Internal Correspondence

RCA

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To G. B. Herzog/R. O. Winder Location Date 26 December 1974

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Subject COSMAC Coin Machine - Status Report

The coin operated amusement device market was discussed in an earlier report. This market includes pinball machines, video games, etc. We have been looking at the application of COSMAC in this area. So far, things look very promising. This report discusses our philosophy, approach, progress, plans, etc.

Philosophy and Approach

A variety of amusement-type coin machines could be developed using COSMAC. We have initially decided to build on our FRED experience. This requires the minimum development effort and yields the shortest lead time for a final product.

Our initial machine will be a general purpose computer system. We will plan to exploit the computer theme via styling, game design, etc. A minimum cost system will be developed first. This lets us have a product prototype in the shortest time. The minimum cost system also provides a reference with which future enhanced machines can be compared.

The machine will utilize ROM for program storage. 2K bytes appear to be sufficient initially. The ROM will be contained on a small plug-in card. A variety of different ROM cards can be sold. Each ROM card will convert the machine to a different set of games. This will give the basic machine a long life. New games will not require redesigning the machine because operators (users) can easily convert the machine to play new games in the field.

I/O approaches must be carefully chosen to maintain low final product cost, minimize development effort, and achieve a general purpose machine. A dot matrix TV display of the type used in the FRED project satisfies our requirements. Alphanumeric displays are not as flexible, require higher resolution circuits (more costly), and extend development time. Such extension of development time would have included postponement of software effort until the new display formats could be evaluated, designed, and constructed. Prior experience has already verified the usefulness of the FRED type display format for a wide variety of games. Hardware design is completed and an LSI chip already exists for the required interface. For the coin machine, the display will be expanded to provide an array of 32x64 dots. This will almost fill the TV screen and greatly enhances display capability. This display circuitry has been tested with a monitor (versus a standard TV set) and yielded excellent results.

A number of game machine input approaches are possible. These include simple pushbuttons, keyboards, light guns, joy sticks, steering wheels, etc. Our initial choice was limited by considerations of flexibility, development effort,

and end cost. Other considerations must include ruggedness and reliability. Input transducers for coin-operated machines receive severe abuse by players and vandals. We have looked at keyboards, buttons, light guns, card readers, and joy sticks. Simple pushbuttons are the least expensive, most rugged, and most general-purpose input transducers. They are readily available and have already been life tested. They are also consistent with our computer theme philosopy. Initially, we are providing 5 buttons for each player. This seems sufficient for a number of 1 and 2 player games. Interface circuitry is trivial.

A prototype of a minimum-cost, general-purpose, game-playing machine will be constructed during the first half of 1975. A number of sample programs will be developed concurrently for demonstration and field testing. Alternative I/O approaches and enhanced systems will be investigated at a later date.

Hardware

Three distinct hardware development efforts are required. First, a system suitable for program development and debug is required. A suitable system has been designed and constructed and is currently being used for software development. It includes 2K bytes of RAM which simulate the ROM of a final machine. This RAM can be loaded by a self-contained cassette unit or HEX keyboard (initial program entry). The ability to record program cassettes and extensive program preparation/debug facilities are also provided.

A second hardware system will be required as a breadboard prototype for the final product. This system will simulate the final system exactly. It differs from the first system in that no program preparation or debug facilities are included. It will also be packaged to simulate a final system and can be used for demonstration/field testing. It will differ from the final system in its use of PROM rather than ROM and will be hand-wired rather than using a printed-circuit board. Physical packaging will be in the form of a table top unit and optional pedestal to facilitate transportation and demonstration. This system is currently being designed for construction in the first half of 1975.

The third hardware system will be the final product. All electronics will be packaged on a single 8"x10" P.C. board. A socket will be provided to accept a variety of ROM plug-in cards. The design of the final system should be completed by a product line group. Final product design could start as early as the first quarter of 1975 and run concurrently with prototype testing and software development. The mechnical design (box, control panel, etc) would benefit greatly from an early start. We do not currently plan to proceed to a final product design within our group.

Figure 1 illustrates the block diagram of the proposed minimum system. Figure 2 illustrates the input panel layout. Figure 3 shows a proposed package.

The final system will require about 40 chips (excluding ROM). 2K bytes of ROM can be provided on 1 chip. 512 bytes of RAM will be required for TV display and variables. Four 256x4 RAM chips will suffice. Other LSI chips include the 2 COSMAC chips and a custom TV chip (available from FRED project). All other chips are readily available - SSI and MSI types (mixed 4000 COS/MOS and 7400 TTL).

Assuming $50. for the COSMAC chip set, $30. for the custom LSI TV chip, $30. for ROM, and $20. for RAM, a total chip cost of $180. is possible. These could all be mounted on a single 8"x10" P.C. card for a total electronics package cost of $250. Adding $140. for a TV monitor (includes system power supply and audio amplifier) results in a cost of under $400. This leaves $200. for cabinet, switch panel, coin box, and assembly. The resulting $600. manufacturing cost is consistent with a competitive selling price target of $1200.

Software

We are simultaneously trying to do two things in the area of coin-machine software. First, we are developing a number of game programs for demonstration and test of the prototype hardware system. Two games have been designed, and others are in development. These games (unlike home games) must be quick to learn and fast to play. Two minutes is normal for a 25¢ machine to maximize return. These games must be novel and simple enough to prevent frustration on the part of new players. They must also provide continuing challenge for experienced players. They must appeal to the maximum range of age and sex. They must stay within the memory and I/O capability of our low-cost general-purpose hardware. Satisfying this unique set of criteria is a non-trivial task.

Concurrent with game development is the design of new game programming languages. Such languages facilitate developing and experimenting with new games and provide more efficient use of our small memory capacity. These interpretive languages will also be invaluable to future programmers of the coin machine. It is anticipated that programming will become a continuing effort in order to satisfy the secondary market for new ROM's. Rather than spending an inordinate amount of time on one inefficient general-purpose language, we are developing a number of special-purpose ones. Each is suitable for a group of games. So far, two such languages have been developed. Others will be investigated as the need arises.

All software is being developed exactly as it will go into the prototype PROM and/or final product ROM. This will eliminate the future need for recoding and resulting unexpected problems and costs.

Conclusions

For a new understaffed project, a great deal has been accomplished:

a. A market study has been completed,

b. Useful contacts within the trade established,

c. Specifications developed for a practical minimum system,

d. Hardware system designed and built for program preparation/testing,

e. Product prototype design underway, and

f. Software development underway with several demonstration programs now running.

The project to date is considered to be a very healthy one, for the following

reasons:

a. Marketing and distribution problems and costs will be minimal because of existing industry-wide distribution systems.

b. Ideal initial COSMAC application since the system is completely self-contained, requiring only 5 volts and 20 μsec instruction time.

c. The general-purpose hardware estimate (40 chips) compares very favorably with existing special-purpose machines (~125 chips).

d. Only cabinet and software are now unknowns, and no major problems are expected for either one.

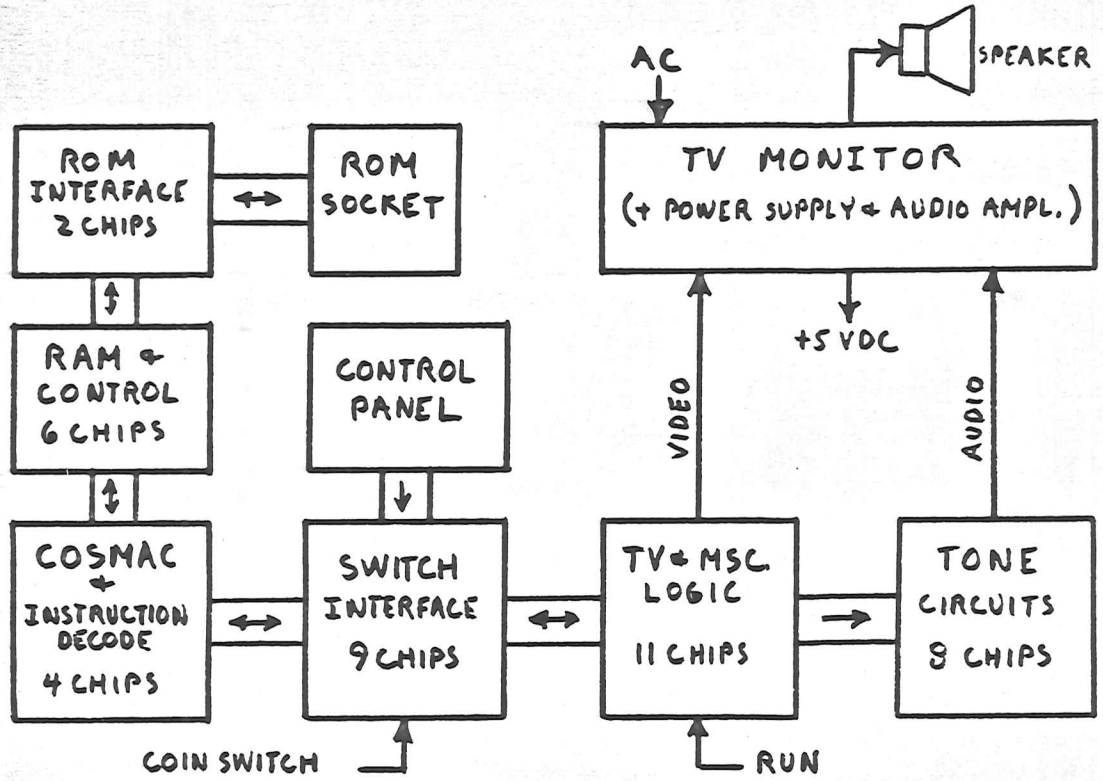

FIGURE 1- COIN MACHINE BLOCK DIAGRAM

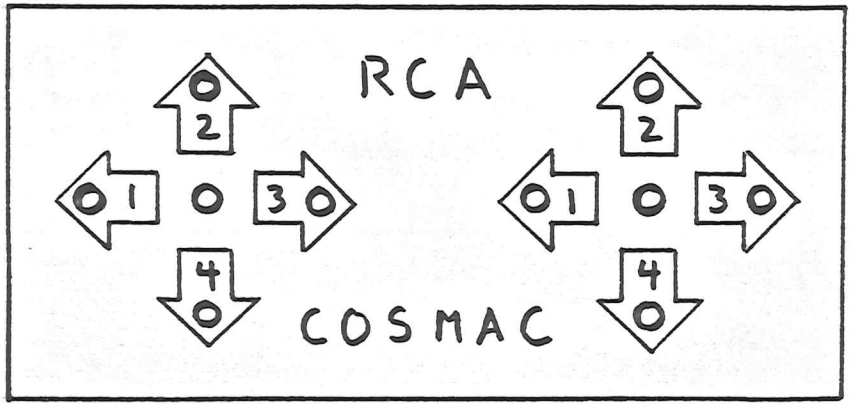

FIGURE 2- SWITCH LAYOUT

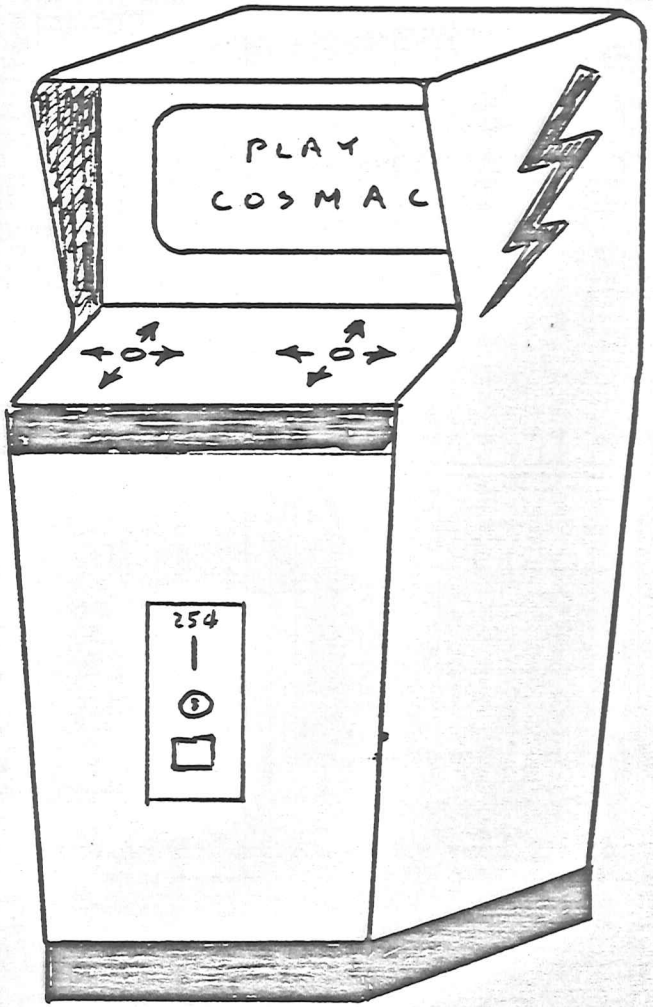

FIGURE 3

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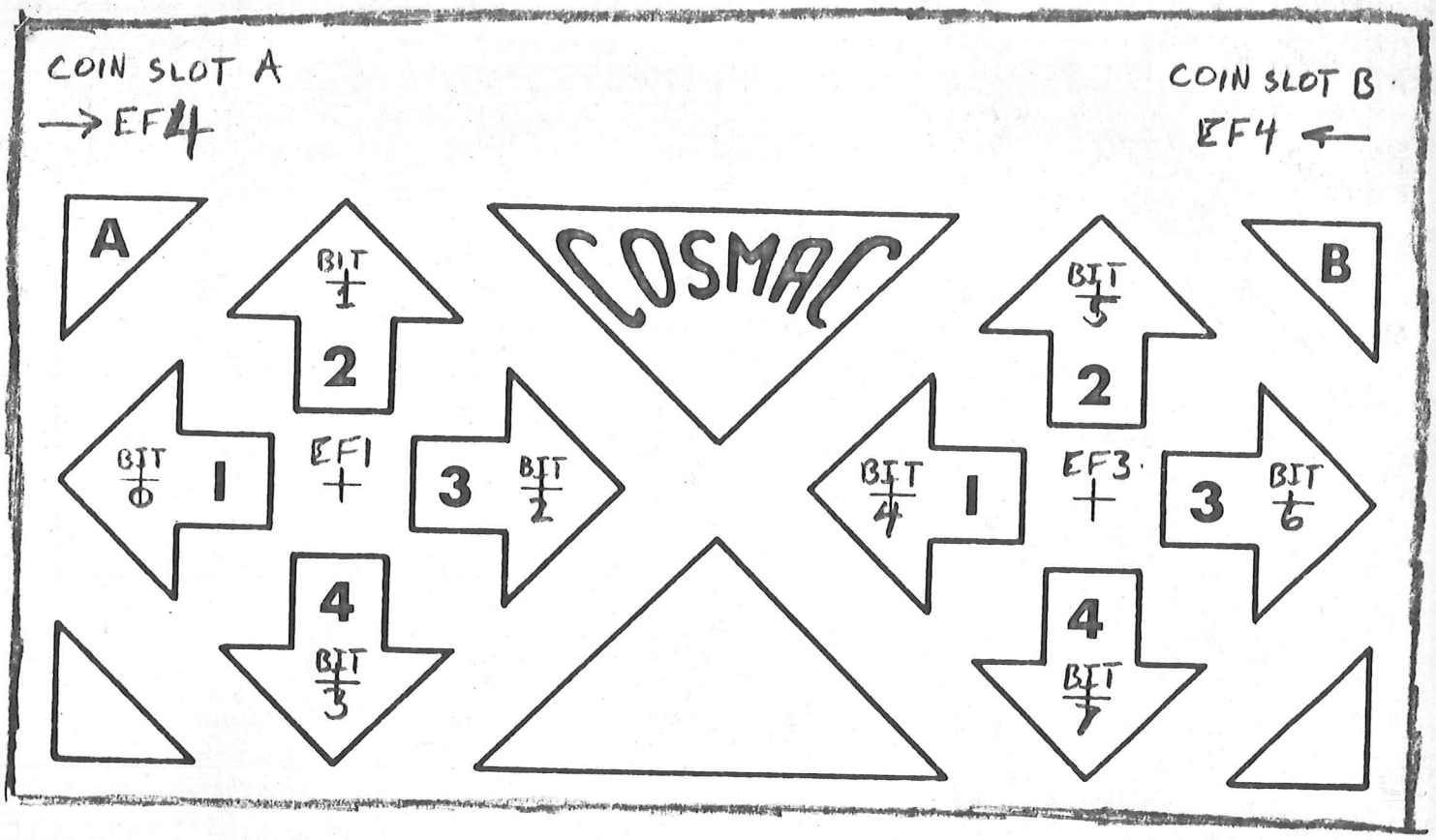
COSMAC COIN GAME PANEL



COSMAC COIN GAME INSTRUCTIONS

INPUT (6E = BIT ϕ-7 SWITCHES → M(x)
(SW. PRESSED = 1) -)

DISPLAY (61 & M(x) = ϕ2 SELECTS TV OUTPUT CHANNEL
62 & M(x) = ϕ3 TURNS ON 32×64 DISPLAY AFTER TV SELECT)

TONE OUTPUT (63 & M(x) = ϕ4 SETS EFF = 1 } EFF FED TO SPEAKER
63 & M(x) = ϕϕ SETS EFF = ϕ } FOR PROGRAMMED TONES)

OPTIONAL SOUNDS (65 & M(x) = KK SETS OPTIONAL OUTPUT SOUND EFFECTS CIRCUITS)

PARAMETER INPUT (6D = ϕP (FROM 4 PARAMETER BIT SWITCHES) → M(x))

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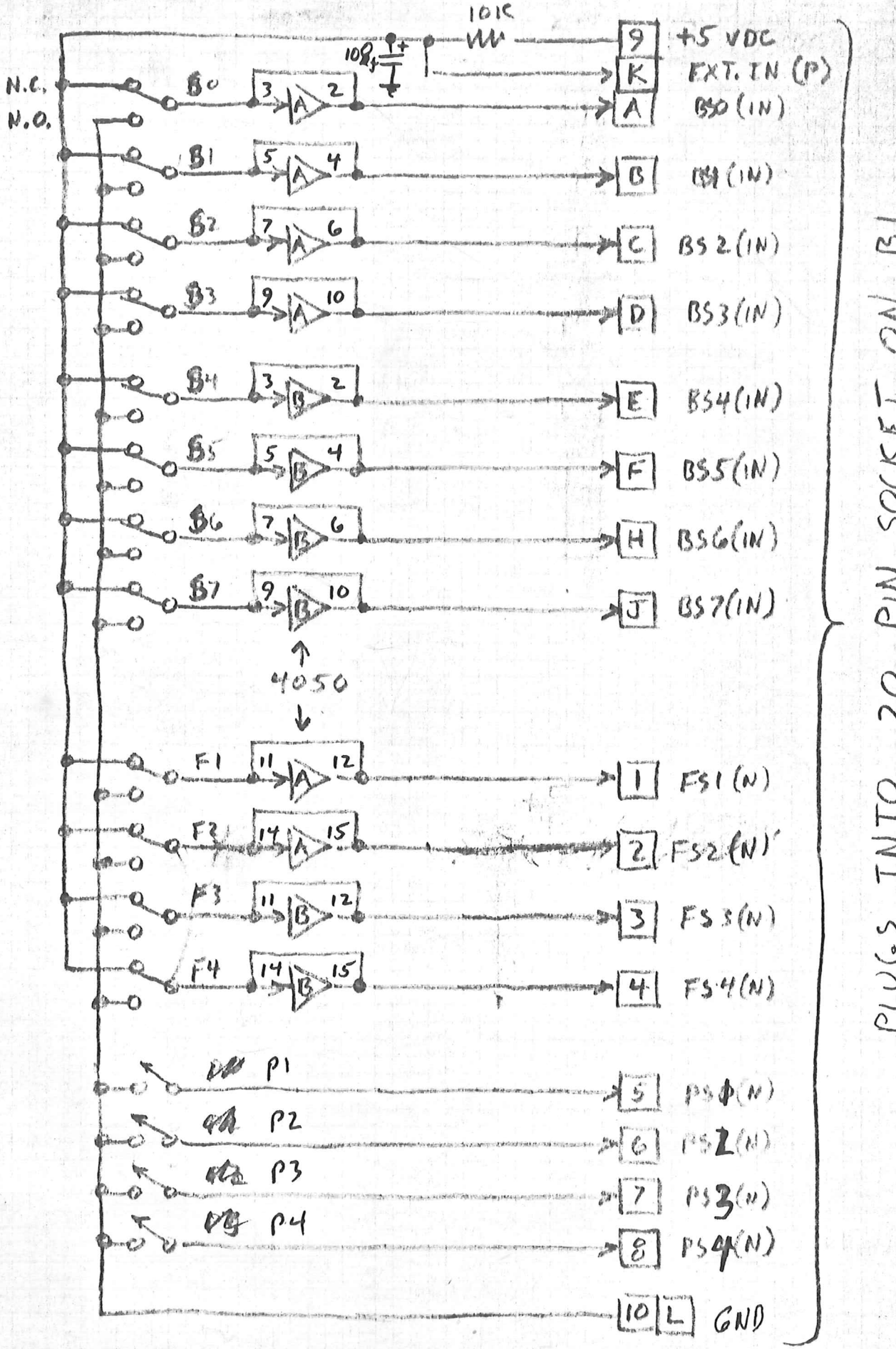
COSMAC COIN GAME PANEL LOGIC



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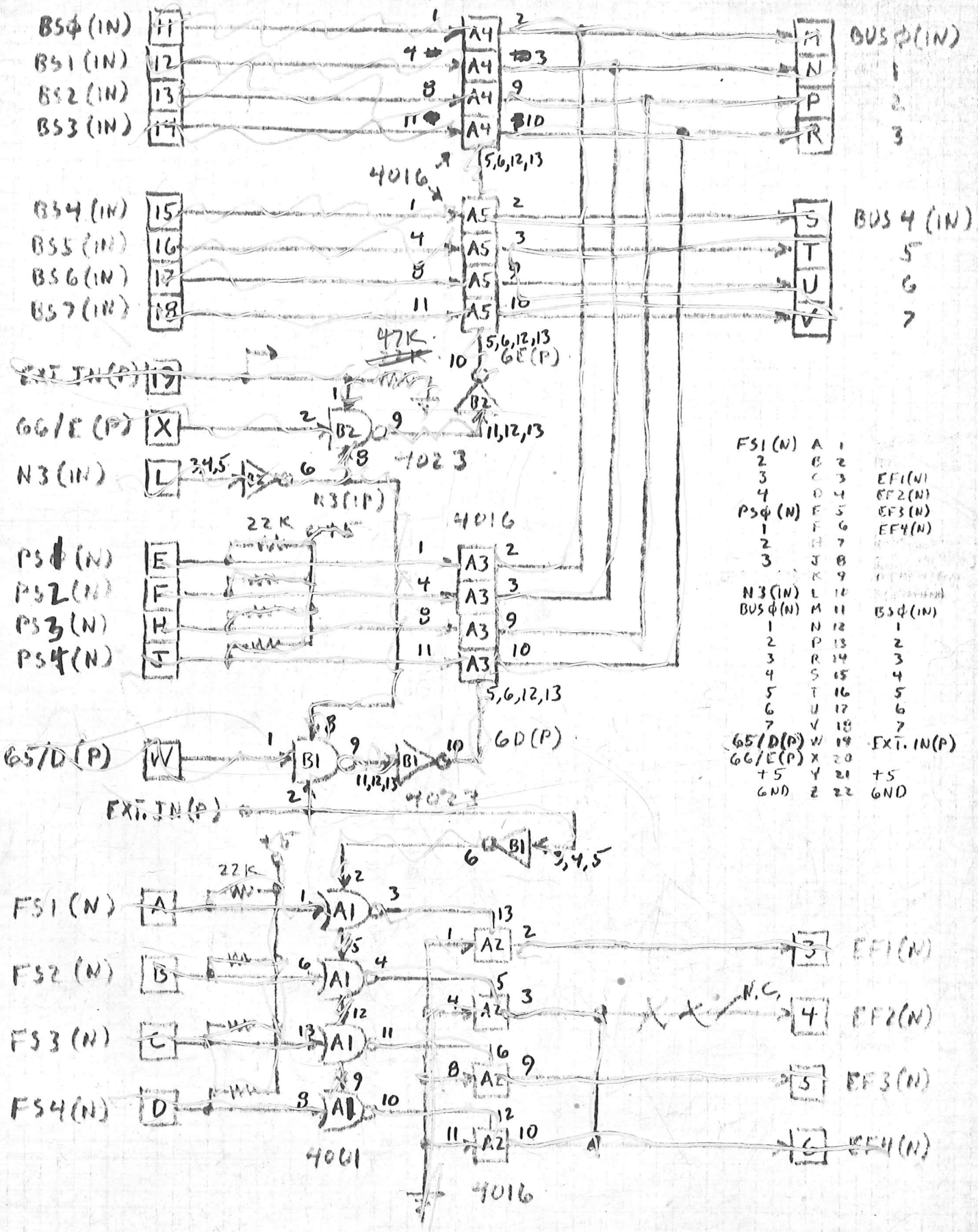
COIN GAME CKTS
COSMAC CARD A9



FS1 (N)	A	1	
2	B	2	
3	C	3	EF1(N)
4	D	4	EF2(N)
PSφ (N)	E	5	EF3(N)
1	F	6	EF4(N)
2	H	7	
3	J	8	
	K	9	
N3(IN)	L	10	
BSφ(N)	M	11	BSφ(IN)
1	N	12	1
2	P	13	2
3	R	14	3
4	S	15	4
5	T	16	5
6	U	17	6
7	V	18	7
65/D(P)	W	19	EXT. IN(P)
66/E(P)	X	20	
+5	Y	21	+5
GND	Z	22	GND

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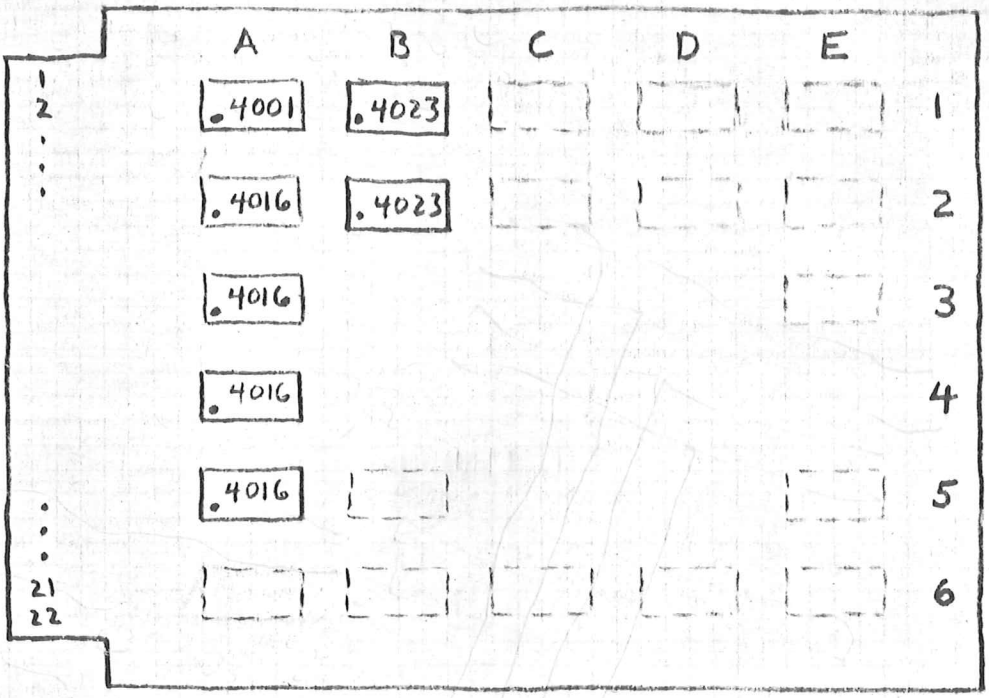
COIN GAME CKTS
COSMAC CARD A9



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I/O PANEL ADDITIONS
COSMAC CARD B1

20 PIN EXTERNAL CONNECTION SOCKET

CARD B1 PINS

ADD THESE BACK PANEL WIRES

1	1	FS1(N)	→	A9-A
2	2	FS2(N)	→	A9-B
3	3	FS3(N)	→	A9-C
4	4	FS4(N)	→	A9-D
5	5	PSΦ(N)	→	A9-E
6	6	PS1(N)	→	A9-F
7	7	PS2(N)	→	A9-H
8	8	PS3(N)	→	A9-J
9	Y,21	+5		
10	Z,22	GND		
A	A	BSΦ(IN)	→	A9-11
B	B	BS1(IN)	→	A9-12
C	C	BS2(IN)	→	A9-13
D	D	BS3(IN)	→	A9-14
E	E	BS4(IN)	→	A9-15
F	F	BS5(IN)	→	A9-16
H	H	BS6(IN)	→	A9-17
J	J	BS7(IN)	→	A9-18
K	K	EXT. IN(P)	→	A9-19
L	Z,22	GND		

ALSO ADD! A9-L TO A45-15 [N3(IN)]
A9-W TO B3-10 [G5/D(P)]
A9-X TO B3-11 [G6/E(P)]

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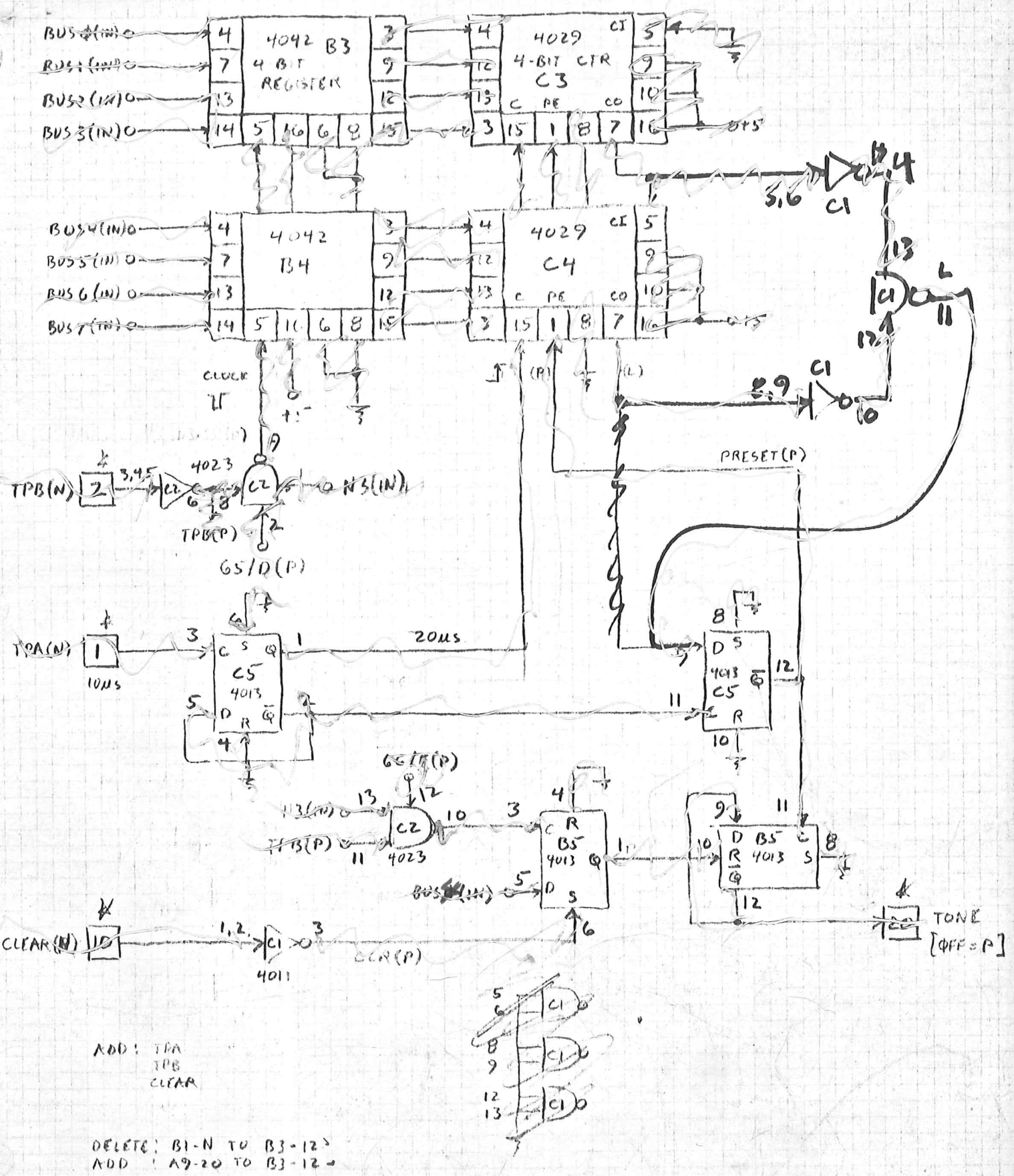
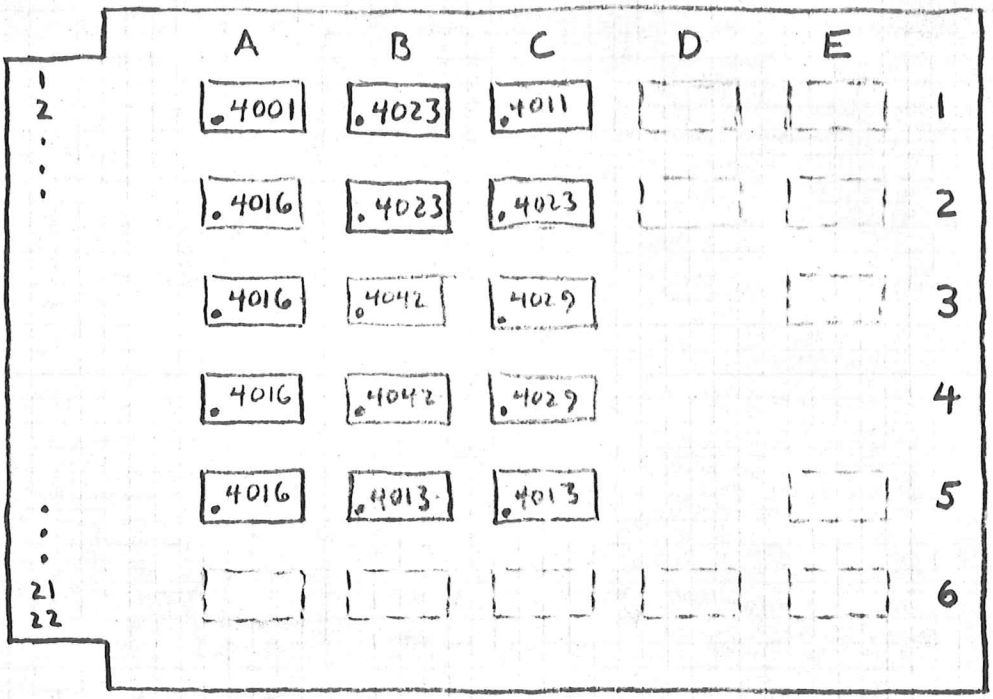
COSMAC CARD A9



COIN GAME CKTS.
COSMAC CARD A9.



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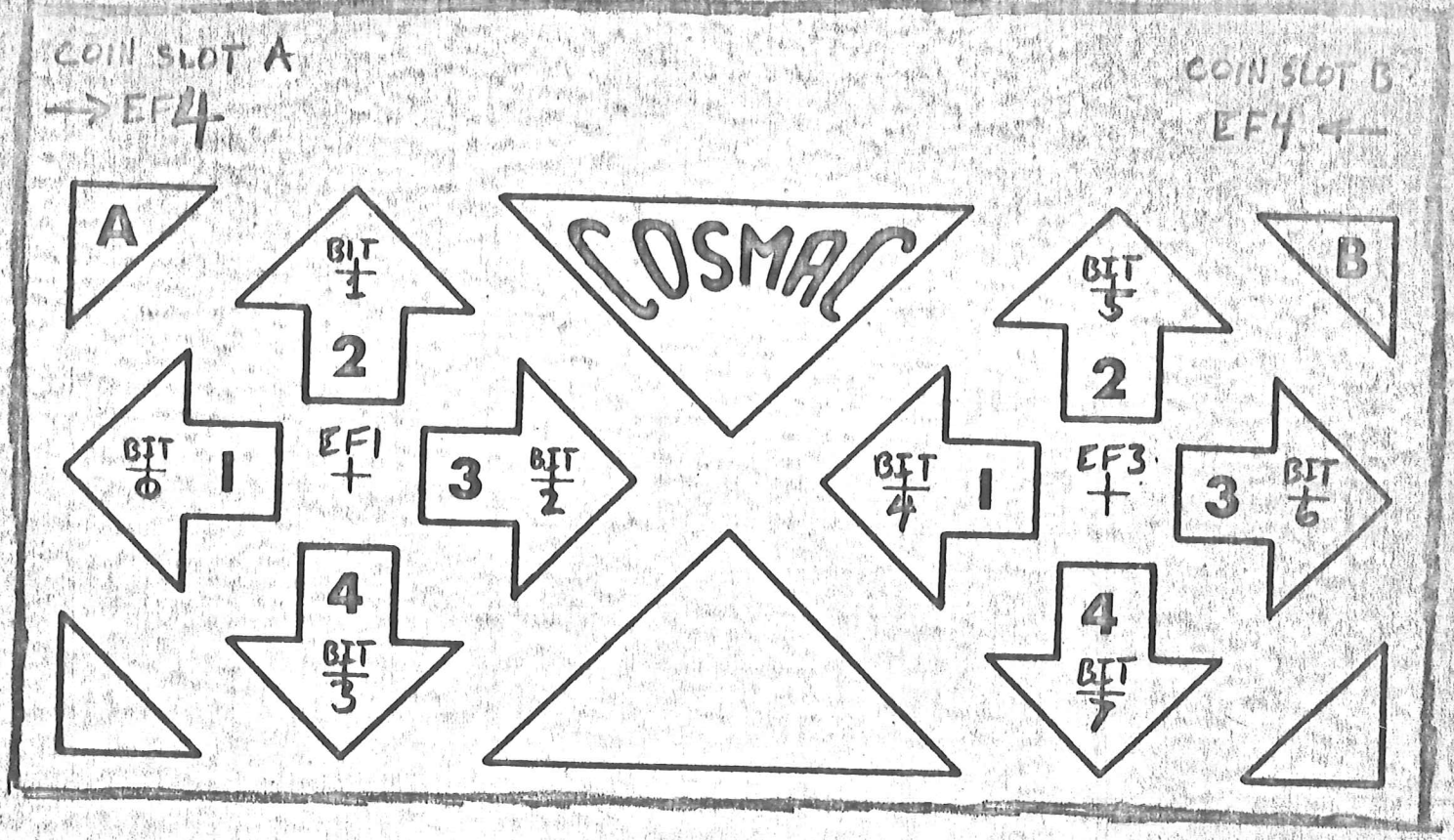
COSMAC COIN GAME PANEL



COSMAC COIN GAME INSTRUCTIONS

INPUT (GE = BIT Φ-7 SWITCHES → M(X) (SW. PRESSED = 1) - (X+Φ))

DISPLAY (61 ↔ M(X) = Φ2 SELECTS TV OUTPUT CHANNEL
62 ↔ M(X) = Φ3 TURNS ON 32×64 DISPLAY AFTER TV SELECT
(X+1))

TONE OUTPUT (63 ↔ M(X) = Φ4 SETS EFF = 1
63 ↔ M(X) = ΦΦ SETS EFF = Φ
(X+1)) } EFF FED TO SPEAKER FOR PROGRAMMED TONES
EFF = 1 DISABLES PRESET TONE GENERATOR

PRESET TONE GENERATOR (65 ↔ M(X) = KK SETS EXTERNAL TONE GENERATOR FREQUENCY
(X+1) EFF MUST = Φ (NORMAL RESET STATE))

PARAMETER INPUT (66 ↔ M(X) = ΦΦ DISABLES TONE GEN.
66 ↔ M(X) = ΦΦ ENABLES TONE GEN.
(X+1)
6D = ΦP (FROM 4 PARAMETER BIT SWITCHES) → M(X))
(X+Φ)

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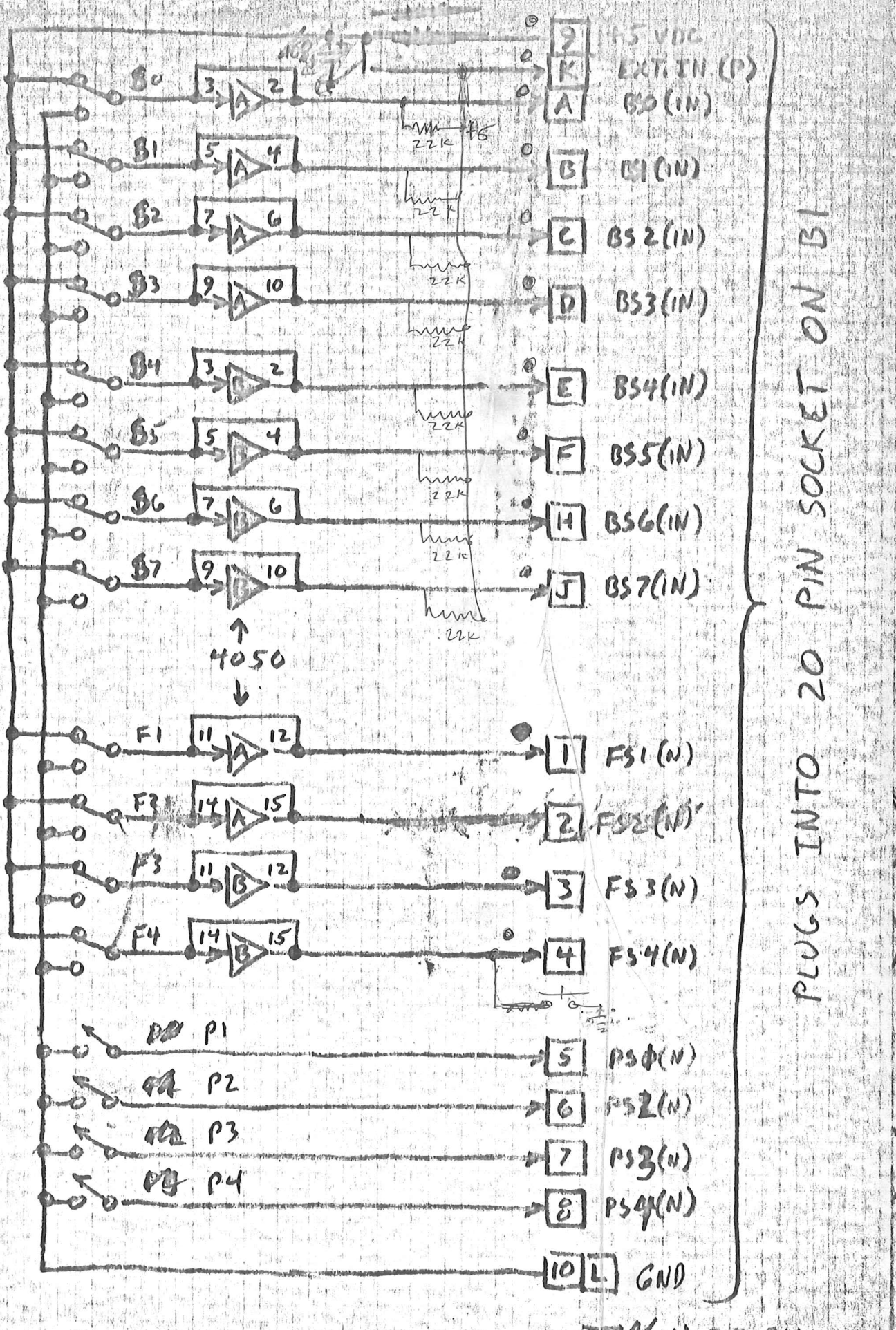
COSMAC COIN GATE PANEL



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