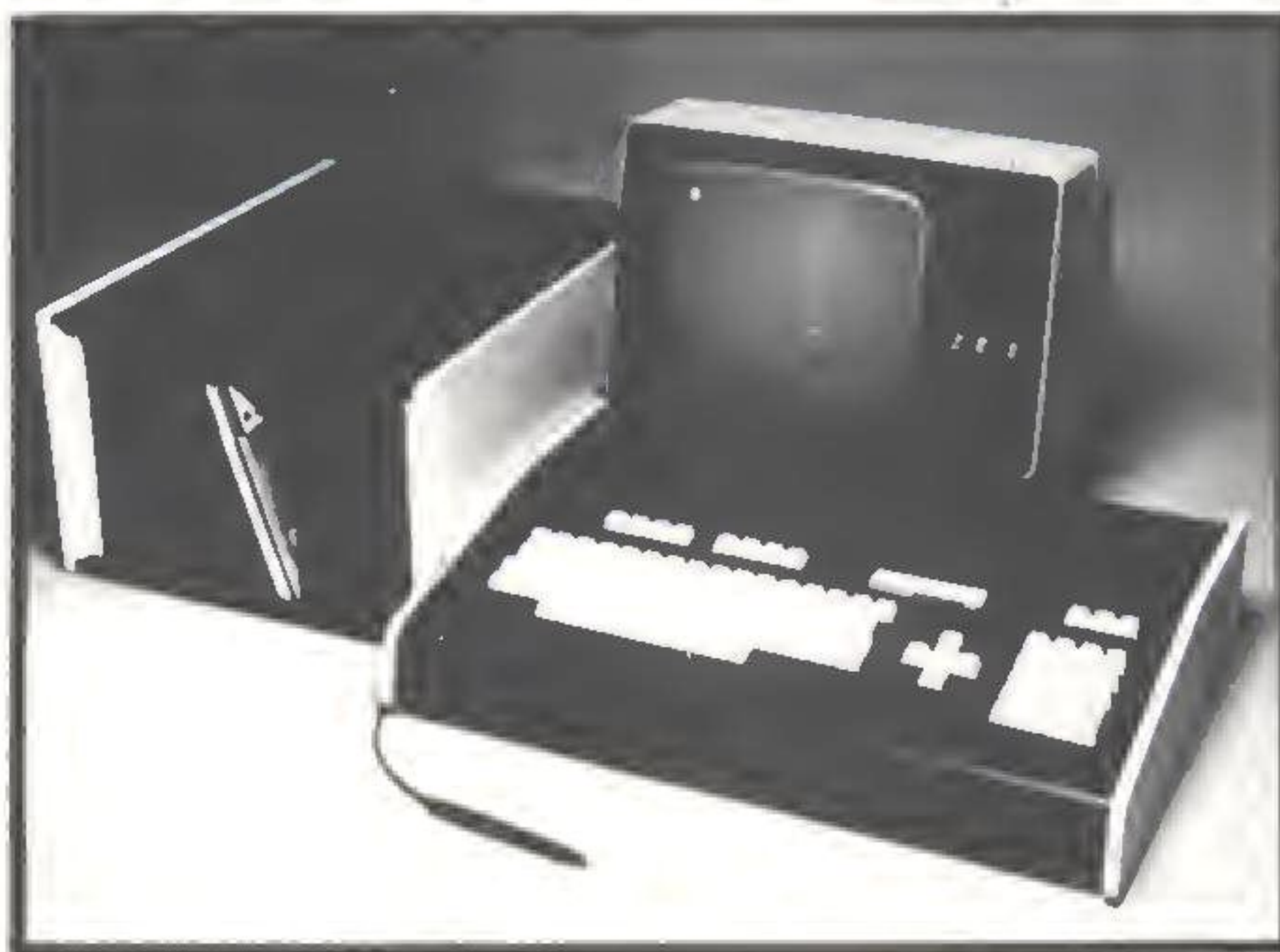


Graphics, Music and More

Carl Strobel



The MTU-130.

Photography by David Hornick.

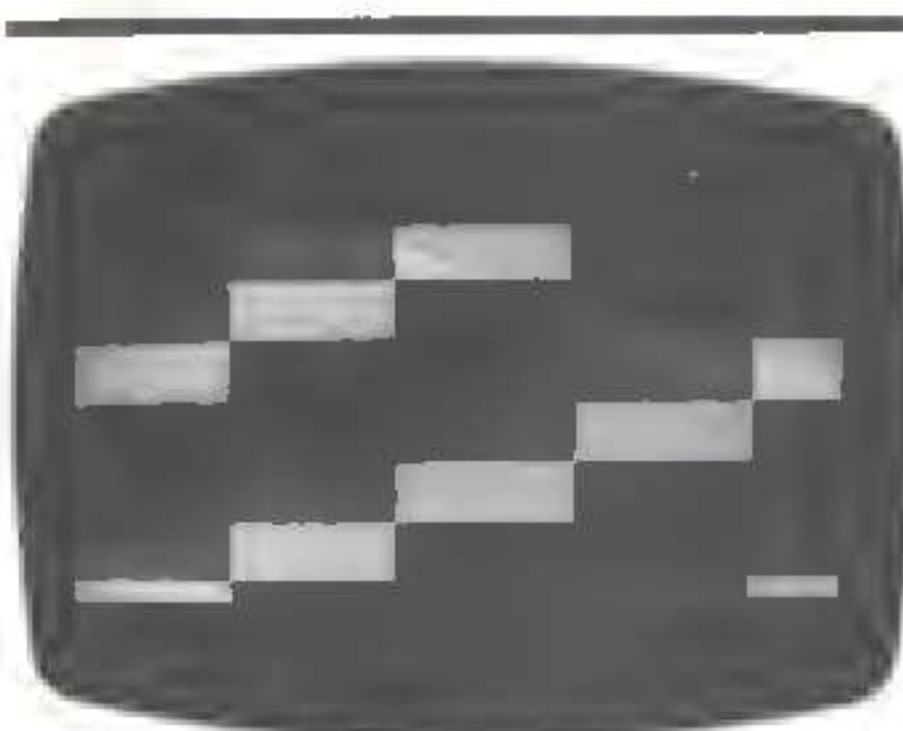
When computer professionals get more excited over a new computer than the kids next door, you know the machine has to be impressive.

The computer that is receiving this kind of attention at my house could easily be the most powerful and versatile micro-computer yet offered for personal, professional and small business use. It is the MTU-130, a superb new computer just introduced by Micro Technology Unlimited, a small Raleigh, North Carolina company that up to now has specialized in developing advanced hardware and software enhancements for computers produced by other people.

If the phrase "most powerful and versatile" sound a bit extravagant, add the words "advanced design" and "expansion capacity" and a few other adjectives and take a look at what the MTU-130 offers. It will be a long look because there is a lot to

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see—memory capacity, quality sound and music, high resolution graphics, a disk operating system that puts many of the bigger systems to shame, Basic and assembly



Two shades of gray, in addition to black and white, can be created in the medium resolution mode. In this mode, the computer provides a 240 x 256 dot matrix for graphics creation.

language programming capabilities acclaimed by my professional programmer friends.

The computer comes with 80K of system and user RAM and is easily expandable to a directly addressable 256K. If you need more memory, virtually unlimited expansion is possible through a memory bank switching capability.

High resolution graphics has been one of MTU's specialties. The MTU-130 has two graphics levels in addition to its standard 80-column, 25-line alphanumeric display. One level offers the ability to create objects on a 240 x 256 dot matrix in black, white and two shades of gray. The second level provides double that resolution through the addressing of individual pixels on a 480 x 256 pixel screen. The results, as shown in the accompanying photographs, are impressive, indeed.

A high definition light pen feature is standard and provides an easy means of creating graphics on the screen as well as

allowing direct user response for such things as menu selection. Programming the light pen is as simple as any other Basic programming, thanks to special commands in the extended Microsoft Basic.

Hal Chamberlin, one of the pioneers in microcomputer music, is vice president for research and development of MTU, so you could expect emphasis on a sophisticated music capability.

The MTU-130 has an 8-bit digital-to-analog converter that not only provides exceptional quality four-voice music but also allows implementation of very life-like human voice and other complex sounds in user programs. This music capability, incidentally, has been used since last fall by Ohio State University in teaching music courses. The computer music has an eight-octave range and programmable envelopes, and each of the four voices has 16 harmonics which are programmable.

The computer music has an eight-octave range and programmable envelopes.

CODOS 2.0

The computer offers what is probably the most advanced disk operating system available for microcomputers. It is superior even to a well-known minicomputer system I've used. Called CODOS 2.0, or Channel-Oriented Disk Operating System, it is a more advanced version of a DOS offered by MTU for the past several years and was written by MTU's software manager, Bruce Carbrey.

CODOS merits a lengthy discussion by itself, and I shall expand on its power and subtleties more fully later. Just a quick word here to note that it offers true I/O device independence and provides a programming flexibility that has to be used to be believed. CODOS also dynamically allocates file space on disk; no need to declare to your DOS in advance how big your files are going to be—even if you know.

CODOS supports up to four double density 8" disk drives, either single or double sided or any mixture of the two types. Disk capacity is 500K bytes for single sided and 1 megabyte for double sided disks. My entire collection of game programs on cassette now resides on one side of one disk with room to spare.

Not insignificantly, the sustained data transfer rate under CODOS is 19.7K bytes per second. MTU claims, and my experience supports it, that CODOS will locate, load



The beginning of a game of pool on the MTU-130 which combines high-resolution graphics with sound effects. The two lines which cross at the upper left pocket form the graphics cursor used in this game to specify the point at which the cue ball is aimed.

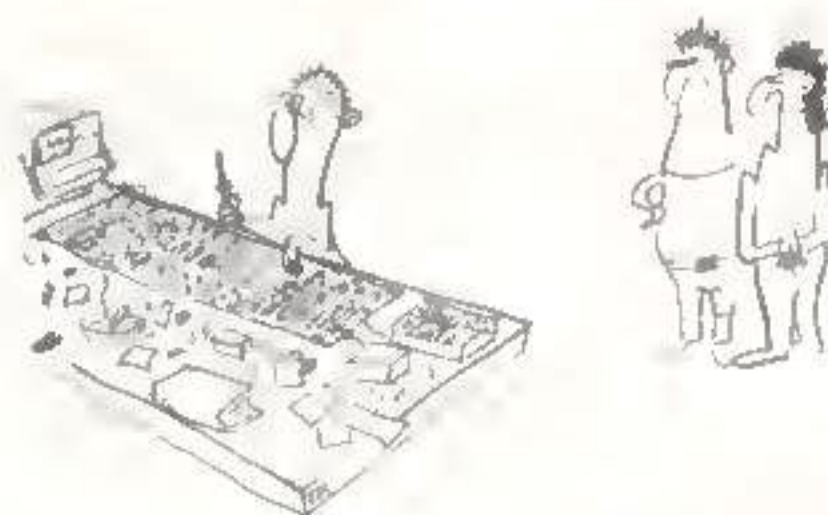
and begin execution of a 32K file in three seconds.

The MTU-130 is clearly designed for floppy disk operations to take advantage of the speed and power of the system. But an audio cassette port is there for those who want to use tape for input and output. With appropriate software, being developed by MTU, nearly all audio cassette formats in use by microcomputers today can be read and written through the port, making possible tape exchange between the MTU-130 and other computers.

Other I/O ports include an 8-bit parallel and an RS-232 serial port. The RS-232 port has software selectable data transfer rates from 50 to 19,200 baud with programmable data format. It offers another handy way to transfer programs or data from one machine to another, using the Download and Upload utilities in CODOS.

Local netting of the computers, which has significant educational and business applications, is also possible through an internal I/O port. Software, in conjunction with a Network Transceiver Board, will allow data communications at 50K baud.

Finally, for music enthusiasts who want greater sound fidelity than is available from the standard 3" x 5" speaker (which actually provides good quality sound), there is an



"Yesterday I bought a chip that does all that for 50¢."

output for connection to a high fidelity system.

Those ubiquitous folks at Microsoft have written a powerful, extended Basic for the machine. The interpreter is loaded from disk rather than residing in ROM which is the way the minis and mainframes work. It simplifies upgrades and the introduction of more features later on at a cost of about one second's delay while the interpreter loads. Those of us who have lived through Commodore's frequent changes to the PET ROMs can appreciate MTU's good intentions.

The concept of disk-based operating software also makes it easier to implement other languages on the MTU-130.

The Computer

The computer itself is in a nicely styled brown and tan case 22" wide by 14" deep. A 96-key keyboard makes the case wider than that of an Apple, but it is not as high or deep. Upper and lower case letters, numbers and standard symbols are provided, along with special function and control keys. Eight user-definable function keys are at the top of the keyboard where they can easily be correlated to eight "legend" boxes on the monitor—of which more in a moment.

The MTU-130 is a 6502-based machine.

Press a key and you get an audible click through the on-board speaker; "auditory feedback" is probably the elegant name for the feature. As you might have anticipated by now, MTU has made the tone, duration and volume of the click adjustable. Simple modifications to the I/O driver software allow the user a choice—or no click at all. Admittedly, the ability to make keys click to your preference is not a key criterion in judging a computer. But to me it illustrates the thought that went into the design of the MTU-130.

A 12" green-phosphor high resolution monitor sits atop the computer case while the disk drives go on the side of the computer where they are out of the way. Both the monitor and disk drive power supply can be plugged into AC receptacles on the back of the computer case, allowing the MTU-130 power switch to control everything.

The heart of the computer is what MTU has called the Monomeg processor board. It contains the 48K of user RAM, 16K of two-port RAM for the bit-mapped video display which is the basis of the high resolution graphics capability, the I/O and sound generation logic and associated hardware, and a 6502 microprocessor with a 1 Mhz clock rate.

Yes, the MTU-130 is a 6502-based machine. The company was adamant that this computer, with its highly efficient instruction set and flexible addressing codes, have the speed and power to meet personal computing needs for some time to come. MTU also points to the availability of 6502 machine language programs and programmer expertise in support of their decision.

For those who need some number crunching capability, MTU has a 68000 board in production that will share tasks with the MTU-130. Full handshaking and bidirectional interrupts allow the two processors to communicate. Initially the 68000 will be on a 128K RAM board; this will be upgraded to 512K using 256K RAM chips with the 68000 having straight addressing to all 512K. Up to three boards can be mounted inside the MTU-130.

Memory

The MTU-130 uses dynamic RAM for memory, but the display section keeps on-board RAM refreshed without introducing wait states or other types of system delays.

The exceptional quality of the high-resolution display is achieved by having each pixel addressable in bit-mapped memory. Setting the bit causes the corresponding pixel on the screen to light. The mathematics required to draw objects in high resolution gets a bit complex, but MTU's machine language software routines called by Basic commands make the process rapid and painless for the user.

In the gray scale graphics mode, shades are created combining two horizontally adjacent pixels into a single wider dot. The brighter gray scale dot is set at the same intensity as the white dot in the other mode, creating a relatively dimmer gray and a brighter white.

An 18-bit address bus on the Monomeg board supports the direct addressing of up to 256K of memory. Because the addressing techniques use the address modes of the 6502, in practice the memory is divided into 64K for programs and 64K for data. Further expansion, as mentioned earlier, is possible through use of bank selection registers.

An expansion bus, with sufficient electrical power already available on the MTU-130 as delivered, makes memory expansion a simple matter of inserting memory boards into the existing card files in the case.

Mounted above the Monomeg board is the CODOS disk controller board with 16K of read/write memory, a 256-byte bootstrap loader PROM and the disk controller circuitry.

CODOS is loaded automatically from disk into the memory on the board by the bootstrap PROM in about one second. The critical top 8K of RAM is then write-protected to prevent inadvertent crashing

CODOS loads automatically.

of the system by a user program.

Don't judge the power of CODOS by the memory space it occupies. It acts like a much bigger DOS, partly because it is. It is written with 15 overlays which are moved into memory only when needed with no delays in response apparent. The other part of the power story is the fact that CODOS is written in optimized machine language.

CODOS loads automatically. Put a disk in drive 0 or power up with a disk already in the drive and the loading begins.

Once loaded the CODOS monitor assumes control and a series of commands from a job file designated "Startup" are read and executed. The Startup file initially provided with the system does the basic housekeeping needed to get the system running and concludes by asking, in a pleasantly modulated voice (there's that sound capability again) for the date. However, Startup can easily be modified by a user to perform any desired action—such as loading and executing a specific program on disk without involving the user. Totally customized operation is possible.

The automatic booting of CODOS and the possibilities of the Startup file seemed a nice convenience until I talked to Susan Semancik of the Delmarva Computer Club, which has been breaking new ground with its work in computer support for the handicapped. The club was initially interested in the MTU-130 because its fine graphics and animation capabilities lend themselves to work on sign language for the deaf. But Susan saw the automatic loading and customized operation of Startup as a boon for the severely handicapped, such as quadriplegics. A simple device to



The MTU-130 displays the company's symbol in high-resolution graphics mode, which allows individual addressing of the 122,880 pixels on the screen.

turn the MTU-130 on, such as a mouth switch, would unlock the full power of the machine.

CODOS Commands

Back to the power of CODOS. It provides for several different types of facilities: there are 35 free format built-in commands, all of which are oriented to system operations, opening and closing drives for example, and manipulation and execution of machine language programs.

The ASSIGN command is at the heart of the channel-oriented DOS and the I/O device independence. What it means is that any file on disk or any I/O device can be simply assigned a channel number and then data can be moved to or from it over that channel. CODOS keeps track of the mundane details.

The system is so simple and flexible that it was actually hard for me to accept at first.

For example, under Basic program control, data can be read in from channel 5, which might be assigned to a data file on disk, and read out to channel 6, assigned to a printer. Reassign channel 6 to a modem, either through the Basic program or by a direct command, rerun the output part of the program and the same data is sent over the phone lines. Once they realize the power this capability provides, newcomers to CODOS are totally converted.

Easy manipulation of machine language files is possible through such commands as GETLOC, display load addresses of files; DUMP, display the contents of memory in both Hex and ASCII; HUNT, search for a string of bytes in memory; and TYPE, display contents of a file.

The convenience and versatility of CODOS is underlined by the way in which the TYPE command can be applied, not only for machine language programs but for a file of any type—Basic program, data or whatever.

The command TYPE XFILE will display the contents of XFILE on the monitor. TYPE XFILE P will send the contents to a line printer. TYPE XFILE YFILE:I will write a duplicate copy of the file, renamed YFILE, on the disk in drive 1. Another example TYPE 5 ZFILE, will cause input from the device or file assigned to channel 5 to be written on disk as a file named ZFILE.

The system is so simple and flexible that it was actually hard for me to accept at first. I thought I had to be overlooking something.

Software protection against inadvertent deletion of files is provided by LOCK, with UNLOCK making them vulnerable again. RESAVE allows an updated file to replace an older version on the disk. The dynamic file space management of CODOS even allows new files to be larger than the originals; CODOS allocates the additional space as needed. Incidentally, the only maximum limit to file size is that of the disk capacity—500K bytes for single sided and 1 megabyte for double sided.

One feature that long-time disk users have liked is the fact that files do not have to be OPENed or CLOSEd. Only the disk drives need that care.

If the user can't find a CODOS command to his liking, he can create his own. Simply SAVE a machine language program that performs whatever function is needed and the name of the program becomes the CODOS user-defined command. The flexibility of the system is evident everywhere.

CODOS also includes utilities which allow for formatting new disks, copying all or specified files and deleting files. BACKUP is a particularly handy method for duplicating all files on a given disk at high speed.

Two utilities allow users to identify permanently to CODOS the specific configurations of their systems. SYSGENDISK is used to define number of disks, disk drive track-to-track step time and head load time if they are changed from the as-shipped version. SYSGENDEVICE probably gets greater use; with it up to six I/O devices can be added as standard system components, and devices can be deleted or their characteristics modified.

Machine language programmers on the MTU-130 can get mainframe-style support with Supervisor Call instructions, a powerful tool found on many large computers. The SVCs allow programmers to call 30 different subroutines. They are far easier to use and more powerful than a Call Subroutine (JSR in 6502 mnemonics) for several reasons.

The SVCs are address independent, and preserve the value of the machine registers (no saving and then restoring the values when going to a subroutine through an SVC). They are a tremendous aid to program debugging. An error which occurs during the processing of an SVC automatically aborts the program, generates an error message explaining the problem, displays the address of the SVC and records the value of all registers.

Reliability

A few words about the reliability of disk operations with CODOS. Long after many of my friends were boasting of loading speeds with their floppy disk drives I was still wedded to cassette tapes. Their complaints about disk crashes and loss of data, combined with my own experiences on a minicomputer system, led me to choose the slow but reliable magnetic tape.

I am still waiting to report my first crash.

After more than a month of intensive use of CODOS and the Shugart SA801 drives that came with the system, I am still waiting to report my first crash. I have been reasonable, but not fanatic, about environmental controls. The MTU-130 sits in an otherwise unused bedroom where no smoking is allowed and which I dust and vacuum on occasion. But a constant stream of visitors, including my short-haired cat who has penetrated my defenses on at least two occasions and left behind an ample supply of hair, has made the environment less than pristine.

I can't give any data on mean time between crashes or data errors per 1000 disk accesses simply because there haven't been any.

For those who use the MTU-130 in an even less controlled environment than mine, it's worth noting that both the computer case and the disk drive case have positive pressure ventilation—the internal fans suck air in from the outside—which makes filtering a simple task.

Another CODOS feature that supports data recording reliability is an option under the FORMAT command used to write timing information on new blank disks. CODOS will check the disk for bad sections and automatically bypass them in allocating file space.

Extended Basic

I have already mentioned the extended Basic that is standard with the MTU-130. It has several extra commands designed specifically for the computer.

It bears a close resemblance to Commodore Basic, even to the use of the "?"



A sample of MTU-130 high-resolution graphics. The boxes, or "legends," at the bottom of the screen give the names of routines which can be called by pressing the corresponding user-defined function key.

symbol as a shorthand for the PRINT command. It includes PEEK and POKE, and the handy Microsoft string function commands LEFT\$, RIGHT\$, MID\$, CHR\$, ASC, VAL, and LEN. The standard arithmetic and trig functions are also included.

Expanded commands include BYE, to exit Basic and reenter the CODOS monitor and TONE, which allows Basic program control over the pitch, waveform and volume of sound generated by the CB2 signal on the parallel output port.

ENTER loads a Basic program in ASCII from a file or device which can then be SAVED in tokenized MTU Basic. LIST outputs in ASCII format from the machine to a file. These commands make programs more transportable between the MTU and other computers.

OUTCHAN provides I/O independence in Basic by directing output to any previously designated channel as in the CODOS discussion above.



The name of a popular computer magazine is written on the screen using the light pen capability. The screen was first made all white and the light pen used to turn off pixels, creating a pattern in black. Reversing the video produced the image shown here.

I mentioned the eight function keys at the top of the MTU-130 keyboard and their relation to the "legend" boxes on the monitor screen. These boxes can display menu information or any other data that a user might have to choose among for input.

One simple example of their utility and the Basic commands that support them was in a simple program using the light pen in creating logic circuits. The LEGEND command, followed by the appropriate labels, printed the names of the logic gates in the "legend" boxes on the screen. By pressing the function key under the appropriate box, I selected the gate to display on the screen where the light pen was pointed.

KEY is used in an ON KEY GOTO ... or ON KEY GOSUB ... command where the KEY value ranges from 1 to 8.

The LIB command adds additional power to the Basic by linking in a designated library of additional specialized Basic

Graphics, Music & More, continued...



A digitized photograph often demonstrated on the Apple. Shown here in close up, the picture occupies less than half the MTU-130 screen while providing the same detail as the full-screen Apple presentation.

commands. Three such libraries come with the system, the IGL (Integer Graphics Library), VGL (Virtual Graphics Library) and CIL (CODOS Interface Library). Asked why these powerful extensions to MTU Basic weren't included in the Basic itself, MTU had a reasonable answer. Since they are for specialized applications, the decision was made to free up memory space for general use by allowing them to be linked in only if needed.

IGL supports simple graphics by allowing a user to draw lines (solid or dashed according to your specifications) and make use of the light pen.

The light pen command, SLTPEN, is simple to use. It recovers the x and y coordinates of the position of the pen on

the screen and sets a flag when this is accomplished. The command checks for the light for 1/60th of a second so a simple loop keeps the pen checking until it sees the light and sets the flag. Use the TONE command and you get an audible signal when the action is completed.

IGL provides the ability to LABEL drawings with textual information. A visible graphics cursor can be moved around the screen to aid in drawing by determining the x and y coordinates of a given point.

VGL is a more powerful library that includes the IGL commands and adds a few of its own. Most notable is the ability to define a WINDOW and a VIEWPORT. The WINDOW allows graphics display of data using any reference system for measuring x and y coordinates by setting their range. Scaling, in effect, can be done by the program. Any values beyond the range are clipped, as though the lines were actually being viewed through a physical window. VIEWPORT establishes that physical part of the screen where the window will exist.

The third library supplied with the computer, CIL, provides a set of CODOS disk operating commands callable from the Basic program. If the one required isn't there, SYSTEM followed by the CODOS command will make it part of the program.

For ease in machine language programming, MTU-supplied software also includes a two-pass resident assembler which accepts assembly language source programs and outputs source code and listings with error messages and a symbol table and cross



A simple repetitive pattern shows the capability of the MTU-130 for advanced graphics. This is from the demonstration program provided with the computer.

reference map. It is a fast and elegant operation according to an experienced programmer who has experimented with it.

Summary

One thing rare for a new machine is the total lack of critical comment I have received from other users. Pressed to say something less than laudatory, I could only come up with the complaint that on-screen editing of programs, prior to their storage on disk, is not as good as that of the PET. But few computers are. Lines in programs, for example, cannot be changed by typing over errors and hitting Return. Programs retrieved from memory, as well as text and other files, can be edited very efficiently with a resident Editor program.

In summary, the MTU-130 is a powerful machine. The cost, which no doubt puts it out of reach of the casual or first time buyer is a bargain considering the capabilities of the machine. Prices for the system, which includes the computer, monitor, CODOS, Basic and the libraries, are \$3995 with one single sided disk drive, \$4195 for a double sided drive, \$4495 for two single sided drives, and \$4995 for two double sided drives.

No matter how well designed or powerful a computer is, however, there are two key questions which must be considered when evaluating it.

Are there any bugs lurking in the machine that would make the glowing technical specifications meaningless? How much software will there be to support the computer?

Anticipating the first question MTU has carried out a testing program that may well be unique for personal computers. A group of experienced microcomputer owners across the country and in Canada, with backgrounds in such key areas as 6502 assembly language programming, graphics and computer music tested the machine for several months. They provided weekly feedback to MTU engineers. Apart from a few minor or improbable problems

MTU-130 Technical Specifications

CPU	MOS 6502, 1 MHz
Memory	80K dynamic RAM (48K user, 16K display, 16K DOS), expandable to 256K direct addressable
Keyboard	96 keys including alphanumeric, calculator display, cursor controls, 8 user-defined keys, Interrupt/Reset
Screen	12" high-resolution green phosphor
Graphics	80-column, 25-line alphanumeric, gray scale graphics on 240 x 256 dot matrix, black and white graphics on 480 x 256 matrix
I/O	Two 8-bit parallel ports, 6522 chip (one internal port); RS-232 serial; cassette interface; video out; audio out
Sound	8-bit analog-to-digital converter, 1 watt amplifier, 3" x 5" speaker, volume control
Light Pen	Plus or minus two pixel resolution, 1/60 second digitizing speed
Language	Extended Basic interpreter loaded from disk, three libraries
DOS	Channel-Oriented Disk Operating System (CODOS 2.0)
Assembler	Two-pass assembler

(simultaneously pressing the Mod, Reset and Interrupt keys would cause the system to crash) the computer received outstanding marks.

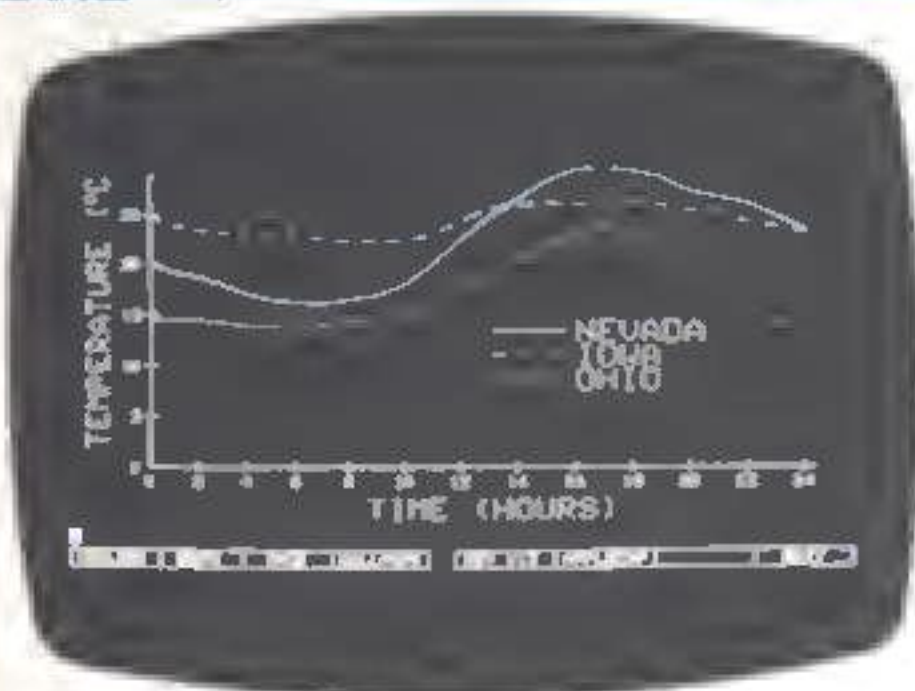
Software

Software development always presents a chicken-and-egg question. No one wants to spend time writing first rate programs unless a large market exists, but the market won't develop unless there is software support for the computer.

Some impressive software, music composition and graphics packages, for example, are already available from MTU's earlier projects. Software development houses are also working on supporting programs, according to David Cox, president of MTU. Among the projects is a compiler for COMAL, a structured programming language that has gained popularity in Europe for business applications.

Another project is rumored to be a Visicalc-like program with expanded applications and more flexible formats.

One feature of the MTU-130 should attract software vendors—a unique software protection feature that allows authorized users to make copies but helps protect software from piracy. MTU would program a unique user number into systems needed for a user, such as high school or university, who planned to purchase software on a use license basis. Only those systems with the proper user number would be able to use the software.



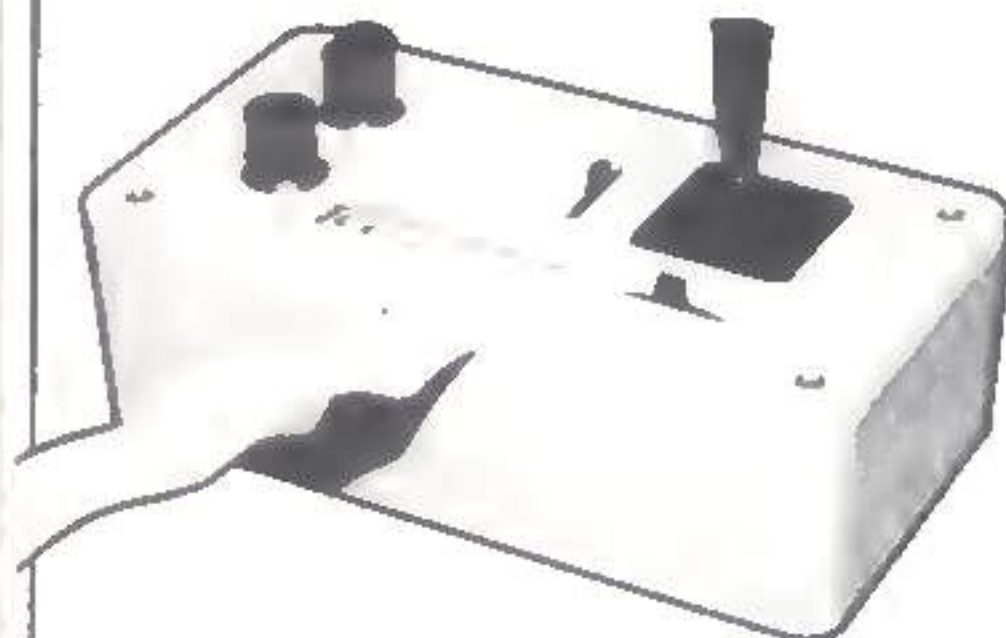
A simple graph drawn with the MTU-130 graphics software enhancement to Basic.

Similarly, a unique vendor number can be assigned to companies buying directly from MTU and selling a customized system to a specific market.

Two user groups have already been formed for the MTU-130, one by MTU itself which plans a quarterly newsletter, which will be free to MTU owners for the first year. The other group is an independent one formed by Jack Brown of Saturn Software Ltd., Delta, BC V4C 5Y9 Canada. Jack is also developing a version of Forth for the machine.

The MTU-130 is an exciting machine which has an exciting future. □

Why would anyone spend \$59.95 for a joystick?



Super Joystick

Star Wars. Played with paddles, it's difficult at best and frustrating at worst. But with a joystick it becomes an entirely new experience. It's still challenging. It's also fun. And very addictive.

Have you ever used a drawing program in which one paddle controls the horizontal movement of the "brush" and the other paddle the vertical? It's slow, tedious work. But with a joystick, drawing is an absolute joy.

Exceptional Precision

The Apple high-resolution screen is divided into a matrix of 160 by 280 pixels. To do precise work on this screen, you need a precise device. Most potentiometers used in paddle controls are not quite linear. If you rotate a paddle control at a constant speed, you'll notice that the cursor speeds up slightly at the beginning and end of the paddle rotation.

The Super Joystick has a pure resistive circuit which is absolutely linear within one tenth of one percent. In other words it would give you precise control over an image of 1000 by 1000 pixels, were such resolution available. Thus it is suitable for high precision professional applications as well as educational and hobbyist ones.

Matched to your application

The Super Joystick also has two external trim adjustments, one for each direction. This allows you to perfectly match the unit to your application and computer. Say you want to work in a square area instead of the rectangular screen. Just reduce the horizontal size with the trim control.

How many times have you played Space Invader and had your thumb ache for hours from the repeated button pressing? This won't happen with the Super Joystick. It's two pushbuttons are big. Moreover, they use massive contact surfaces with a life of well over 1,000,000 contacts. A few games of Super Invader using these big buttons will justify the purchase of the Super Joystick.

The Super Joystick is self-centering in both directions. That means when you take your hand off it, the control will return to the center. However, if you want it to stay where you leave it, self-centering may be easily disabled.

The Super Joystick plugs right into the paddle control socket and doesn't require an I/O slot.

High-quality construction

The sturdy high-impact molded plastic case of the Super Joystick matches that of the Apple computer. Every component used is the very highest quality available.

We invite your comparison of the Super Joystick with any other unit available. Order it and use it for 30 days. If you're not completely satisfied, return it for a prompt and courteous refund plus your return postage. You can't lose.



By removing two springs, self-centering can be defeated.

The Super Joystick consists of a self-centering, linear joystick, two trim controls, and two pushbuttons mounted in an attractive case. It comes complete with instructions and a 90-day limited warranty. Cost is \$59.95.

Order Today

To order the Super Joystick send \$59.95 plus \$2.00 postage and handling (NJ residents add \$3.00 sales tax) to our address below.

Experience the joys of using the world's finest joystick. Order your Super Joystick at no obligation today.

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