History of
Atari 7800 ProSystem
at General Computer

Steve Golson

Classic Gaming Expo 2012
August 12, 2012

Introduction

Who am I

What was General Computer (GCC)

When did it happen

Why it matters

Discussions of GCC History

Vintage Computer Festival East 2.0, 2004

PAX East 2010

California Extreme 2010

PAX East 2011

PAX East 2012

California Extreme 2012

Recent Articles about GCC

Game Informer 201, January 2010

Retro Gamer #81, September 2010

MIT

Doug Macrae

Kevin Curran

Pinball and video games at MIT dorms

Pioneer

Playboy

Paragon

Fire One

Star Castle

Rip Off

Battlezone

Missile Command

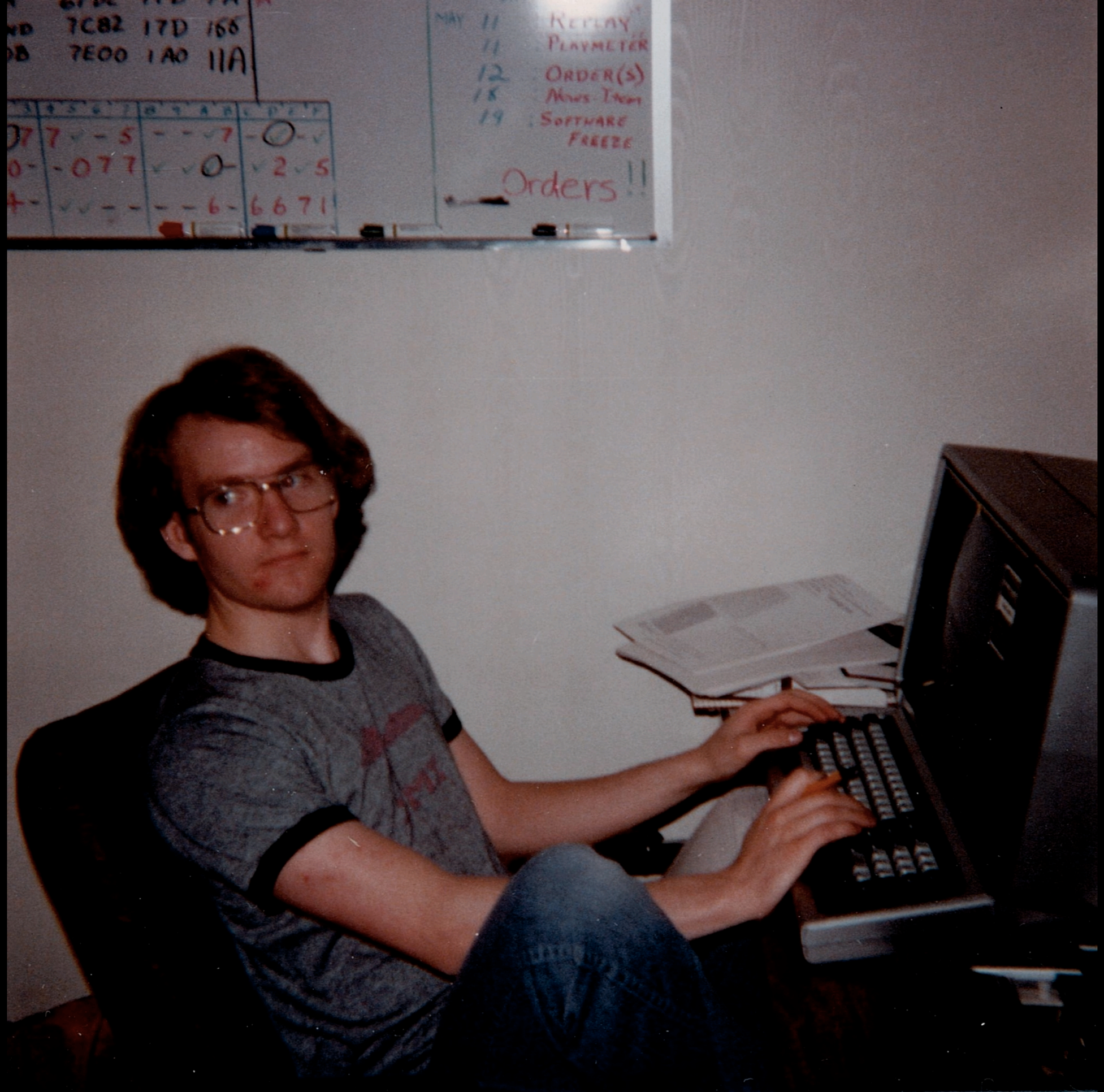
…and more

March 1981

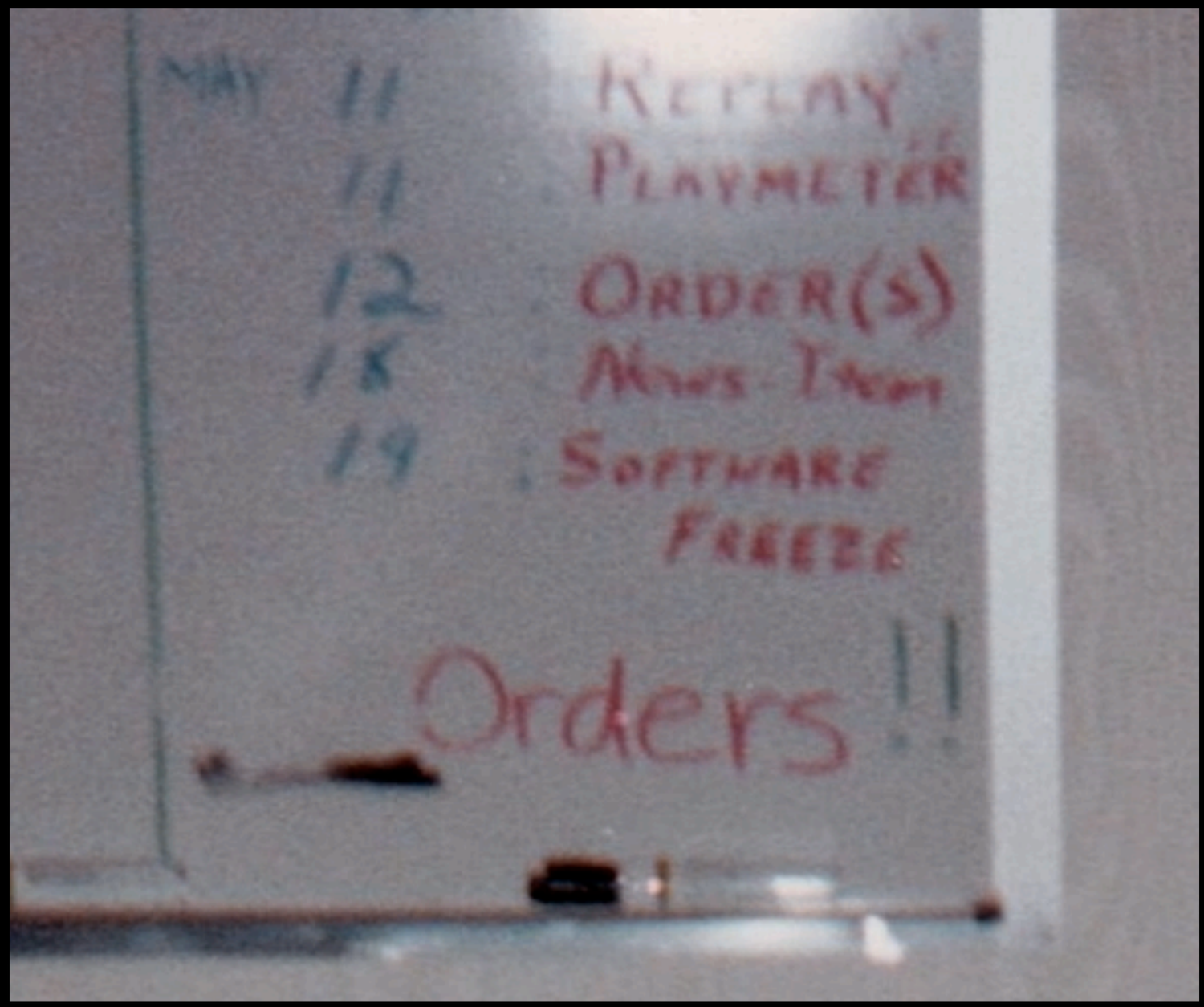
General Computer Corp.

Super Missile Attack

enhancement kit for
Atari Missile Command


7C82 17D 166
7E00 1A0 11A
MAY 11 REPLAY
11 PLAYMETER
12 ORDER(S)
18 NEWS ITEM
19 SOFTWARE FREEZE
Orders !!

Scheduling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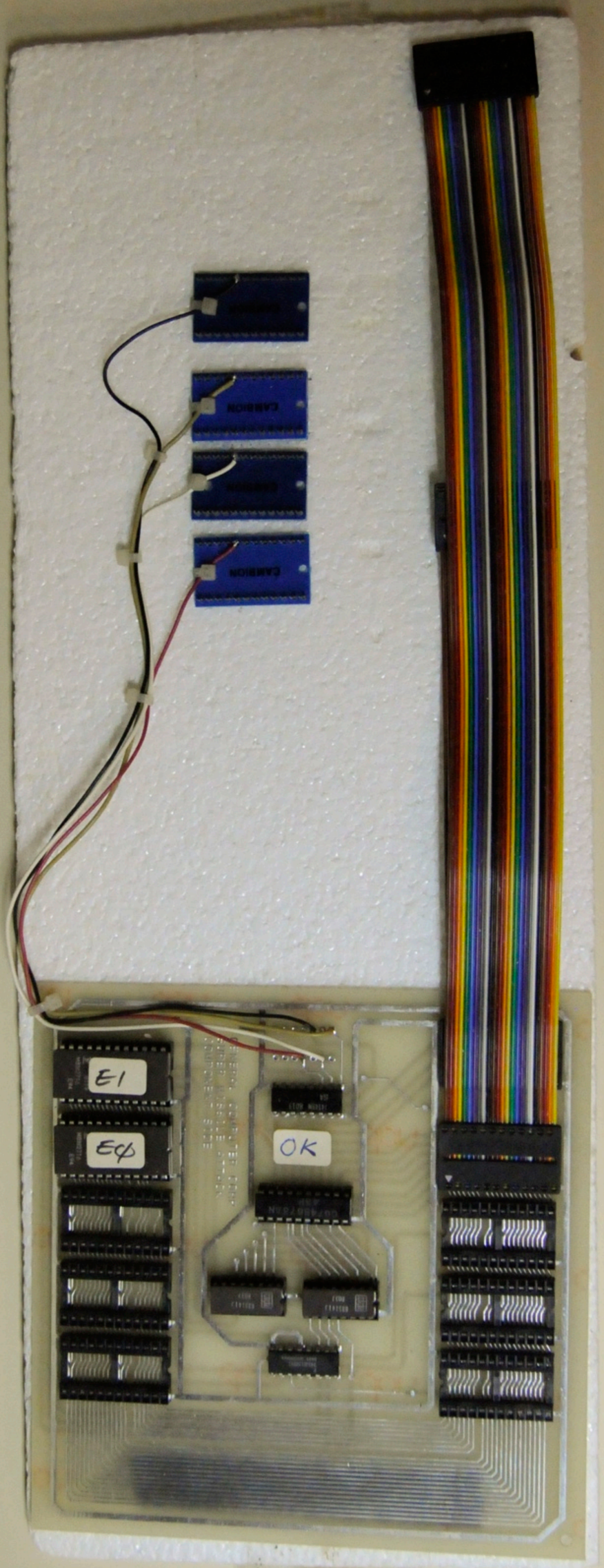
SOFTWARE
FREEZE
Orders!!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OK

4: Place the bottom edge of the **SUPER MISSILE ATTACK** PCB into the wooden track above the Atari Game PCB. The bottom edge is the edge from which the ribbon cables project. Fasten the new board to the side of the cabinet using the Velcro strip that has been provided. The position for the **SUPER MISSILE ATTACK** board within the cabinet is found in FIGURE 5.

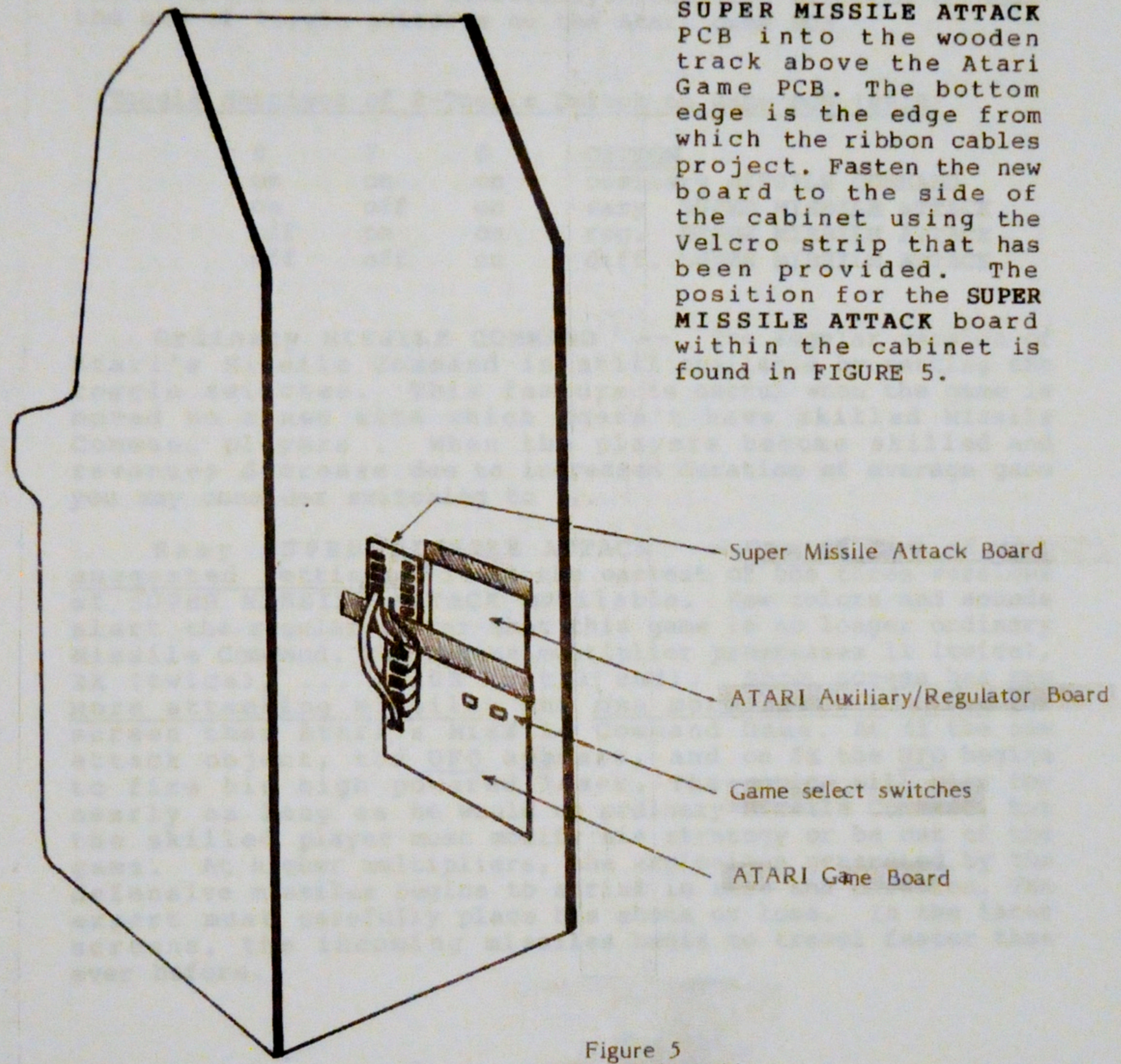


Figure 5
Completed Assembly

It's here! The game enhancement you've been waiting for - SUPER MISSILE ATTACK.™ Designed by General Computer for your Atari MISSILE COMMAND™ Cabinet, it breathes new life into a proven winner.

The simple insertion of a plug-in circuit gives new dimensions to your MISSILE COMMAND™ Game. Increase excitement, difficulty, and your revenues.

SUPER MISSILE ATTACK™ is a software enhancement. All the characteristics that made MISSILE COMMAND™ a champion have been retained or improved. SUPER MISSILE ATTACK™ is a cashbox winner in test locations. Set the operator selectable difficulty levels and make it a winner in yours.

A General Computer Software Enhancement is your best equipment investment today. For about 10% of the price of a new game you can get your original investment in your MISSILE COMMAND™ working hard for you today.

Call **800·343·9500**
for immediate delivery or further details.

In Mass. call collect **617·232·9220**

HERE'S HOW TO ORDER:

Gentlemen: I am ordering my **SUPER MISSILE ATTACK™** Enhancement(s).
Enclosed is check or money order for_____
Enhancement(s) at $295.00 each.

name: _____

address: _____

city/state/zip: _____

Mail to: **GENERAL COMPUTER CORPORATION**
1726 Beacon Street
Boston, Mass. 02146

Immediate Shipment Available.

General Computer Corp.

Atari takes notice

UNITED STATES DISTRICT COURT
DISTRICT OF MASSACHUSETTS

ATARI, INC., a corporation, Plaintiff, v. GENERAL COMPUTER CORPORATION, a corporation, KEVIN CURRAN, and DOUGLAS MACRAE, Defendants.	)	Civil Action No. 81-1883-S

COMPLAINT FOR COPYRIGHT INFRINGEMENT, FALSE DESIGNATION OF ORIGIN, TRADEMARK INFRINGEMENT, UNFAIR COMPETITION AND TRADEMARK DILUTION

Plaintiff ATARI, INC. alleges as follows:

GENERAL ALLEGATIONS APPLICABLE TO ALL COUNTS

1. Plaintiff is a corporation duly organized and existing under the laws of the State of Delaware, having a principal place

UNITED STATES DISTRICT COURT
DISTRICT OF MASSACHUSETTS

ATARI, INC.	:	
	:	
v.	:	CA 81-1883-S
	:	
GENERAL COMPUTER CORP., ET AL	:	
GENERAL COMPUTER CORP.	:	
	:	
v.	:	CA 81-1854-K
	:	
ATARI, INC.	:	

HEARING

BEFORE THE HONORABLE ROBERT E. KEETON, U.S.D.J.

Courtroom 11
United States Courthouse
Boston, Massachusetts 02109
Friday, July 31, 1981

Development agreement with Atari

Signed October 8, 1981

The Atari Settlement

Atari pays $50,000 per month to GCC
to develop video games for Atari (2 year term)

GCC discontinues sales of Super Missile Attack

Atari drops its suit against GCC with prejudice

GCC will not market enhancement kits without permission from the manufacturer

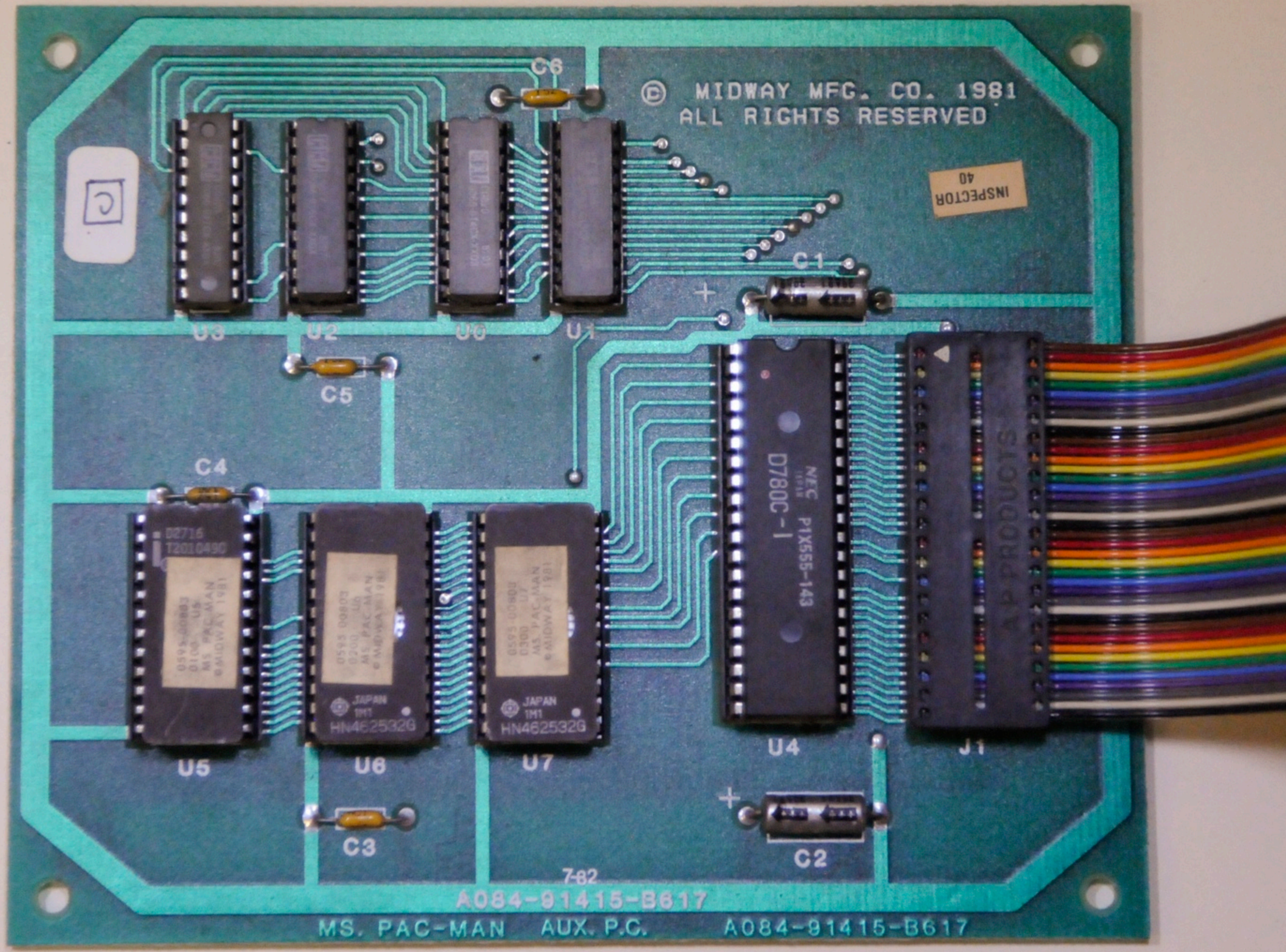
Meanwhile…

Crazy Otto

enhancement kit for
Namco/Midway Pac-Man

Licensing agreement with Bally Midway

Signed October 29, 1981


© MIDWAY MFG. CO. 1981
ALL RIGHTS RESERVED
INSPECTOR
40
C6
C1
C5
C4
C3
C2
U3
U2
U0
U1
U5
U6
U7
U4
J1
D2716
T2010490
JAPAN
1M1
HN4625320
NEC
P1X555-143
D780C-1
7-82
A084-91415-B617
MS. PAC-MAN AUX. P.C. A084-91415-B617

1UP HIGH SCORE 2UP

00

"MS PAC-MAN"

STARRING

MS PAC-MAN

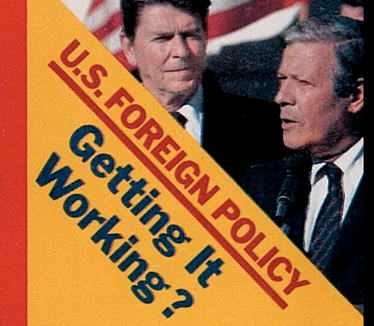
© MIDWAY MFG CO
1980/1981

CREDIT 0

January 1982

JANUARY 18, 1982 $1.50

TIME



U.S. FOREIGN POLICY
Getting It Working?

GRONK! FLASH! ZAP!

Video Games Are Blitzing the World

03
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MARK KAUFFMAN

Living

COVER STORY

Games That Play People

Those beeping video invaders are dazzling, fun—and even addictive

Let us have no more lamentation that our microprocessed era lacks heroes (plinkety-plunk of Pete Seeger's banjo). The spirit of mighty John Henry, the steel-driving man who beat the steam drill (plunk-plunk-plunk), lives on in the indomitable courage and abused optic nerves of a Mount Prospect, Ill., high school boy named Steve Juraszek (Seeger whacks out several yards of fancy banjo work and begins a ballad):

Well, Steve Juraszek dropped in his quarter,
Just half an hour before noon (plink-plunk).
He would die in the end, when the blasters zapped his men,
But he vowed that wouldn't happen soon, poor boy,
He vowed that wouldn't happen soon.

At six that night they called his mother,
Said, "Ma'am, your boy's not comin' home.
He's shootin' fast and hot, at the mutants and the pods,
And the microchip is processing a groan, oh my,
The microchip is letting out a groan."

Oh, they fed him on pizza and cola,
His fingers were cramping up and cold."
His eyeballs were raw, when a dum-dee-dum he saw,
*And it something, dum-dee-dum foretold.**

What nonsense is this? The answer is very nearly, but perhaps not quite, in the increasingly crowded category labeled If You Have to Ask, You Will Never Understand. What Juraszek, 15, recently did at an Arlington Heights, Ill., arcade called One Step Beyond was play Defender, one of those beeping, flashing, quarter-eating arcade video games, for 16 hours and 34 minutes on the same 25¢, ringing up a score of 15,963,100 before he finally made a mistake and lost his last ship. Anyone who knows arcade games, and especially Defender, which is one of the most difficult, will agree that this is very close to being impossible. It is definitely not one of those non-feats thought up by the untalented to memorialize themselves in *The Guinness Book of World Records*, such as eating seven miles of spaghetti, or riding an exercise bicycle for a week and a half.

Defender is an attack-from-outer-space game. It is played on a large color video screen where nullity bombs and destructo beams are hurled at the player by the machine's computer. Increasingly rowdy sound effects suggest what James Joyce, under the influence of William Blake (who would have loved these gadgets), called "the ruin of all space, shattered glass and toppling masonry, and time one livid final flame." The Defender player controls a small cannon-firing jet plane that flies at varying altitudes and speeds over a barren planetscape. He must shoot down a bewildering variety of alien bad guys, each with his own pattern of behavior; dodge an assortment of missiles; and rescue helpless spacemen, vulnerable to being kidnaped, who appear randomly on the planet's surface. He must have reflexive control of a joystick that determines altitude and of five separate buttons that fire the cannon, change forward thrust, reverse direction, make the ship skim off the screen into hyperspace and fire a limited supply of smart bombs, which blow up everything in sight. As is fiendishly true of all of the good new video games, as the game progresses, Defender shifts to subtler strategies and sends out its alien waves with increasing speed. You play the machine and it plays you.

A neophyte has as much chance with Defender as he would if he were to take over the controls of an F-16. A reasonably good video-game athlete—that is how game junkies are beginning to describe themselves—will last it out for a few thousand points, or a couple of minutes. A superb player, the kind not seen in every arcade, may hit 500,000 on his best day. That is why when Juraszek began to close in on 1 million points toward the end of the first hour of his enchanted run, people began to notice. Darrell Schultz, one of the arcade's owners, asked Steve if he thought he could set a record.

"I said, 'Yeah,'" Juraszek recalls, "and he said, 'Go for it!'" Juraszek is a gangly young man who began playing pinball when he was ten, before video games had hit the scene. "I could buy a car or something with the money I've put into games," he says, with no appearance of regret. He started playing Defender in June, and by August he was pretty good. On his record day he kept up his strength by snapping at pizza slices that people held in front of his face. He said later that he was so excited he never even thought about going to the bathroom. His mother Joanne Juraszek watched for a while, utterly unimpressed, and agreed reluctantly to let him play till he dropped. "I just wish," she said later, "that he was this good about doing his homework."

As the scornful cry "So what?" echoes from glen to glen, and as the unmoved Joanne Juraszek admits that she finds her son's new fame "very strange," skeptical citizens might do well to pay attention to a peculiar clinking sound audible across the land. The noise is made by the estimated 20 billion quarters that poured last year into the arcade monsters. This is a figure that may be the public relations roar of a healthy young industry beating its chest, but one that investment analysts who specialize in the entertainment industry agree is not far wrong. While they spent this $5 billion, video-game addicts also were spending 75,000 man-years playing the machines.

These figures do not include an estimated $1 billion that consumers paid for video-game consoles that hook up to home television sets, and for the expensive cassettes that make them work. For comparison, $5 billion is exactly twice the reported take in the last fiscal year of all of the casinos in Nevada. It is almost twice the $2.8 billion gross of the U.S. movie industry. And it is three times more than the combined television revenues and gate receipts last year of major league baseball, basketball and football.

From what vast aquifer of cash does this astonishing gush of money flow? From the lunch money of schoolchildren, say angry parents who are determined, so

*Or gold, or fold, or mold. A jar of pickled space invaders to the reader who most ringingly completes this and other appropriate verses.

A young Missile Command warrior defends her cities at a New London, N.H., pizza parlor

Tense combat on-screen in Pleiades game

Pac Man scuttles about maze, eating dots

MC COY

Pac Man scuttles about maze, eating dots

February 3-4, 1982

Ray Kassar and Manny Gerard
visit GCC

February 1982

Projects being worked on include:

- Fireman
- Food Fight
- Molecular Magic (Quantum)
- music driver for TI sound chip
- character development system (on Apple II)

All are coin-op projects…

March 4, 1982

Manny Gerard and Skip Paul
visit GCC

March 5+, 1982

Entire company
at Disney World

Meanwhile…

what’s going on at Atari?

In February 1982, when another group of VCS programmers threatened to leave, Kassar panicked. If they quit, Atari would have had no VCS programmers left. "Kassar was desperate. He was running scared," Kaplan says. He responsed by throwing money at the designers. Salaries were increased and a hastily-created bonus plan was instituted.

"What Went Wrong at Atari"
San Jose Mercury News
November 6, 1983

Kevin gets a phone call

Spring 1982
Work begins on VCS carts

Combat II

Phoenix

Vanguard

Galaxian

Centipede

Rubik's Cube

Ms. Pac-Man

others…


ATARI

Summary of June 17, 1982 Meeting

Attending:	Kevin Curran	John Mracek	Tom Westburg
	John Tylko	Art Ng	Claudia Newcorn
	Mark Ackerman	Glenn Parker	
	Tom Calderwood	Dave Payne	
	Bill Hofmann	Chris Rode	
	Patty Goodson	Jim Salem	
	Roy Groth	Keith Sawyer	

Kevin Curran opened the meeting by presenting the central tenet of General Computer Corporation: that of looking towards and developing for the future. The goal of these meetings are to provide an open forum for unrefined ideas, suggestions, aspirations, information, etc., in a casual and informal atmosphere. Although the company is product oriented with specific goals in mind and its bottom line is the consumer market, it is essential that we not lose sight of the larger picture and should consider investing time in research. GCC has the ability to actively change and affect the future. One has a great sense of pride when they see Ms. Pac-Man in a cinema or arcade and know that they were involved in the production of that game. Now, the company needs to look beyond the day-to-day production and create long-term goals.

After participants had introduced themselves, Kevin presented a brief overview of GCC and its current relationship with Warner Communications/Atari. He emphasized that our central function is to develop and provide ideas by applying our talents to computer aided entertainment. Mr. Manny Gerard, President of Warner Communications, states that we "can shape the future by inventing it." Mr. Gerard looks to us to "climb up and down the corporate ladder, becoming involved in all aspects of Atari, not just videogames." He perceives GCC as providing a supplement for Atari's in-house engineering.

Prior to opening the floor, Kevin reiterated the importance of two things:
(1) working with an eye towards the future and (2) that no idea is too incredulous to be suggested. The more ideas thrown on to the table, the better.

June 17, 1982

After participants had introduced themselves, Kevin presented a brief overview of GCC and its current relationship with Warner Communications/Atari. He emphasized that our central function is to develop and provide ideas by applying our talents to computer aided entertainment. Mr. Manny Gerard, President of Warner Communications, states that we "can shape the future by inventing it." Mr. Gerard looks to us to "climb up and down the corporate ladder, becoming involved in all aspects of Atari, not just videogames." He perceives GCC as providing a supplement for Atari's in-house engineering.

June 17, 1982

The following provides a summary of the ideas/suggestions presented during the remainder of the meeting. Initials of the speaker follow in parentheses.

1. Design new entertainment base units to replace the current VCS units. (KS)

September 1982
Delivered to Atari

Combat II

Phoenix

Vanguard

Qix

Centipede

Atari's Cube

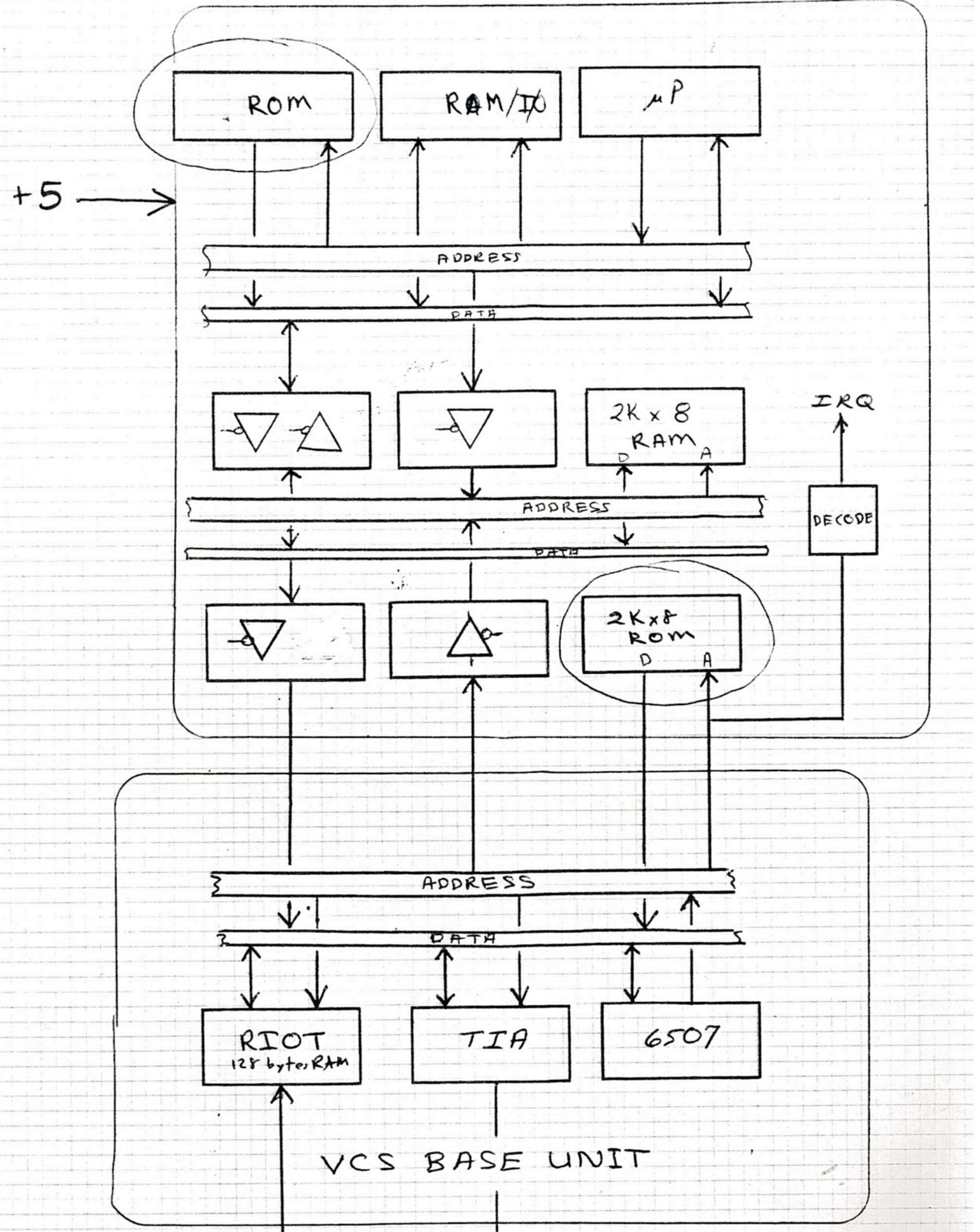
proposal for VCS
Extended RAM
Cartridge

General Computer Company

215 First Street
Cambridge, Massachusetts 02142
Telephone (617) 492-5500

Proposal for a Video Cartridge System
Extended RAM Cartridge

Tom Westberg and Alan Hodgkinson
General Computer Company
September 15, 1982


ROM
RAM/IO
μP
+5
ADDRESS
DATA
2K x 8
RAM
D
A
IRQ
DECODE
ADDRESS
DATA
2K x 8
ROM
D
A
ADDRESS
DATA
RIOT
128 byte RAM
TIA
6507
VCS BASE UNIT

October 18, 1982

VLSI Technology, Inc.

October 18, 1982

4 week VLSI design class
begins at VTI

November 1982

More meetings with VTI

Begin setup for VLSI design work at GCC

SPRING

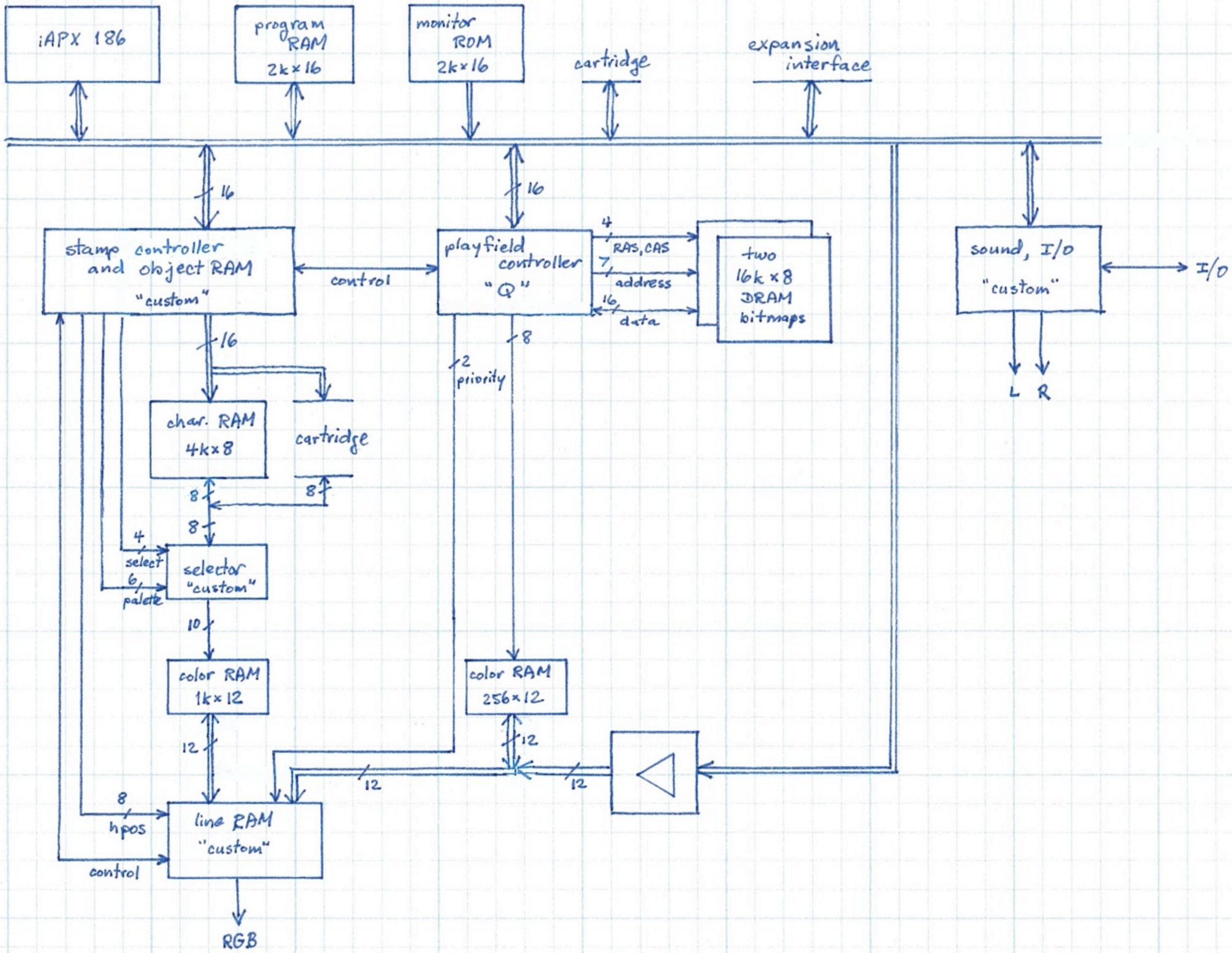
or,

Life after PAM

Prepared by
Steve Golson

December 7, 1982

SPRING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program RAM 2k×16
monitor ROM 2k×16
cartridge
expansion interface
16
16
stamp controller and object RAM "custom"
control
playfield controller "Q"
4
RAS, CAS
7
address
16
data
two 16k×8 DRAM bitmaps
sound, I/O "custom"
I/O
L
R
16
8
2
priority
char. RAM 4k×8
cartridge
8
8
8
4
select
6
palette
selector "custom"
10
color RAM 1k×12
color RAM 256×12
12
12
12
8
hpos
control
line RAM "custom"
RGB

12/7

January 3, 1983

3 week VLSI class begins at GCC

SPRING

Prepared by

Kevin G. Curran
Steve Golson
Scott Griffith
Art Ng
Chris Rode
Tom Westberg

January 12, 1983

Gumby.spc created 2/4/83 sjs

Update log: sound synthesis features added 2/7/83 roy

GUMBY

or, the SPRING Sound Chip

0. INTRODUCTION

The GUMBY chip is intended to handle the sound synthesis and user interface chores for the SPRING base unit/home computer family. It will live on the SPRING processor's bus, and will communicate with the processor via a number of registers.

Sound synthesis features:

* Two discrete sound channel outputs (left and right), for stereo, as well as a mono mix (sum) of the two for rf sound subcarrier modulation.

* Each stereo channel will be a mix of eight distinct voices.

* The mixed output will have a sample rate of at least 50Khz (useable upper frequency around 15 to 20 Khz).

Q chip spec V2.0
Orig: 28-feb-83 ayn/tw

Update log:

Abstract

This document gives preliminary specifications for the Playfield Address Controller chip, nicknamed Q chip. The Q chip is a monolithic VLSI implementation of a DRAM addressing subsystem to support high resolution graphics in the Spring family product line. This preliminary version is a subset of the projected final Q chip, which will serve the following three purposes:

* MPU DRAM access controller,

* Display Address generator for display buffers stored in DRAM,

* Block move/ Line drawing hardware assist for creating DRAM display buffers from other sources.

The preliminary Q chip will implement the first two features in a "minimal Q chip" and the third feature will follow at a later date.

March 1983

TIA+

Pre-Spring Fling

March 1983
Pre-Spring Fling

"build a TIA with more players"

add a scanline buffer

add a double-buffered scan line

"just put a TIA on the board"

design a whole new graphics+sound chip…

Code names

TIA

Television Interface Adapter

TIA-Maria

Maria

GCC codename: Maria

VTI codename: Ginger

Maria

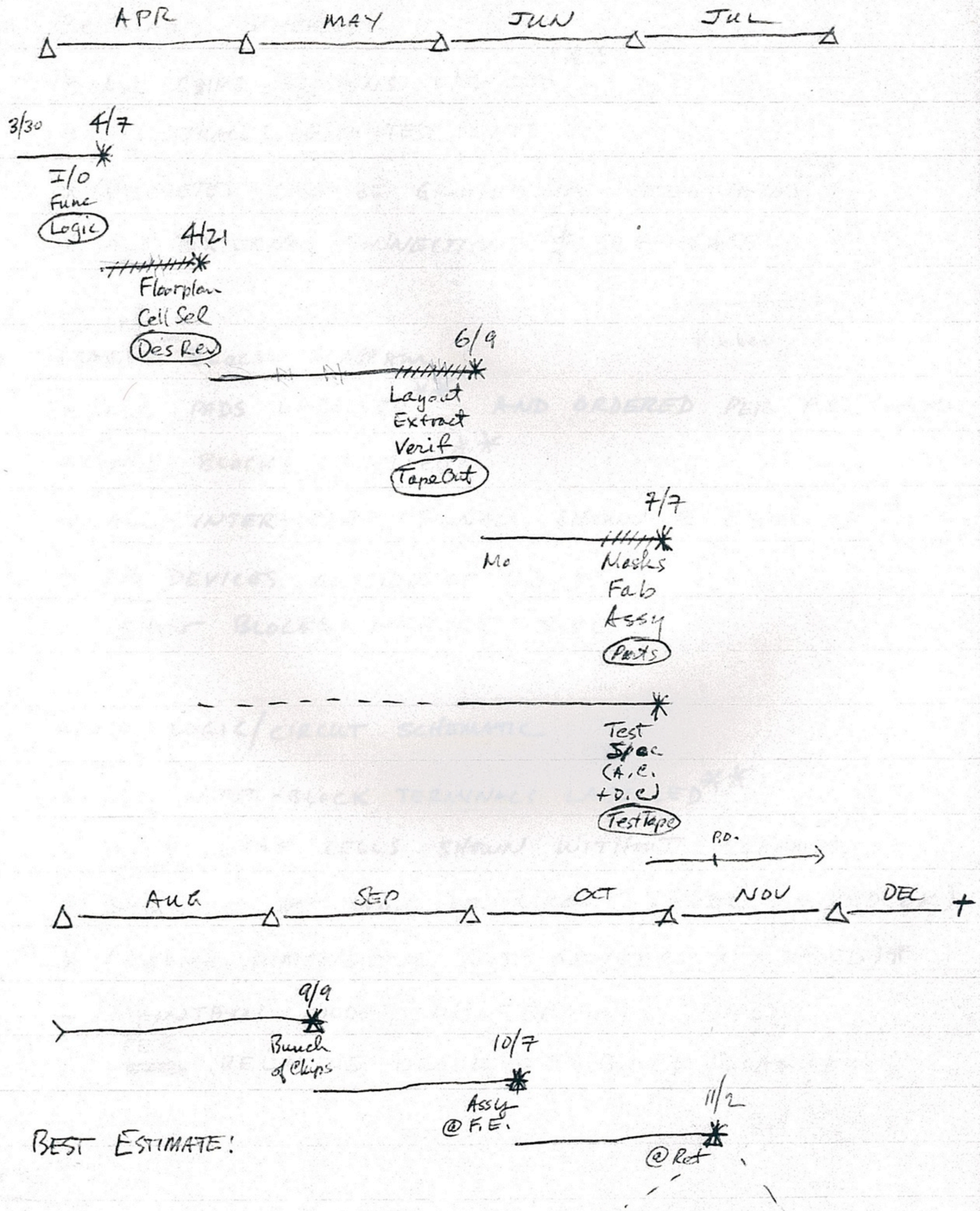
- internal double-buffered line RAM
- DMA with display list
- sound
- same color phase shifter as TIA
- same color sync as TIA

3600 System

- completely 2600 compatible
- more RAM
- 64k addressable
- all address pins and R/W available on cart
- better graphics+sound from Maria

Gary Boone

SCHEDULE:



BEST ESTIMATE!

From: LUNDY1::GARY 6-APR-1983 08:09
To: LUNDY2::BILL LUNDY2::THIERRY LUNDY2::GARY
Subj: GINGER PROJECT REPORT

STATUS

Reasonable I/O pin assignment completed from p.c. viewpoint.

Roush schematics for sound and r.f. sections completed.

SRAM input scheme worked out consistent with normal groupings of Y-decode columns.

CONCERNS

Floorplan-style block diagram still not done; will do today for sure.

Not sure all inter-block signals accounted for; planning VNET model at block level as cross check on block diagram.

At system level, there are some problems wi: r.f./sound circuit, multiplexing of LUM pins, and relative TIA <--> 6502 clock timing. So far, no chip impact from these problems.

PLANS

Above status about two days behind schedule in 3/30 report (page 7).

Still planning 4/11 start in San Jose; but will re-assess completeness of necessary documents again tommorrow.

CONCLUSIONS

No show-stopper technical issues have come up.

As expected, system design issues continue to affect schedule, chip size

From: LUNDY2::GARY 6-APR-1983 09:41
To: LUNDY2::BILL LUNDY2::GARY
Subj: GINGER -- DETAILS

1. For your information, most of GCC are going today to Disney World on company trip. Tom is going only Sat and Sun. Chris is not going. It is likely this will make telephone contact awkward; there is no direct line into our basement quarters. If phone doesn't work, try 'mail' or get me at Holiday Inn - Cambridge.

2. Enthusiasm is great; These guys work at all hours. Tom is putting out very readable pla-style schematics, and his part of the chip contains all the really random logic. Chris is still struggling with the data structures mapping into and out of the ram; He views this as the kernal of the chip, and probably cannot focus on other matters until he has it worked out. I think we have to live with this situation.

3. Mike has been helpful with logistics, intro to prism, and we plan for him to work on path timing. He likes to use 'tau' approach; I said fine, we just need someone trying to find the tight timing paths. Mike has also been spending some time on other design center matters, per direction from Wes. I emphasized the criticality of this week, and Mike agreed to put in full day here regardless of other tasks.

4. Still waiting for P.O. number.

Gary 4/6/83

April 6+, 1983

Disney World redux

April 18, 1983
Gary Boone status report to VTI

2, Regarding overall program risk, GCC thinks there is a good chance Atari will drop the ball somewhere (re this Xmas), but GCC is not discouraged -- They believe it's good 1984 Xmas as well.

April 21, 1983

Project status

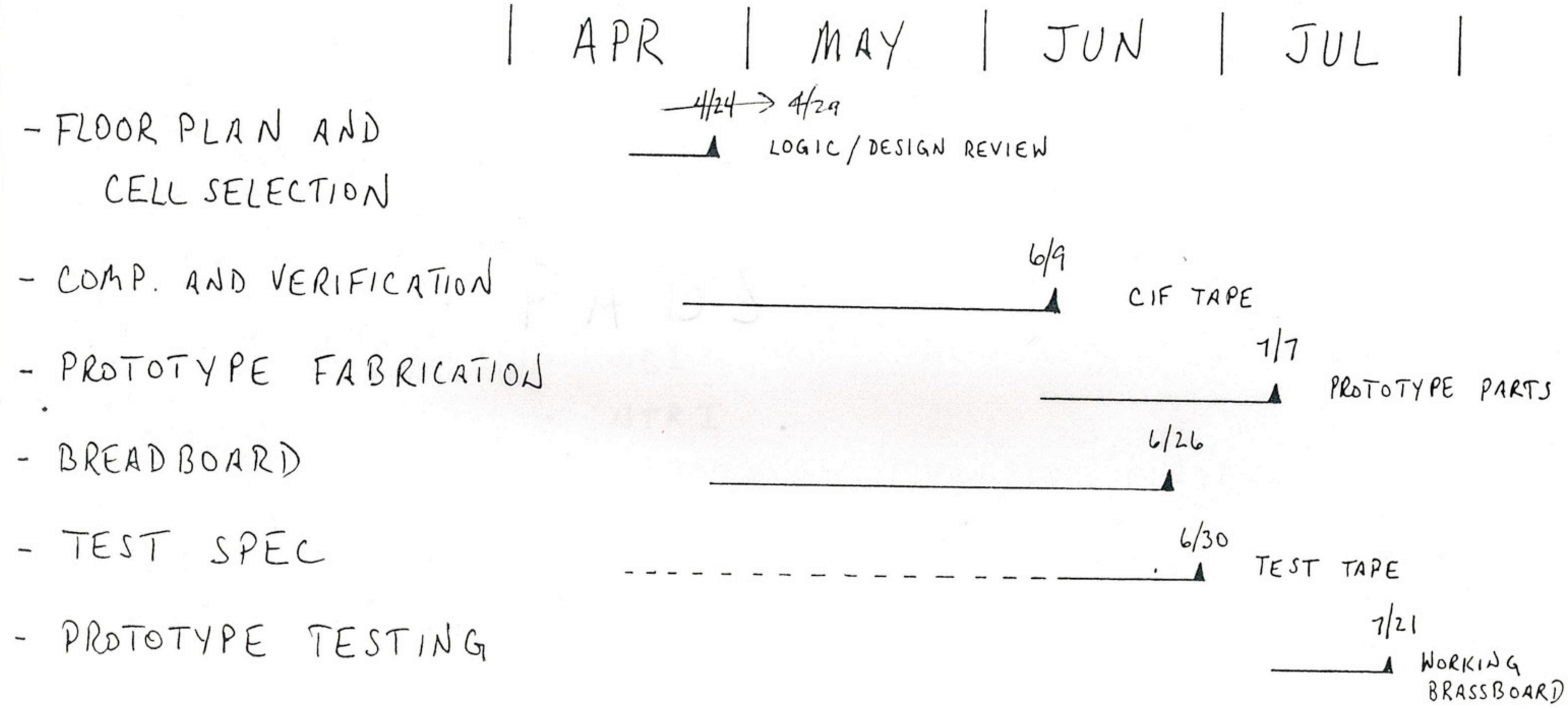
PROJECT

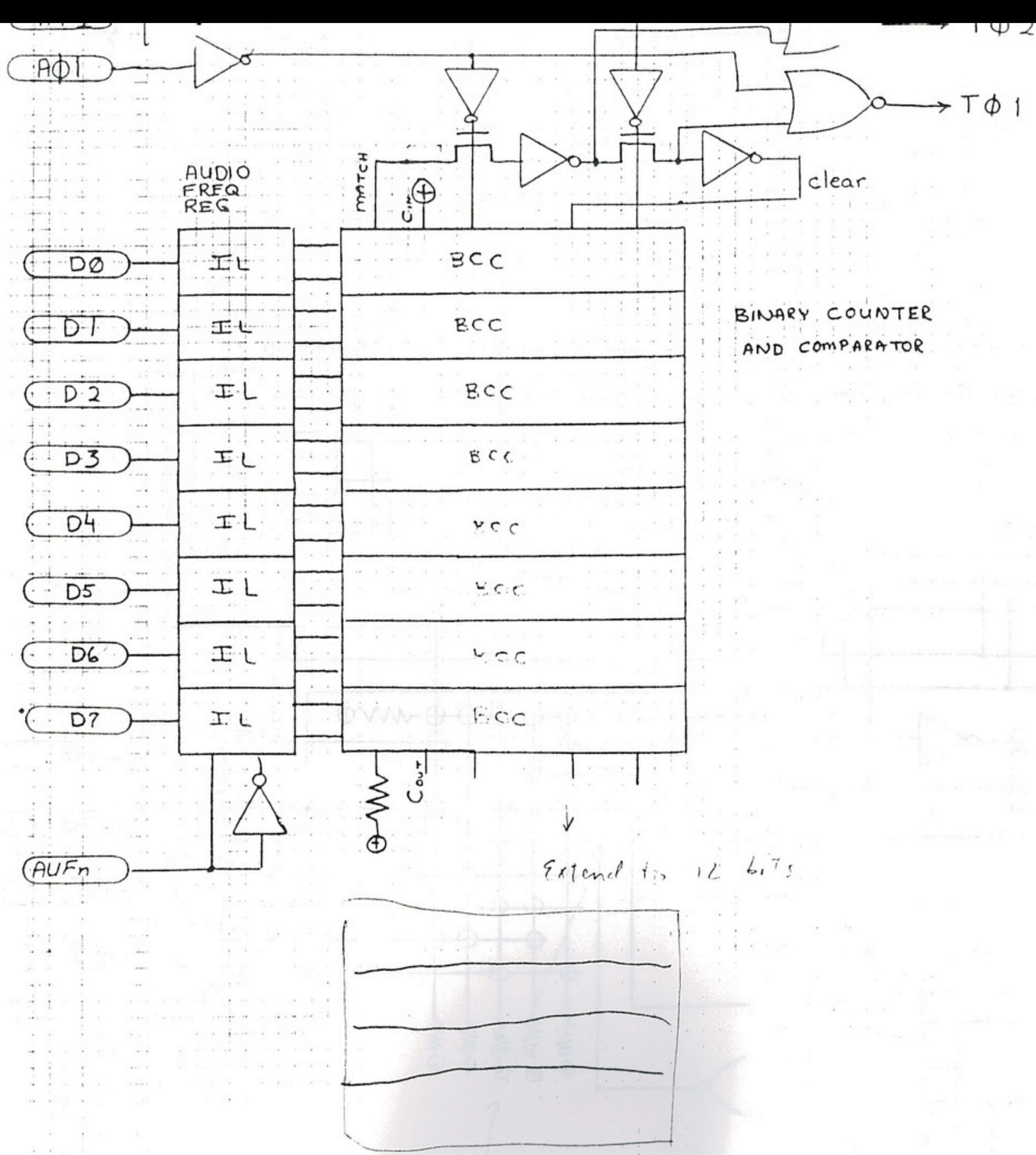
GINGER

Reviewed with T. Laurent 4/19/83

& B. Smithson 4/21/83

PROJECT SCHEDULE





TW 4/6

AUDIO
FREQ DIVIDER
(2 REQ'D)

General Computer Company

215 First Street
Cambridge, Massachusetts 02142
Telephone (617) 492-5500

Survey Results

SPRING Discussion

April 21, 1983

TO: GCC Employees
FROM: John Ison
DATE: 9 June 1983
RE: Spring Software Breakthrough

This summer we are working to define the non-game software to be offered on the Spring home computer. For those who do not already know, Spring is now thought of as a "beyond-the-state-of-the-art" game unit that can be easily upgraded to a full function home computer with the addition of a keyboard and extra RAM modules.

Anyone who attended the CES or has been following the literature knows that the market is being quickly saturated with new, sometimes good, always cheap, home computer hardware. Because software availability is an important factor in choosing a machine, most new entries are designed to be compatible with a large software base (e.g. CP/M, Apple, or IBM PC). The home computer software market is becoming homogenous.

To stand out in a market flooded with similar products, Spring will have to offer revolutionary <u>software</u> as well as hardware.

<u>Brainstorming Groups</u>

Next week, depending on your response, I would like to run between four and eight brainstorming sessions to identify issues and ideas for home computer software. We will avoid hardware issues. The sessions will each last approximately two hours and will be run on June 15, 16, 17. Everyone is welcome.

We will look at two main issues:

1. New and innovative uses for a computer in the home.
2. New ways to interface with a home computer.

April–June 1983

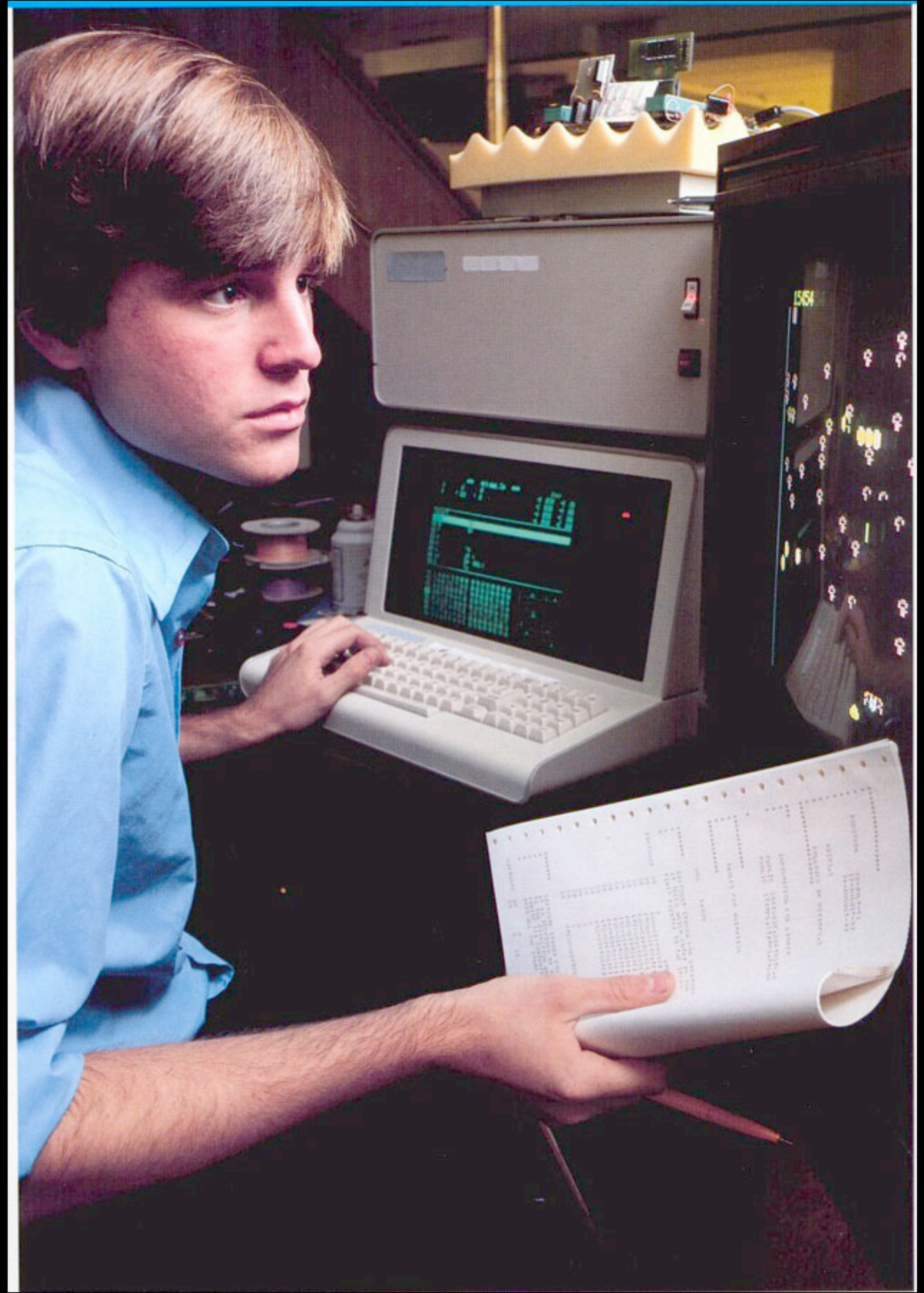
Maria chip

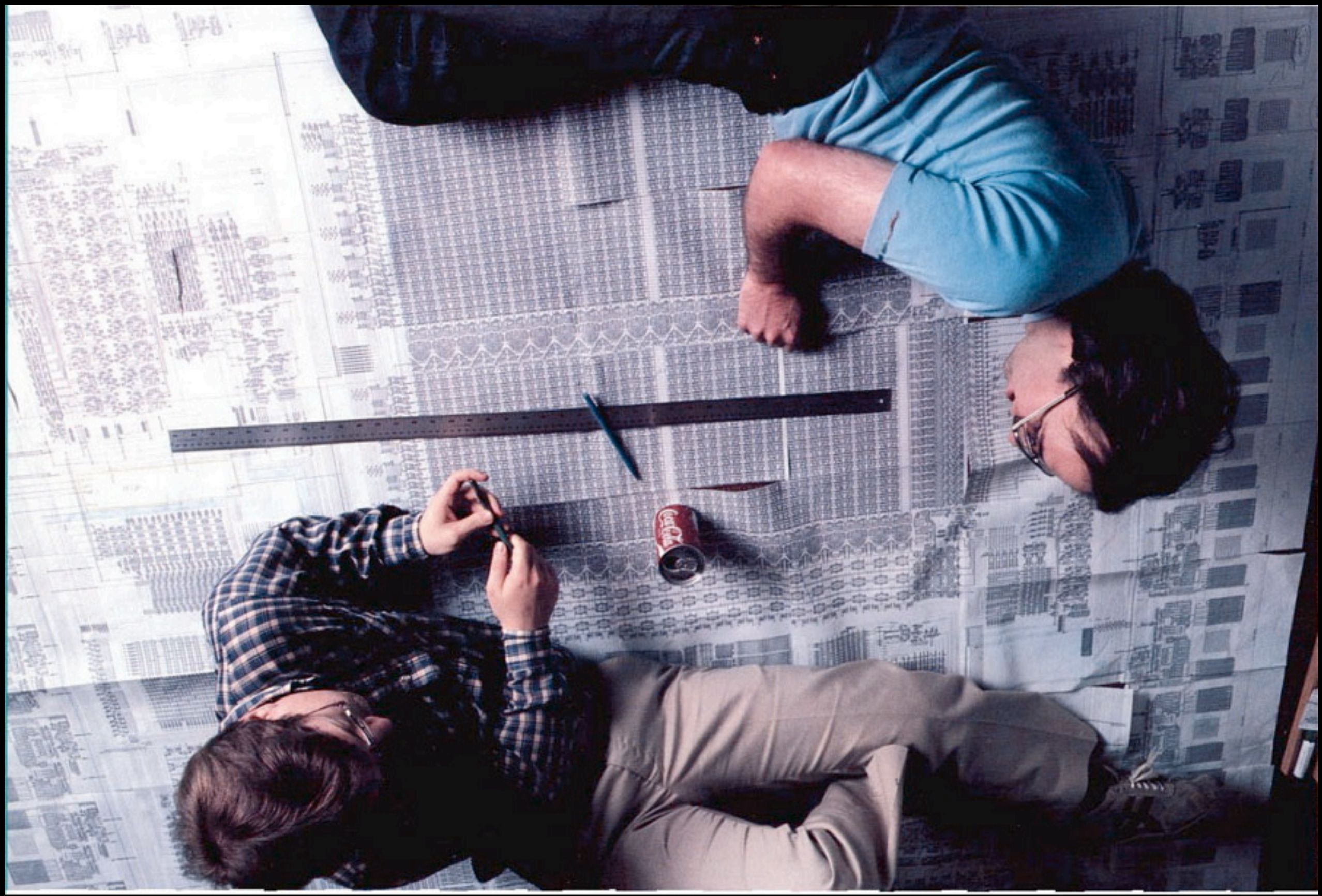
Maria TTL breadboard

3600 game system

many game carts

3600 Home Computer

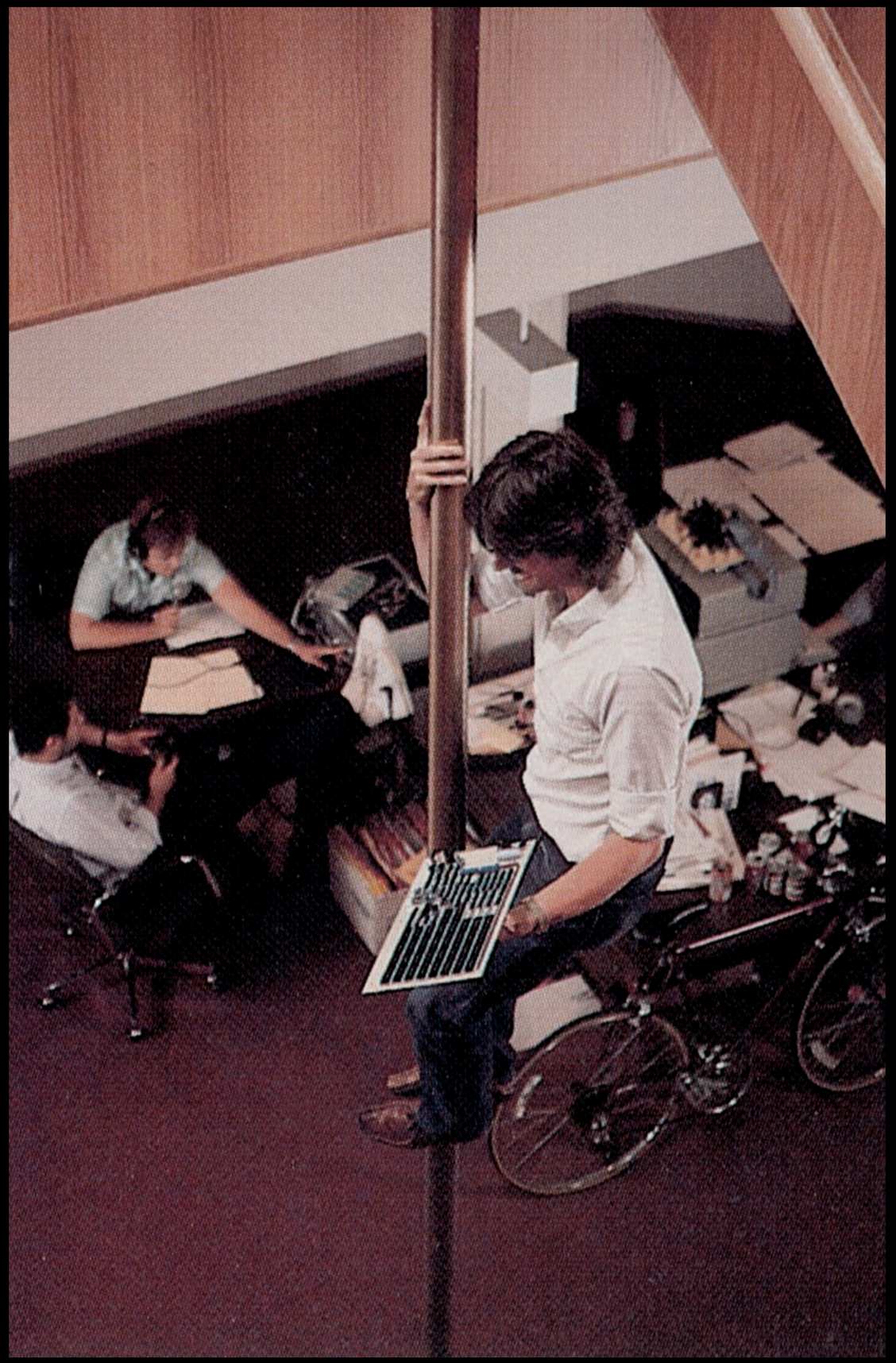





MARIA


MILLIPEDE
ZAXXON
ROBOTRON


MEGAPS




GPLUS!


ATHENAEUM ROAD

THE NEW 3600 HEADER

UPDATED 5/30/83
UPDATED 6/14/83

-DBM

A7	A6	A5	A4	A3	A2	A1	A0
P2	P1	P0	W4	W3	W2	W1	W0
A15	A14	A13	A12	A11	A10	A9	A8
H7	H6	H5	H4	H3	H2	H1	H0

OR

LOW ADDRESS	
PALETTE	WIDTH
HIGH ADDRESS	
HORIZONTAL POSITION	

Maria part number?


U.S.S. ENTERPRISE
NCC-1701

GCC 1701

July 1983

Maria tapes out July 4

Parts back late July

Success!
(one missing depletion implant)

One small problem…

7/2
tw

Maria II

It has become apparent that the current Maria architecture requires too much cpu time to allow effective use of its display capabilities. You can put a lot on the screen but there's no time to move it. Solutions to this problem have ranged from doubling the cpu clock (which would have required 120 nsec ROMs-- too fast to be economical today) to adding a second processor to the system board (which would require a much larger cartridge bus). An alternative to this is to modify the Maria chip architecture to remove some of the processor's burden. To be practical (without completely re-designing the Maria chip) we need to keep any changes small and localized. The following changes have been proposed:

1) The processor should not have to set up the Maria chip on each scan line. With Maria I the cpu spends most of its time either waiting (WSYN) or acting as a simple counter for vertical position. Maria II should be able to load its own display list pointers from a display list list. As before, we cannot have a unique display list for each scan line, so a given display list must be repeated throughout each line of a 'zone'. The offset register must be incremented at the end of each line of dma. Once the offset register reaches zero a new display list must be fetched (otherwise, the previous display list will be repeated). There seem to be two ways to go with the display lists; make them all linked together or have a second list of list pointers. Although the first method is simpler in hardware, we have chosen the list of lists to simplify the software overhead involved.

list of list ptrs.

So. The programmer interface has now changed. You no longer get a pair of dp's and an offset register to write to. You now have

Maria 2

Features of this system:

- The display will remain onscreen, even if you halt the emulator processor.
- Available cpu time is greatly increased: Assuming a minimum 15-cycle kernel on each of 192 scanlines, and the rest of on-screen time dedicated to dma, available cycles increase by at least 25%. In general, the increase will be much greater than this, since most scanline dma's do not require 390 7M cycles.
- Kernels go away, except for dli handlers.
- A reasonable Computer add-on is possible for very little cost. Essentially, the current dumb keyboard work still applies, while a RAM-I/O expander cart could make it very useable.

Negative features:

- The Loader still lives, at least for some games.
- Many zeroes are still wasted in char ROM.
- Flexibility is all but dead. You can't do a whole lot more than we envision today. (Actually the flexibility in Maria I may have been a myth; there wasn't enough cpu time to use it.)
- Relative to split-bus systems, a lot of cpu time is still lost to dma.

July 1983

Maria 2 begins

Scheduled tapeout:
September 16

From: BOONE 13-JUL-1983 15:05
To: TOM,CHRIS,ART,OPUS::LARRY,STEVE,RUSS,JOHNK,DANS,DOUG,KEVIN,BOONE
Subj: Status 7-13

Since the 7-11 status was somewhat grim on several points, this status report gives several updates (plus and minus) keyed to the same six topics.

1. 1702: The improved version requested by the programmers is also requested by Kevin, and this information has been given to VTI management. The basic plan is that Tom and Chris will characterize/verify/prove the 1701 initial baseline (working with Thierry and Bob in San Jose); and Larry, Art and Steve are being asked to design/implement the 1702 changes in Cambridge.

2. BREADBOARD: A major problem was isolated yesterday, which means that 1701 masks require a change local to RLOG to assure 6502A - 6532A compatibility. (This change will of course be included with the new 1702 version.)

3. BOARD: One fully-funtional board is avaible for 1701 test/characterization, and a second one is being prepared today.

4. CRYSTAL: Parallel-resonant 7.16 MHz crystals have been ordered. For testing, VTI's precision digital pulse generator will be injected on pin 4, initially.

5. CHANGES: As discussed in point 2 above, one necessary change has surfaced. No other changes have been isolated, but breadboard debugging and some VSIM is still proceeding.

6. TEST: Chris has tried for two nights without success to generate a simple two-scan .trc for VTI conversion to SETF patterns. He will try again tonight. Bob want this to at least check out the test/conversion procedure, but he believes the most important method of characterization will use available 6502 header/graphics routines and the 'real' boards and video output.

Overall, it looks like: WE WILL SUCCEED, BUT NOT AS SOON AS WE EXPECTED.

Gary

DIFFERENCES (From GCC1701 --> 1702)

July 17, 1983 /sb

Global Wires

- Add EOVB and STARTSCAN from m5 to m2b
- Add HALTRST from m2b to m5
- Add HALT from m5 to m0
- …
- …

- Delete OFFRF and OFFLF from m4b to m2a
- …

- Use (previous TST wire) for INT from m2b to m0
- Use (previous RAW wire) for TEST from m9 to m2b

MO PADS

- TEST input pin deleted
- Use (previous TEST pin) for INT output to microprocessor
- ABn outputs are slowed down, adding 20nsec to Ta max values
- Video outputs are slowed down, for XOR mux with TIA signals
- …
- …

M2a DMACTR is replaced by a new module

- DP and PP counters are turned into latches
- additional DPS and PPS shadow latches are added
- additional PPP 8-bit latch and shadow PPPS are added
- 8-bit adder becomes full 16-bit adder
- input decoders are added to define the latch and bus controls
- 5-bit width latch becomes a 5-bit counter (WCTR)
- …

3600 Home Computer

3600 Computer Project Proposal

Alan Hodgkinson
August 3, 1983

The 3600 Computer Product Line

The 3600 Computer is an add on keyboard for the 3600 Video Game Player. Figure 1 shows the complete product line.

The 3600 Computer would probably be sold with a single application cartridge (thrown in for 'free'). All software should include prerecorded 'interesting' software (perhaps on cassette or wafer tape). The idea is that a cartridge the consumer buys is immediately useful. Thus the system will be 'fun' right away, without the user having to expend any effort typing in programs or data.

The RAM memory in the keyboard unit will have a battery backup and will remember whatever the user was doing when he shuts it off. This non-volatile RAM eliminates the need for the low end user to buy a mass storage device. A wafer tape drive will be available for mass storage, or if the user wants to save money and still store data, he can use his own cassette tape machine.

The word processing package will be available with two optional printers: a letter quality printer and an inexpensive dot matrix printer (which might be used with the computer language cartridges).

Software to be offered with the 3600 Computer:

80 Column word processor

The Game Designer

BASIC

LOGO

LOGO CARTRIDGE PROPOSAL
Steven McDougall
August 3, 1983

PROPOSAL

This is a proposal to offer a LOGO cartridge as an application for the 3600 keyboard. LOGO is a lisp-like language that has been developed at MIT over the past decade. The language definition is in the public domain. There are or soon will be versions of LOGO offered for ATARI, Commodore, TI, APPLE and IBM home computers.

DIFFICULTIES

Like all lisp languages, LOGO requires a large amount of storage, both for the language processor and for the user's application code. It is also slow to execute. Furthermore, LOGO requires substantial graphics facilities to support its "turtle graphics".

PRIORITY OF LANGUAGE FEATURES

Any LOGO system must provide recursive functions and arithmetic operations. A text editor must be included to allow the user to define his fuctions.

John Ison's market studies indicate that consumers are strongly attracted to graphics. Providing turtle graphics is therefore the next priority. Recently, "turtle graphics" and "LOGO" have become nearly synonomous. This is therefore the smallest system that we could expect to market successfully.

"Sprites" are stamps that the user defines using a built-in CDS. Recent LOGO systems have included sprites and related facilities that allow the user to created animated scenes or simple video games. Again, this has strong consumer appeal. As the avaliable RAM increased, we would probably offer something along these lines.

Game Designer

The *Game Designer* cartridge allows the user to develop their own games using an icon based, menu driven development system. In particular, the playfield and moving characters of the game can be designed; the movement and firing algorithms of both the Hero and the Enemies can be specified; and conditional interactions with the playfield can be defined.

Detailed Functionality

Playfield: The user will be able to develop the playfield by piecing together built-in playfield characters (not bitmap) which include starfields, mountains, maze walls, roads, water, buildings, dots and other generic background characters.

Moving Characters: There are three kinds of moving characters which the system recognizes: Hero, Enemy, and Background. The actual characters for each of these will be developed using a fairly standard character development scheme. The user will be able to develop several versions of each character and group these versions into sets where the members of each set make up an animation for that character, and the different sets represents different modes the character is in.

Heros: There are two aspects of the hero which the user will be able control: Movement and Firing. For movement, the user will be able to select from a menu of movement options how the hero moves and how it responds to the joystick. The basic choices are:

1. Horizontal Motion: The left and right positions of the joystick move the hero left and right on the screen, no vertical motion is possible (Like Space Invaders, etc.).

3600/Educational Applications

Specifications — Bill Hofmann, August 4, 1983

Educational application software for the 3600/Keyboard Computer can be broken down into several areas:

- Drill (mathematics, state capitals, etc.),
- Teaching geometry, physics, etc. (Turtle geometry, Newtonian turtles),
- Development of logical skills, planning and organization,
- Introductory programming (elements of computer science, language tutorials).

Of the four areas, drill is the easiest to program, and probably the least useful and interesting application. However, since it is easy to generate, much current educational software is drill. Seymour Papert makes a case for the use of computers (running a Logo system) to teach young children the basics of geometry and physics in his book *Mindstorms*. While his case is unconvincing, many educators have jumped on the Logo bandwagon and are enthusiastically promoting it. This will help make our Logo product marketable. It may make sense to put hooks into the standard Logo which would allow a cartridge implementing some of the characteristics of Logo that Papert experimented with to be added on.

Spinnaker Software, Inc. of Cambridge (downstairs, in fact) has a product called *Snooper Troopers* which is designed to encourage students to develop logical skills (by making conclusions from a set of clues) and planning and organizational skills (by encouraging them to keep track of clues and places they've 'visited'). Other programs, such as *Robot Wars*, introduce the concept of procedural thought in a non-threatening fashion.

Most people consider themselves 'computer literate' if they can write a simple Basic program, however, this definition of computer 'literacy' is likely to change as computers penetrate the market. There may be a market for simple tutorial software which would introduce an inexperienced user to programming languages.

All of these comments are speculations. However, I feel that educational software (of at least the final three types) would enhance the marketability and reputation of the 3600/Computer.

3600/Word Processor

Specifications — Bill Hofmann, August 4, 1983

The 3600/Word Processor is an attachment to the 3600 Game Player/Computer. It is an add-on to the 3600/Keyboard. The hardware bundled with the 3600/Word Processor (3600/WP) software would be an inexpensive, 80-column printer and a wafer-tape drive.

Details of the specifications of the printer are as yet unclear. Thermal printheads, a lá the Brother EP-20 personal typewriter, are inexpensive, but generally require either thermal paper or a ribbon to transfer thermally-deposited ink onto conventional paper. Because of the small number of moving parts in thermal printers, they are currently the cheapest printers available. The other contender for the printer would be a bottom-of-the-line dot-matrix printer. In either case, the print quality would be low (so-called "draft quality"). The user should have the option of attaching a more expensive printer later.

The wafer-tape drive is a continuous-loop microcassette drive manufactured (currently sole-source) by AMJ Microdrive, Inc., of Sunnyvale, California and is available in quantities of 100,000 for $20 (preliminary price). The drive and the printer would be controlled by the Pokey included in the keyboard.

An additional peripheral which should be compatible with the 3600/WP software is a tab mouse. A tab mouse is an inexpensive pointing device similar in conception and design to standard optical mice, but which doesn't require a special pad to operate. The tab mouse was developed by Cyan Engineering for the Atari 800-series computers, and with minor modifications to the interface harware could be used with the 3600. The production cost for the tab mouse (less interface) is $6 (quantity uncertain, but probably large). The interface could easily be a custom chip, since all that is required is a pair of up-down counters, two Schmidt triggers, latches and some random logic.

There are several possible ways to connect peripherals to the 3600/Keyboard. The simplest and cheapest would be to bring a male edge connector to the side or back of the keyboard, a lá the VIC-20 or Sinclair. Another option would be to provide connectors similar to joystick connectors. This is clearly more expensive than extending the PC card to provide an edge connector. The third option would be to provide a low-profile attachment which would plug into the cartridge slot atop the keyboard, with connectors similar to joystick connectors. The first option has the advantage of low cost. The third option allows the user to defer the cost of the connectors to the purchase of peripherals which require them (or put another way, it keeps

3600 HC Adventure Game

There are two basic approaches to Adventure games on home computers, and most products of this kind tend to fall in the spectrum between these two points. The first approach is to see the game as a puzzle where the "right" commands in the "right" order means you win the game. Puzzle adventure games (which include Zork and Adventure) tend to be static, text intensive systems that rely on detailed descriptions of rooms and objects to give you clues as to what the "right" commands are. The second approach is to view it as an action game where you move about a complex of rooms fighting monsters and collecting treasure. Action adventure games (which include Atari's Swordquest and D&D games) tend to be randomized, code intensive games which rely on complex monster movement and object action code to keep the player's interest.

As I said at first, most adventure games lie somewhere in the spectrum between a pure Puzzle game and a pure Action game. Zork and Adventure both randomize combat and monster movement around the maze, and Swordquest has a puzzle subplot. A good example of a middle-of-the-road game is Rogue. In Rogue, the player gets a top down view of the current level of the dungeon which gets filled in as he explores the complex. As he explores, he finds treasure; magical rings, scrolls, wands, and potions; and monsters, each with different powers. In so much as the player spends his or her time killing monsters and collecting treasures, it is and Action game; but because of the wide range of options available to the player (do I explore the next room, Quaff the potion of healing, or try to find out what the scroll I found does) and since the properties of the various magic items are randomized, Rogue posseses many of the aspects of a Puzzle adventure game.

What does all this mean to us at GCC? Well, Puzzle adventure games tend to take allot of ROM for the textual description of the rooms and objects. Most of the commercial ones rely on random access disk files to hold the text since its too large to keep in memory. They also tend not to use graphics well if at all. Action Adventure game, as may be noted by the examples I gave, are the sort of thing which Atari has been doing for years. Our graphics and

THIS IS REV 2. HSCATTRACT IS NOW HSCATRCT. THE FORM OF THE ARGUEMENT BLOCK HAS BEEN CHANGED. IT IS NOW DEFINATE THAT THE ARGUEMENT BLOCK WILL BE THE FIRST FEW WORDS OF THE 2 PAGE RAM AREA, SO THERE IS NO NEED TO PASS A SEPERATE POINTER TO THIS. NOTE OTHER CHANGES.

High Score Cart (HSC) for 3600
proposals and specifications

The high score cart will plus into the cart slot on the 3600 and provide a cart slot for other carts. It will provide nonvolitile ram for recordins high scores achieved by home same players, and the initials of the players who sot the scores. For this to be possible all 3600 carts will have to provide a certain interface to the software in the high score cart. The HSC will not provide this facility to 2600 carts, but it will not interfere with them either.

The high score cart will store the five highest scores of up to 70 different sames. Each different difficulty level of a cartridge is considered a different same. The same difficulty level but with different controls may also be considered a different same? (NO,Rev2) When a score is entered for a same that does not already have a high score table, one is created. If all 70 are in use then the table for the same that was played least recently is cleared and used for the new same.

The high score cart is ordinarily inactive. It has control only when explicitly called by the same program. There are two entry points defined for the HSC. The first, HSCATRCT, is called durins the cart's attract mode, between auto play and the title page. The second, HSCENTER, is called with each player's score immediately after all players have finished their sames. It determines if the score qualifies for the high score table, and if it does, sets the players initials, and adjusts the high score table. Both routines display the high score table for the same, except for HSCATRCT when there is no high score table for a particular same. Then it will not change the display list. Both routines return with 0 if the display list wasn't changed (HSCATRCT only), 1 if it was but the high score table was (both), and 2 if both were

Encryption

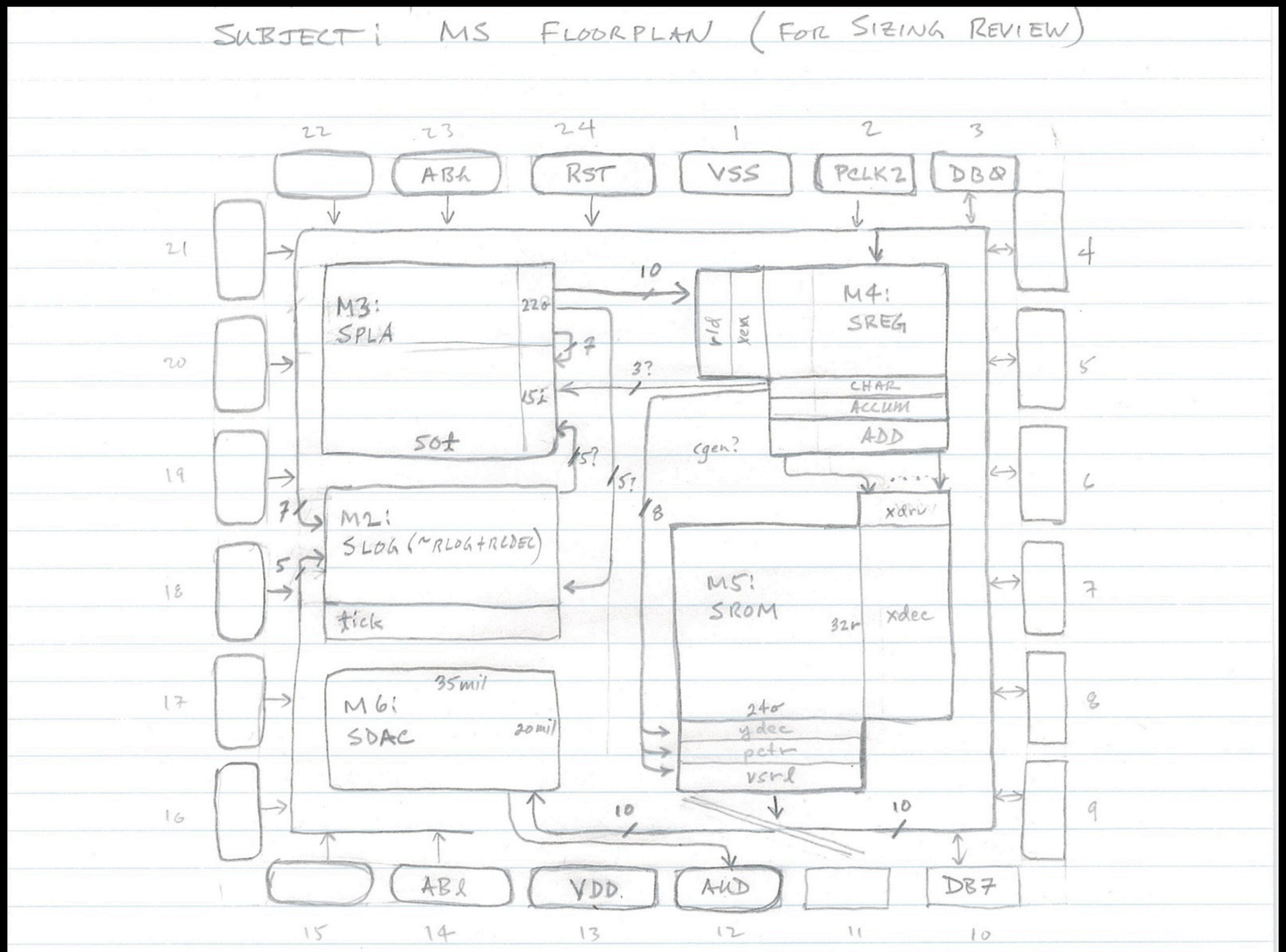
Authentication

MARIA2 Graphics Modes -- version 8

S. Golson 9/7/83

MODE	WM	RM1	RM0	CRA4	CRA3	CRA2	CRA1	CRA0
160	0	0	X	P2	P1	P0	D7	D6
							D5	D4
							D3	D2
							D1	D0
160B	1	0	X	P2	D3	D2	D7	D6
					D1	D0	D5	D4
320A	0	1	1	P2	P1	P0	D7	0
							D6	0
							D5	0
							D4	0
							D3	0
							D2	0
							D1	0
							D0	0
320B	1	1	0	P2	0	0	D7	D3
							D6	D2

September 14, 1983
Mini Gumby



GCC 1702 / Maria 2

tapeout to VTI
September 17, 1983

parts back
September 28, 1983

Maria-2 handy hints 10/03/83

This little document should help out in converting your programs to work on Maria-2. The main difference between Marias one and two is that a kernel is no longer necessary. Instead, our graphics chip figures out what it is supposed to be displaying by looking at something called, for lack of a better term, the display list list (henceforth referred to as DLL). This is, as it sounds, a list telling Maria where our display lists are in memory (I know this is elementary to many of you but I wanted to cover all bases). In addition this DLL informs Maria of the height of this zone, whether or not to trigger a display list interrupt (old hat to you 5200 programmers) and controlls "HOLY DMA." Detailed discussions of these concepts are available in the Tom Westberg Papers (Random House paperback).

Excerpted from these papers is the following information:

DLL format is as follows:

<dli> <a12en,a11en,X> <offset -- 4 bits>

<dph> -- display list pointer high

<dpl> -- display list pointer low

Note that registers dpl and dph are no longer needed externally. To avoid confusion the pointers to the DLL resides at there previous addresses. If the dli bit is set, a non-maskable interrupt (NMI) will occur. It is up to the programmer to determine which interrupt just occurred. A12en should be set if you wish to utilize holy dma for sixteen raster zones. When accessing graphics rom while this is set, Maria will "see" zeros at addresses that have both A15 and A12 set. A11en should be set if you want holy dma for eight line zones. Please note that you really can't use this feature yet, as current ram carts go from $4000 -- $8000 or $A000. Because maria also wants A15 to be high for holy dma, graphics must be located above $8000 for eight high zones, and above $A000 for sixteen high zones. The moral of this story is, don't kiss your zeros goodbye

32

Steven McDougall

3600 SOFTWARE GUIDE

INTRODUCTION

revised 10/19/83

The 3600 is a product which combines the ATARI 2600 hardware with a new graphics chip called MARIA. The entire 2600 library of cartridges will run on the 3600 as they do on the 2600, but new cartridges designed to access the improved hardware will be able to take advantage of a large number of improvements.

OVERVIEW OF 3600

Ignoring the 2600 environment, which is identical to the ATARI 2600, the 3600 environment is characterized by the following:

```
(2) 6116's      - 4K bytes of RAM.
    6532        - I/O.
    TIA         - sounds, some input ports.
    Expanded cartridge slot.
    SALLY(6502)- microprocessor running at 1.79 MHz.
    MARIA       - all video.
```

Additionally, there is a protection circuit which verifies that each cartridge has the correct encrypted data before enabling 3600 mode. Encryption will be covered in another document, but see Appendix 1, 3600 Memory Map, for information about reserving space for encryption.

6116's

MARIA

This is the custom chip which is the heart of the 3600. It handles all graphics and video including the VSYNC and VBLANK signals.

OVERVIEW OF MARIA

GRAPHICS

MARIA does not employ the concepts of players, missiles, and playfield, as do the 2600 and 5200. Instead MARIA uses an approach to graphics commonly used in coin-operated games. Each raster of the display may be thought of as a bit map. This map is contained in an area of the MARIA chip called the Line RAM. Information is first stored into the Line RAM, then later read from Line RAM and displayed on the screen.

Consider for a moment just one raster of display. One would compose this raster's graphics by storing data into Line RAM. This is done by specifying what data should be put at what horizontal location. Graphics may be specified in small pieces, and overlapped. The order in which pieces of a raster are specified determines object priority with the last object specified on top.

When graphic data is specified to be stored into Line RAM, it will reference any one of eight (8) color palettes. Each pixel of data will take on any one of three (3) colors from the specified palette, or may be turned off (transparent). Again, the Line RAM contains only one raster of graphics information. There are actually two Line RAM

loading must occur during one scan line.

DISPLAY

There are a total of 262 rasters per frame (1/60th second). The "visible" screen (during which MARIA attempts display) starts on raster 16 and ends on raster 258. The area found visible on all television sets starts on raster 41 and ends on raster 232, 192 scan lines later. Any display outside this area may not appear on all televisions. See Appendix 4, Frame Timing, for more details.

Display is accomplished automatically by MARIA and consists of two tasks: constructing the Line RAM, and displaying the graphics. These happen simultaneously in MARIA. Construction of Line RAM is automatically initiated every raster by MARIA, and is directed by a predefined list of instructions called the Display List. Line RAM construction occurs through a process called DMA (Direct Memory Access). This means that the 6502 (SALLY) processing is suspended while MARIA comes in and interrogates the RAM and ROM for Display List and graphics information. DMA will occur every "visible" scan line and lasts no longer than one scan line. Because the Line RAM being constructed is displayed on the following scan line, MARIA will read each Display List one line before it is actually displayed. All Line RAM is cleared on a line by line basis and BACKGRND color will be displayed if no data is written.

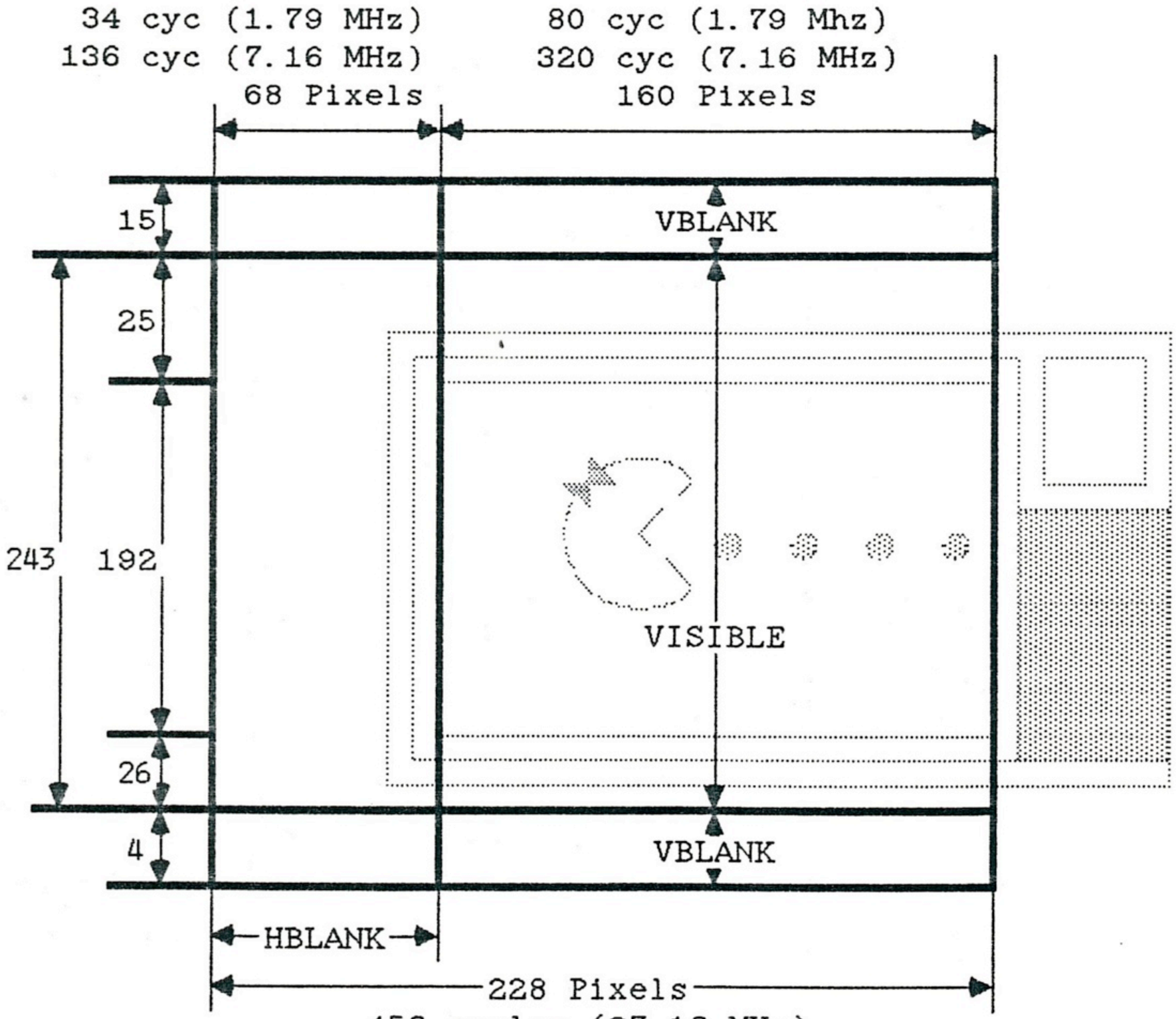
Display List

DMA is mainly concerned with reading the Display List. This is a list of instructions for where to find graphics data, where to put it on the screen, and other details for constructing a scan line. The Display List is made up of many "headers." Most headers are four (4) bytes long (the exception is discussed later). If the second byte of a header is zero, it indicates the end of the Display List, and DMA will stop, allowing the 6502 to continue processing. The format of the header is as follows:

Display List List

MARIA locates the Display Lists by reading a Display List List (referred to as DLL from now on). This list is a series of 3 byte entries. Each entry points to a Display List. Included in each entry is a value called OFFSET, which indicates how many rasters should use the specified Display List. OFFSET is decremented at the end of each raster until it becomes negative, which indicates that the next DLL entry should now be read and used. Each time graphics data is to be fetched, OFFSET is added to the specified High address byte, to determine the actual address where the data should be found. This allows one display list to specify many rasters of graphics. Without OFFSET the only approach to graphics is to have a Display List for each raster, and a DLL for each Display List. Not only would this use a lot of RAM, but it would also take quite a bit of processing time to manipulate these Display Lists when objects move. Because OFFSET is added to the HIGH address byte, each raster of graphics for an object must be separated by x'100' bytes, or one page.

The group of rasters specified by one DLL entry is called a "zone." Again, the number of rasters in a zone equals OFFSET+1. Larger zones mean less RAM is needed for DLLs, Display Lists, and Character Maps (see DMA MODES below). But upon consideration of how to use zones, you will realize that to achieve smooth vertical motion each stamp must be padded at top and bottom with zeros. For example, if the top raster of an object is to appear on the last line of a 16 high zone, it must have 15 lines of zeros above it. If that object is 8 pixels (2 bytes) wide, and its top line of data is located at x'CF04' and x'CF04', then you will need two bytes of zeros at x'D004', x'D104', x'D204', x'D304', ... , and x'DE04' (remember that OFFSET decrements). As this can add up to many pages of zeros, you can specify that MARIA should interpret certain data as zeros, even if it isn't. This is called "Holey DMA" because DMA will see "holes" in the data that aren't really there. This can be enabled and disabled on a zone by zone basis via a DLL entry. Holey DMA has been aimed at 8 or 16 raster zones, but will have the same effect for other zone sizes. MARIA can be told to interpret odd 4K blocks as zeros, for 16 high zones, or odd 2K blocks as zeros for 8 high zones. This will only work for addresses above x'8000'. This means that these blocks can hold meaningful code, or tables, or graphics data used in a zone where Holey DMA is not on.


34 cyc (1.79 MHz)
136 cyc (7.16 MHz)
68 Pixels
80 cyc (1.79 Mhz)
320 cyc (7.16 MHz)
160 Pixels
15
25
243
192
VBLANK
VISIBLE
26
4
VBLANK
HBLANK
228 Pixels
456 cycles (@7.16 MHz)
114 cycles (@1.79 MHz)

Appendix : 1

PROGRAM MODIFICATIONS TO WORK WITH THE SECURITY ROM
November 4, 1983

The following modifications should be made to all Maria programs:

1) All programs should execute the following statements soon after they are called:

```
LDA #$07
STA $01
```

This will lock the 3600/7000/9000 into Maria mode. Doing any other write into TIA RAM could turn Maria off or turn the cartridge address lines off unless this is done first.

2) The ROM from $FF80 - $FFF7 must be reserved. (You might want to put zeros into it now to make sure you do not use it.)

3) The locations $FFF8 - FFF9 must have $X7, $5A in them where "X" is the high nybble of the address your cartridge ROM starts at. If you have a 16K cart, which starts at $C000, it should be $C7, $5A. A 24K cart (starting at $A000) should have $A7, $5A. Cartridge ROM must start on a $1000 byte boundary, and any cartridge RAM must be below all cartridge ROM. Cartridge ROM must be continuous through $FFFF. No cartridge can have RAM or ROM below $4000.

NOTE: New boards will have a "stand-alone security ROM" which does no encryption, but code must still encorporate 1) & 3) to run on them. 2) is only required for final carts.

From: TOM 23-NOV-1983 12:13
To: BOONE,JERRY,CHRIS,ART,LARRY
Subj: second sources and more

(Note: this mail message has turned into more of a Memo than a message. I recommend that you print it out; don't bother trying to read it on the screen.)

Monday 11/21 we met briefly with ASG people (including Gary S.) to discuss cost reductions on the Maria chip. Several interesting points were brought up.

- ASG wants us to use their 'Stephanie' version of the TIA. This is a cost-reduced TIA, using 3 micron HMOS, rather than the current 6 micron technology. TIA costs about $1.85. Stephanie will cost about $2.25 for the first year.

- They do not believe VTI's price quotes (around $9, even with the 240+ mil die size). They do not expect a second source to come on line to compete and drive the price this way.

- They have spread the word that AMI is not doing a second-source version of the current mask. We ran into that rumor several places.

- They are currently looking at going directly to a TIA/Maria combo. Dan S. and I determined that it could fit in 48 pins. They will submit a business plan on it.

- They do not consider Chip On Board practical from a VLSI testing standpoint.

- They are now people-constrained. They have been losing employees.

A second meeting occurred with the International Division.

- They are much better to work with, including their engineers, than most of the rest of Atari.

- The 2600GC will come out around $109. The 5200 may increase in price.

- I agree with the outcome of this meeting entirely. If you have any problems with any of these points (and believe me, I did initially), come talk to me.

- They REALLY like the 3600.

Final note. Apparently word is beginning to leak out to the press. We got a call from a Video Game mag about a rumor that we were developing a new base unit for Atari. An article appeared mentioning that the 5200 would be phased out in favor of the "3600" which has 3-D graphics capability (probably the Asteroids 3D cart).

December 1983

Atari in-house name: 9000

plan to build Centipede into encryption ROM

final silicon on Maria 2B (2, 2S, 2A, 2B)

PAL Maria starts

videodisc interface

Mini-Gumby scheduled complete 2/15/84

3600 adapter for 5200

3600 Trakball

3600 Home Computer:
Keyboard, Game Designer, Word Processor

Steve Golson
General Computer Company
December 2, 1983

CONFIDENTIAL

Future Technology Group -- Project Proposals

1. stamp ORC -- "standard" ORC from Spring, supports fast zoom/mooz by using four ALUs in parallel to compute pixel addresses

2. stamp LR -- line ram used in conjunction with stamp ORC, can write four non-consecutive pixels simultaneously

3. polygon ORC -- using two DDAs in the ALU section of the ORC, can draw arbitrary 2D polygons

4. polygon LR -- line ram used in conjunction with polygon ORC, can fill any number of consecutive pixels with the same color in three write cycles

5. super ORC -- combination of 1. and 3.

6. super LR -- combination of 2. and 4.

7. 3D polygon engine -- basically a 3D front end machine using 3. and 4. as final display sections

Even if no detailed design work is done, I think we should immediately begin patent application work on super ORC and the polygon LR.

January 1984

Winter CES

JANUARY CES 1984

FLIGHT INFORMATION

The standard reservations for the trip to Las Vegas are as follows:

<u>January 6, 1984</u>

United #117
leaves Boston @6:45pm
arrives in Chicago @8:15pm

United #555
leaves Chicago @9:50pm
arrives in Las Vegas @11:25pm

<u>January 9, 1984</u>

United #448
leaves Las Vegas @1:15pm
arrives in Denver @3:54pm

United #
leaves Denver @4:55pm
arrives in Boston @10:35pm

Any other reservations are indicated on the individual's itinerary enclosed with the ticket. Please double check all flights as soon as you receive your ticket so that possible problems can be solved immediately.

ADV/MKTG/PR/CONSULTANT

'84 INTERNATIONAL
WINTER CONSUMER
ELECTRONICS SHOW

11

STEVE GOLSON
GENERAL COMPUTER CO
215 FIRST ST
CAMBRIDGE MA 02142

LOANER CARTRIDGE

RETURN TO:

Douglas B. Macrae
General Computer Company

January 1984
Winter CES

January 1984 CES

Robotank vs Battlezone

Enduro vs Pole Position

January 1984

Munitions Control Board

Centipede + encryption ROM released

BallBlaster for 7800 starts (Topsy Turvy)

Mini-Gumby TTL working

7800 ProSystem official name

GCC1702B "MARIA" CHIP

Acceptance Specification
(Atari Part Drawing)
Draft January 16, 1984

GENERAL COMPUTER COMPANY

CONFIDENTIAL

Comments on pages:
24, 25

3600 GAME STANDARDS II

1/19/84 26

The following documents the user interface and coding standards we are using for the 3600. This is meant both to provide a guide to program development and as a check list for finished carts. Please compare these against any existing games. Some of these standards are changed, and they supercede previous standards. Note that these standards may be waived on a case-by-case basis to maintain copyright loyalty or for games with exceptional requirements

SECTION I: USER INTERFACE

I.1) Power-up

Games should power-up displaying a TITLE page. Game parameters should be single player and DEFAULT DIFFICULTY. After about 20 seconds, the game should go into the HI SCORE display. After this, AUTO-PLAY is started. From then on the game alternates between TITLE page, HI SCORE display, and AUTO-PLAY. This is called the IDLE SEQUENCE.

I.1.1) Title Page

The TITLE PAGE should contain spiffy graphics including the game title and logo. The ATARI copyright MUST appear in the form:

(c) ATARI 1984

or

copyright ATARI 1984

Some games may also require a copyright message for the licensor. The names GCC, General Computer, etc should NOT appear anywhere on the display.

I.1.2) Hi Score Display

All games should be made compatable with the Hi Score Cart. When doing the HI SCORE display, the game should cycle through each possible game difficulty or option giving about 5 seconds of display for the high scores for each. These should go from low difficulty to high. The time each is displayed can vary depending on how many hi score tables exist.

If there is no Hi Score Cart plugged in, the HI SCORE display is bypassed. Please refer to the Hi Score Cart documentation for implementation details.

I.1.3) Auto-Play

All games should go up to $FFFF (where the vectors are) down as far as they need. All ram should be below all rom. No addresses less than $4000 should be used on the cart. Rom has to start on a $1000 byte boundary.

II.1.2) Encryption

The memory between $FF80 and $FFF7 is reserved for an encryption key. Make sure there is no code or data here.

The following two locations have special meanings:

- $FFF8: $FF. Region verification. Just put an $FF here. This will be used to define 8 market regions and allow any given cart to only be played in a subset of them.
- $FFF9: $X7. The X is the start of your rom. If you start at $C000, this should be $C7. The 7 is there to identify most 2600 carts immediately (they won't usually have a 7).

II.1.3) Vectors

All vectors (NMI, Start, IRQ) must point to within the code. Setting unused vectors should point to an RTI 'just in case'.

II.2) Startup

Games cannot assume that any state is initialized or zeroed when the cart is powered up. It is possible that the security rom might presently leave the machine in some state, but a future base unit might have a different security rom or none at all. The following things should be done in all carts on startup:

- $07 to INPTCTRL: this locks the machine in 3600 mode.
- SEI, CLD: to initialize 6502 status.
- $7F to CTRL: to turn dma off. Some equivalent may be used, but DO NOT store anything with the $80 bit on!

From: SCOTT 3-FEB-1984 15:54
To: ROY,LARRY

MiniGumby Sound Synthesis System

Analog Output Section Specification

v1.0 2/3/84 sjs

<FF>

MiniGumby Sound Synthesis System

Analog Output Section Specification

The Great Color Flip Disaster!
2/5/84

Color Flips are dead. The cost should be about $.01 per board for two resistors. In case anyone is interested, here is a description of what we think was happening and why this should fix it:

The Maria color ram is static; that is, it was designed to hold its values without being "refreshed" as dynamic RAMs require. Unfortunately, the RAM wasn't holding data correctly. Through several iterations, we chased down the problems until it appeared that the only values written <u>into</u> the RAM were values already present in some other color ram location. The thing was just doing a memory-to-memory transfer internally. Art came up with a possible reason for this to happen. If addresses within Maria changed at just the last possible moment, two different bytes of the RAM could be selected, one after another. Because of strangenesses within the RAM, the first value read would end up being written into the second byte. Even though the write line was never asserted. It only took a read cycle to do this. (We confirmed that by disconnecting Maria's write line while running Centipede; it still flipped.) The remaining problem was that the 6502 timing specifications should not allow that address to change when it had to change for this to happen. Solution: DMA timing. In the 3600 system, either Maria or the 6502 can drive the address bus, depending on whether DMA is taking place. At the beginning and end of DMA, however, there is a slack time when nobody drives the bus and it floats. At this time the address might change spuriously, causing a color flip. We were able to cause the address lines to tend towards the Maria address space by putting pullup and pulldown resistors on the address lines, so that during those dead cycles, Maria would get selected. To get the address to actually change during this time, we put a noise source into A0 as well. Color flips occurred wildly. When we

February 1984

Atari increases production from 50k to 200k

1984 production 1M

2-3M in next 3 years

Anna VLSI chip begins
for 7800 Keyboard Computer

TO: Doug Macrae
FROM: Alan Hodgkinson
RE: Software Offerings for the 7800 Keyboard
DATE: March 14, 1984

NOTE: UPDATED AS OF WED 3/14/84

Below is a list of the proposed software offerings for the 7800 Keyboard:

The Word Processor

A sophisticated word processor with a smooth scrolling display. The user would be able to enter and edit documents of up to one page in length. With the RAM supercharger the user would be able to enter much longer documents. The word processor includes such commands as Cut, Paste, Search, Replace and many formatting options.

ROM size: 16K
ASIO compatibility: Printer, Disk
Supercharger compatibility: Expands document size up from one page
Engineering time required to complete: Will finish for CES
Engineers: Bill H., Lucy G.

The Game Designer

A 32K (to 48K max) cart that would require the RAM supercharger. Allows the user to design his own games with up to 10 moving characters. The user is able to save the games he designs on the Atari floppy disk drive.

ROM size: 48K
ASIO compatibility: Disk (user can save games he designs)
Supercharger compatibility: required for operation

April 4-8, 1984

Disney World re-redux

April 1984

security ROM finished, no Centipede

security + Pole Position II ROM developed

High Score Cart accepted
as official Atari product

Lucasfilm Games: Ballblazer, Rescue Mission

Maria2C (internal pullup in wrong place)

April 1984
7800 Keyboard Computer

new interface through joystick

no need for Anna

2 prototypes built in 26 hours

uses standard Atari peripherals

A Guided Tour of Maria II

Incomplete...

Tom Westberg

Purpose of Maria II

The Maria II graphics controller chip is intended mainly for generating a raster-scan video display suitable for a personal computer or video game image. It has several other functions in a microprocessor-based system, intended to reduce overall chip count and aid in compatibility with a previous video game system, the Atari 2600.

This Guided Tour will be broken up into two major parts: the first section will discuss the chip as a graphics controller, while the second section will address the system-related features of the chip. Throughout this description, it will be assumed that the reader is familiar with raster-scan video and at least some methods of generating computer images on a raster display.

Graphics Controller:

Introduction

The Maria II chip operates fundamentally by transferring blocks of data from the microprocessor's memory space into an internal staging memory

will discuss the chip as a graphics controller, while the second section will address the system-related features of the chip. Throughout this description, it will be assumed that the reader is familiar with raster-scan video and at least some methods of generating computer images on a raster display.

Graphics Controller:

Introduction

The Maria II chip operates fundamentally by transferring blocks of data from the microprocessor's memory space into an internal staging memory (the **line ram**) and then synchronously sending out the contents of this internal memory as pixel data. The final output of the chip is in a form which is easily converted to an NTSC (or PAL) video signal. The video functions of the chip may be divided into four blocks: The **sync** circuit provides the overall horizontal and vertical video timing. It also provides some timing signals to the **dma** circuit. The **dma** circuit handles the transfer of memory blocks from the microprocessor's memory space into the internal staging memory, the **line ram**. The **line ram** is used to build a single scanline image of the video display, prior to its output. The **output** section includes **color ram** and a **color phase shifter** circuit.

Sync

Consisting of two counters, some decoders, and flip-flops, the sync section provides horizontal sync, horizontal blank, vertical sync, and vertical blank timing signals to the outside world and to the output section. These signals approximate the timing required by NTSC (or PAL) video receivers.

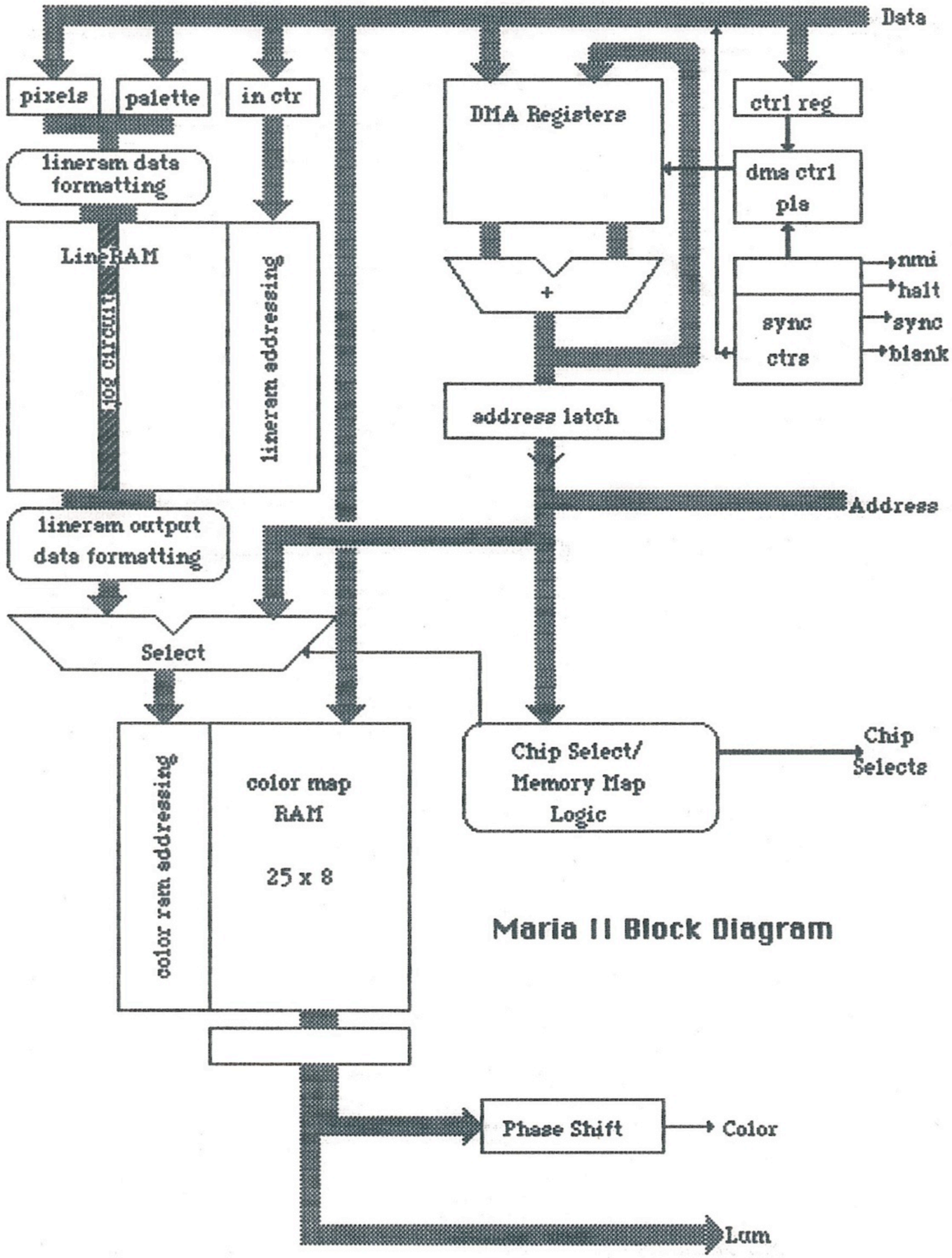
output varies, depending on operating modes of the chip.

An **object** on the screen consists, ultimately, of a sequence of graphics data which must be transferred into the lineram in order to be displayed at the correct horizontal and vertical position on the screen. A given object draws all of its colors from a single color **palette** (see color ram description). An object may also be a **character map**, which will be described later.

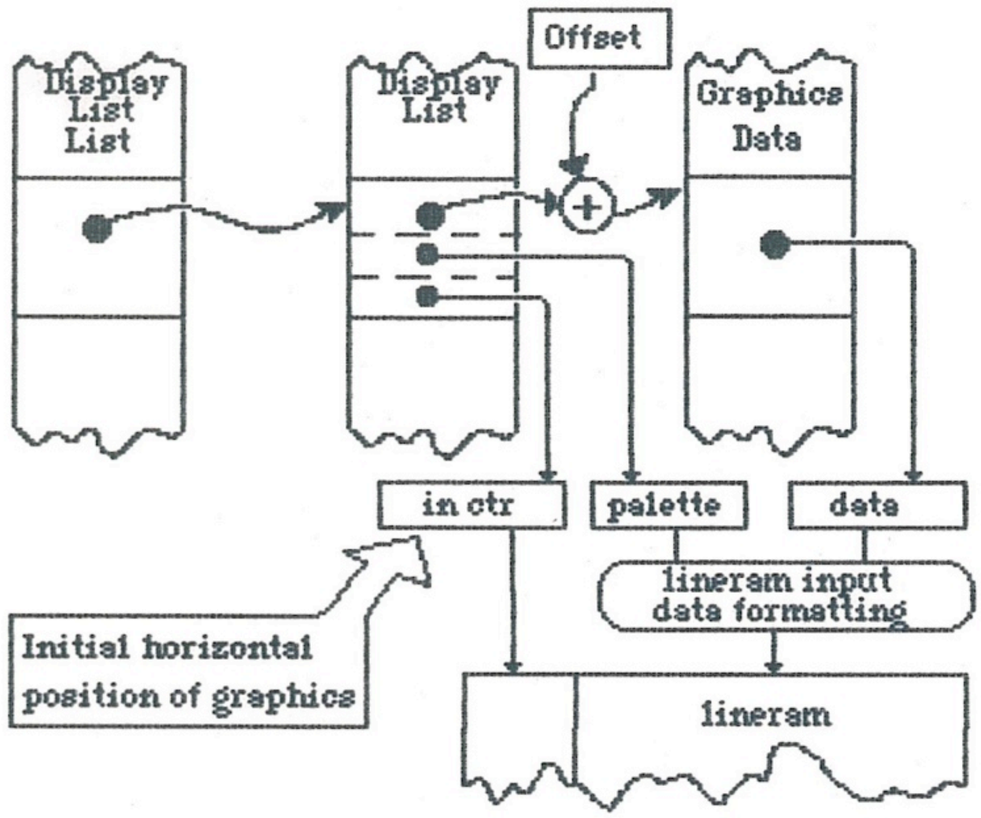
An object is described by a data block called a **header**. A single header contains information as to an object's *width, palette, horizontal position,* and *address* (the location in microprocessor memory to find the graphics data patterns describing the object. If an object is a character map, the address in the header is that of the map, not of the actual graphics data to be displayed.

A **display list** is a variable-length sequence of headers. When the last header of a display list is read (signified by a special header), the dma for that scanline ends, and the microprocessor is allowed to continue its work. Display lists are read by the dma controller each visible scanline of the video image. A given display list is read repeatedly for each scanline of its **zone**.

A zone is defined by the **display list list** which is a list of display list pointers and zone-heights. Each display list list entry contains an address pointer to the first byte of a display list, a 4-bit zone height field, and three control bits which will be described later.

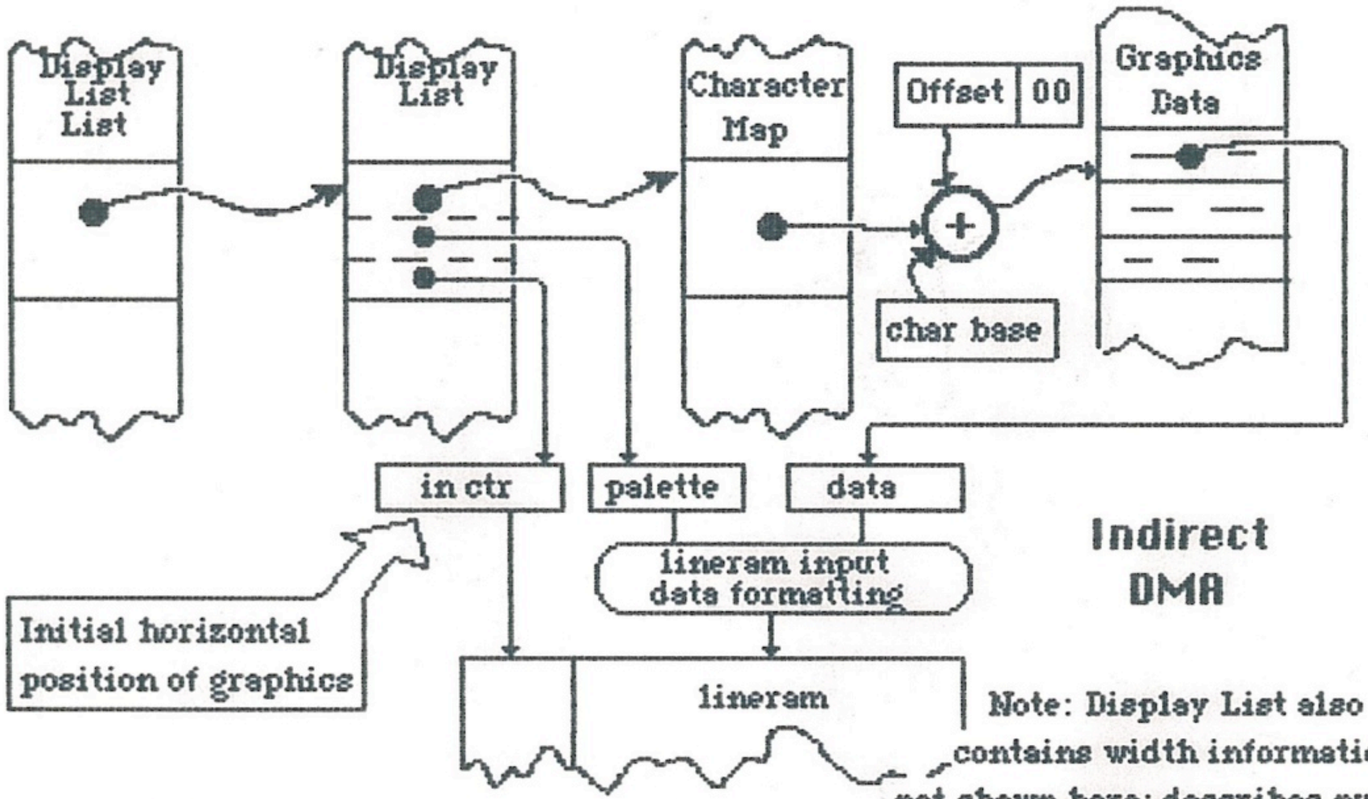


Maria II Block Diagram



Direct DMA

Note: Display List also contains width information, not shown here.



Indirect DMA

Note: Display List also contains width information not shown here: describes number of characters in char map.

5/16

① May 21 ▽ show to media + distribs

② June 5 CES

③ late June ? early July ? first public sale

"middle July" – Joel Oberman

1984 Summer CES

TO: CES people
FROM: Doug
RE: CES
DATE: May 25, 1984

On Sunday, June 3, Atari will be officially introducing the 7800 ProSystem at the summer Consumer Electronic Show in Chicago. The entire system will be shown with stations showing the following projects:

Ms Pacman	Pole Position	Centipede
3D Asteroids	Joust	Dig Dug
Desert Falcon	Robotron	Galaga
Xevious	Food Fight	Ball Blazer
Rescue on Fractalus	Track and Field	high Score Cart
5200 Adapter	Basic	Atari Lab
Text Editor	Typing Tutor	Terminal

In addition 2600 Jr Pacman, 2600 Track and Field, and 5200 Jr Pacman will be shown.

General Computer will be sending a group to the show to help with the introduction of our product and to learn more about the consumer electronic field. General Computer people will be manning (and womanning) the stations to explain the products and to help with questions. It is estimated that each person will work one three hour shift each day. More information on this will be available next week.

This is a business trip. Meetings and group discussions regarding the show will be scheduled. Everyone is asked to please follow the travel plans that have been made for the group. Changes will be made for emergency/unavoidable situations only. All changes should be taken care of no later than Tuesday, May 29, by Mary Jo.

General Computer's policy on shows allows people to attend any show at which a

GCC Consumer Electronics Party Line

In general, keep people's attention on the 7800. We are there to get people excited about the 7800, not to talk about the GCC-Atari relationship or to talk about Atari's situation.

Specifics:

o Don't be the first person to bring up who you work for during a conversation.

o Wear your Atari badge while on duty.

o If asked, you may say that you work for a design group that is affiliated with Atari. If pressed, you may say that you don't work in California. Don't go beyond this though; refer persistent questions to the Atari staff.

o If you are asked if GCC designed the 7800, say that it was done jointly with Atari. Be vague about who did what (even though we did it all).

o Atari reorganization and layoffs: No comment. Refer to Atari.

o Encryption: this is a little sticky since Atari hasn't really announced encryption. Say that you don't know anything about it, even whether it exists or not.o Availability and Pricing:

Base unit:	July	$149 retail
Keyboard:	Fourth quarter	Under $100
HSC:	Fourth quarter	Not yet determined
Int'l:	Third quarter	Not set; varies among countries

May 31, 1984

Doug Macrae & Mike Feinstein
GENERAL COMPUTER, CO.
215 First Street
Cambridge, Mass 02142

Gentlemen:

Attached are copies of the press releases prepared by Atari to announce the 7800 game system and peripherals at C.E.S. Please use these as a guide to prepare those G.C.C. employees who will be on duty at the booth.

On the issues of pricing and availability, please have your people follow the information given in the press releases as closely as possible.

Given the recent reorganization and reduction in work force here at Atari, management is stressing the need to express a positive attitude towards Atari, our products and the video game market.

As frontline spokespersons for Atari we will all be subjected to critical questions on these issues. If questions arise which cannot be answered from the materials provided here, please have your people consult Atari product management personnel, who will always be on duty at the booth.

I am looking forward to meeting and working with all of you.

Mike

Mike Pommer
Sr. Product Manager

CONTACT: Jamie Williams
(408) 745-5312

Margaret Lasecke
(408) 745-5624

FOR IMMEDIATE RELEASE

ATARI DISPLAYS ADVANCED 7800 PROSYSTEM VIDEO GAME

CHICAGO (June 3, 1984) — Atari Inc. today displayed the 7800 ProSystem, a powerful video game console that boasts the most advanced color graphics of any home computer or video game currently available. The versatile ProSystem, which plays a new line of software as well as all game cartridges designed for the ATARI 2600 Video Computer System, can be expanded into an introductory computer with the addition of an optional full-stroke keyboard.

To maximize its extraordinary graphics capabilities— made possible by a custom semiconductor chip nicknamed "Maria" — Atari showed 13 specially designed games for the 7800 ProSystem. The recently announced ATARI/LUCASFILM* titles are featured on the ProSystem, as well as an original game, five exclusive arcade hits never before available for any home system and five arcade favorites with enhanced graphics.

In a technological advance, the 7800 ProSystem will play the nearly 400 video game titles designed for Atari's popular 2600 VCS — without an adapter. In addition, Atari 5200 owners will have access to the 7800 ProSystem library of software via a special adapter that also will play 2600

To transform the 7800 ProSystem into an introductory home computer, the owner can attach an optional full-stroke professional keyboard to the system. The 7800 Computer Keyboard is compatible with virtually all Atari Home Computer peripherals. A line of selected computer software, including word processing and creative learning and personal development titles are scheduled to be available on the system. The Computer Keyboard will operate with 4K of Random Access Memory (RAM) expandable to 20K, ample memory for the novice.

"We believe the 7800 ProSystem represents the state of the art for video games," said David Ruckert, executive vice president of Atari. "The 7800 ProSystem is a complete system that will grow with consumers through the 1980's."

A spokesperson from Toys-R-Us, one of the leading consumer electronics retailers in the United States, said, "There are still many opportunities for new entries into the video game market that use new technology to create innovative products."

As the premiere video game in the market, the 7800 ProSystem packs several trendsetting features and capabilities not available before on any single system.

Beginning in September, the 7800 ProSystem will come equipped with Pole

The 7800 ProSystem also features new ProLine Controllers. The controllers, smaller and more streamlined than earlier models, have a self-centering joystick and independent firing buttons easy-to-use for both right and left handers. In addition, all joysticks and controllers for the 2600 VCS are compatible with the 7800 ProSystem.

A new Hi-Score cartridge provides at-home game enthusiasts with a feature that has fueled friendly arcade rivalries for years: the ability to record top scores. By inserting the special Hi-Score cartridge, players for the first time can record high scores achieved in up to 65 games.

In addition to an almost limitless color palette and eye-popping resolution, the 7800 ProSystem can display more than 100 video characters simultaneously — a tremendous advance over competitive home systems. Designed by Atari's software engineers, the unique transistor circuitry in the "Maria" chip creates arcade-like graphics that previously required a circuit board 10 times larger to produce.

The 7800 ProSystem also features an expansion interface connector that will allow the use of future technologies with the system.

The 7800 ProSystem will be shipped in July and it will sell for approximately $150.00. The optional

ATARI INTRODUCES 7800 PROSYSTEM
COMPUTER KEYBOARD SOFTWARE

CHICAGO (June 3, 1984) -- Atari Inc. today unveiled the first four programs in a line of introductory computer software to be used with the 7800 ProSystem Computer Keyboard, and the first two educational products available for the powerful new game system.

The Computer Keyboard transforms the newly announced 7800 ProSystem videogame console into an introductory computer designed for the first-time computer user. The software covers a wide range of topics, including telecommunications, typing, word processing, programming and science.

'This software demonstrates the versatility of the 7800 ProSystem which boasts the most advanced graphics of any home computer or video game currently available,' said David Ruckert, executive vice president of Atari. 'It is further proof that the 7800 ProSystem is the system that will grow with consumers.'

-- more --

What could possibly go wrong?

July 1, 1984

Jack Tramiel

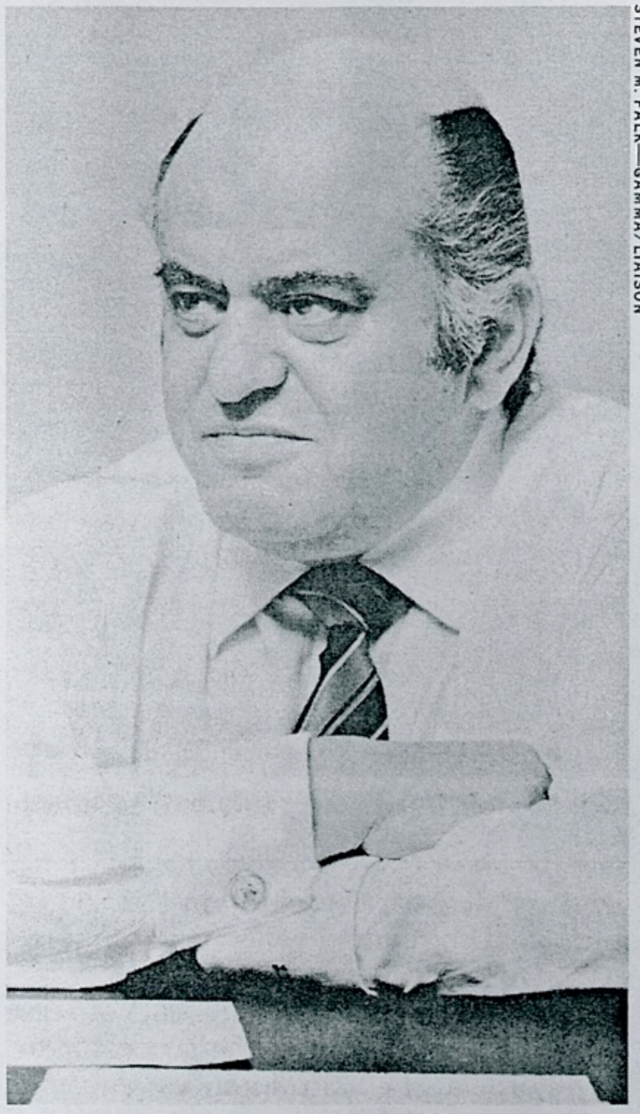
TIME, July 16, 1984

A New Pac-Man

Jack Tramiel gobbles Atari

Of all Silicon Valley's microchipped wonder companies, Atari was one of the earliest and most colorful. It gave birth to the video-game industry and churned out amusements like Pong, Asteroids and the home version of Pac-Man. It saw its sales explode from $30 million in 1976 to a peak of $2 billion in 1982. It spun off famous employee alumni, like Steven Jobs, co-founder and chairman of Apple Computer. Physically, it spread to 49 buildings around Sunnyvale, Calif. But its fall came even faster, as a fickle public cooled to its video games. Losses hit $539 million last year. Not even TV commercials featuring *M*A*S*H* Superstar Alan Alda could revive Atari. Last week Warner Communications, which has owned Atari since 1976, gave up on turning the company around and sold it. The principal buyer and new boss: Jack Tramiel, 56, a blunt, balding executive whose adage is "Business is war."

Tramiel, the former president of Commodore International, who built it into the leading home-computer manufacturer, will pay no cash for Atari but will pick up $240 million of the company's debts. He will also get rights to buy 1 million Warner shares at $22 each, about equal to last week's price. Warner, which evidently believes that Tramiel can succeed where it failed, will hold onto a 32% stake in Atari.



STEVEN M. FALK—GAMMA/LIAISON

The boss at Sunnyvale: "Business is war"

Unleashing a mighty flood of pink slips.

complete, undisputed authority." The new chairman's blitz would make Atari "leaner and meaner," said Vice President Bruce Entin. "The guy was in command. He was kind of like a general."

A Polish immigrant and survivor of

July 1984

Jack Tramiel wants to build 100,000 7800 for Christmas 1984

retail for $50 (we planned for $150)

carts retail for $10–$15 (half of plan)

cost-reduced 2600 for $40

7800 R.I.P.


FRAGILE
THIS SIDE UP

Maria coin-op?

Maria Convertible Game System

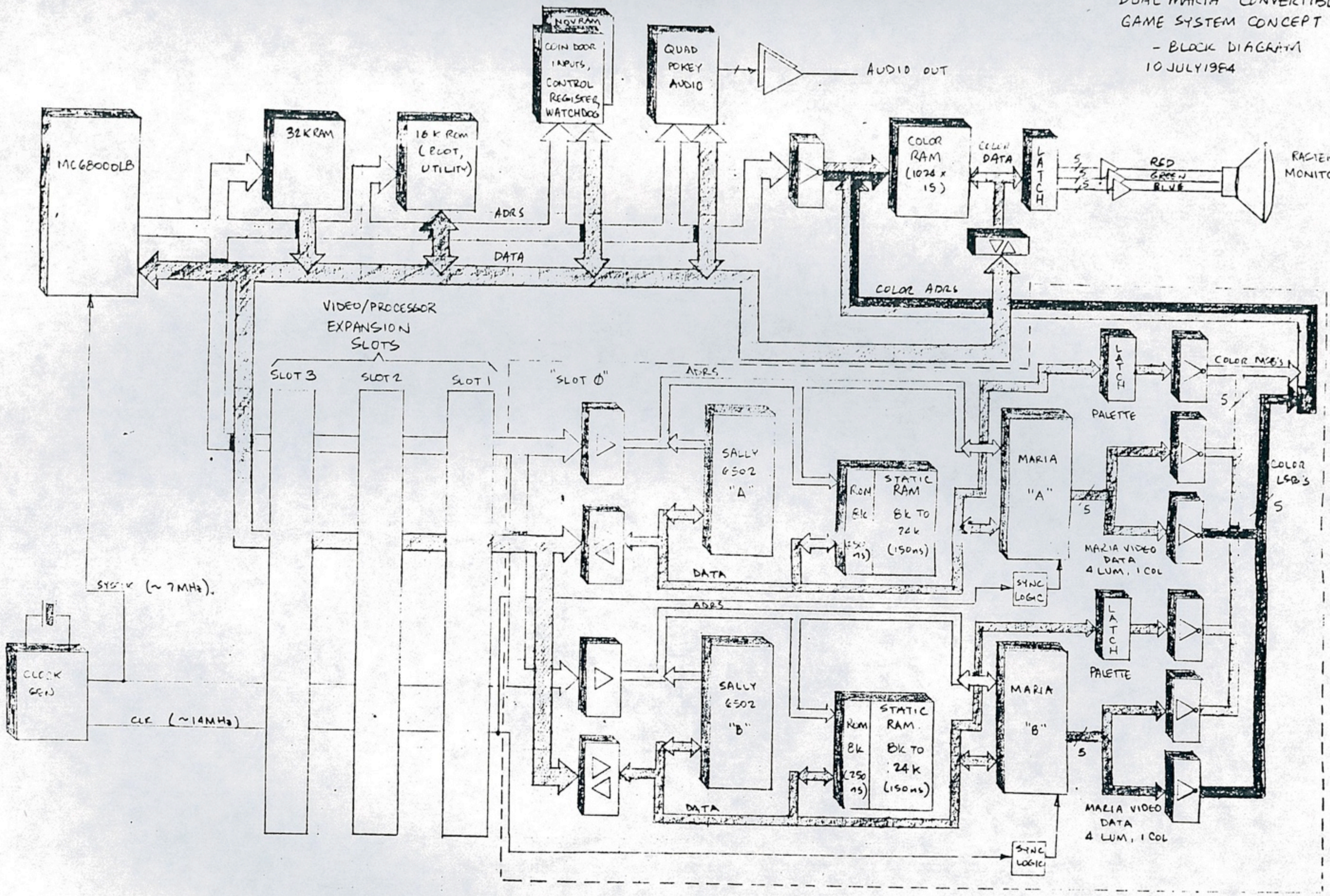
This system was designed to achieve the following goals:

1. Low cost
2. Use avaiable parts
3. Allow simple expandability
4. Use a fast processor which supported high level code

This system employs the Motorola 68000L8 processor which is readily available and dropping in price. The graphics subsystem uses two 6502 microprocessors and two 1702B *Maria* graphics processors. The resulting combination of the 68000 processor and two 6502 microprocessors gives a large amount of flexability and a very high level interface between hardware and software. This high level interface will make game programming on this system easier and more straight forward.

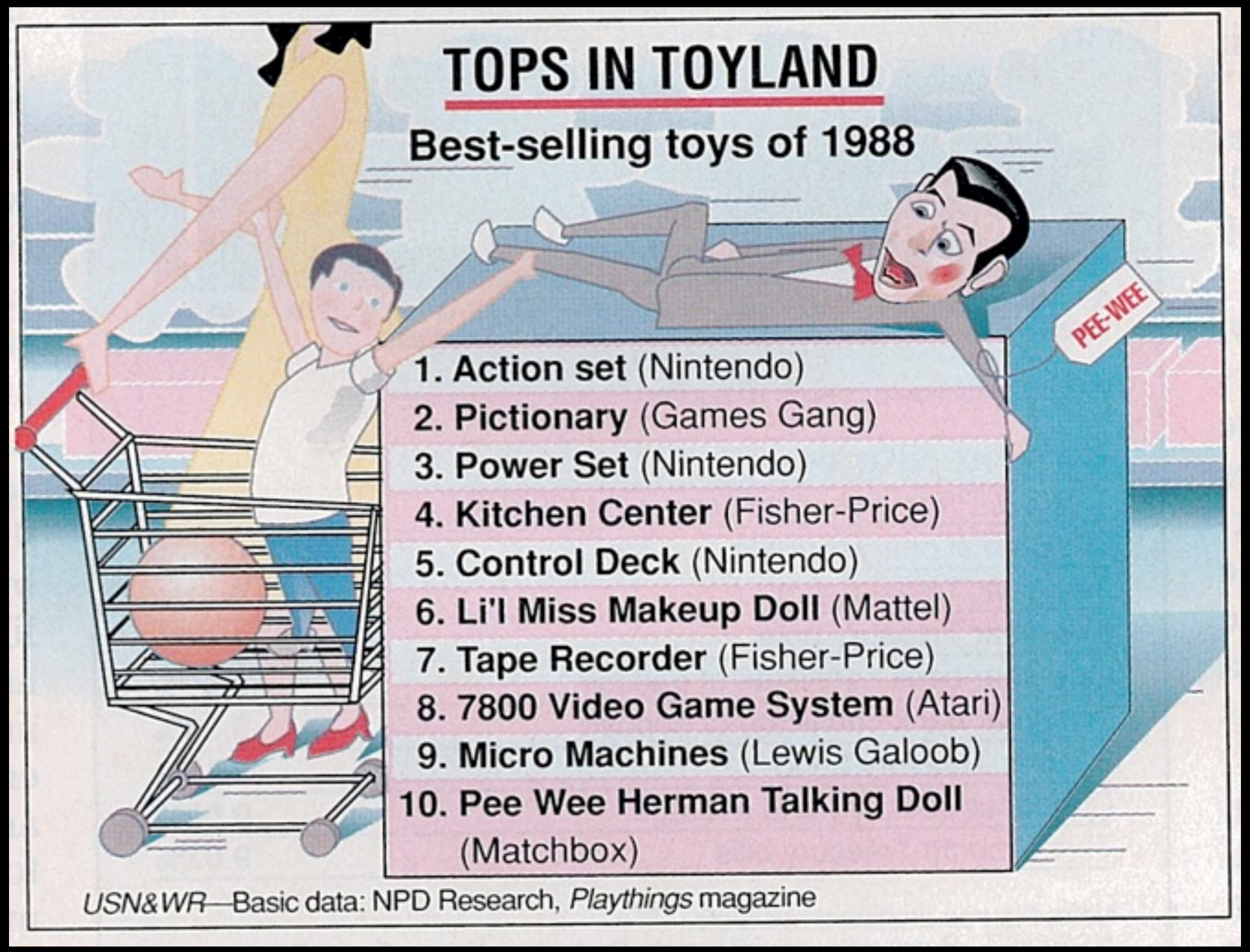
The system will allow changing games to be as simple as plugging in a cartridge. The most complicated change may involve removing one or more previously installed cartridges and plugging in one or more new cartridges. The front panel interface could be easily manufactured as a cartridge and simply plugged in when the new front pannel is installed.

DUAL "MARIA" CONVERTIBLE
GAME SYSTEM CONCEPT
- BLOCK DIAGRAM
10 JULY 1984



7800 R.I.P. ?

1988


TOPS IN TOYLAND
Best-selling toys of 1988
1. Action set (Nintendo)
2. Pictionary (Games Gang)
3. Power Set (Nintendo)
4. Kitchen Center (Fisher-Price)
5. Control Deck (Nintendo)
6. Li'l Miss Makeup Doll (Mattel)
7. Tape Recorder (Fisher-Price)
8. 7800 Video Game System (Atari)
9. Micro Machines (Lewis Galoob)
10. Pee Wee Herman Talking Doll (Matchbox)
PEE-WEE
USN&WR—Basic data: NPD Research, Playthings magazine

Products designed by GCC for Atari 2600, 5200 & 7800 Game Systems Atari 400/800 Computers

Asteroids, Atari Video Cube, Ballblazer, Battlezone, Berzerk, Centipede, Combat II, Desert Falcon, Dig Dug, Food Fight, Galaga, Galaxian, Joust, Jr. Pac-Man, Jungle Hunt, Kangaroo, Millipede, Moon Patrol, Ms. Pac-Man, Phoenix, Pole Position, Pole Position II, Qix, RealSports Tennis, Rescue on Fractalus, Robotron 2084, Track & Field, Vanguard, Xevious

Q & A