American Classic Arcade Museum presents

From Crazy Otto to Ms. Pac-Man

Steve Golson

ReplayFX
July 31, 2015

Introduction

Who am I

What was General Computer (GCC)

When did it happen

Why it matters

MIT 1978

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

Speedup Kits

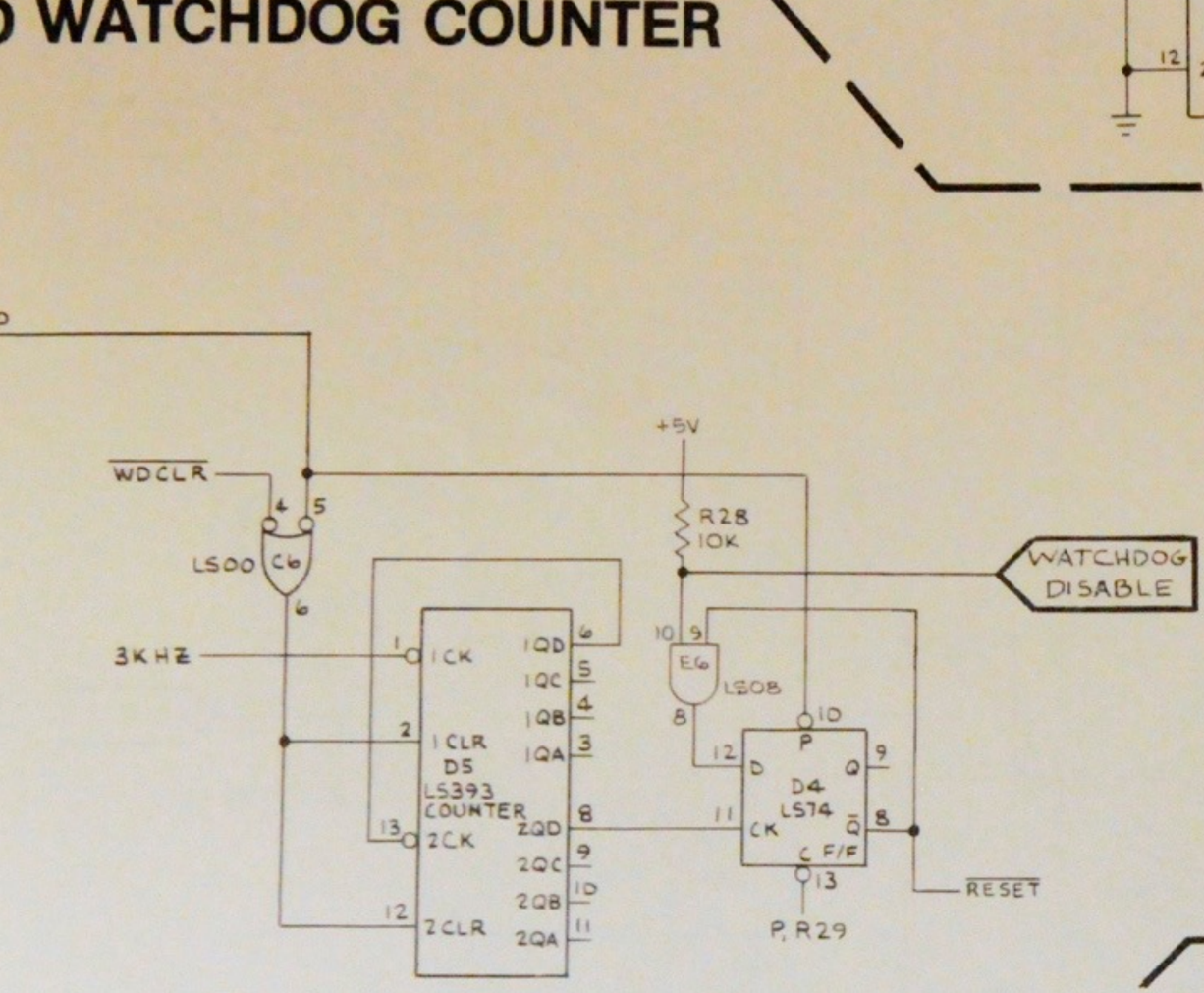
Asteroids

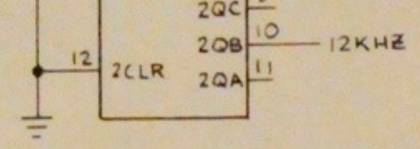
Atari, 1979

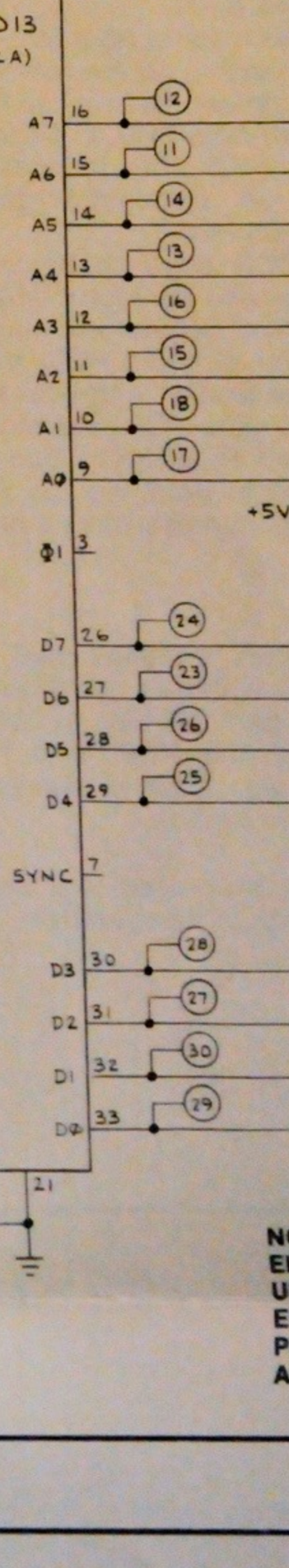
Vector display

Interrupt driven at 250Hz

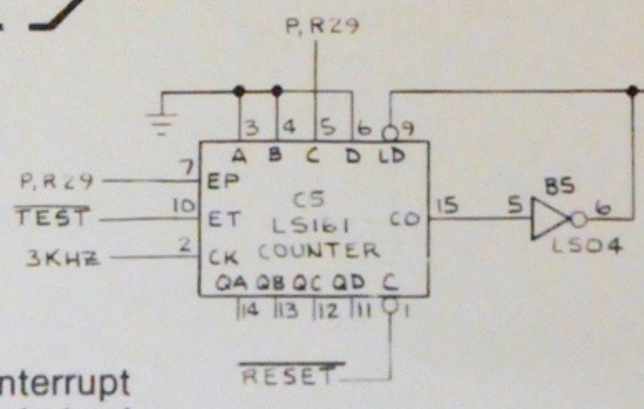
WATCHDOG COUNTER







NMI COUNTER



The NMI (non-maskable interrupt) counter causes an interrupt at the NMI input of the MPU every 4 msec. The interrupt is derived by dividing 3 KHz by a factor of 12 through counter C5. The interrupt occurs when pin 6 of inverter B5 goes low. During power-up, the NMI counter is disabled by $\overline{\text{RESET}}$. During Self-Test, the NMI is disabled by $\overline{\text{TEST}}$.

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pinball
Boar, 6212
55424

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monitors
or $2195.00
. 503/684-

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town, PA.

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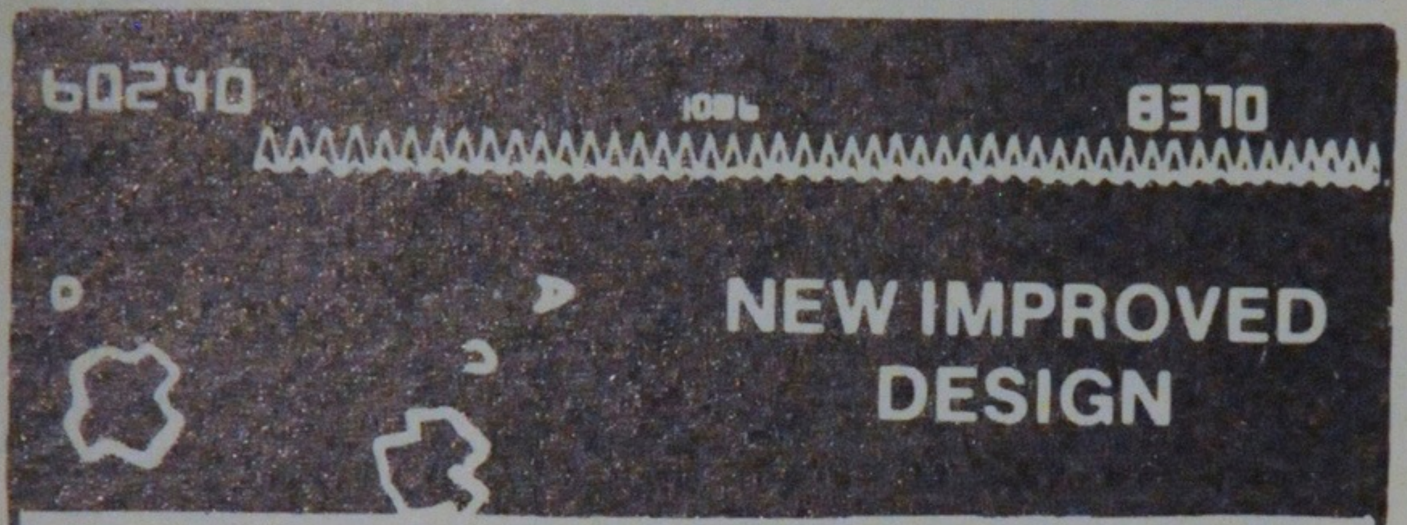
Mountain Climber in excellent condition. Bally Bingos, Silver Sails, Roller Derby Lido's, all with innovations. CALL 314/636-4096.



Asteroid Operators - DON'T LET THIS HAPPEN TO YOU! Our modification Kit II is adaptable to all asteroid games allowing you to vary any of 3 speeds. virtually eliminating machine turnover, even with your best players! **TESTED and PROVEN.** Games with this modification kit take in more money and faster than any other game on the street. **Kit II** installs in minutes without changing chips. **Kit II** was designed to improve play and increase profits and is operator adjustable. INCREASE PROFITS IMMEDIATELY send $19.95 +$2.00 shpg (includes all parts necessary to modify 1 game)

To **Design Wizardry, ltd.**
P.O. Box 519, Brooklandville, Md. 21022

Used cocktail ta

Berzerk (uprigh
Asteroids (uprig
Carnival (uprigh
Galaxian(uprigh
Moon Cresta(co
Carnival(cocktai
Astro Fighter (c
Space Invaders
Space Invaders
Space Invaders
Space Firebird.
Asteroids (Atari

All games c
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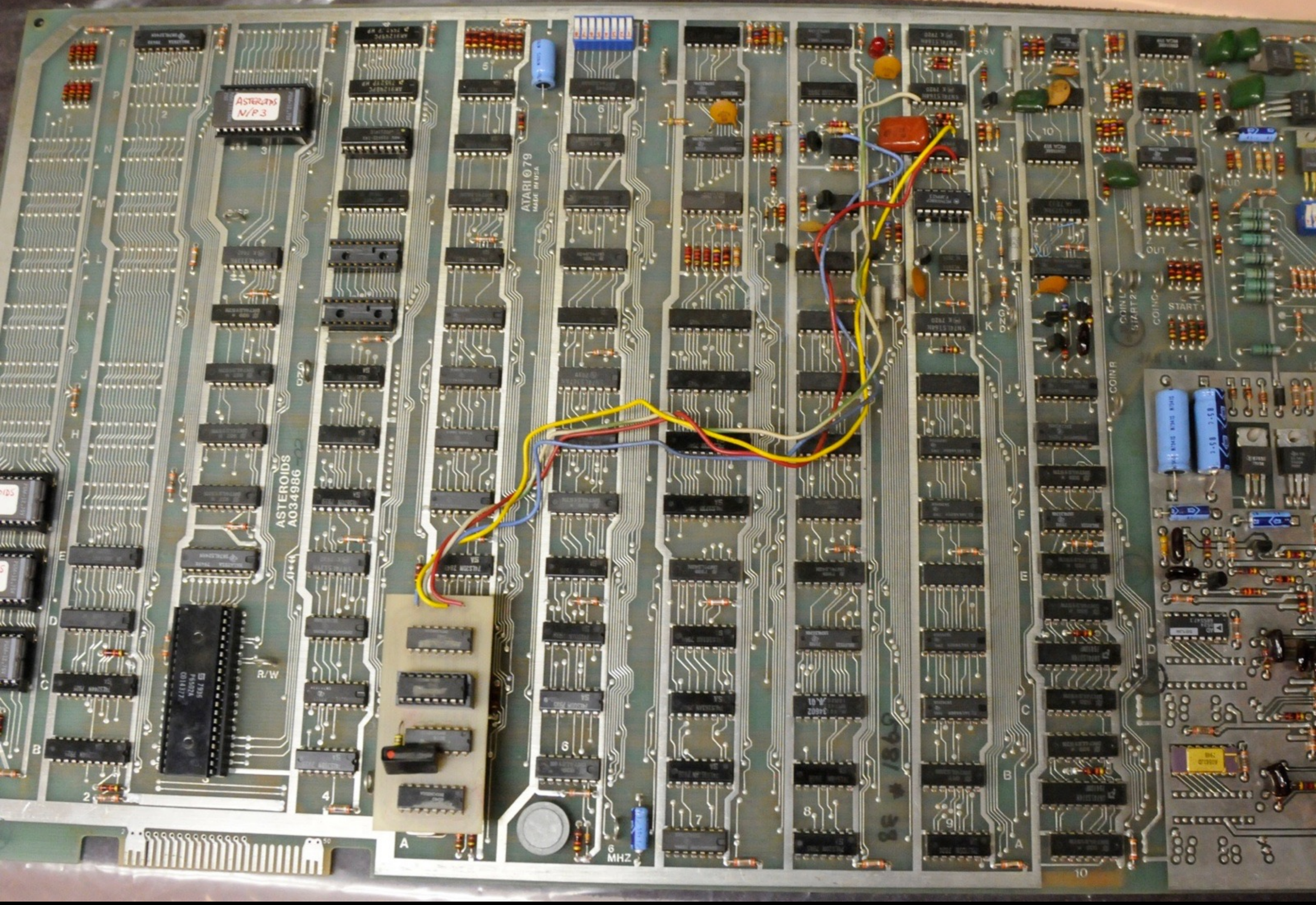

ASTEROIDS
N/P 3
ATARI 079
ASTEROIDS
A034986
R/W
6
MHZ
COIN R
COIN L
START 2
START 1
+5V
GND
AUDIO
OUT

Galaxian

Namco/Midway, 1979

Character display

Tables in ROM

ing UFO which fires a laser weapon tha
cities and missile bases. The plane now d
bombs. We've extended the play to the
The game has new sounds and new color
out. Another feature is that the difficu
operator-selectable. All together, it is re
an exciting amusement device," he boas

"We knew we had a winner when th
lease version was first put on a test loc
large college dormitory. 'Missile Comm
were calling fellow fans from all over ca
first two days brought in a solid $16
week was over $400; the second week
This was a dramatic increase from the p
the enhancement kit was installed. The k
the million point player to a quick 50,0
points," Curran declared.

To install this kit, the operator ba
moves the six Atari ROMs, plugs them i
al's board, then plugs this board into th
ant Atari ROM sockets and turns on the

"We have a very reliable unit, and e
tested before it leaves the factory," Cu
"Should a problem occur in the field w
mediately send out a new unit via UPS F

How well is the product doing so fa
says one problem is that many operator
personally experienced "the economic a
of a software enhancement kit such as
Missile Attack'. As operators, the prev
ware enhancements we utilized made a
of money for our route. 'Super Missile
doing the same thing. There's an arcade
New York City who loves our software
ion. He said he had it on 50 cent play
over $600 in one week. He thought it w
fantastic."

Curran also says the hit video game
out by the factories are "fantastic mone
Current hot videos cost $2,500 or more
generate tremendous revenue for sever
but as the players develop their hard-ea
they are able to tie up the machines for
periods of time. Sometimes, the play
good at a game that it bores him, so he s
ing it. Our business is to provide softwar
ments to pump higher earnings from a
high-quality cabinet the operator already

The new company has already deve
of the two-man partnership and now
roster of eight engineers and several su
ple (including field engineers Steve G
Chris Rode). Their Wayland, Mass. orga
currently working on two additional so

Pac-Man

Namco/Midway, 1980

Character display

Maze tables in ROM

Separate graphics ROMs

Missile Command

Atari, 1980

Sophisticated programming

Bitmap display
256 x 231, pixel addressable

2 or 3 bits per pixel

March 1981

General Computer Corp.

Super Missile Attack

enhancement kit for
Atari Missile Command

Design flow at GCC

GenRad 6502 microprocessor emulator

- Disassembler (single screen only)
- Memory display/modify
- Interactive edit/assemble/run

TRS-80 to capture MC code and notes

Design flow at Atari

Designer writes code on programming sheets

Typist enters code into DEC PDP11

PDP11 cross-assembles

Floppy disk/serial port download to blue/black box

Designer marks changes on listing

Typist edits files

Repeat…

SUBROUTINE 5458

UPDATE CLOUD STATUS

```
5458    LDY     00B4    <- [redacted]
        DEY
        BPL     545F
        LDY     #04
545F    STY     00B4
        LDA     008E    <- #CURRENT CLOUDS
        BEQ     54B0    (NO CLOUDS)
        LDX     54B2    -- 3
5468    LDA     016E,X
        BEQ     54A7
        STA     009C
        INC     01C2,X
        LDA     01C2,X
        AND     #7F
        TAY
        CMP     #1B
        BCC     5492
        LDA     01C2,X
        BMI     5486
        DEC     008F
        CLV
        BVC     5488
5486    DEC     0090
5488    DEC     008E
        LDA     #00
        STA     016E,X
        CLV
        BVC     54A7
5492    LDA     0139,X
        STA     009B
        LDA     54B7,Y  }
        STA     00B5    }  JSR RADII
        LDA     54B8,Y  }
        STA     009A
54A1    JSR     5E71
        JSR     54D4
54A7    DEX
        LDY     00B4
        TXA
        CMP     54B1,Y
        BNE     5468
54B0    RTS
```

~~(DEXING) JMP 5492~~

JMP CONDITIONAL CHECK
INC
JMP NORMAL

CLOUD RADII CALCULATIONS

USR RADIUS!
STA 9A
JMP 54A4

JSR CONDITIONAL DRAW

;DRAWS CLOUD
;DESTROYS MISSILES IF WITHIN CLOUDS

Start	End	R/W	Description	Type/bytes
....				
002C	0043	R/W	Initials for "High Scores"	A 3
0044	0056	R/W	Scores for "High Scores"	BCD 6
....				
0066	0066	R/W	Number of credits.	Byte
....				
009F	009F	R/W	Important to Interrupt handler	
....				
00A0	00A2	R/W	No. of missiles in a base (L to R)	
....				
00C0	00C0	R/W	Number of cities	
00C5	00C5	R/W	City map !3!5!4!1!2!6!X!X!	(Notation indicates correspondence of bits in the byte to existence of city.)
....				
00ED	00ED	R/W	Coin switches	Bit?
00EE	00EE	R/W	Game switches	Bit?
....				
00F6	00F6	R/W	Coin switches	Bit?
00F8	00F8	R/W	Coin switches	Bit?
....				
01E0	01FF	R/W	Stack	
0200	05FF	R/W	3-bit-color region of screen	Bit
....				
0640	37BF	R/W	2-bit-color region of screen	Bit
37C0	3FFF	R/W	3-bit-color region of screen	Bit
....				
4800	4800	R/W	Coin switches	Bit?
4900	4900	R/W	Game play switches	Bit?
....				
4C00	4C00	W	Watchdog	
4D00	4D00	W	Interrupt Acknowledge	
....				
7312	7319	R	Pixel map for blank	Bit 8
731A	7369	R	Pixel map for 0-9	Bit 8
736A	7439	R	Pixel map for A-Z	Bit 8

9 A B C D E F 0 1 2 3 4 5 6 7

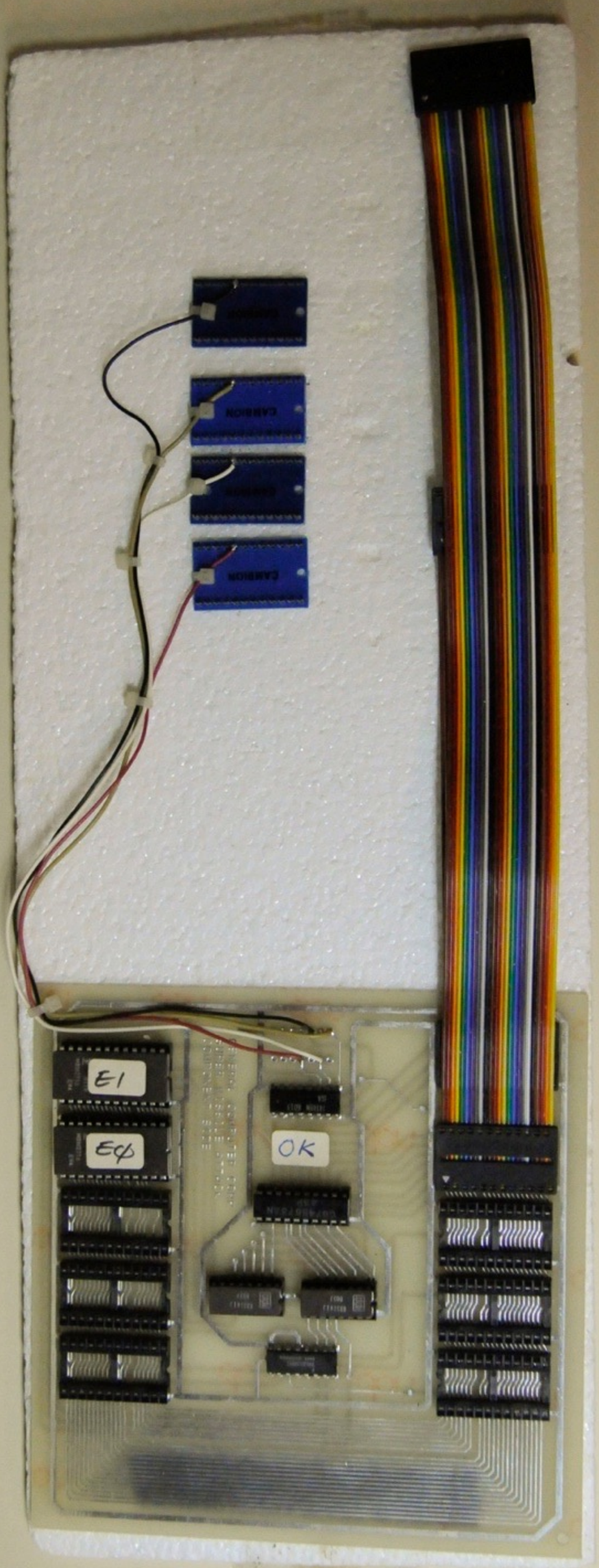
3

2

1

F

D


CARBON
CARBON
CARBON
CARBON
E1
Eφ
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.

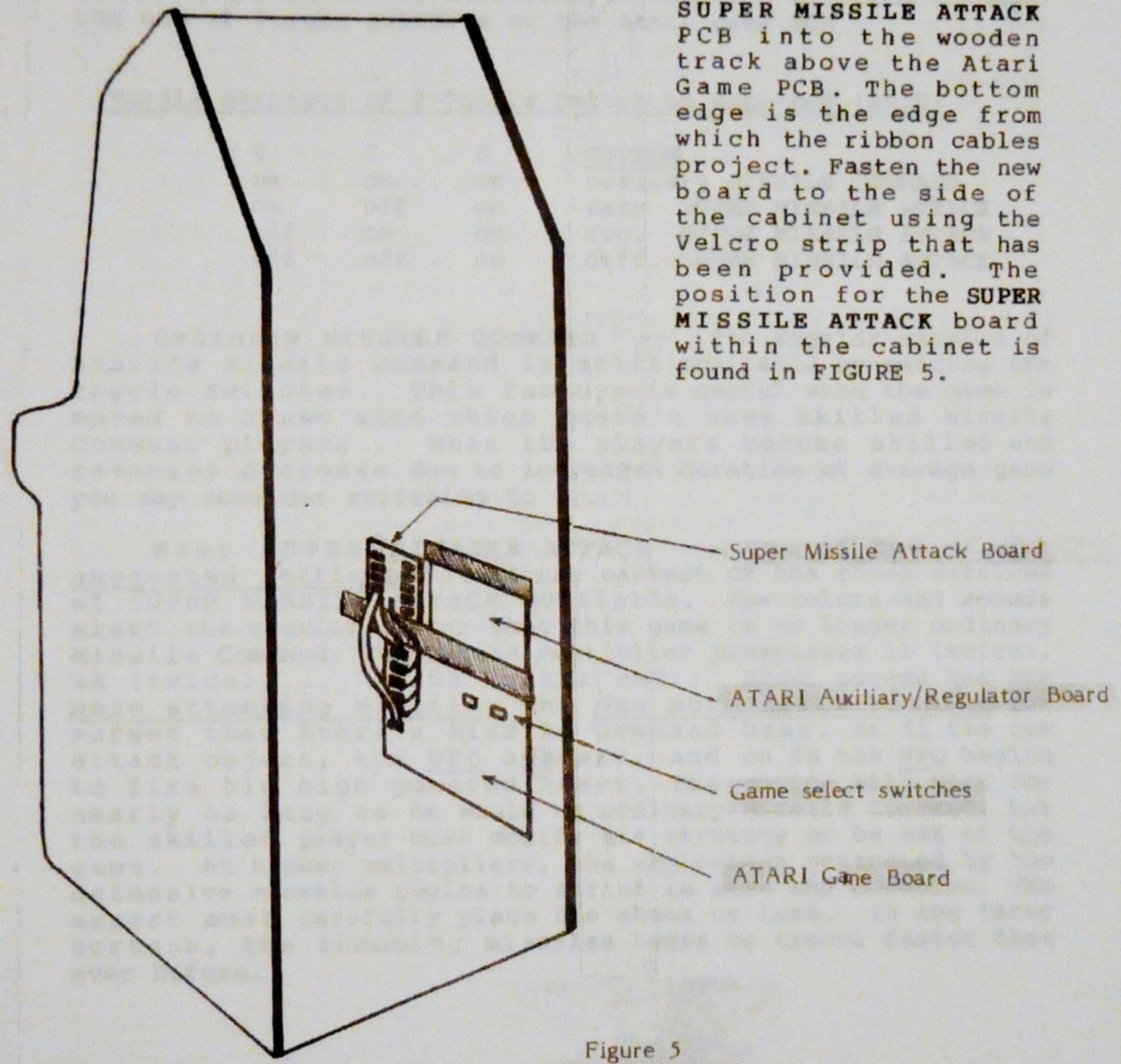
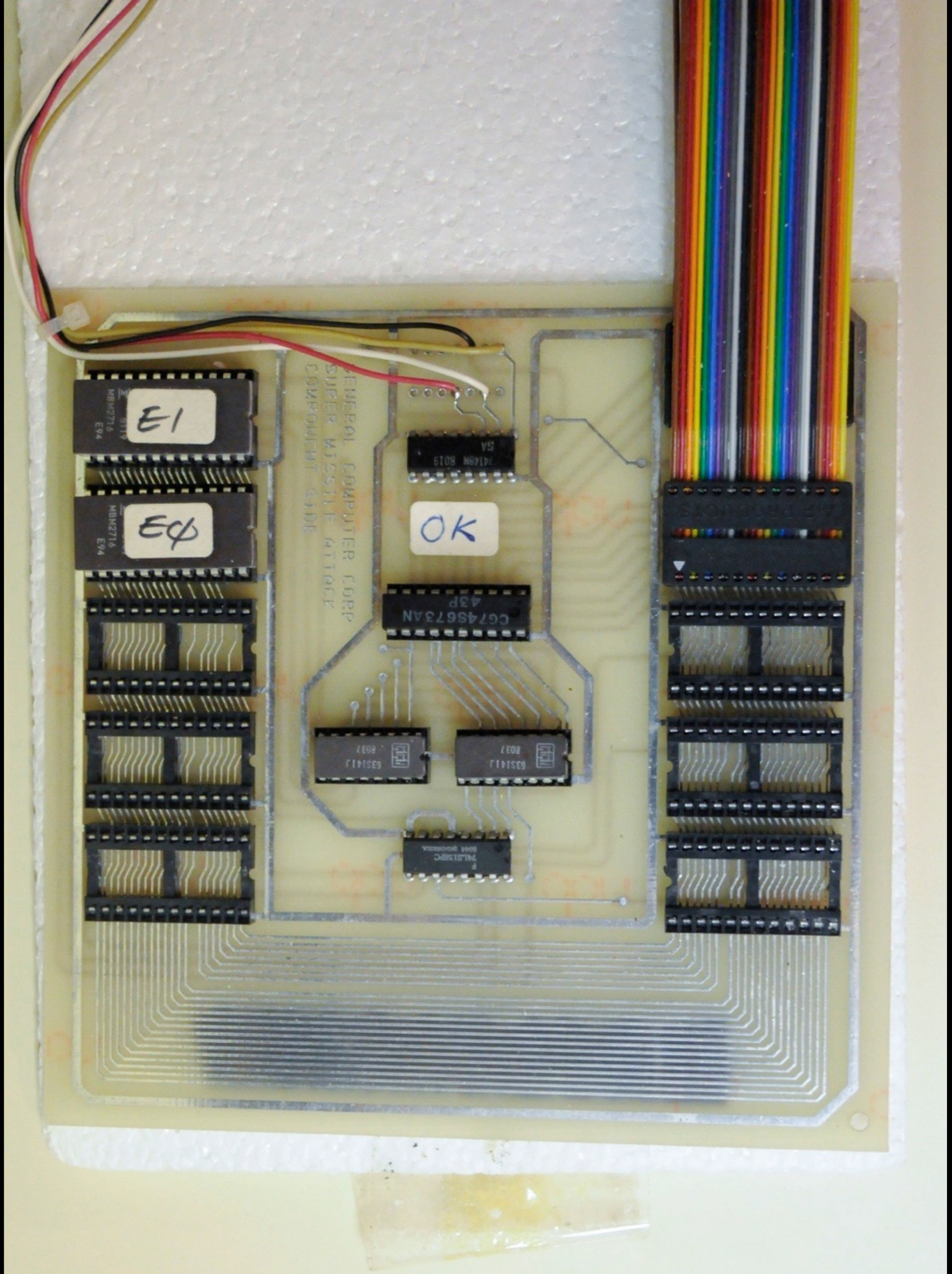


Figure 5
Completed Assembly


E1
Eφ
OK
GENERAL COMPUTER CORP
SUPER MISSILE ATTACK
CORPORATION 6108

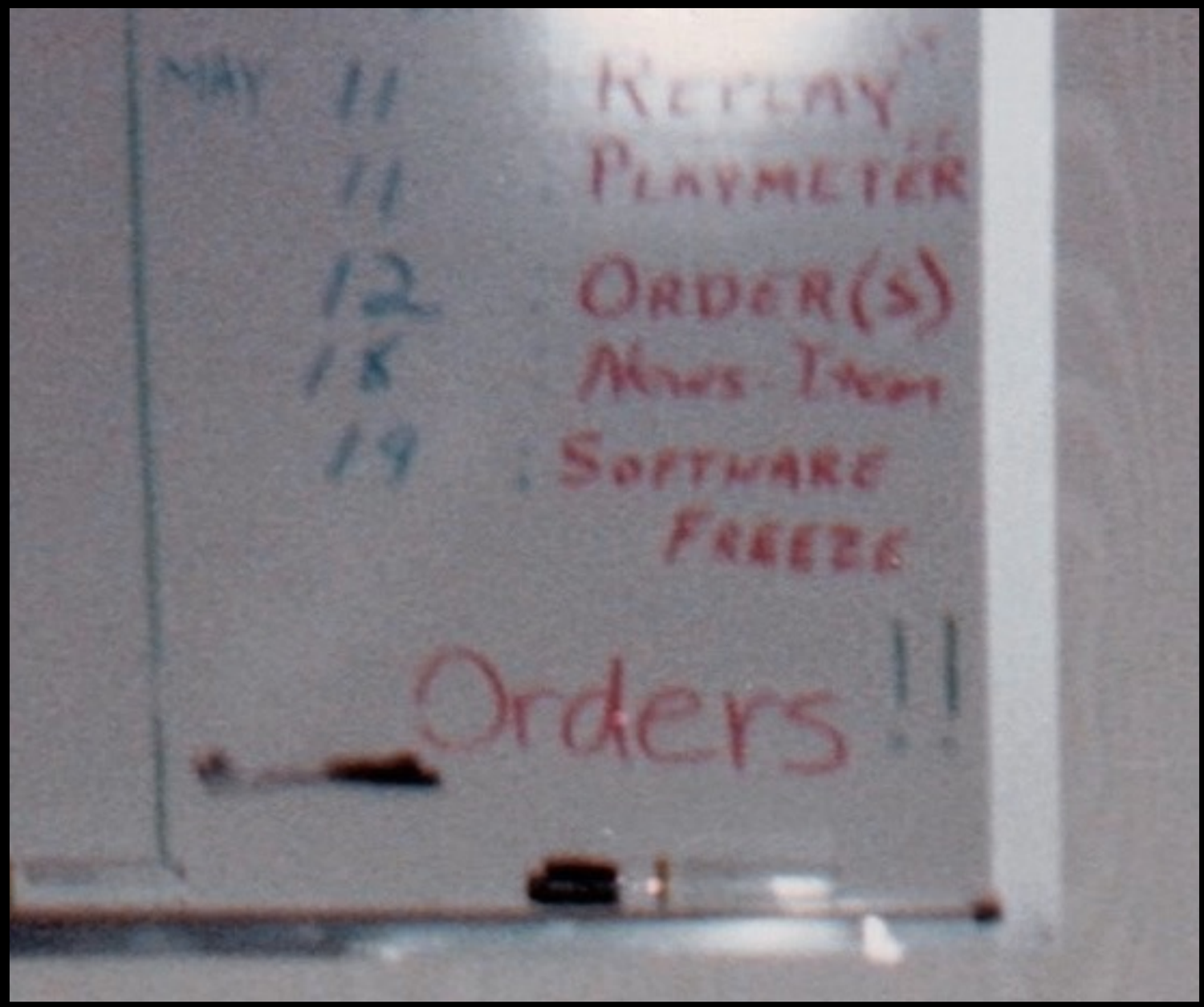
PAL markings removed
and replaced with:

GCC74S673AN
43P

Oh well.


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

Scheduling


MAY 11 REPLAY
11 PLAYMETER
12 ORDER(S)
18 NEWS ITEM
19 SOFTWARE FREEZE
Orders !!

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**
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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.

Super Missile Attack

Game Play

Attract Mode

UFO

Developers of Super Missile Attack

Doug Macrae

Kevin Curran

John Tylko

Chris Rode

Larry Dennison

Steve Golson

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

Boston Globe, July 31, 1981

Customer plays Atari game.

New game plan lands 2 in $10m court case

By Ronald Rosenberg
Globe Staff

When Atari's coin-operated video game Missile Command gets dull, arcade operators can breathe new life into it just by sliding in a printed circuit board.

Instead of scrapping the game and buying a different machine, which costs $2500, General Computer Corp. of Wayland will retrofit it for $295 with a board that contains the software for a new game that provides more play objects and a greater degree of difficulty to challenge customers anew.

But inexpensively tweaking Missile Command (there are more than 10,000 already installed) for greater play value does not sit well with the joint chiefs at Atari, a wholly owned subsidiary of Warner Communications Corp.

So they have fired off a $10 million lawsuit against Kevin Curran and Douglas Macrae, who last month founded General Computer, claiming they have violated Atari's copyrights and trademarks.

The suit, filed yesterday in US District Court, Boston seeks to stop the small company from manufacturing and selling the single board. The Sunnyvale game firm also wants $5 million each in punitive damages from Macrae and Curran along with all profits from the add-in board.

"They (the General Computer game enhancment) appear to our customers and to the public as Atari products, creating confusion and siphoning off legitimate returns from our investment in research and development," said Frank A. Ballouz, Atari's vice-president of marketing for the coin-operated video-game division in a prepared statement.

Curran claims the enhancement, the company's first product, has been originally engineered. It went on sale in early June.

"We have tried to avoid all legal difficulties," he said yesterday. "We have not copied or infringed on their software and we will respond to their suit."

Boston Globe, August 2, 1981

Instruments Co. Ludlow Corp. of Needham owns a large block of Heinicke stock . . . **Atari** has asked for $10 million in a suit against General Computer Corp. of Wayland, which makes a printed circuit board which modifies Atari's Missile Command game . . . **Chevron USA** has agreed to pay $82.5 million to settle overcharging since 1973 . . . The Justice Department was de-

Boston Globe, August 14, 1981

Atari gets restraining order

Atari Inc. has received a temporary restraining order that bars General Computer Corp. of Wayland from selling its Super Missle Attack add-in printed circuit boards. An Aug. 25 review of the situation that led Atari to sue the small startup company was scheduled by US District Court Judge Robert E. Keeton. General Computer sells the boards, which slide into Atari's Missle Command game, to arcade game operators. Atari claims General Computer is infringing and diluting its copyrights and trademarks and is seeking $5 million in damages.

The Wayland-Weston Town Crier
August 20, 1981

Atari files $10 million suit against Wayland company

WAYLAND — If you want to add a little kick to your Atari "Missile Command," General Computer Corporation of Wayland will transform the $2,500 video game into "Super Missile Attack" for a mere $295.

The company, which was incorporated last March, began selling its software enhancer in June. The additional software is attached to an existing game through an overlay circuit without copying or changing any of the Atari software, according to General Computer Chairman Doug MacCrae.

Atari, however, stated in a press release that the new enhancer "infringes and dilutes" its copyrights and trademarks, labelling it "unfair competition." Last month, Atari slapped General Computer and its founders MacCrae and Kevin Curran with a $10 million suit.

MacCrae noted that he and Curran had contacted Atari in March while they were in the process of incorporating to see if their enhancement infringed on the company's rights.

Atari told them that it had never prosecuted anyone in the past on an enhancement and that it was not in the process of prosecuting anyone, but that there were rights that were held by Atari, related MacCrae. MacCrae also noted that those rights were never clearly defined.

Necessary Steps

"Back in March we took expensive, but necessary steps not to copy the Atari code," he said, later adding, "I was surprised that it (the suit) was slapped on us without consultation. I still feel that Atari lumped us together with pirates (those that copy and sell Atari software outright). I think they (Atari) decided to go ahead with the suit before they knew what we did."

MacCrae also pointed out that in the past other companies have developed mostly speedup kits; the General Computer version adds characters and difficulty to the game.

On August 11, General Computer submitted a second version of its enhancer to the courts, said MacCrae. In the new version, he explained, everything that Atari specifically complained about on its suit had been changed. The revised enhancer has new artwork for the exterior of the game cabinet and each symbol in the game itself, including the text font, has been changed from those used by Atari, he said.

"Of course, since this is an enhancement to their original game, it is still similar, but improved," commented MacCrae.

Atari had "no comment" about the second version of the enhancer.

Thus far, General Computer has spent between $20,000 to $30,000 in legal fees according to MacCrae's estimates. There is also a restraining order preventing the company from selling the original version of the enhancer. MacCrae expects a decision on the sale of the second version of the enhancer this week.

Company beginnings

Before its sales were frozen, MacCrae said, the company was doing very well. He and Curran, both students at the Massachusetts Institute of Technology (MIT), had been in business together before. The two owned and operated three video games in the dorms at MIT and had found that within two to six months players learned the game well enough to become bored or play for inordinately long periods of time.

"We decided the best remedy to this was to change the one weak part of the game - the software," said MacCrae.

Using their own machines for testing, Curran and MacCrae, along with several others built a software board which could enhance an existing game by giving the machine operator the option of increasing the difficulty.

Said MacCrae, "Our unit starts off easier and ends up more difficult than Atari's 'Missile Command.'"

Making the board was a full-time job. At the outset, company engineers, most of whom are MIT students, spent 24 hours a day in shifts working on it. After the first two-and-a-half weeks, they continued to spend 14 to 20 hours a day working on the project. To months later it was finished.

Smaller Salaries

Despite the initial success of their project, MacCrae noted that he and Curran are drawing smaller salaries from the company than they had received from other companies they had worked for in the past. MacCrae spent two years at Computervision in Bedford, first as an intern and then as a full-time employee. Working for himself was one of his ambitions.

Things went on schedule once MacCrae and Curran decided to start the business. They did original cost estimates, took out a loan and raised the rest of the capital themselves. Later, John Tylko, the only other shareholder in the company also invested some capital. Only the suit has disrupted their plans.

Stated MacCrae, "If enhancements (in general) are determined illegal, which I can't imagine, we are working on new game development ourselves.

Zapped by Atari

ATARI HAS LEVELED a $10 million dollar suit against Doug MacCrae (above) and Kevin Curran for infringing on its trademark and copyright. Their company, General Computer Corporation in Wayland, has built an overlay circuit that "enhances" Atari's "Missile Command." Story on page 5.

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Development agreement with Atari

Signed October 8, 1981

The Atari Settlement

Atari drops its suit against GCC with prejudice

GCC discontinues sales of Super Missile Attack

GCC will not market enhancement kits without permission from the manufacturer

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

Meanwhile…

Pac-Man Kit

Development begins June 1981

Tektronix 8550 Z-80 emulator

- Supports line printer!

Kevin Curran
calls
Dave Marofske

Visit to Midway

October 9, 1981

boarding pass

tarjeta de embarque

carte d accès à bord

AA American

FLIGHT / VUELO / VOL	CABIN / CABINA / CABINE	DATE / FECHA	SEAT / ASIENTO / SIEGE	SMOKING / FUMAR / FUMEUR
54	Y	90CT	29H	NO

GATE / PUERTA / PORTE: K11A

FROM / DE: CHICAGO OHARE

TO / A / DESTINACION: BOSTON

PASSENGER NAME: GOLSON

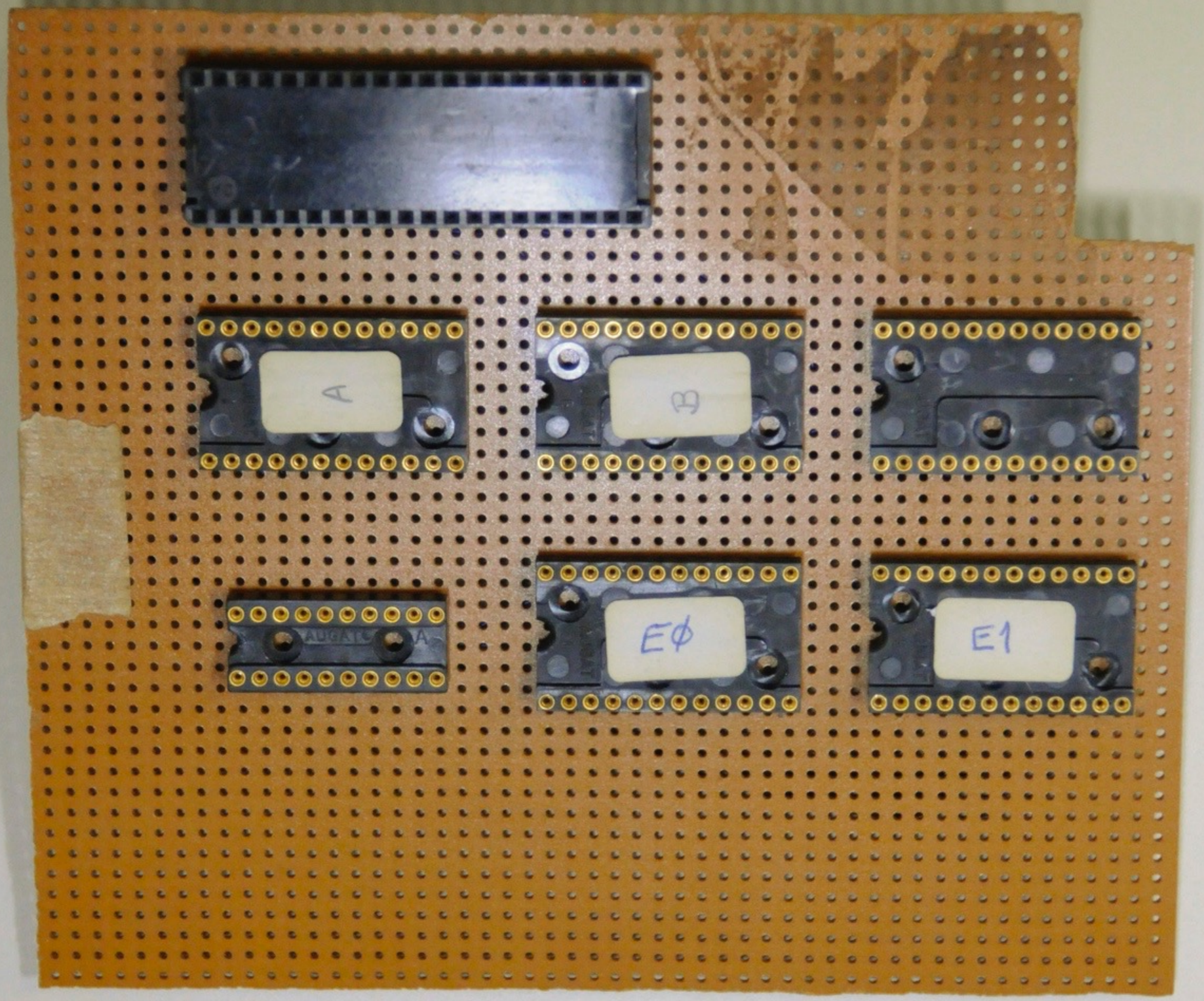
ORD5M

MIDWAY MFG. CO.

VISITOR

10-9-81

FORM-00207-8004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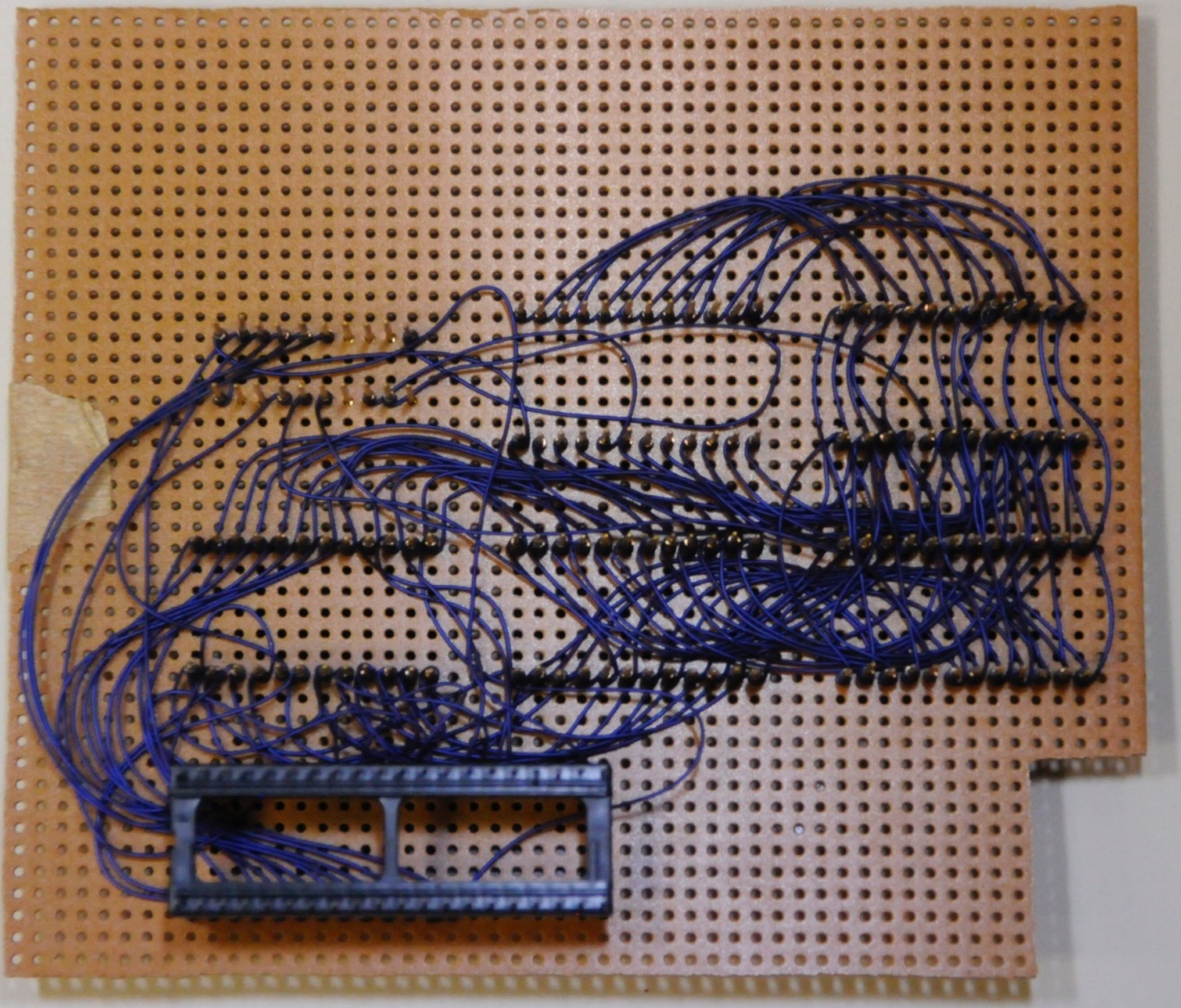
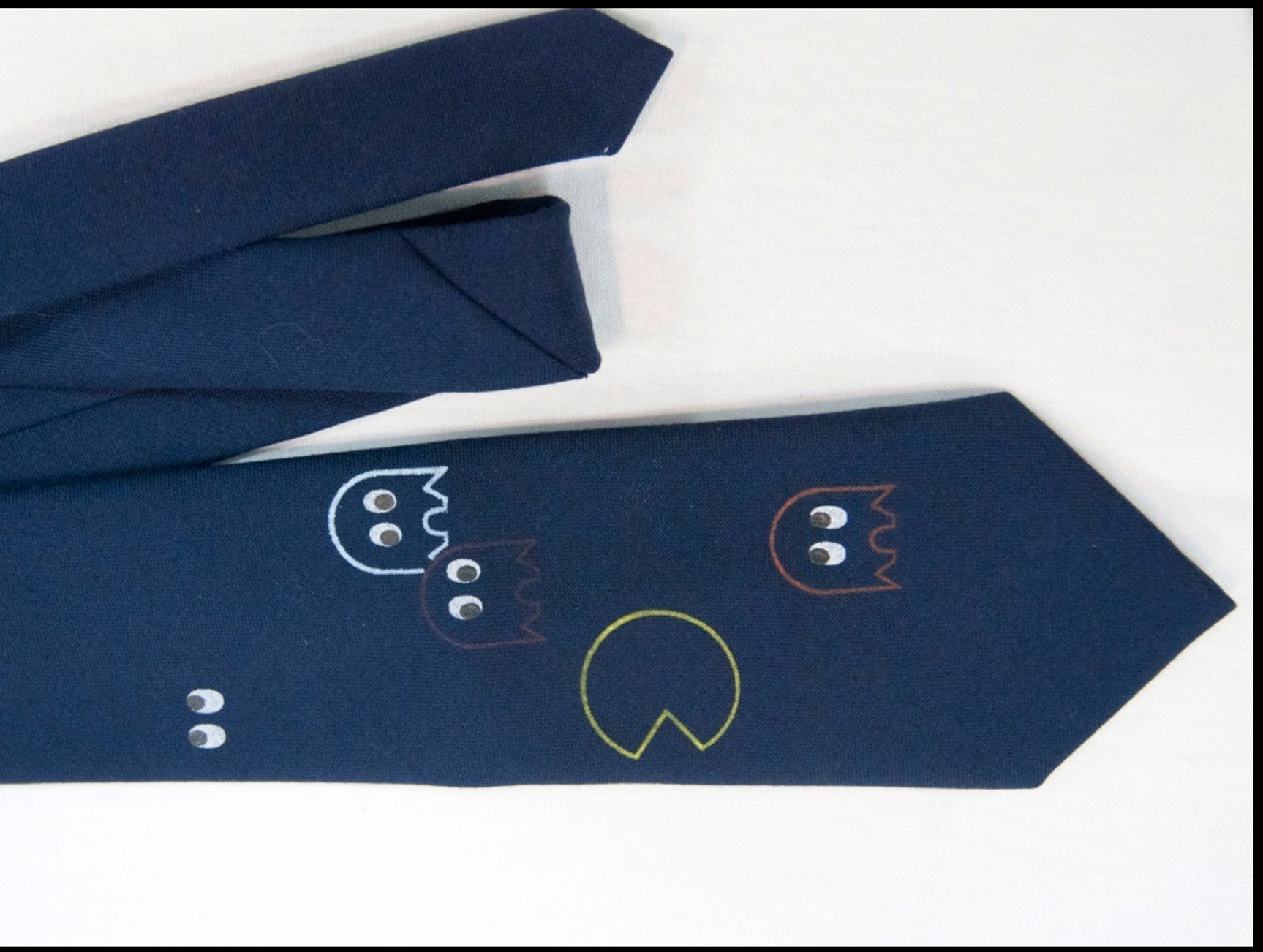
B
EØ
E1





Visit to Midway

October 15, 1981

WM
10-12 E

WM
10-12 D

WM
10-12 C

WM
10-12 B

Attract Mode Intro

Attract Mode Fakeo Game

1UP HIGH SCORE 2UP

00

GAME OVER

CREDIT 0

Detail of Otto Movement

Mazes

1UP HIGH SCORE

00

READY!

1UP HIGH SCORE

00

READY!

1UP HIGH SCORE

00

READY!

1UP HIGH SCORE

00

READY!

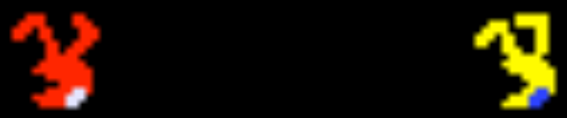
Animations

THEY MEET






THE CHASE



JUNIOR

MEMORY OK

1 COIN 1 CREDIT
BONUS 10000
WACAMAN 3
UPRIGHT

Crazy Otto Copyright

Type of Work: Visual Material

Registration Number / Date: PA0000150332 / 1982-10-19

Title: Crazy Otto.

Imprint: [s.l. : s.n.], c1980.

Description: 1 videogame.

Notes: Deposit consists of 1 videocassette & descriptive material (2 p.) deposited in lieu of videogame.

Copyright Claimant: Bally Midway Manufacturing Company

Copyright Notice: notice: Midway Manufacturing Company

Date of Creation: 1981

Date of Publication: 1981-10-15

Authorship on Application: General Computer Corporation, employer for hire.

October 29, 1981

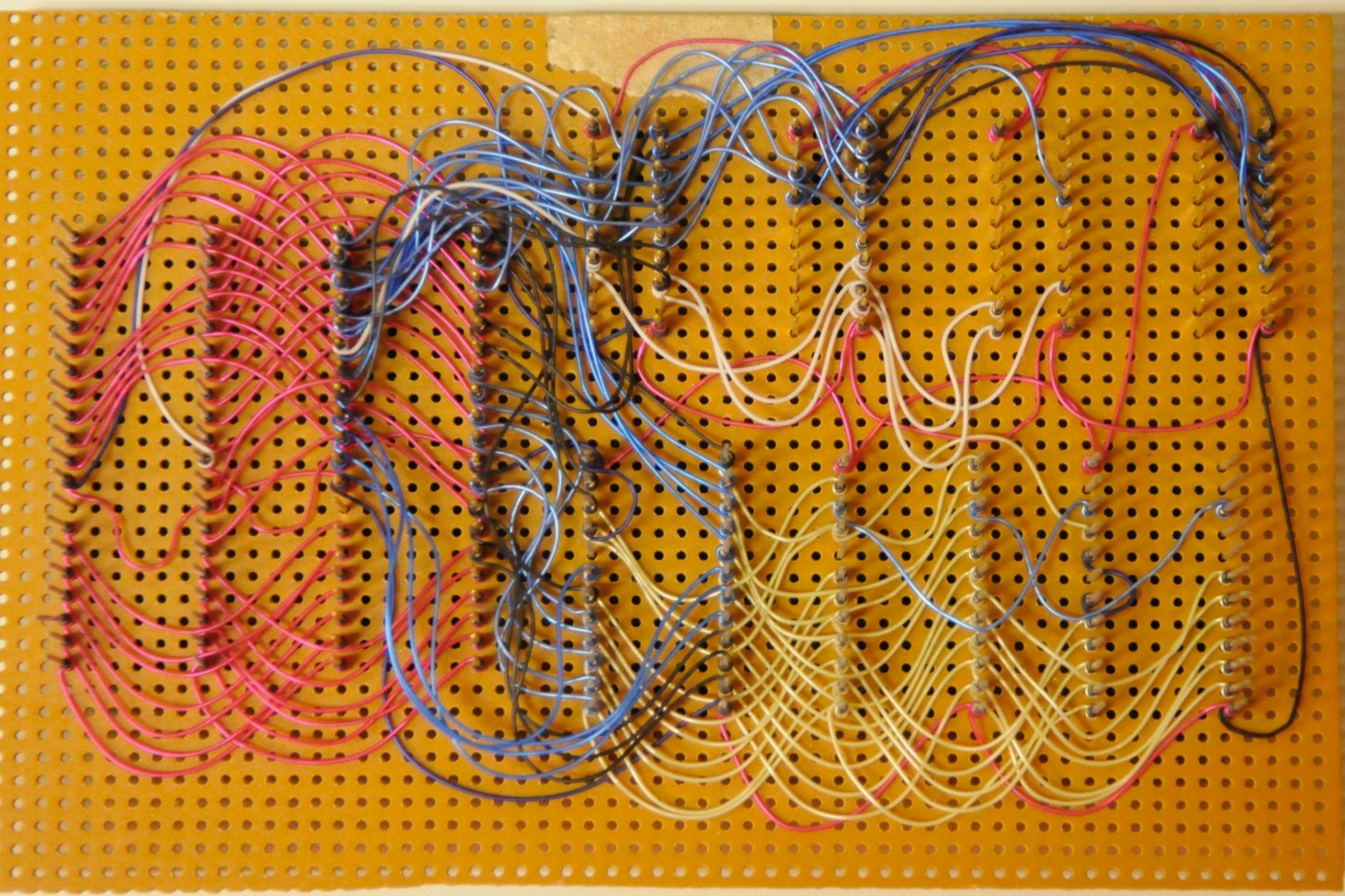
Signed Crazy Otto contract with Midway

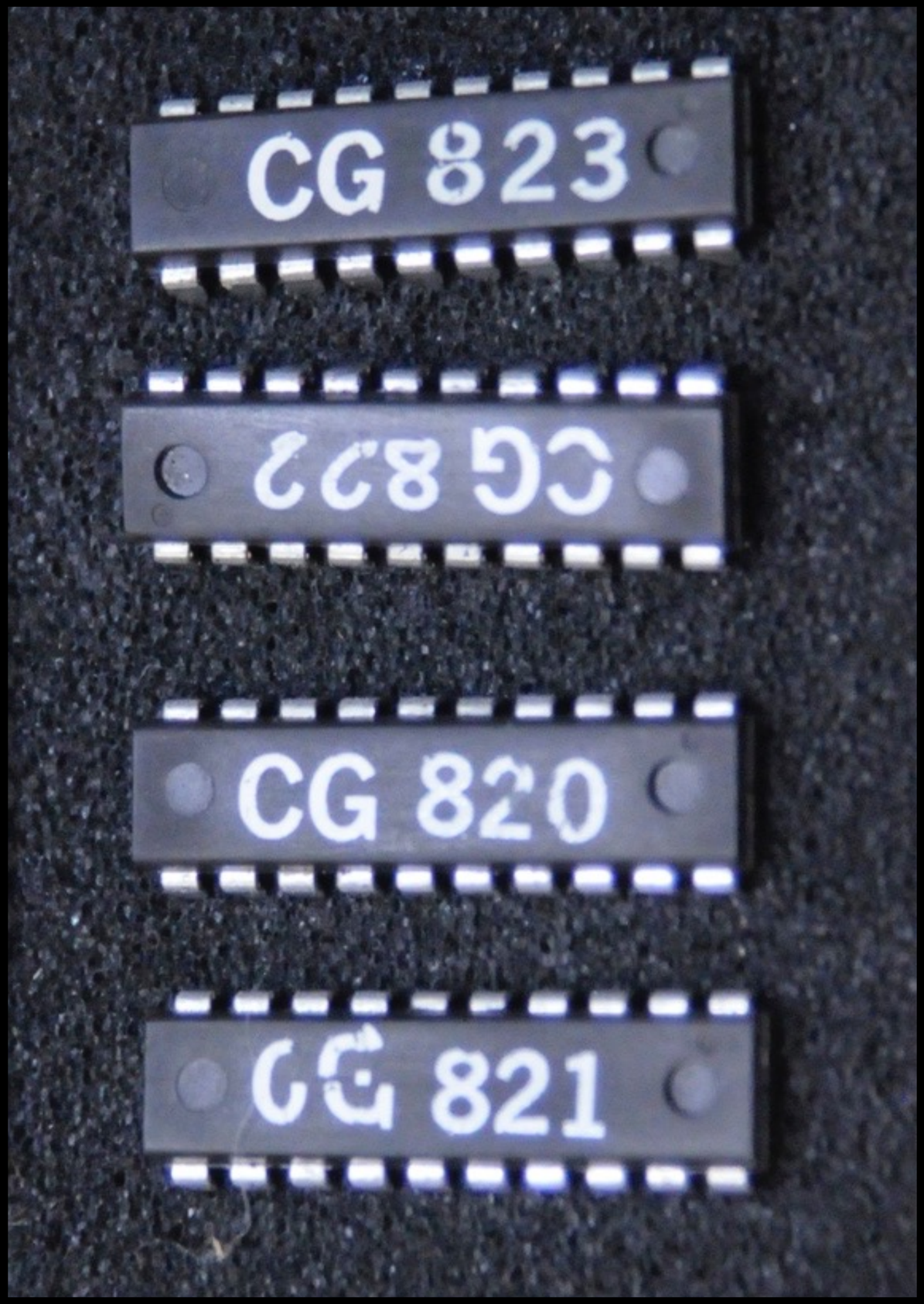
Three Crazy Otto prototype boards

- 2 delivered to Midway
- 1 at Fun and Games, Framingham, Mass.

ROM dumps


PROTO
11/6

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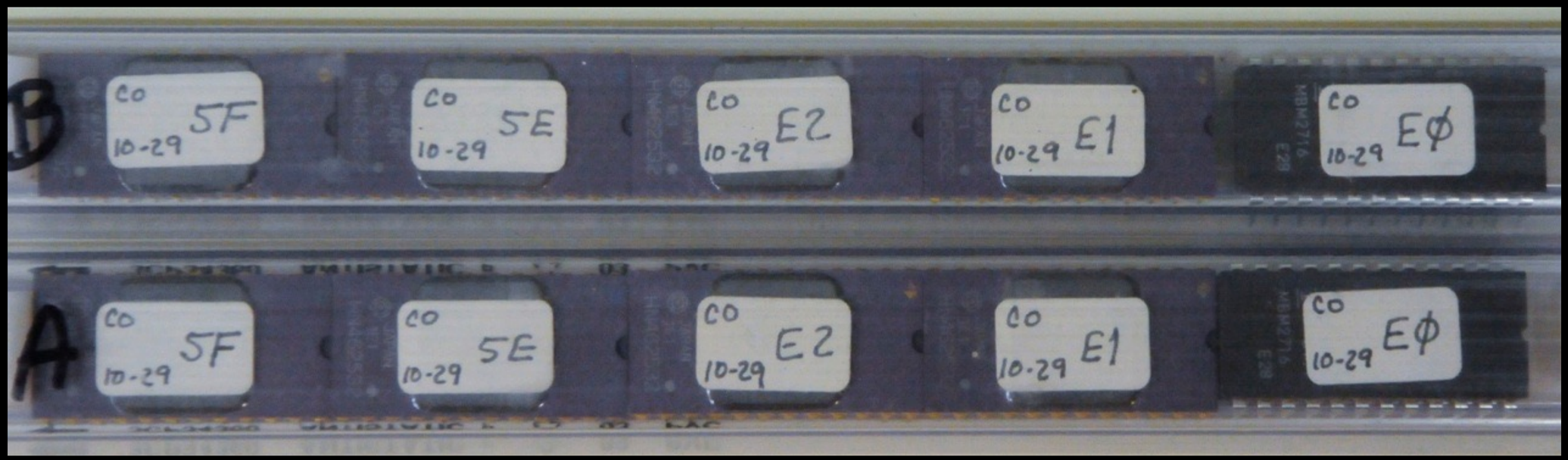
CG 822
CG 820
CG 821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CO 10-29 E2
CO 10-29 E1
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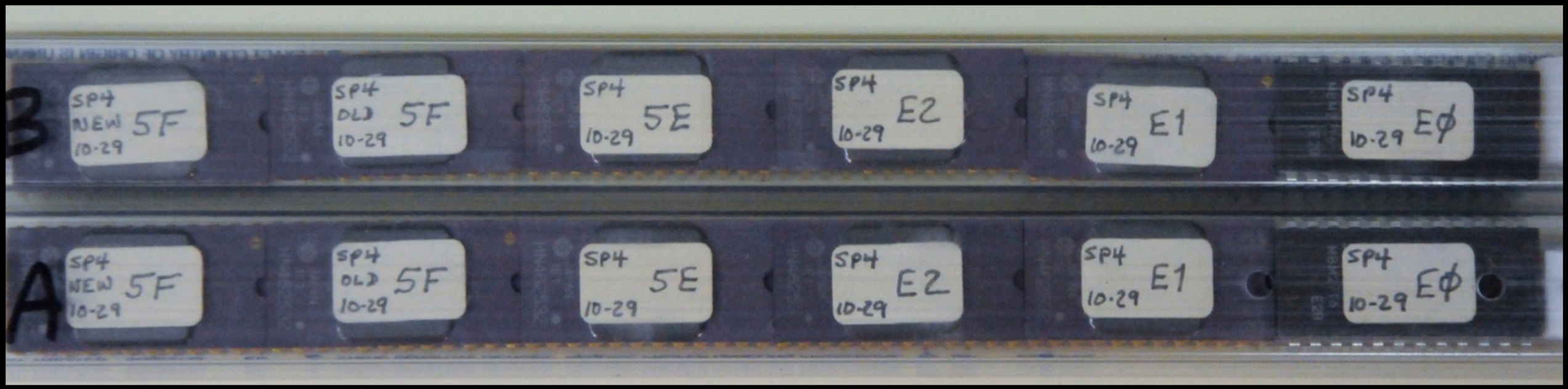
CO 10-29 E2
CO 10-29 E1
CO 10-29 EΦ


B
SP4 NEW 10-29 5F
SP4 OLD 10-29 5F
SP4 10-29 5E
SP4 10-29 E2
SP4 10-29 E1
SP4 10-29 EΦ
A
SP4 NEW 10-29 5F
SP4 OLD 10-29 5F
SP4 10-29 5E
SP4 10-29 E2
SP4 10-29 E1
SP4 10-29 EΦ

Crazy Otto

October 29, 1981

1UP HIGH SCORE 2UP

00

"CRAZY OTTO"

STARRING

CRAZY OTTO

MIDWAY MFG CO

© 1980

CREDIT 0

MEMORY OK

1 COIN 1 CREDIT
BONUS 10000
OTTOMEN 3
UPRIGHT

Super Pac-Man

October 29, 1981

1UP HIGH SCORE 2UP

00

"SUPER PAC-MAN"

STARRING

PAC-MAN

MIDWAY MFG CO

© 1980

CREDIT 0

1UP HIGH SCORE 2UP

00

"SUPER PAC-MAN"

STARRING

PAC-MAN

MIDWAY MFG CO

© 1980

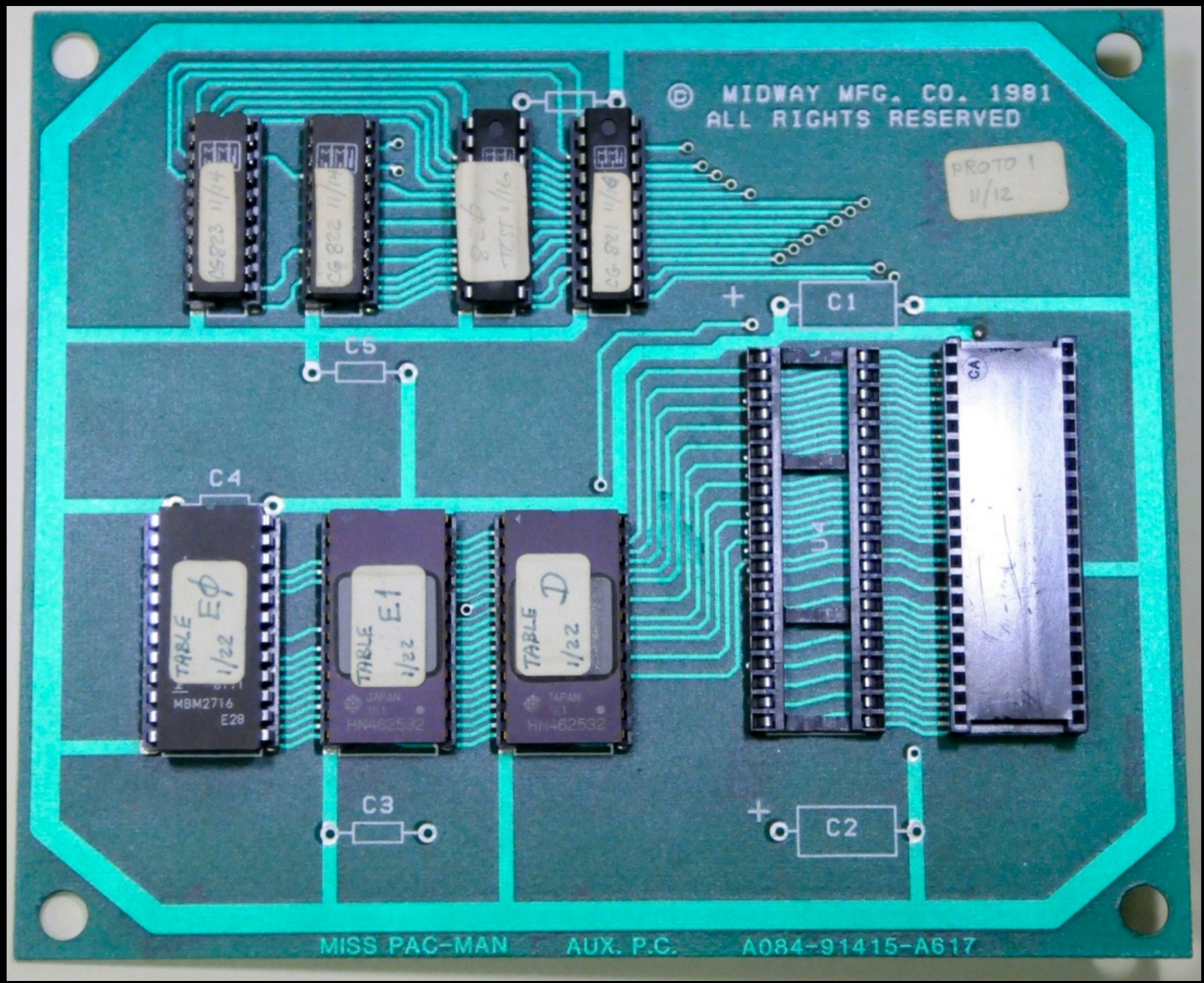
CREDIT 0

Stan Jarocki

calls

GCC

November 12, 1981



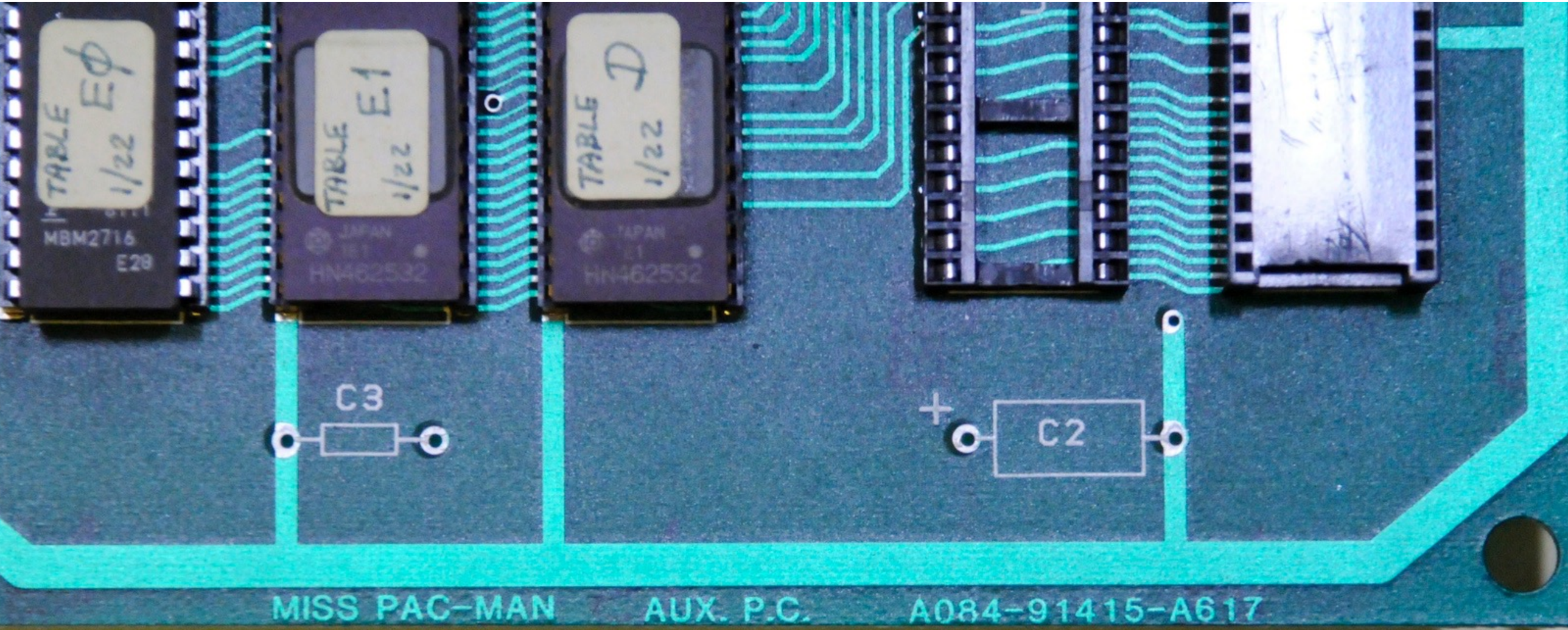


TABLE Eφ 1/22
MBM2716
E28
TABLE E1 1/22
JAPAN
HN462532
TABLE D 1/22
JAPAN
HN462532
C3
C2
MISS PAC-MAN AUX. P.C. A084-91415-A617

late November 1981

MISSY

28	200	400	800	1600
2C				
30				
34				
38				
3C				

late November 1981

STAN

1UP HIGH SCORE 2UP

"MS PAC-MAN"

STARRING

MS PAC-MAN

© MIDWAY MFG CO
1980

CREDIT 0

November 24, 1981

Stan Jarocki of Midway sends a letter to Masaya Nakamura of Namco:

Enclosed find a videotape of Midway's Pac-Man game using the Ms. Pac-Man enhancement program…

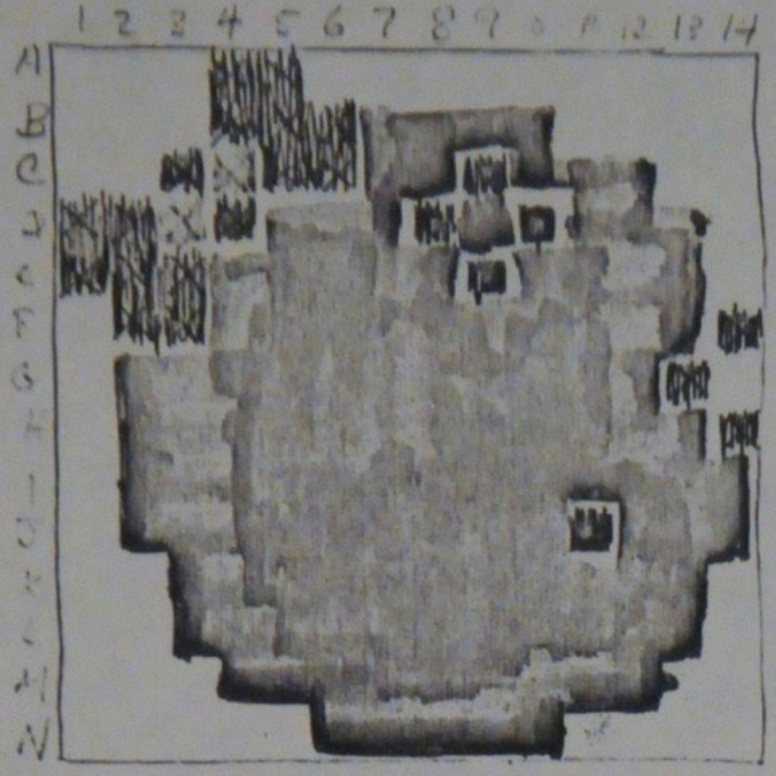
December 18, 1981

NAMCO

12321 & 1231

12/17
from
George Gonka

1



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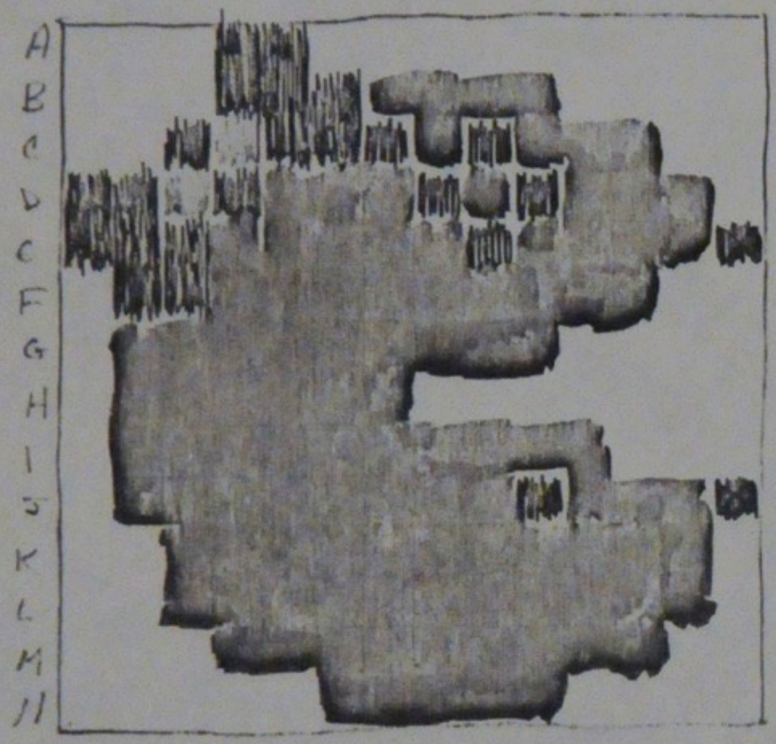

1UP HIGH SCORE 2UP

00

"MS PAC-MAN"

STARRING

MS PAC-MAN

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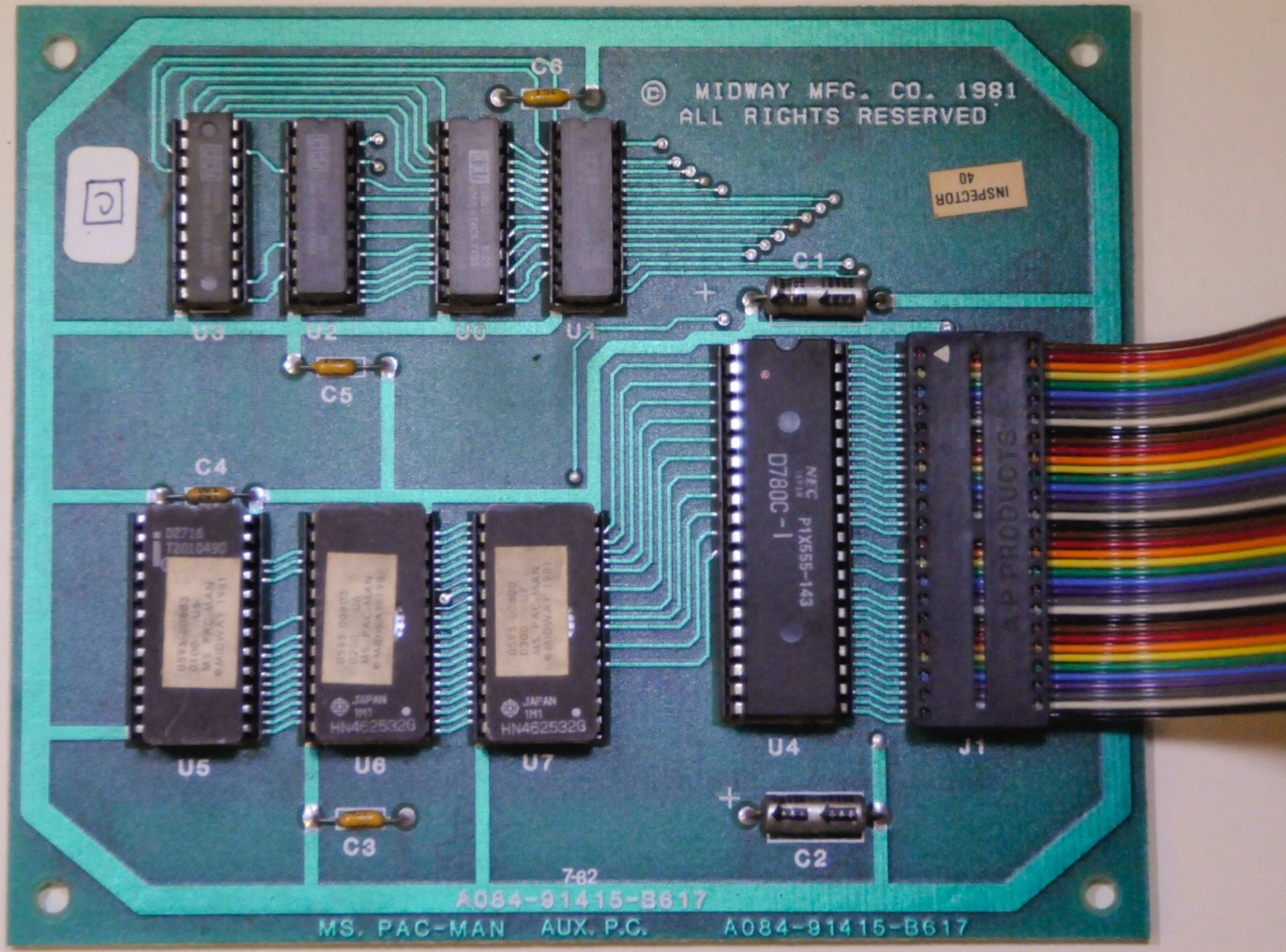
1980/1981

CREDIT 0

Ms. Pac-Man

Production PCB

January 1982


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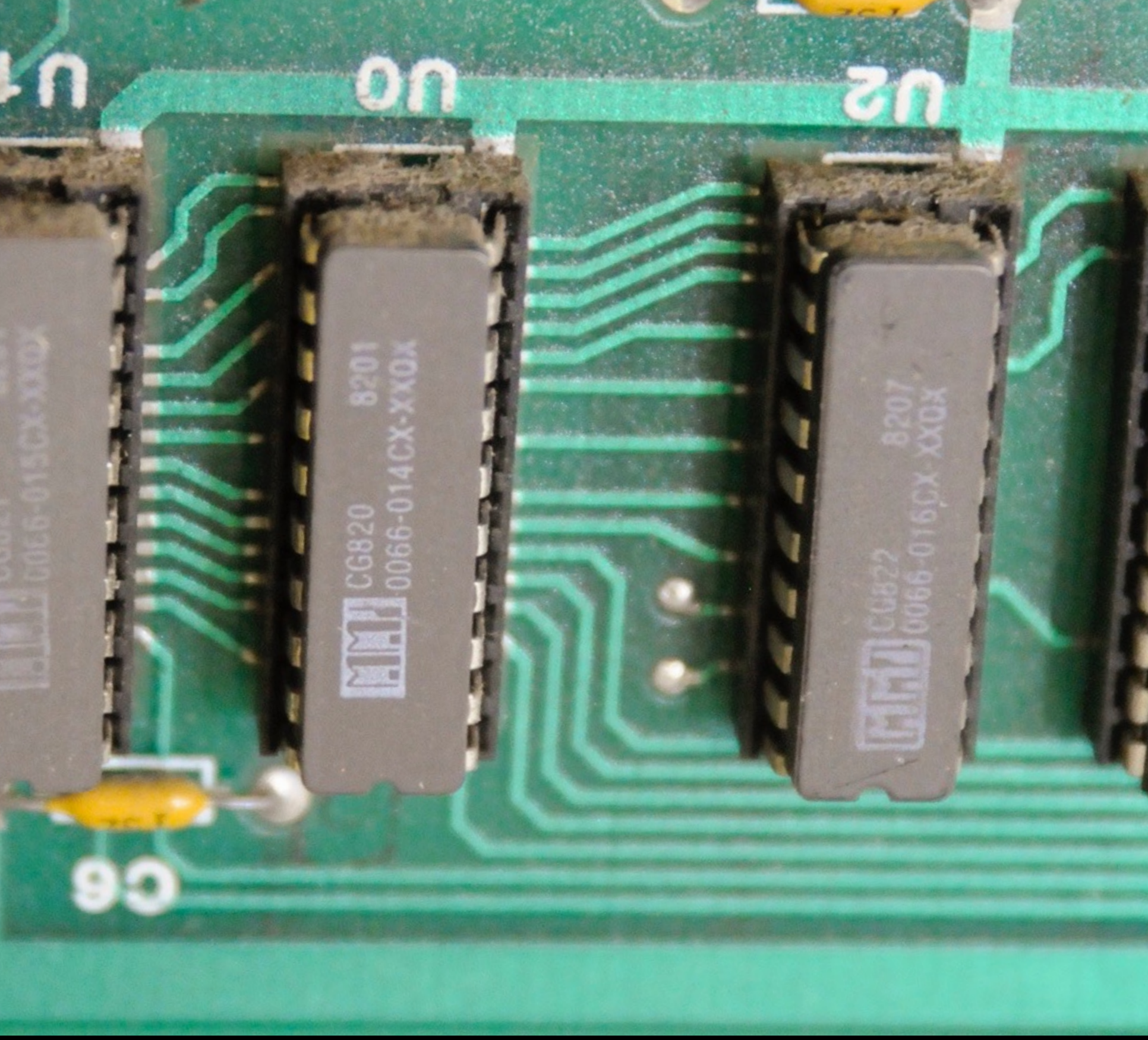
MS. PAC-MAN AUX. P.C.
A084-91415-B617


U4
U0
U2
C6
8201
8207
MMI

Source code

```
     TITLE     "SONATA FOR UNACCOMPANIED VIDEO GAME"

     GLOBAL    MELODIES,HARMONIES,AUXILIARY

     SECTION   MUSIC

MELODY    EQU  0
HARMONY   EQU  1

     MACRO     TUNE

          IF '1' = 0 & '2' = MELODY
     BYTE 0F1H,00H,0F2H,02H,0F3H,0AH,0F4H,00H
     BYTE 41H,43H,45H
     BYTE 86H,8AH,88H,8BH
     BYTE 6AH,6BH,71H,6AH,88H,8BH
     BYTE 6AH,6BH,71H,6AH,6BH,71H,73H,75H
     BYTE 96H,95H,96H,0FFH
```

```
 TITLE "FRUIT DRIVER"
;THIS CODE IS TO MAKE THE FRUIT BONCE ACROSS THE SCREEN.
;THE FRUIT ENTERS AT P0 AND GOES COUNT0 SPACES BEFORE GOING POOF!!
;IN A SMALL EXPLOSION.  THE PATH IS TABLE DRIVEN.
;EACH MAZE HAS AN ASSOCIATED P0,COUNT0,PATH.

;SOME RAM LOCATIONS:
;THE FRUIT POSITION
FRUITP EQU 4DD2H
;THE VALUE OF THE CURRENT FRUIT (0=NO FRUIT)
FVALUE EQU 4DD4H
;THE CURRENT PLACE IN THE PATH
COUNT EQU 4C40H
;FLAG TO INDICATE THAT THE FIRST FRUIT HAS BEEN RELEASED
FIRSTF EQU 4E0CH
;FLAG TO INDICATE THAT THE SECOND FRUIT HAS BEEN EATEN
SECONDF EQU 4E0DH
;THE CURRENT PLACE WITHIN ONE BOUNCE
BCNT EQU 4C41H
;POINTER TO THE PATH THE FRUIT IS CURRENTLY FOLLOWING
PATH EQU 4C42H
;HOW MANY DOTS THE CURRENT PLAYER HAS EATEN
DOTSEAT EQU 4E0EH
;SET BIT 5 OF BNOISE TO MAKE THE BOUNCE SOUND
BNOISE EQU 4EBCH
```

```
 TITLE "CODE PATCHES (PATCHES)"

     GLOBAL ATTRACT,CALCADR,MAZENUM
     GLOBAL DOFRUIT,EATFRUIT,MAXFRUIT,PROMPTHACKS
     GLOBAL WALLADR,DOTSA1,DOTSA2,MOREDOTS
     GLOBAL DRAWEN,READEN,FLASHEN
     GLOBAL RCORNER,R1CORNER,R2CORNER,SCOLOR,RCOLOR,SLOWMAP
     GLOBAL ENTRY1,ENTRY2,ENTRY3
     GLOBAL FRUITPNTS
     GLOBAL CHOOSETUNE,MELODIES,HARMONIES,AUXILIARY


;PATCH TO MAKE RED MONSTER GO AFTER OTTO TO AVOID PARKING
 ORG 0E5CH
 XOR A
 NOP


;PATCH FOR NEW ATTRACT MODE
 ORG 0413H
 JP ATTRACT


;PATCH TO THE PRIMARY FRUIT ROUTINE, THIS ROUTINE IS CALLED ONCE PER
;GAME STEP (THE MINIMUM TIME IT TAKES A MONSTER TO MOVE A PIXEL)
 ORG 0EADH
 JP DOFRUIT
```

```
 ;PATCH TO MAKE THE PACMAN AWARE OF THE CHANGING POSITION OF THE FRUIT
 ORG 19ADH
 JP EATFRUIT

;PATCH TO MAKE FRUIT not SCROLL ACROSS SCREEN BOTTOM WHEN MAXFRUIT IS REACHED.
     ORG 2BF4H
     JP MAXFRUIT

;MISCELLANEOUS HACKS THAT OCCUR WHEN PROMPTS ARE WRITTEN.
     ORG 23E0H
     WORD PROMPTHACKS

;PATCH TO USE A MAZE FROM THE NEW MAZE TABLE RATHER THAN THE OLD MAZE
 ORG 241CH
 CALL WALLADR

;PATCH TO DO SAME THING FOR DOTS
;NOTE THAT THE DOT TABLE IS USED TWICE, ONCE TO WRITE THE DOTS ONTO
;THE SCREEN THEN AGAIN TO SEE WHICH DOTS HAVE BEEN EATEN.
 ORG 244BH
 JP DOTSA1
 ORG 248AH
 JP DOTSA2

;PATCH TO ADJUST THE TOTAL DOT NUMBER
 ORG 08E1H
 JP MOREDOTS
 NOP

;PATCH TO USE NEW ENERGIZER LOCATIONS
```

```
;PATCH TO USE NEW ENERGIZER LOCATIONS
 ORG 2472H
 JP DRAWEN
 ORG 24B4H
 JP READEN
;PATCH TO MAKE THE ENERGIZERS FLASH IN NEW AND EXCITING COLORS
 ORG 0C21H
 JP FLASHEN

;PATCH TO MAKE THE MONSTERS MOVE RANDOMLY
 ORG 274BH
 CALL RCORNER
 ORG 2781H
 CALL RCORNER
 ORG 27BBH
 CALL R1CORNER
 ORG 2803H
 CALL R2CORNER

;PATCH TO MAKE THE SLOW AREAS OF THE SCREEN DEPENDENT ON THE MAZE
 ORG 24F9H
 JP SCOLOR

;PATCH TO MAKE BIT 6 OF THE COLOR MAP INDICATE SLOW AREAS
 ORG 2060H
 JP SLOWMAP
 NOP

;PATCH TO CALL AMAZING NEW COLOR ROUTINE INSTEAD OF USING THE SAME DULL BLUE
 ORG 24DDH
```

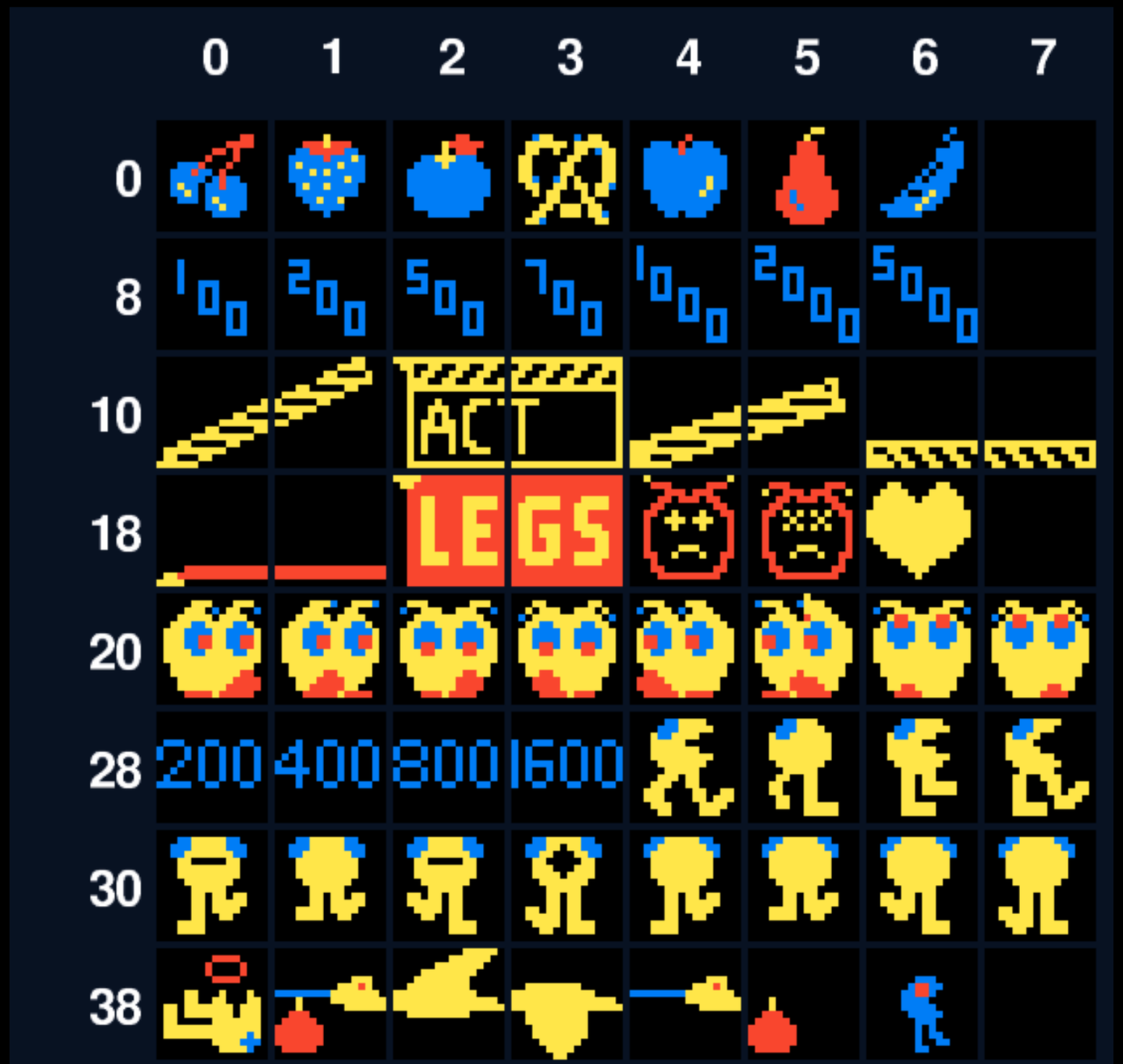
```
ST5  BYTE SETN,     5AH,PAUSE

     BYTE SETPOS,   0FFH,34H
     BYTE SETCHAR
     WORD           RIGHT_OTTO
     BYTE SETN,     7FH,PAUSE
     BYTE SETN,     24H,PAUSE
     BYTE SETN,     68H,LOOP,0D8H,00,09
     BYTE SETN,     7FH,PAUSE
     BYTE SETN,     18H,PAUSE
     BYTE SETPOS,   00H,094H
     BYTE SETCHAR
     WORD           LEFT_ANNA
     BYTE SETN,     68H,LOOP,028H,00,09
     BYTE SETN,     7FH,PAUSE
     BYTE SETPOS,   0FCH,7FH
     BYTE SETCHAR
     WORD           RIGHT_OTTO
     BYTE SETN,     18H,PAUSE
     BYTE SETN,     68H,LOOP,0D8H,0,09
     BYTE SETN,     7FH,PAUSE
     BYTE SETN,     18H,PAUSE
     BYTE SETPOS,   00H,054H
     BYTE SETCHAR
     WORD           LEFT_ANNA
     BYTE SETN,     20H,LOOP,070H,00,09
     BYTE SETPOS,   0FFH,0B4H
     BYTE SETCHAR
     WORD           RIGHT_OTTO
     BYTE SETN,     10H,PAUSE
```

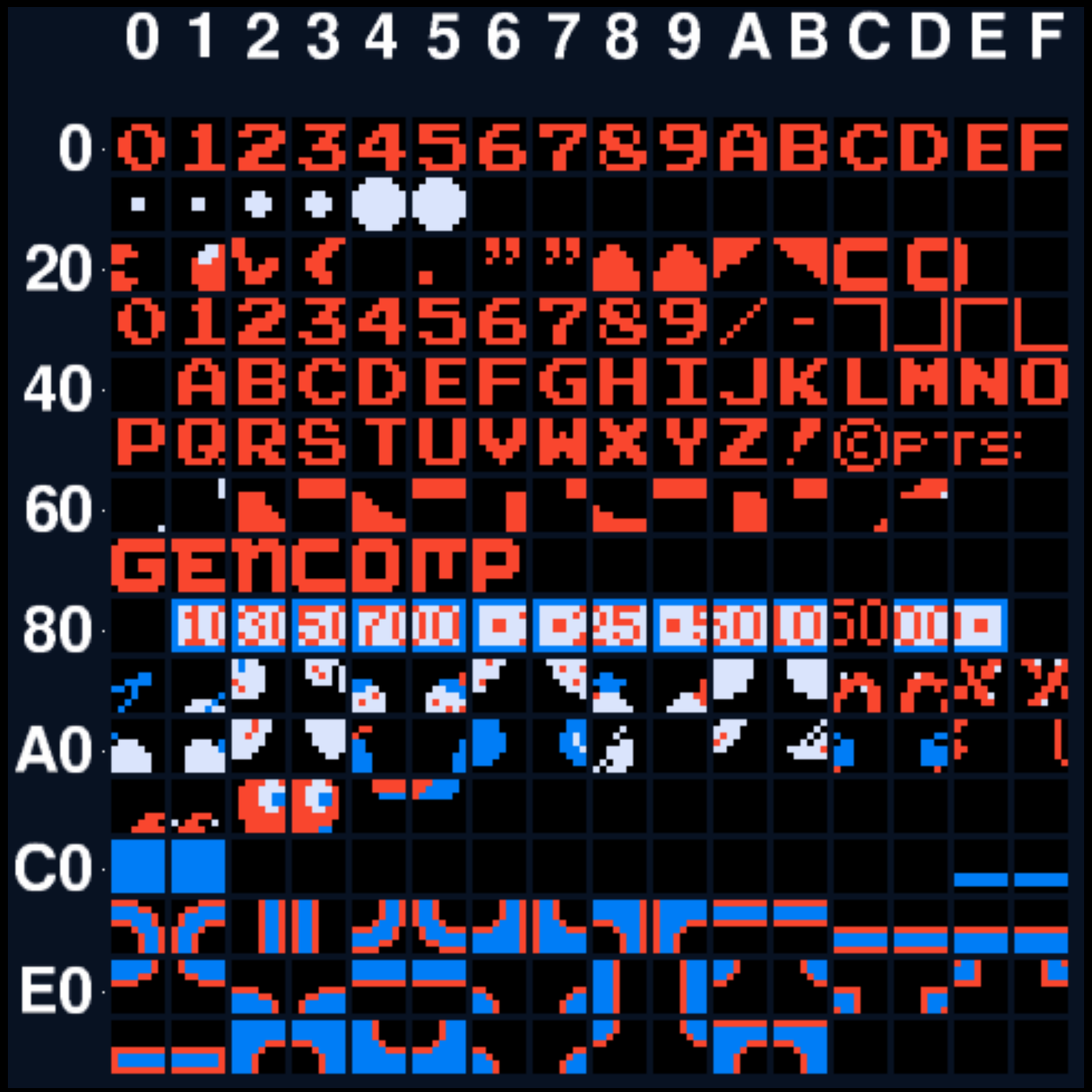
Character Design

GCC Character Development System

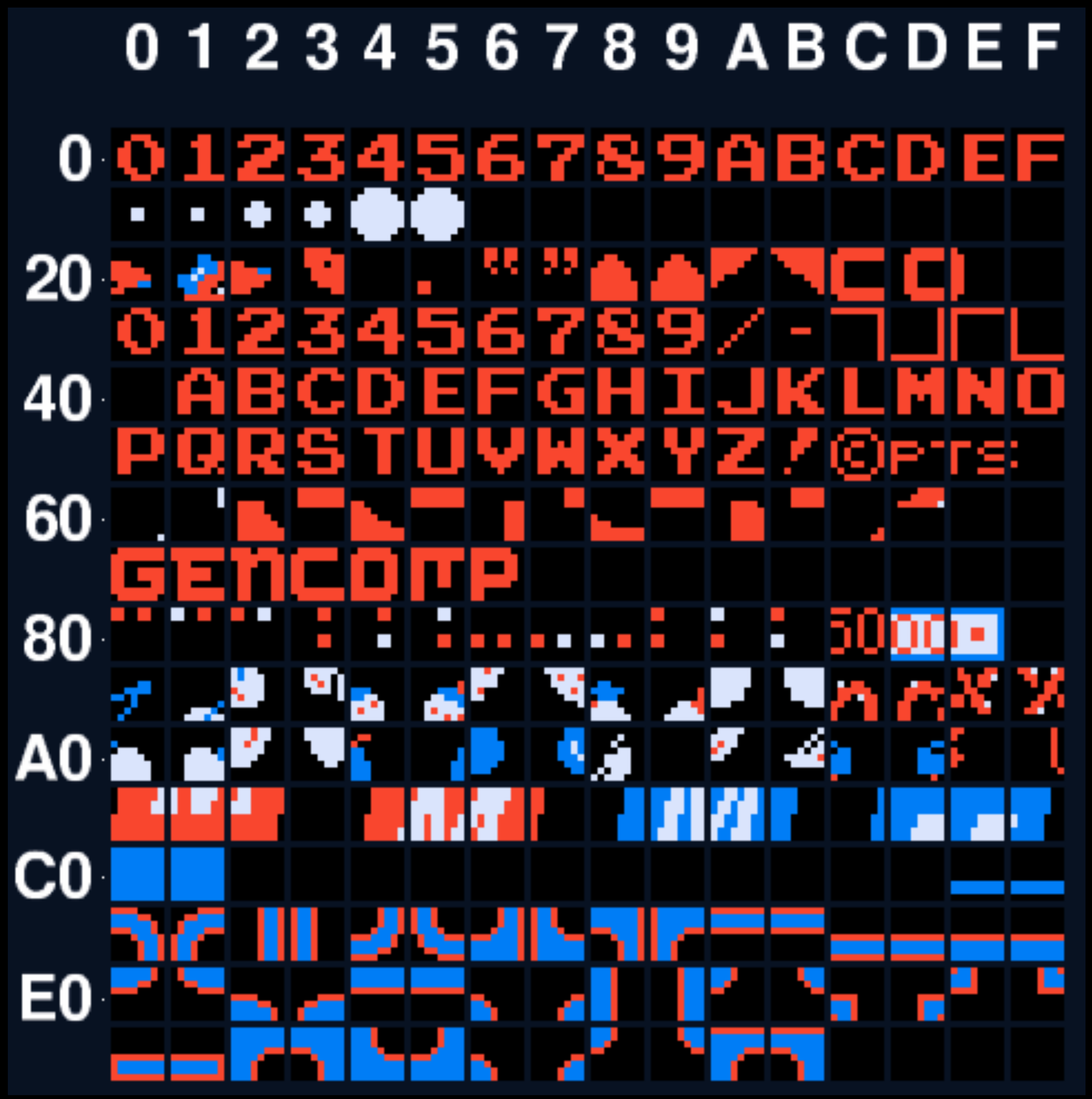
Crazy Otto October 12



Crazy Otto October 12

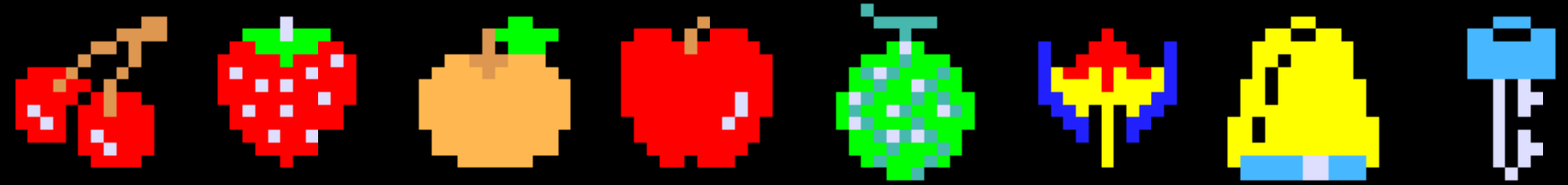


Ms. Pac-Man



Bonus Fruit

Pac-Man



Ms. Pac-Man

Hidden Messages

PROTO.NAMCO

```
00750: f30a f400 6564 6588 6788 6163 6485 6485  ....ede.g.acd.d.
00760: 6a69 6a8c 7593 9091 9091 708a 6871 fff1  jij.u.....p.hq..
00770: 02f2 03f3 0af4 0265 9068 7068 6766 6590  .......e.hphgfe.
00780: 6170 6165 6866 9063 9086 9085 9085 7086  apaehf.c......p.
00790: 6865 ffff bacd 3dba 2104 00e5 2163 04d1  he....=.!...!c..
007a0: 4745 4e45 5241 4c20 434f 4d50 5554 4552  GENERAL COMPUTER
007b0: 2020 434f 5250 4f52 4154 494f 4e20 2020    CORPORATION
007c0: 3231 3520 4649 5253 5420 5354 5245 4554  215 FIRST STREET
007d0: 4341 4d42 5249 4447 452c 204d 4153 532e  CAMBRIDGE, MASS.
007e0: 2e2e 2e2e 2e2e 2e2e 2e2e 2e2e 2e2e 2e2e  ................
007f0: 4865 6c6c 6f2c 204e 616b 616d 7572 6121  Hello, Nakamura!
```

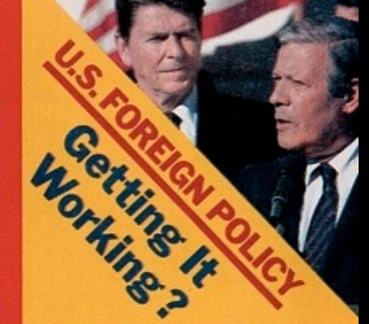
Ms. Pac-Man

```
0770: 71ff f102 f203 f30a f402 6590 6870 6867  q.........e.hphg
0780: 6665 9061 7061 6568 6690 6390 8690 8590  fe.apaehf.c.....
0790: 8570 8668 65ff ff3a 004f fe00 280b 1102  .p.he..:.O..(...
07a0: 4c21 504f 010c 00ed b03a 094e 2172 4ea6  L!PO.....:.N!rN.
07b0: 280c 3a0a 4cfe 3f20 053e ff32 0a4c 2185  (.:.L.? .>.2.L!.
07c0: 96c3 c42c ffff ffff ffff ffff ffff ffff  ...,............
07d0: 4745 4e45 5241 4c20 434f 4d50 5554 4552  GENERAL COMPUTER
07e0: 2020 434f 5250 4f52 4154 494f 4e20 2020    CORPORATION
07f0: 4865 6c6c 6f2c 204e 616b 616d 7572 6121  Hello, Nakamura!
```

January 1982

JANUARY 18, 1982 $1.50

TIME



U.S. FOREIGN POLICY
Getting It Working?

GRONK! FLASH! ZAP!

Video Games Are Blitzing the World

0 724404 03
10090

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.

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

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."

Tense combat on-screen in Pleiades game

Pac Man scuttles about maze, eating dots

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.

Pac Man scuttles about maze, eating dots

Developers of Crazy Otto / Ms. Pac-Man

Doug Macrae

Kevin Curran

John Tylko

Mike Horowitz

Chris Rode

Steve Golson

Phil Kaaret

United States Patent [19]

Curran et al.

[11] **Patent Number: 4,525,599**

[45] **Date of Patent: Jun. 25, 1985**

[54] **SOFTWARE PROTECTION METHODS AND APPARATUS**

[75] Inventors: **Kevin G. Curran**, Sudbury; **Steven E. Golson**, Wayland; **Christian S. Rode**, Cambridge, all of Mass.

[73] Assignee: **General Computer Corporation**, Cambridge, Mass.

[21] Appl. No.: **380,771**

[22] Filed: **May 21, 1982**

[51] **Int. Cl.**[3] **H04L 9/00**

[52] **U.S. Cl.** **178/22.08**; 178/22.09; 364/200

[58] **Field of Search** 178/22.05, 22.08, 22.09; 364/200, 900; 340/825.34

[56] **References Cited**

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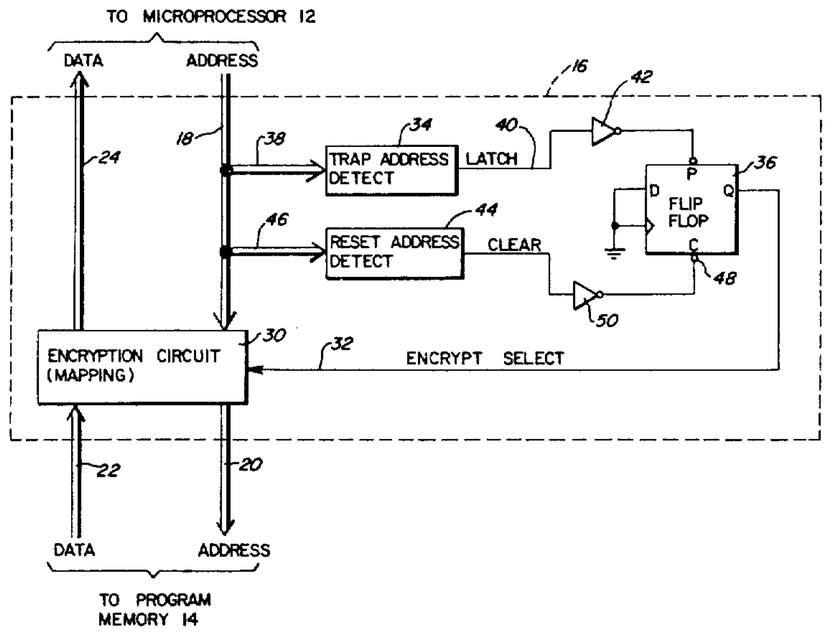
IBM Technical Disclosure Bulletin, vol. 21, No. 2, (7/78), Gurugé, pp. 836–837.

Primary Examiner—Sal Cangialosi
Attorney, Agent, or Firm—Hosier & Sufrin, Ltd.

[57] **ABSTRACT**

Methods and apparatus are disclosed for inhibiting the unauthorized copying of ROM-resident computer software or the like, for example, the audio-visual display of an electronic video game. A protection circuit including encryption/decryption means is coupled between the microprocessor and the ROM-memory and is operable in a first mode to properly encrypt/decrypt the program information according to a first algorithm and in a second mode to prevent proper encryption/decryption. The address-data buses are monitored by the protection circuit to detect an invalid program event, such as may occur when a microprocessor emulator is used to attempt an unauthorized copying or "dumping" of the program information. Upon detection of the invalid program event or "trap condition", the protection circuit switches to its second operating mode thereby to prevent copying of the decrypted program information.

27 Claims, 4 Drawing Figures



Q & A