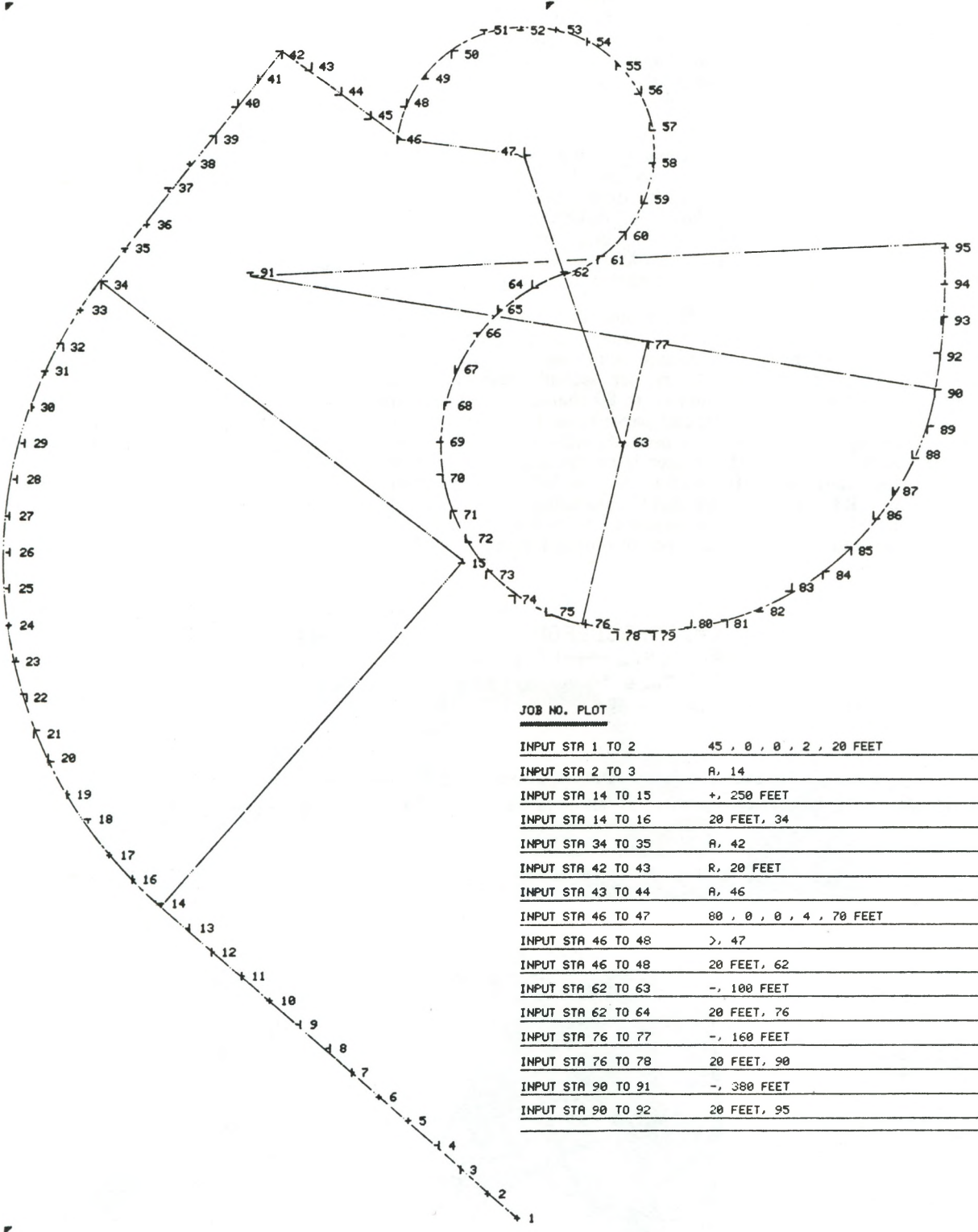Because of the computer's ability to concatenate, truncate, scan, or alter alphanumeric strings, and to make de-
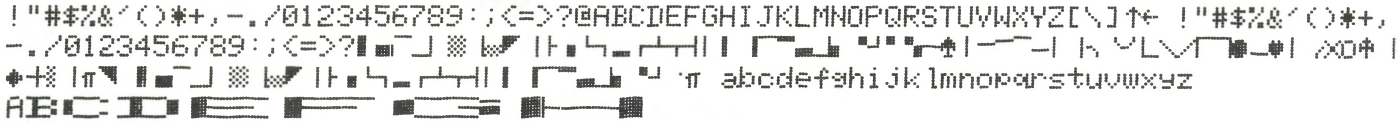
Shown above are some of the character representations possible with the Commodore printer. Access to each individual pin of the dot matrix printer, as well as to the carriage feed servos, provide maximum printer control.
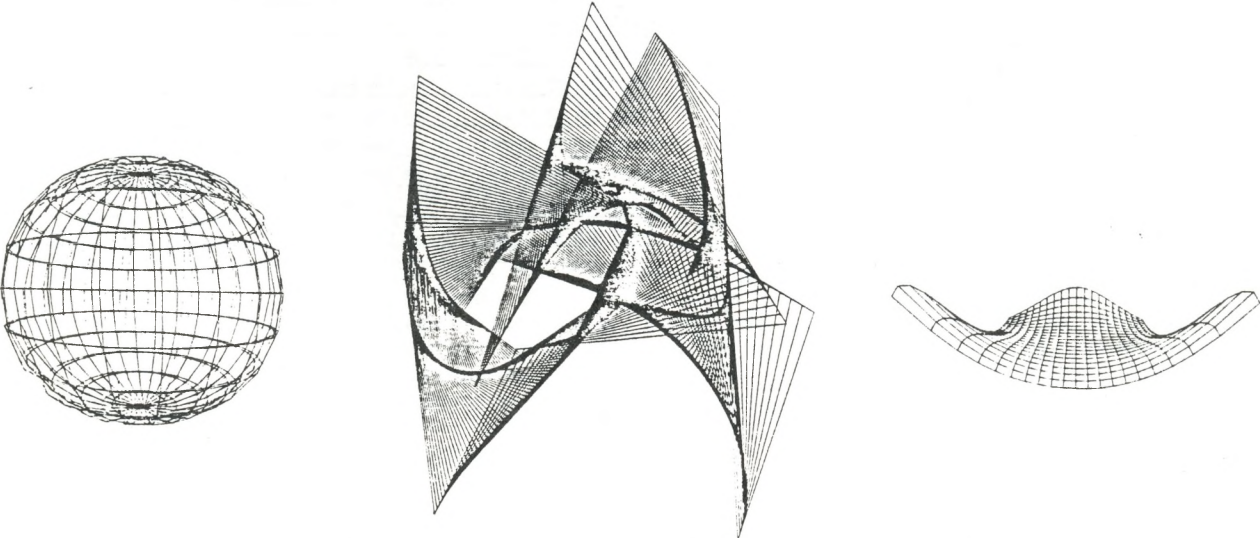
Future developments include the adaptation of x,y plotters into the system.

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JOB NO. PLOT
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INPUT STA 1 TO 2        45 , 0 , 0 , 2 , 20 FEET
INPUT STA 2 TO 3        A, 14
INPUT STA 14 TO 15      +, 250 FEET
INPUT STA 14 TO 16      20 FEET, 34
INPUT STA 34 TO 35      A, 42
INPUT STA 42 TO 43      R, 20 FEET
INPUT STA 43 TO 44      A, 46
INPUT STA 46 TO 47      80 , 0 , 0 , 4 , 70 FEET
INPUT STA 46 TO 48      >, 47
INPUT STA 46 TO 48      20 FEET, 62
INPUT STA 62 TO 63      -, 100 FEET
INPUT STA 62 TO 64      20 FEET, 76
INPUT STA 76 TO 77      -, 160 FEET
INPUT STA 76 TO 78      20 FEET, 90
INPUT STA 90 TO 91      -, 380 FEET
INPUT STA 90 TO 92      20 FEET, 95
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PLOT COMPLETE

The scaled plot shown above consists of 95 points coordinated with 16 entries using the self-
prompting system incorporated into the survey program. For the purpose of display, the linework
has been added, the input print-out arranged onto the plot, and a 50 % reduction made of the result.

cisions based on complex logic statements, it can do much more than calculate. Under program control, it continuously monitors all stations in memory, current input mode (metric or imperial - reversible), calculation time, etc. It is aware at all times of what data is required and what options are available to complete any selected calculation, providing understandable prompts for each entry, controlling all keyboard functions to ensure that only the necessary keys for any particular input will operate, and verifying each completed entry for validity. Input print-out and calculations are delayed until all entries have been made, in the event that the user wishes to abandon any calculation routine already in progress and select another program.

Program selections are divided into 2 catagories; main program routines and sub-program routines. Main program routines, for example, are accessed, whenever required, by entering the command code letter "M". This command results in a listing on the CRT of 16 numbered main program functions ranging from coordination, intersections, etc. to boundary summaries and scaled plots.

When the number of the desired main program routine is entered, any sub-programs become available for selection. Main program selection No. 1 (Coordinate), for example, offers 9 sub-programs ranging from stadia to automatic input corrections, and provides up to 14 methods of coordination ranging from bearing, azimuth, or angle entries to self-prompting automatic routines (see sample plot).

In addition to being a powerful calculation tool, the microcomputer is capable of performing a wide variety of business functions. For instance, with appropriate software, filing information for hundreds of survey projects can be permanently stored onto a single diskette. In conjunction with specialized routines related to the survey profession, a file program can print, list, add, insert, delete, or search files. Since all file information can be instantly accessed and readily searched, a cross-reference system would no longer be necessary. Other types of office programs include accounts payable and receivable, payrolls, income taxes, general ledgers, word-processors, expanded survey programs, and so on.

Because many accessory components to a basic microcomputing system can be added in the future, requiring only the correct interface, the microcomputer's potential uses can be expanded. These future additions to a basic system can include such things as flat-bed plotters and electronic data collectors.

In this article, we have attempted to explain some of the functions of a microcomputers, and some of its present and potential applications in the professional land survey office. Thanks to low-cost modern technology, computing systems once reserved for the realm of big business, can now be afforded by virtually any business; from the small insurance agency that uses a microcomputer to calculate premiums and claims, to the large corporation such as the CBC, which uses one for choreography.

The key to any good microcomputing system is a well-planned, comprehensive software library, designed to meet specific professional needs. For, without a program, the computer is a blank piece of micro-circuitry, ceaselessly winking its cursor light while awaiting a command.