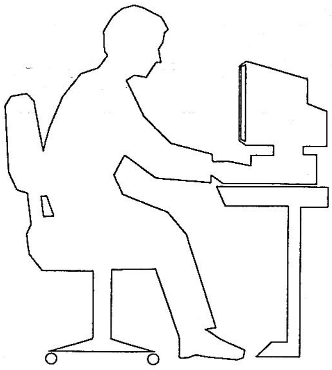
Texas Instruments Brisbane User Group (TIBUG)



BUG BYTES

September/October 1998

Editor's Note

Dennis Remmer
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I can't seem to stop travelling this year! Anastasia and I managed to get a month off, so we took the plunge and took a trip around Europe for 4 weeks in July. Great fun, and as it happens we were in Paris on the weekend of the World Cup final. I had to see whther the numerology of the last TIBUG issue would prove correct, you see! In the end, France won, and England didn't, so another statistical anomily bites the dust!

Enough rambling...

This month's meeting will be at the swank new premises of my employ, on Wednesday night, 16th September at 8p.m. The new address is Level 7, General Purpose South, Staffhouse Road, University of Queensland. Its not far from the old building (there is a map on the back page), and there is ample parking outside. I will meet you all downstairs between 7:45 and 8.

Bring along 3 blank (formatted if possible) floppy disks for your PCs, as I will be providing a tutorial on installing the TI Emulator, and supplying copies of the shareware software and the archives I have created to-date. If you have a laptop, bring that as well.

Best Regards...

News from TI

Lars A. Yoder
www.ti.com

ED: Here's another episode in our periodic look at what TI as a company is up to these days...

The State of the Art in Projection Display: An Introduction to the Digital Light Processing (DLP) Technology

Digital Light Processing (DLP) is a revolutionary new way to project and display information. Based on the Digital Micromirror Device (DMD) developed by Texas Instruments, DLP creates the final link to display digital visual information. DLP technology is being provided as subsystems or "engines" to market leaders in the consumer, business, and professional segments of the projection display industry. In the same way the compact disc revolutionized the audio industry, DLP will revolutionize video projection.

DLP has three key advantages over existing projection technologies. The inherent digital nature of DLP enables noise-free, precise image quality with digital gray scale and color reproduction. Its digital nature also positions DLP to be the final link in the digital video infrastructure. DLP is more efficient than competing transmissive liquid crystal display (LCD) technology because it is based on the reflective DMD and does not require polarized light. Finally, close spacing of the micromirrors causes video images to be projected as seamless pictures with higher perceived resolution. For movie projection, a computer slide presentation, or an interactive, multi-person, worldwide collaborationDLP is the only choice for digital visual communications, today and in the future.

Digital Light Processing: How It Works

In the same way a central processing unit (CPU) is the heart of a computer, a DMD is the cornerstone of DLP. One-, two-, and three-chip DLP systems have been built to serve different markets. A DLP-based projector system includes memory and signal processing to support a fully digital approach. Other elements of a DLP projector include a light source, a color filter system, a cooling system, and illumination and projection optics. A DMD can be described simply as a semiconductor light switch. Thousands of tiny, square, 16 x 16 mm mirrors, fabricated on hinges atop a static random access memory (SRAM) make up a DMD (Figure 1).

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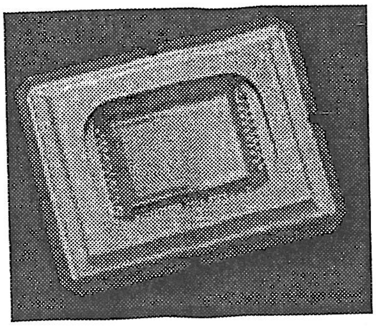

FIGURE 1. **An 848 x 600 Digital Micromirror Device. The central, reflective portion of the device consists of 508,800 tiny, tiltable mirrors. A glass window seals and protects the mirrors.**

Each mirror is capable of switching a pixel of light. The hinges allow the mirrors to tilt between two states, +10 degrees for "on" or -10 degrees for "off". When the mirrors are not operating, they sit in a "parked" state at 0 degrees. Depending on the application, a DLP system will accept either a digital or an analog signal. Analog signals are converted to digital in the DLPâs or the original equipment manufacturer's (OEM's) front-end processing. Any interlaced video signal is converted to an entire picture frame video signal through interpolative processing. From here, the signal goes through DLP video processing and becomes progressive red, green, and blue (RGB) data. The progressive RGB data are then formatted into entire binary bitplanes of data.

Once the video or graphic signal is in a digital format, it is sent to the DMD. Each pixel of information is mapped directly to its own mirror in a 1:1 ratio, giving exact, digital control. If the signal is 640 x 480 pixels, the central 640 x 480 mirrors on the device will be active. The other mirrors outside of this area will simply be turned to the off position.

By electrically addressing the memory cell below each mirror with the binary bit plane signal, each mirror on the DMD array is electrostatically tilted to the on or off positions. The technique that determines how long each mirror tilts in either direction is called pulsewidth modulation (PWM). The mirrors are capable of switching on and off more than 1000 times a second. This rapid speed allows digital gray scale and color reproduction.

At this point, DLP becomes a simple optical system. After passing through condensing optics and a color filter system, the light from the projection lamp is directed at the DMD. When the mirrors are in the on position, they reflect light through the projection lens and onto the screen to form a digital, square-pixel projected image (Figure 2).

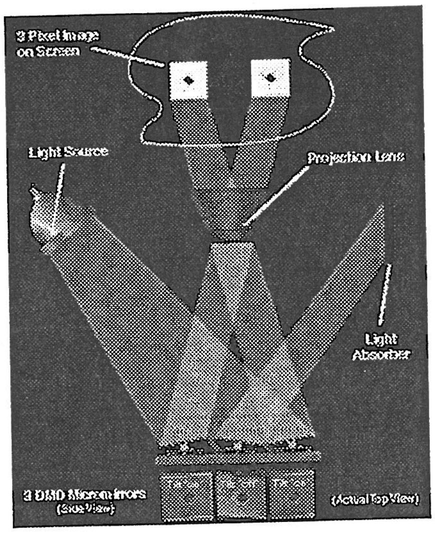

FIGURE 2. **Three mirrors efficiently reflect light to project a digital image. Incoming light hits the three mirror pixels. The two outer mirrors that are turned on reflect the light through the projection lens and onto the screen. These two "on" mirrors produce square, white pixel images. The central mirror is tilted to the "off" position. This mirror reflects light away from the projection lens to a light absorber so no light reaches the screen at that particular pixel, producing a square, dark pixel image. In the same way, the remaining 508,797 mirror pixels reflect light to the screen or away from it. By using a color filter system and by varying the amount of time each of the 508,800 DMD mirror pixels is on, a full-color, digital picture is projected onto the screen.**

The Digital Advantage

The audio world started the trend toward digital technology well over a decade ago. Recently, an abundance of new digital video technology has been introduced to the entertainment and communications markets. The digital satellite system (DSS) quickly became the fastest selling consumer electronics product of all time, selling record numbers of units in its first year of introduction. Sony, JVC, and Panasonic have all recently introduced digital camcorders.

Epson, Kodak, and Apple are a few of the companies that now have digital cameras on the market. The digital versatile disc (DVD), a widely anticipated new storage medium, will feature full-length films with better than laser disc video quality by placing up to 17 gigabytes of information on a single disc.

Today we have the ability to capture, edit, broadcast, and receive digital information, only to have it converted to an analog signal just before it is displayed. DLP has the ability to complete the final link to a digital video infrastructure as well as to provide a platform on which to develop a digital visual communications environment. Each time a signal is converted from digital to analog (D/A) or analog to digital (A/D), signal noise enters the data path. Fewer conversions translates to lower noise and leads to lower cost as the number of A/D and D/A converters decreases. DLP offers a scalable projection solution for displaying a digital signal, thus completing an all-digital infrastructure (Figure 3).

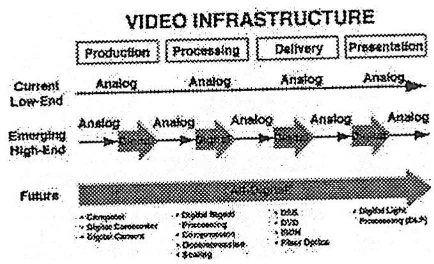

FIGURE 3. **The video infrastructure. DLP offers the final link to a complete digital video infrastructure.**

Another digital advantage is DLPâs accurate reproduction of gray scale and color levels. And because each video or graphics frame is generated by a digital, 8- to 10-bits-per-color gray scale, the exact digital picture can be recreated time and time again. For example, an 8-bits-per-color gray scale gives 256 different shades of each of the primary colors, which allows for 2563, or 16.7 million, different color combinations that can be digitally created (Figure 4).

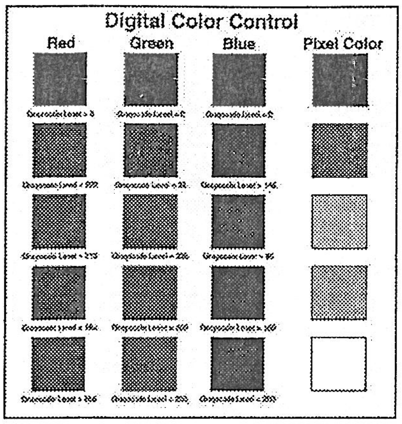

FIGURE 4. DLP can generate digital gray scale and color levels. Assuming 8 bits per color, 16.7 million digitally created color combinations are possible. Above are several combinations of different gray scale levels for each of the primary colors and the resultant digitally created pixel colors.

The Reflective Advantage

Because the DMD is a reflective device, it has a light efficiency of greater than 60%, making DLP systems more efficient than LCD projection displays. This efficiency is the product of reflectivity, fill factor, diffraction efficiency, and actual mirror "on" time.

LCDs are polarization-dependent, so one of the polarized light components is not used. This means that 50% of the lamp light never even gets to the LCD because it is filtered out by a polarizer. Other light is blocked by the transistors, gate, and source lines in the LCD cell. In addition to these light losses, the liquid crystal material itself absorbs a portion of the light. The result is that only a small amount of the incident light is transmitted through the LCD panel and onto the screen. Recently, LCDs have experienced advances in apertures and light transmission, but their performance is still limited because of their dependence on polarized light.

Seamless Picture Advantage

The square mirrors on DMDs are 16 um2, separated by 1 um gaps, giving a fill factor of up to 90%. In other words, 90% of the pixel/mirror area can actively reflect light to create a projected image. Pixel size and gap uniformity are maintained over the entire array and are independent of resolution. LCDs have, at best, a 70% fill factor. The higher DMD fill factor gives a higher perceived resolution, and this, combined with the progressive scanning, creates a projected image that is much more natural and lifelike than conventional projection displays(Figure 5), (Figure6a), (Figure6b).

FIGURE 5. Photograph used to demonstrate the DLP advantage. This digitized photograph of a parrot was used to demonstrate the seamless, filmlike DLP picture advantage detailed in Figures 6a and b.

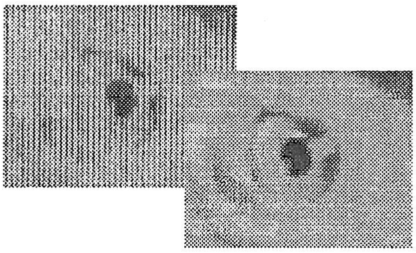

FIGURE 6. Actual closeup photographs of both (a) an LCD-projected image and (b) a DLP-projected image. A three-panel polysilicon VGA resolution LCD projector (a) and a one-chip VGA resolution DLP projector (b) both project the photograph of the parrot shown in Figure 5. Both the LCD and DLP photos were taken under the same conditions, with each projector being optimized for focus, brightness, and color. Note the high level of pixelation in the LCD image in contrast to the seamless DLP image. DLP offers superior picture quality because the DMD mirror pixels are separated by only 1 u thus eliminating pixelation.

A leading video graphics adapter (VGA) LCD projector was used to project the image of the parrot shown in Figure 5. In Figure 6a, the pixelated, screen-door effect common to LCD projectors can be easily seen. The same image of the parrot was projected using a DLP projector and is displayed in Figure 6b. Because of the high fill factor of DLP, the screen-door effect is gone. What is seen is a digitally projected image made up of square pixels of information. With DLP, the human eye sees more visual information and perceives higher resolution, although, as demonstrated, the actual resolution shown in both projected images is the same. As the photographs illustrate, DLP offers compellingly superior picture quality.

Reliability

DLP systems have successfully completed a series of regulatory, environmental, and operational tests. Standard components with proven reliability were chosen to construct the digital electronics used to drive the DMD. No significant reliability degradation has been identified with either the illumination or projection optics. Most of the reliability concerns are focused on the DMD because it relies on moving hinge structures. To test hinge failure, approximately 100 different DMDs were subjected to a simulated 1 year operational period. Some devices have been tested for more than 1 trillion cycles, equivalent to 20 years of operation. Inspection of the devices after these tests showed no broken hinges on any of the devices. Hinge failure is not a factor in DMD reliability.

The DMD has passed all standard semiconductor qualification tests. It has also passed a barrage of tests meant to simulate actual DMD environmental operating conditions, including thermal shock, temperature cycling, moisture resistance, mechanical shock, vibration, and acceleration testing. Based on thousands of hours of life and environmental testing, the DMD and DLP systems exhibit inherent reliability.

Conclusion

Simply put, DLP is an optical system driven by digital electronics. The digital electronics and optics converge at the DMD. Using a video or graphics input signal, DLP creates a digitally

single character (requires my LOAD interrupt modification, and a suitable RTS/CTS handshaking cable)

- keyboard buffering demonstration as part of terminal program
- a few bugs pulled out, here and there... all display functions are now known to work 100%...
- VT100 emulator module makes use of delayed refreshing and delayed cursor updates, for increased throughput.
- escape sequences are handled quickly and intelligently, though I should probably get in there and optimize it a little more. (I know I could save a couple bytes and clock cycles...)

The first source distribution will occur in a few days since I still haven't tested this with a modem! (Currently using a null-modem version of my handshaking cable to communicate with the Amiga... I will probably switch over to the Port cable, which, incidentally, is almost exactly the same as one of the design alternatives I came up with a few months back...)

If anyone else is interested... please send Email. You will receive notification one day before release. Oh... I am contemplating the design of a web page...

Jeff -- still tinkering.

TI Speech Effects

Richard Twyning
007@r-twyning.demon.co.uk

Here's an interesting effect that I think I can take the credit for discovering in the early 1980's!

Needs TE-II & Speech.

```
10 OPEN #1:"SPEECH",OUTPUT

20 PRINT #1:"//0 0"

30 PRINT "Helicopter"

40 PRINT #1:"WWWWWWWWWWWWWWWWWWWWWWWWWW
WWWWWWWWWWWWWWWWWWWWWW"

50 PRINT "A man sawing wood"

60 PRINT #1:"A1A1A1A1A1A1A1A1A1A1A1A
1A1A1A1A1A1A1A1A1A"

70 PRINT "A Rattle Snake"

80 PRINT #1:"HGHGHGHGHGHGHGHGHGHGHGHGHGH
GHGHGHGHGHGHGHGHG"

90 PRINT "A steam train"

100 PRINT #1:"GNGNGNGNGNGNGNGNGNGNGNGNGN
GNGNGNGNGNGNGNGNGNG"

110 PRINT "an helicopter hovering"

120 PRINT #1:"MNMNMNMNMNMNMNMNMNMNMNMNMN
MNMNMNMNMNMNMNMNMN"
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I had this first published in PARCO Magazine, which was produced by PARCO Electrics in Dorset, England. They were one of the last surviving TI-99/4A Distributors in the UK.

TI 99/2 Review

Charles Good
cgood@im3.com

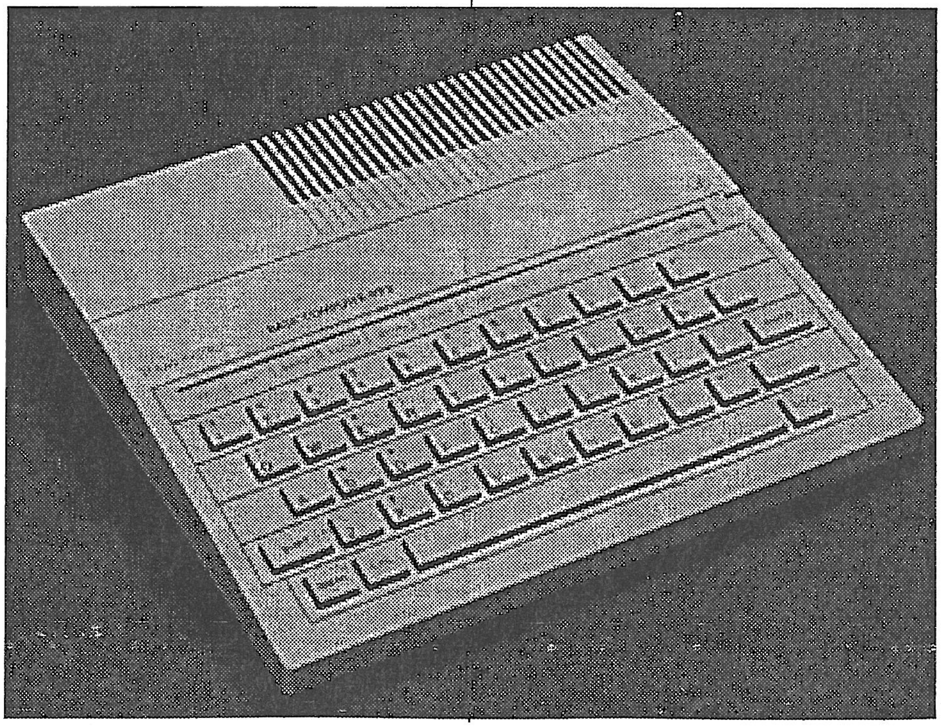
(ED: Following on from the very brief information printed in one of last year's Bug Bytes, here is an excellent article on the unreleased TI 99/2. This article was originally published in the October 1991 Lima UG newsletter)

Did you know that in 1983 TI came very close to selling a \$100 home computer based on the 9995 CPU, the same CPU planned for the never released 99/8 and found today in the Geneve? Officially called the 99/2 BASIC COMPUTER, this cheap entry level machine was envisioned by TI as an inexpensive means of introducing the public to home computing and as a learning tool to teach BASIC programming.

The 99/2 produces a silent black and white display on any TV and comes with a version of BASIC that runs 10 TIMES FASTER than TI BASIC. This is really amazing speed, and compares favorably with the speed of BASIC on some modern MS-DOS computers. I recently acquired one of these "never released" computers and have been playing with it extensively. A photo of the 99/2 appears in the December 1984 issue of MICROPENDIUM showing a little white paper sticker in the upper left side of the computer bearing the notation "Hex OK". My 99/2 has a similar paper sticker, apparently indicating a quality control text of the 99/2's Hexbus interface. I personally know of only two other 99/2's in private hands.

THE LITERATURE, AND A SHORT HISTORY OF THE 99/2:

It was the Summer of 1982 and the home computer price wars were just beginning. TI decided to produce a computer to compete directly with the \$100 Timex/Sinclair 1000, and in 4 1/2 months they had working wire wrap prototypes of the 99/2 for display at the January 1983 Consumer Electronics Show. Photos of the 99/2's on display at



this show appeared in March 1983 issue of 99er Home Computer Magazine showing a machine specific command module inserted in its rear expansion port. It is interesting that these show a difference from later production prototypes like the one I own. Later prototypes like mine have the Hexbus port on the extreme right side of the back of the computer, while the January 1983 CES photos show the Hexbus port in the middle of the back panel.

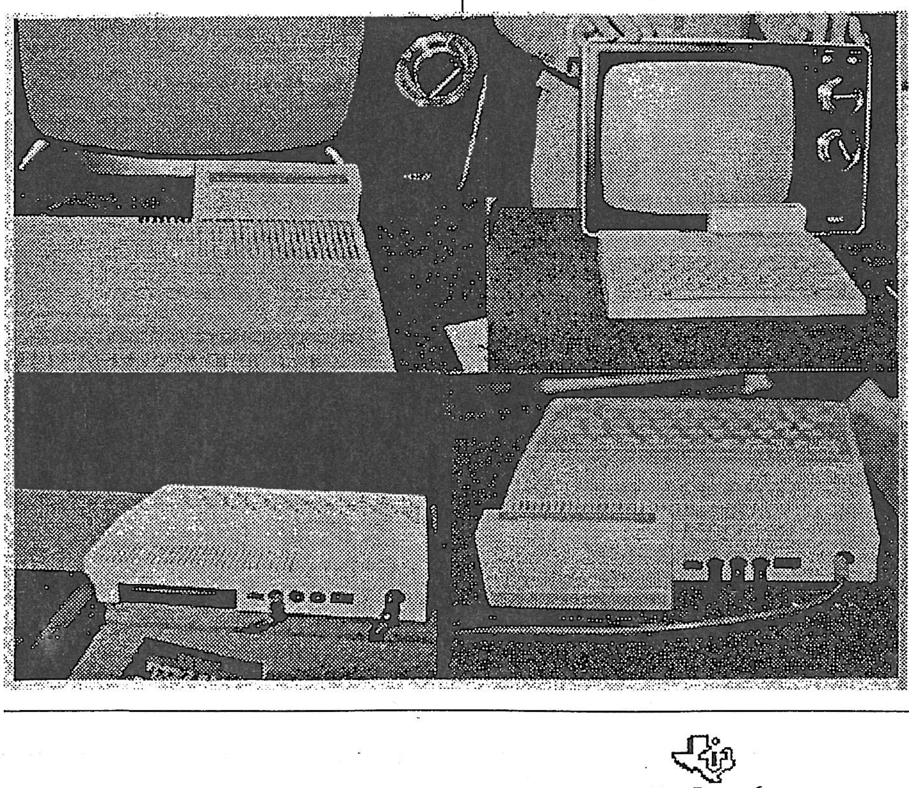
Product development and the FCC certification process continued. I have a copy of the final "TI 99/2 MAIN LOGIC BOARD SCHEMATIC" containing the signatures of Mark Jander, project design engineer, and several other TI people involved in the project. The last of these signatures is dated 5/5/83. The time between initial product conception, FCC certification, and the first limited production run was about 8 months. An advertising campaign was developed and a two page ad showing Bill Cosby holding a 99/2 under his chin actually appeared in the May 1983 issue of Popular Science (inside front cover). An article was written by the 99/2 project development team for BYTE magazine (BYTE, June 1983, pages 128-134) that gives lots of technical details about the 99/2 computer and includes a photograph of the computer's circuit board. A review comparing the 99/2 other very cheap computers of that time appeared in COMPUTERS & ELECTRONICS, June 1983, pp. 48-51.

The 99/2 is also illustrated and briefly described in the March 1983 COMPUTE! (p. 30-31) and the May 1983 issue of POPULAR COMPUTING (p. 28).

And then the price wars really took off! According to ads in 99er Home Computer Magazine (April and May 1983) the price of a new 99/4A was $150. By mid-March the $70 cash price of the Timex/Sinclair 1000 was reduced even more with a $15 rebate (Computers & Electronics, June 83, p. 51). In June 1983 TI initiated a $50 rebate bringing the price of the /4A to $100. This was supposed to be the selling price of the 99/2, so just as full scale production was about to begin the May issue project was put on indefinite hold. The last 1983 published photo of the 99/2 I know about is on the inside back cover of the July 1983 issue of ENTHUSIAST 99 (volume 1, #2). In this advertisement for itself, ENTHUSIAST 99 shows the 99/2 just barely visible in the background shadow, right next to a 99/4 (without the A). How appropriate!

SUMMARY OF THE 99/2's FEATURES:

- 9995 CPU running at 10.7 MHz. The 99/4A's 9900 CPU runs at about 3.3 MHz.
- 32K ROM with built in BASIC closely resembling TI BASIC except that color, sound, and joysticks are not supported.
- 4K RAM plus 256K "scratch pad RAM" directly on the CPU chip. 32K RAM and/or ROM memory expansion is possible.
- Flicker free black and white TV display of 32 characters by 24 lines. This is done using a "direct memory access" video controller chip that uses CPU memory. There is no "video display processor" with its own VDP memory as there is on the /4A and Geneve.
- Cassette interface compatible with the cassette interface of the 99/4A.
- Hexbus port for use with all Hexbus peripherals.



GENERAL DESCRIPTION:

If you removed the right side of the 99/4A, the part with the cartridge port and the top cooling vent holes, what you have left would just be about the length and width of the 99/2. The /2 is, however, only about 1/2 as thick as the /4A. The /2's keyboard very closely resembles that of the /4A in size, number, and position of keys. However, the 99/2 has "chicklet" keys that are not nearly as nice to use as the full depression keys of the 99/4A. Although it IS possible to touch type using the 99/2, it isn't easy. You need a VERY heavy touch to depress the 99/2's keys. There are 48 keys including a CTRL and FCTN key. Where the alpha lock key is located on the /4A there is a BREAK key on the 99/2. The BREAK key does exactly what FCTN/4 does on the /4A (and the /2), it stops the running of a BASIC program and returns to command mode. The FCTN key, in combination with the top row of number keys produces the same results as on the /4A (DEL, INS, ERASE, etc) except for FCTN/=. This combination resets the /4A to the title screen but does nothing on the /2. (I consider the lack of a FCTN/= QUIT to be an improvement.) To exit BASIC with the /2 you either have to turn off the computer or type BYE, which I consider an improvement. As far as I can tell, the CTRL key on the /2 does nothing at all. Apparently this CTRL key can only be accessed from assembly language and not from 99/2 BASIC.

All ports are on the back of the /2. As you face the rear panel, from left to right are the following:

- EXPANSION PORT where cartridges and expansion memory plug in. According to the BYTE article the expansion port has all system control address and data bus signals and allows for expansion with RAM, ROM, or I/O cartridges. There is a 32K expansion memory space available that can be shared by RAM and ROM. The March 1983 99er has photos of a command module cartridge pluged into this port. Both the March 1983 99er and the BYTE article mention two command module programming tutorial titles specifically made for the 99/2. A 32K RAM memory expansion was also supposed to plug into this expansion port. I know of nobody who has actually ever seen these command modules or the memory expansion device.

- TV. An RF modulator is built into the console, so the signal that comes out of this port is modulated. This means you MUST use a TV to display the output. You can't use a composite monochrome (or color) monitor to improve resolution, although a composite monochrome video signal is available via the expansion port.

- "CASSETTE IN" and "CASSETTE OUT". These take take cables with "miniature phono plugs" at both ends and connect to the cassette recorder's earphone and microphone jacks. These cables did not come with my 99/2, but I had no trouble finding the correct cables at my local Radio Shack store. These ports support OLD CS1 and SAVE CS1. There is no automatic control of the cassette motor, but this causes me no trouble. The 99/2 does not support sound, so you hear nothing at all when saving and loading from cassette. The screen display goes blank during the actual save or load, and this helps you keep track of what is going on. The only error message is "NO DATA FOUND". There is no "ERROR DETECTED IN DATA" message as there is in the /4A. This caused me some confusion when I first tried to SAVE and then verify a typed in program. I kept turning up the cassette recorder volume in response to the NO DATA FOUND message, right up to maximum volume, without success. What I should have done was to reduce the volume. I have managed to find the correct volume setting on my TI Data Recorder and my 99/2 OLDs and SAVES quite reliably to and from cassette. The 99/2 BASIC programs I save to cassette can be successfully loaded into and run from my 99/4A.

- "CH3 - OFF - CH4" This three position sliding switch sets the video output for channel 3 or 4, or turns the computer off. This recessed switch is very difficult to get at, and is the only way other then unplugging the power supply to turn off the computer. A more convenient on/off switch would have been nice. I often leave the computer "on" for hours and just turn off the TV. There is no automatic video blanking, so when you turn on the TV several hours later your display is still there waiting for you.

- POWER. The power transformer (TI model AC9700) connects here. The two wire connector on the end of the transformer is apparently unique to the 99/2. It is a little white flat thing and I have seen nothing similar elsewhere.

- "CC PORT" This is the Hexbus port. The "CC" designation on the back of the 99/2 apparently refers to TI's CC40 computer and is meant to indicate that the CC40's peripherals can connect to this port. ALL features of TI's never released HEXBUS INTERFACE for the 99/4A are supported by this port, including some features not mentioned anywhere in the 99/2 documentation. It is a good thing I have the 99/4A HEXBUS INTERFACE USER GUIDE or I would have missed some of these undocumented features. You can SAVE, OLD, LIST to and from this port, as well as OPEN #1:"HEXBUS...." and then PRINT #1 or INPUT #1 for complete file management. Some of the undocumented features include OPEN #1:"HEXBUS.CA.n" to INPUT CAtalog information from a wafertape or disk device number "n", and OPEN #1:"HEXBUS.TR.n" to TRansfer raw binary data between the computer and hexbus device n.

VIDEO DISPLAY AND GRAPHICS:

The only display available is in black and white and is comparable to the 99/4A's TI BASIC screen, with 24 lines that can contain up to 32 graphic patterns or 28 keyboard typed characters per line. The other graphic modes available on the /4A are not supported. The TV display is very clear, and does not show the annoying flicker or diagonal line interference commonly produced by the Timex/Sinclair 1000 computer.

Characters corresponding to ASCII 0-127 are stored in ROM and can be displayed on screen. Only uppercase letters and usual special characters and digits (ASCII 32-96, 123-126) can be entered directly from the keyboard, but the other ASCII characters, including lower case letters, (ASCII 97-122) can be displayed using PRINT CHR$(XX), CALL HCHAR, and CALL VCHAR. The lower case letters are actually the same stupid small upper case letters normally displayed as "lower case" by the 99/4A. ASCII 0-31 are predefined graphic shapes (lines, open and closed squares and rectangles, etc).

ASCII 127 looks really strange. On the 99/4A this is the DEL character and prints as a blank space. On the 99/2 this character looks like a little black round face with short legs. The two eyes and straight mouth show as uncolored (white) pixels. Because there is no CALL CHAR in 99/2 BASIC you cannot define your own custom graphic shapes, so this strange shape is probably included for use in games. I'll bet the 99/2 firmware author who created this was having fun.

TI-99/2 BASIC:

When you PRESS ANY KEY TO BEGIN from the title screen you are presented with the following:

PRESS

1 FOR TI-99/2 BASIC

I suspect that there is provision for command modules to add other items to this menu. When you press 1, the computer tells you TI-99/2 BASIC READY.

99/2 BASIC contains all the features of TI BASIC except those relating to color, sound, joysticks, and custom graphic shapes. The following is a list of 99/2 BASIC's reserved words, most of which should be familiar to you.

```
ABS
APPEND
ASC
ATN
BASE
BREAK
BYE
CALL
CHR$
CLEAR
CLOSE
CON
CONTINUE
COS
DATA
DEF
DELETE
DIM
DISPLAY
EDIT
ELSE
END
EOF
EXP
FIXED
FOR
GCHAR
GO
GOSUB
GOTO
HCHAR
IF
INPUT
INT
INTERNAL
KEY
LEN
LET
LIST
LOG
MCHL
NEW
NEXT
NUM
NUMBER
OLD
ON
OPEN
OPTION
OUTPUT
PEEK
PERMANENT
POKE
POS
PRINT
RANDOMIZE
READ
REC
RELATIVE
REM
RES
RESEQUENCE
RESTORE
RETURN
RND
RUN
SAVE
SEG$
SEQUENTIAL
SGN
SIN
SQR
STEP
STOP
STR$
SUB
TAB
TAN
THEN
TO
TRACE
UNBREAK
UNTRACE
UPDATE
VAL
VARIABLE
VCHAR
```

POKE and PEEK allow the user some access to assembly language programming. These are not found in TI BASIC. CALL MCHL(address) allows you to execute assembly language (machine language) code starting at the specified address.

CALL KEY(KEYUNIT,K,S) on the 99/2 only recognizes key units 0 and 1, both of which are interpreted the same. In TI BASIC you can have your choice of 5 key units, each of which returns different sets of values for K when the same specific keys are pressed.

There is no GPL or GROM in the 99/2. The 99/2 BASIC interpreter is written in assembly, unlike the GPL BASIC interpreter of the /4A. This means that 99/2 BASIC is interpreted only once, not twice as is the case with TI BASIC on the 99/4A. This single interpretation of 99/2 BASIC, plus the faster speed of the 99/2's 9995 CPU (10.7 MHz) compared to the 9900 processor of the 99/4A (about 3.3 MHz) means that 99/2 BASIC is really fast!.

```
100 FOR N=1 TO 10000

110 PRINT N

120 NEXT N
```

The above program takes 30 minutes 20 seconds in TI BASIC with the 99/4A. It takes only 3 minutes and 3 seconds in 99/2 BASIC. In this case, 99/2 BASIC is a blistering TEN TIMES FASTER than TI BASIC. For comparison, the same BASIC program took exactly 6 minutes to run to completion on my Tandy 1000HX, an XT clone running at 7.16 MHz. Barry Traver told me, "I saw a demo of the 99/2 at the original west coast TI show years ago. A guy typed in a benchmark program on the 99/4A and then set it going with RUN. He then walked over to the 99/2, typed in the same program and RUN. The 99/2 caught up with and passed the 99/4A. The 99/2's program terminated first."

DOCUMENTATION:

The 99/2 was supposed to be packaged with 4 instruction books, each book slightly more advanced than the previous. A demonstration cassette tape with three programs, "Cannon Blast", "Addition Tutor", and "Loans" also was supposed to be packaged with the 99/2. None of my sources know anything about the cassette tape except the titles.

I have copies of what is claimed in the header on each page to be the "FINAL DRAFT" of the four 99/2 books, apparently printed by a main frame computer printer. The top of each page bears one of these cryptic notations: 1718L, 0266P, 0318P, 0319P, and 0326P. The books are titled "Getting Started", "BASIC for Beginners", "Advanced BASIC Programming", and "BASIC Reference Guide", also known as books 1,2,3 and 4. Book 4, the Reference Guide, is almost identical (often word for word and sample program by sample program identical) to the 99/4A's User's Reference Guide. Books 2 and 3 resemble, but are not identical to, the 99/4A's Beginner's Basic book (the blue book). Some nice application software listings are found at the end of book 3.

It is obvious to me that these four books are not really FINAL drafts. There are lots of errors. Book one states that the zero is slashed so you can distinguish it from the letter O. It isn't. The docs say that FCTN/= (QUIT) resets the computer to the title screen. It doesn't. One of the sample programs in book 4 uses CS1 and CS2, but the 99/2 only supports CS1 as a mass storage device. The MEMORY FULL error message is mentioned several times in the books when in fact the 99/2 generates the message OUT OF MEMORY. There are other error messages that differ between the /4A and the /2. The documentation lists these messages as they would appear on a /4A. Some of the /4A's error messages are lacking on the /2, but still mentioned in the /2 books. For example, the ERROR DETECTED IN DATA cassette error message is mentioned several times in the books when no such message is generated by the 99/2. Important aspects of the Hexbus interface, such as the CAtalog feature, are not mentioned. I have discovered some error messages that are not mentioned in any of the 99/2 books. For example, under two different sets of circumstances I have run into the message INTERNAL ERROR, PRESS ENTER. Pressing <enter> then resets the computer to the title screen. Book 3 (Advanced BASIC) contains a heavily commented listing of a BASIC program designed to produce a neat moving graphic display with the 99/2's built in graphic characters (ASCII 0-31). The only problem is that the listed program is too large to fit into the 99/2's limited memory. Before you are finished typing in the program as listed, the computer informs you that it is OUT OF MEMORY.

I have been told by knowledgeable sources that there are at least three kinds of 99/2's known to exist; wire wrap prototypes shown at the Jan 83 CES, production versions with 3 ROM chips such as that photographed in the BYTE article, and 99/2's with only one larger capacity ROM. Obviously my 99/2 is not one of the wire wrap jobs. I am afraid to pop the cover off my 99/2 (the cover is held in place by spring loaded metal clips, not screws) to see how many ROM's it has. The documentation errors mentioned above may be due to my 99/2 being different than those available to the documentation authors. Another possibility is that my 99/2 "FINAL DRAFT" documentation was written by individuals who only had printed specifications and did not have hands on access to an actual 99/2.

CONCLUDING REMARKS:

With the promised 32K memory expansion attached, the 99/2 would probably be easy to program in assembly for powerful applications. There is only one kind of programmable memory, CPU RAM. There is no GROM/GRAM or VDP RAM to slow things down and confuse the assembly programmer. BASIC programming on the 99/2 is also easy, and 99/2 BASIC's speed is probably unparalleled among 99/4A related products. Even TI Extended Basic does not begin to approach the speed of the 99/2's BASIC.

Unfortunately, the 32K 99/2 memory expansion device is not known to exist, and the slightly over 4K of RAM is very restrictive. The usual method of estimating free memory with TI BASIC on the 99/4A is to run this program:

```
1 A=A+1

2 GOSUB A
```

When the OUT OF MEMORY message appears, type PRINT A*8 to get the number of bytes of free memory. With TI BASIC the 99/4A without memory expansion and without any cartridge in the cartridge port gives an answer of 14536 to the PRINT A*8 command. My 99/2 shows only 4302.

What little memory the 99/2 does have has to be used to control the video display as well as to store and execute BASIC programs. A BASIC program starting at line number 100, incrementing line numbers by 10, and ending with line number 1000 is about all that can be squeezed into the 99/2's RAM.

Speed, and the potential of expanded memory give the 99/2 lots of potential as a serious computer capable of useful applications. However, without memory expansion, the 99/2 is little more than what TI envisioned for the product, a learning tool.

Bill Was Here

Source Unknown

At a recent computer expo (COMDEX), Bill Gates reportedly compared the computer industry with the auto industry and stated that : "If GM had kept up with technology like the computer industry has, we would all be driving twenty-five dollar cars that got 1000 miles to the gallon."

In response to Bill's comments, General Motors issued a press release stating: If GM had developed technology like Microsoft, we would all be driving cars with the following characteristics:

01.) For no reason whatsoever your car would crash twice a day.

02.) Every time they repainted the lines on the road you would have to buy a new car.

03.) Occasionally your car would die on the freeway for no reason, and you would just accept this, restart and drive on.

04.) Occasionally, executing a manoeuvre such as a left turn, would cause your car to shut down and refuse to restart, in which case you would have to reinstall the engine.

05.) Only one person at a time could use the car, unless you bought "Car95" or "CarNT". But then you would have to buy more seats.

06.) Macintosh would make a car that was powered by the sun, reliable, five times as fast, and twice as easy to drive, but would only work on five percent of the roads.

07.) The oil, water temperature and alternator warning lights would be replaced by a single "general car default" warning light.

08.) New seats would force everyone to have the same size butt.

09.) The airbag system would say "Are you sure?" before going off.

10.) Occasionally for no reason whatsoever, your car would lock you out and refuse to let you in until you simultaneously lifted the door handle, turned the key, and grab hold of the radio antenna.

11.) GM would require all car buyers to also purchase a deluxe set of Rand McNally road maps (now a GM subsidiary), even though they neither need them nor want them. Attempting to delete this option would immediately cause the car's performance to diminish by 50% or more. Moreover, GM would become a target for investigation by the Justice Department.

12.) Every time GM introduced a new model car buyers would have to learn to drive all over again because none of the controls would operate in the same manner as the old car.

13.) You'd press the "start" button to shut off the engine.

User Satisfaction

Anonymous

(ED: This was a cry from the wilderness that recently appeared on a mailing list I subscribe to... The guy was rendering images for a digital movie when frustration set in... Some days are better than others!)

"I just came off a project where one of my _frames_ took 128 hours. Damn Technology. All computers are Quisinarts with lights. Soul-Suckers. I don't even know who I am anymore. This CRT has eaten my personality. How many creatures on this planet are designed to sit perfectly still and stare straight ahead for 10 hours a day? Lizards.

Sony's motto? "LCD" Lowest Common Denominator. A couple weeks ago I was stranded in Vermont in a snow storm with two cell phones that couldn't connect. Ooo, look at me. I'm lying dead in a snow bank with two cell phones in my frozen fists and Walkman(tm) fused to my head. Just like the 5000 year old corpse they found in the Alps. I bet that guy paid a fortune for those unused arrow heads they found in his bag...

The future never came. We live in a dirty 'now' that offers no better quality of life than fifty years ago. Except that I can get cash whenever I want and my watch tells me the phone number of a girl I haven't seen in six years..."

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Submissions of articles, reviews, comments and letters from members is encouraged, however the Editor asks that those submitting keep the following in mind:

Submissions should be about the TI Community in particular, computers in general, or of sufficient general interest. The preferred media is computer file, preferably in ASCII (Text) or Microsoft-Word compatible format, submitted on MacIntosh or IBM-compatible floppy disk or via Electronic Mail to the Editor. Handwritten submissions are acceptable but please remember that they have to be retyped. Other submissions, such as typed, printed or photocopied are welcome but must of reproducible quality.

Submissions are best sent directly to the Editor:

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