

00903C PROGRAM DESCRIPTION I

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Program Title REVERSI

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Program Description, Equations, Variables This program allows the user to play a game of Reversi against an HP-41C.

YOU PLAY 57
FLIP 2 PCES

1	2	3	4	5	6	7	8
1	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—
3	0	0	0	—	—	—	—
4	—	0	0	0	—	—	—
5	—	—	0	***	***	—	—
6	—	—	0	0	0	***	0
7	—	—	—	0	***	—	—
8	—	—	—	—	0	***	0

The present program includes all features required: plays quite well and will easily defeat a beginner, so it provides a challenging level for everyone. The program itself runs the same with or without a printer, but if one is present, it will print the board.

The program is also autonomous: no data cards required, no card reader required. It is also quite fast for such a complex game: the HP-41C performs some 30 moves (whole game) in 25 minutes. Besides, the running speed increases as the game goes on.

You can select who makes the first move, and the type of opening: either diagonal or parallel. Also, you may select to print the board after every new position, or only after HP moves (so saving paper and time). The machine recognizes and rejects illegal moves. Can play a single move for you against itself. Even a whole game against itself if you want (imagine, the HP-41C playing both black and white at the same time!)

Though you are supposed to know the rules of the game, a brief explanation will be given, for the sake of completeness. Here is a brief outline of the rules:

Necessary Accessories 3 single-density memory modules (or a quad module).

Operating Limits and Warnings Your move must be of the form xy, with both x and y ranging from 1 to 8, limits included, and the two exceptions to this rule being 0 (no move) and -1 (HP plays for you). Any negative number may be used instead of -1, if desired. The game generally ends when the board is full of pieces, but it may also end if no player can make a legal move. In that unlikely case, the counting of the pieces is not automatically performed. You must do it by yourself.

References New Mathematical Diversions, by Martin Gardner. Includes the rules of Reversi, and some other curiosities. You can also have a look at the Games Pac for the HP-85 computer, which includes a program to play Reversi (not related to this program in any way, to be sure!!!)

This program has been verified Only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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Reversi is played on an 8×8 board. There are two standard openings (see illustrations):

- diagonal opening (left)
- parallel opening (right)

	1	2	3	4	5	6	7	8
1	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—

One of the players plays the white pieces (represented by the 0), the other the black ones (represented by the checkerboard character).

To make a move, the player places one of his pieces in an empty location (represented by a dash) taking into account that:

- it must be adjacent to a piece of the other player.
- at least one enemy piece must be enclosed between the just placed piece and another piece of the same color.

	1	2	3	4	5	6	7	8
1	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—
3	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—

This is, any number of pieces enclosed between the played piece and any other of the same color are flipped: they become of the capturer's color. No empty locations can be enclosed, only full rows of enemy pieces can be flipped. The row can be placed in any direction: horizontal, vertical or diagonal. If more than one row is enclosed at the same time, all are flipped. You can capture only when putting a piece on the board: enemy pieces which are left enclosed by yours because of other factors are not captured, of course.

	1	2	3	4	5	6	7	8
1	0	—	—	—	—	—	—	0
2	0	0	0	0	0	0	0	0
3	0	0	0	—	0	0	0	0
4	—	0	—	0	0	0	—	0
5	—	—	0	0	—	0	—	0
6	—	0	—	0	0	0	—	0
7	—	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0

Some example should make it clear. Look at the diagonal opening. If black plays to 64 (6 vertical, 4 horizontal), then the white piece at 54 is between the 2 black pieces at 44 and 64 (just played), so it's flipped: the white piece at 54 becomes black. (By the way, you play black, HP plays white).

Now, look at the illustration at the left of these lines: if white plays at 14, the black pieces at 12 and 13 are enclosed between the just played piece at 14 and the white piece at 11, so they would be flipped. Simultaneously, the black pieces at 15, 16 and 17 are between the just played piece at 14 and the white piece at 18, so they would be flipped, too.

On the other hand, in the same board position, if black plays at 63, it would flip the white pieces at 62, 53, 43, 33, 23, 64, 65, 66, and 67, because there is another black piece at the end of each row of white pieces, and none of the rows contain empty locations between pieces.

PROGRAM CHARACTERISTICS

The program is exactly 672 bytes (96 registers) long, so it exactly fits onto 3 magnetic cards. The program is optimized for running speed: each location on the board is stored into a single data register, so a minimum SIZE 117 is required. This makes it necessary to have at least 3 single-density memory modules attached, in order to run the program, leaving a port free to plug in the card reader or the printer.

Registers are used as follows: R00 through R07 are scratch. R08 through R15 contain the directions array, necessary to scan each row. R16 through R27 store an array of constants used by the strategic part of the program to compute each move. R17 through R116 store the 8×8 board, including edges (thus being actually a 10×10 board). As you may see, the constants array and the board overlap, so saving 11 registers. This is possible because the edges may be any number except +1 or -1, and none of the constants have those values. White (HP's) pieces are stored as +1, black (yours) ones as -1, and empty locations are 0. The edges are typically 0, but can be any number except +1 or -1.

The program uses flags 1, 2, 3, 4, and 5. If flag 3 is set, your move is being tested for legality, or HP is playing your pieces against its own. If flag 4 is set, a given number is not yet considered legal. If flag 1 is set, HP plays

your pieces for you. If flag 2 is set and the printer is present, the board will not be printed after your moves (except, of course, if you make the last move). If flag 2 is clear, the board is printed after every move. All flags are controlled by the program, except flag 2, which is user-dependent: you may set or clear it from the keyboard as often as you like. Flag 5 is set before a sequence of board positions is tested. If the flag is set at the end of the sequence, none of the positions tested are valid.

Remember that the program is printer-compatible: if you do not use a printer, it runs the same, except that the board is not printed, of course.

TIPS AND REMARKS

Here are a few typical running times. These times are just the time needed to compute HP moves. They do include time required to print the board, but, of course they do not include the time required for you to think out your own move.

- an average game : 30 HP moves
 - without printer: 25 minutes
 - printer, SF 02 (1 board): 60 minutes
 - printer, CF 02 (2 id.): 75 minutes

As you may see from these figures, the printer slows down significantly the execution speed, but the convenience of the automatic handling of the board, and the fact that an actual board is not needed at all, together with the game being recorded on the paper tape, make it worth the price.

Remember also that execution gets faster as the program progresses, from some 70 seconds for a move near the beginning of the game, to a few seconds for a move near the end of the game. This is possible because HP keeps track of already occupied locations, and once a group of 5 locations is tested to be occupied, they are not tested any more, speeding up the search algorithm quite a lot when the game is close to its termination.

No moves are random, so the same game is played if you make exactly the same moves. This feature is useful: if you made a mistake that allowed HP to win, you can repeat that game once more, this time avoiding the error, to see who wins now. As you'll see, the level of play is quite good for such a tiny program running under the speed limitations of the HP-41C. Any improvements to the playing logic are welcome, however.

There are several ways of making room for improvements, or to fit the program into 2 RAMs (instead of 3). Possible shortcuts are:

- 1) Delete lines 68, 69, change LBL "REVERSI" to LBL "R", line 260 to "OK", and shorten other alpha comments. This saves 27 to 30 bytes at almost no cost.
- 2) If you have no printer, or do not want printing of the board, you can delete lines 6, 62, 195 through 251, 254 through 258 (limits always included) and change line 49 to 60 instead of 61. This modification saves 116 bytes.
- 3) You may use a data card: delete lines 7 through 30 (both included) and insert in their place:
07 16.027
08 RDTAX

This saves another 148 bytes, but a card reader is needed, and you must load a data card when the program asks for one. The data card contains the constants that the program stores (in lines 7 through 30) in their respective registers. See program listings.

Remember that, although the game normally ends when the board is full of pieces, it may end if no player can make a legal move (or if a player loses all his/its pieces). In these cases, the automatic counting of the pieces to decide the winner is not performed: you'll have to do it manually.

Printer is set to
Normal Mode

DIAG ? SF 02
XEQ "REVERSI"
RUN

1 2 3 4 5 6 7 8
1 - - - - - - - -
2 - - - - - - - -
3 - - - - - - - -
4 - - - # O - - -
5 - - - O # - - -
6 - - - - - - - -
7 - - - - - - - -
8 - - - - - - - -

HP 1ST ? N
MOVE ? 64
YOU PLAY 64
FLIP 1 PCES
I PLAY 63
FLIP 1 PCES
RUN

1 2 3 4 5 6 7 8
1 - - - - - - - -
2 - - - - - - - -
3 - - - - - - - -
4 - - - # O - - -
5 - - - O # - - -
6 - - - O # - - -
7 - - - - - - - -
8 - - - - - - - -

acknowledges your move, and, since flag 02 is cleared, prints the board reflecting your move.

The board is printed. Your move at 76 just flipped the white piece at 65, which became black. You must be aware that this printout is not a direct continuation of the previous one, since we took the game up two moves later.

The machine plays to 66, so flipping once more the piece at 65. As you may see, unlike other games, such as chess or checkers, pieces never move from where they are left, but merely change sides any number of times. Of course, the object of the game is to have the maximum number of pieces on the board when the game ends.

The board is printed now, showing the effects of the machine move on the position.

SAMPLE GAME: Load the program, SIZE 117, and press the following:
SF 02 (selects one board only)

XEQ "REVERSI" : see printout at the left.

- the display asks you whether you want to play DIAGONal opening: you agree by pressing R/S
- the board is printed now reflecting the diagonal opening that you have selected. This is the initial position. You are playing black (checkerboard characters) and HP plays white (the 0's).

(if you are not using a printer, you need an actual 8×8 board, and a set of 64 reversible pieces, one side white, the other black. Dispose them as in the printout, and always actualize the board after your moves and after HP moves).

- the machine prompts you whether it makes the first move
- enter an N and press R/S (N stands for NO): you move first
- the machine then prompts for your move
- enter 64, then R/S (you put a piece at 6 vertical, 4 horizontal)
- the machine tests your move, finds it legal, and acknowledges the move, displaying also the number of flipped pieces
- then computes its move, displays it, the number of pieces it flips, and prints the board

(the board was not printed after your move because we set flag 02)

the board reflects the position after the moves. Your move at 64 flipped the white piece at 54, which became black, but then the machine moved to 63 flipping that same piece once more to white. This is so because by playing at 63 the piece at 54 is enclosed between both white pieces at 63 and 45

... the game continues ... (You:53, HP:65) then, we decide to have a printing of both boards, so we clear flag 02, and enter 76, R/S as our move: (the flag is cleared using the keyboard sequence CF 02). The machine

MOVE ?
CF 02
76 RUN
YOU PLAY 76
FLIP 1 PCES

1 2 3 4 5 6 7 8
1 - - - - - - - -
2 - - - - - - - -
3 - - - - - - - -
4 - - - # O - - -
5 - - - O # - - -
6 - - - O O # - - -
7 - - - - - - - -
8 - - - - - - - -

I PLAY 66
FLIP 1 PCES

1 2 3 4 5 6 7 8
1 - - - - - - - -
2 - - - - - - - -
3 - - - - - - - -
4 - - - # O - - -
5 - - - O # O - - -
6 - - - O O O O - - -
7 - - - - - - - -
8 - - - - - - - -

00903C PROGRAM DESCRIPTION II

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1	2	3	4	5	6	7	8
1	0	❖	❖	❖	❖	❖	0
2	0	❖	❖	❖	❖	❖	-
3	0	0	0	❖	0	0	0
4	❖	❖	0	0	0	❖	0
5	❖	❖	0	0	0	0	0
6	❖	0	0	0	0	0	0
7	❖	0	0	0	0	0	0
8	0	0	0	0	0	0	0

MOVE ? -1 RUN

NO MOVE
I PLAY 28
FLIP 8 PCES

1	2	3	4	5	6	7	8
1	0	❖	❖	❖	❖	❖	0
2	0	0	0	0	0	0	0
3	0	0	0	❖	0	0	0
4	❖	❖	0	0	0	❖	0
5	❖	❖	0	0	0	0	0
6	❖	0	0	0	0	0	0
7	❖	0	0	0	0	0	0
8	0	0	0	0	0	0	0

GAME IS OVER

HP: 49, YOU: 15

I WON

SAMPLE GAME CONTINUED: In the printout at the left, a typical game ends.

HP has just moved. Then you are prompted for your move. In the position shown, there is just one empty location left. But you cannot place a piece there, because no white pieces would result enclosed between your piece and another of your pieces. So you have no legal move. However, if you are a beginner, you may be unsure about it, so you decide to have the machine select your move (if any) for you:

Enter -1, R/S. HP begins to search for a suitable move for you. But as expected, finds none, displays (and beeps; you may have noticed by now that most messages are beeped as well as displayed and printed) NO MOVE, then proceeds to search for its move. Finally, after a few seconds, it moves to 28 (where else?!) and, while doing so, flips no less than 8 of your pieces: those located at 22, 23, 24, 25, 26, 27, 37, and 46.

The board is printed for the last time. Then the machine realizes that the game has ended, displays GAME IS OVER, and counts both black and white pieces on the board, to decide the winner. This time, it displays HP: 49, YOU: 15, meaning there are 49 white pieces on the board, while you have only 15 of your pieces remaining. Obviously, HP has won, so it displays a final I WON message. Once this message is on the display, there is only one possibility left for you: TRY AGAIN.

TEST GAME: If desired, test that your program is correctly loaded by executing the following game.

Diagonal opening, HP first. Only the moves are shown (no flip pieces)

YOU	HP								
--	65	42	68	57	85	25	16	38	48
46	33	75	36	83	58	26	52	78	82
64	63	35	84	76	41	32	47	71	87
43	66	86	51	61	34	23	14	12	11
72	53	31	56	62	74	15	73	0	21
67	81	27	18	24	13	17	37	77	88
								22	28

FINAL SCORE: 17 47, so HP WON.

NOTE: If you play with a printer (and set it to NORM, as recommended), you'll have each machine move printed, as well as displayed. However, if you play without a printer, and you happen to miss the I PLAY xy display, do not worry. Simply use backarrow to clear the MOVE ? display, and the last HP's move will be in the display, in the form xy. (Use backarrow just once. Using it twice or more consecutively would also clear the xy move! You can also simply turn alpha on and off to clear the MOVE ? prompt from the display.)

<u>STEP</u>	<u>INSTRUCTIONS</u>	<u>INPUT</u>	<u>FUNCTION</u>	<u>DISPLAY</u>
1	Load the program. You play black. HP white.			
2	If you want to use the printer, plug it in now and set NORM position.			
3	If a printer is used and you want to suppress board printing after your moves, press: the board will now be printed just after HP moves. This can be done at any time		SF 02	Flag 2 annunc. on
or 3	To print the board each time, press:		CF 02	Flag 2 annunc. off
4	Make sure you have at least SIZE 117.			
5	Begin the game, press:		XEQ "REVERSI"	DIAG?
6	If you want to play diagonal opening:		R/S	HP 1ST?
or 6	If you want to play parallel opening:	N	R/S	HP 1ST?
7	If you want HP to make the first move:		R/S	I MOVE
or 7	If you want to make the first move:	N	R/S	MOVE?
8	<u>IF IT IS YOUR TURN</u> (MOVE? on the display) Enter your move (x=vertical, y=horizontal) (Your move is tested for legality. If it is found to be illegal, you'll be prompted once more for your move with MOVE?. Go to Step 9, then)	xy	R/S	YOU PLAY xy FLIP p PCES or ILLEGAL MOVE?
or 9	You have no legal move: enter: and HP proceeds to compute its move.	0	R/S	
or 9	You want the machine to play your pieces against its own in this turn: enter: and HP computes your move, displays: and then automatically computes its own move. NO MOVE is displayed if the machine finds no legal move for your pieces. If you want a whole machine/machine game, always enter -1 as your move.	-1	R/S	YOU PLAY xy FLIP p PCES or NO MOVE
10	<u>IF HP MOVES</u> it will think about its move for a while, then display: xy is the location where HP puts its piece and p is the number of your pieces flipped, NO MOVE is displayed if no legal move is possible for HP. You then have the turn once more: Go to Step 8			I PLAY xy FLIP p PCES or NO MOVE

11	<p>Once the last player makes the last move, you should see:</p> <p>where nn = number of white (HP) pieces on the board</p> <p>mm = number of black (you) pieces on the board</p> <p>Of course, <u>the player with the most pieces at the end of the game wins the game</u>. So, if HP has 24 pieces on the board and you have 40, you won. If HP has 40 and you 24, HP wins. But if both have 32 pieces, it is a tie and no winning message is displayed.</p>			GAME IS OVER HP: nn, YOU: mm I WON or YOU WON
----	--	--	--	--

NOTES: If the printer is plugged in, everything that appears in the display is printed as well, and the resulting board position is printed after every legal move if Flag 02 is clear, and only after HP moves if it is set. After the last move, the board is printed also, regardless of the status of Flag 02.

You may set or clear Flag 02 using SF 02 and CF 02 respectively from the keyboard as often as you like. You may do it at any time during program execution, when~ ever the machine is at a halt.

If no player can make a legal move, or if one player loses all his pieces, the game is ended, but this is not recognized by the program, and the automatic counting of the pieces is not performed. Do it yourself, to determine the winner. The board, if not already printed, may be forced to be printed by the following series of keystrokes:

GTO .202
R/S

and halt the program just after the 8th row is printed, by pressing R/S. Once the board is printed, you can perform the counting.

The machine-plays-for-you feature is very useful. You can use it freely whenever you don't know what to play: let the machine play (honestly) your pieces, hoping its selection is a good one. Or, if you are unsure whether you have any legal move or not, let the machine play your pieces:

- if there is a legal move for you it will be found
- if no legal move at all, NO MOVE is displayed, and the machine now computes its own move.

This capability is especially useful for beginners; also, if you want the machine to play a whole game against itself, always enter -1 as your move, and you'll see HP in action as never before!

STEP/ LINE	KEYCODE (67/97 only)	COMMENTS	STEP/ LINE	KEYCODE (67/97 only)	COMMENTS
01	LBL "REVERSI"		59	STO 61	
02	CLRG	Initialization	60	X<>Y	
03	FIX 00		61	STO 71	
04	CF 29		62	XEQ 06	Print board
05	CF 01		63	"HP FIRST?"	"Who moves
06	CF 12		64	PROMPT	first?" test
07	.8188111883	Store move	65	AOFF	
08	STO 16	constants	66	FS?C 23	
09	.8661683130		67	GTO 00	
10	STO 17		68	"I MOVE"	HP first
11	.1316636633		69	AVIEW	
12	STO 18		70	SF 29	First move of game
13	.36845518		71	LBL 14	
14	STO 19		72	"I"	HP's move
15	.414814156		73	CF 03	
16	STO 20		74	LBL 08	
17	.6556564346		75	16.027	
18	STO 21		76	FS?C 29	First move of game
19	.3435747552		77	21	
20	STO 22		78	STO 05	
21	.5742472425		79	LBL 11	
22	STO 23		80	RCL IND 05	Recall constant
23	.7376626732		81	X=0?	Constant exhausted?
24	STO 24		82	GTO 05	Get new constant
25	.3723268287		83	SF 05	
26	STO 25		84	LBL 13	
27	.717821212		85	RCL 10	10
28	STO 26		86	X^2	
29	.177277227		87	*	
30	STO 27		88	STO 06	
31	SIGN	1	89	INT	
32	STO 62	Initialize	90	XEQ 12	Best position
33	STO 09	test constants	91	FC?C 04	Invalid move?
34	CHS	-1	92	GTO 00	
35	STO 08		93	RCL 06	
36	STO 72		94	FRC	
37	9		95	X#0?	If constant not
38	STO 15		96	GTO 13	exhausted, recycle
39	CHS		97	FS? 05	
40	STO 14		98	STO IND 05	All squares tested
41	+		99	LBL 05	full? Null constant
42	STO 11		100	ISG 05	
43	CHS		101	GTO 11	Next constant
44	STO 10		102	"NO MOVE"	All tested moves
45	11		103	AVIEW	failed
46	STO 13		104	TONE 09	
47	CHS		105	PSE	
48	STO 12		106	LBL 00	Your move
49	61		107	FS?C 01	
50	STO 07		108	GTO 14	
51	"DIAG?"	Query for parallel	109	"MOVE?"	
52	CF 23	or diagonal	110	PROMPT	
53	AON	opening	111	X=0?	No move?
54	PROMPT		112	GTO 14	Go to HP's move
55	RCL 09		113	SF 03	
56	RCL 08		114	"YOU"	Your move
57	FS?C 23		115	X<0?	
58	X<>Y		116	SF 01	

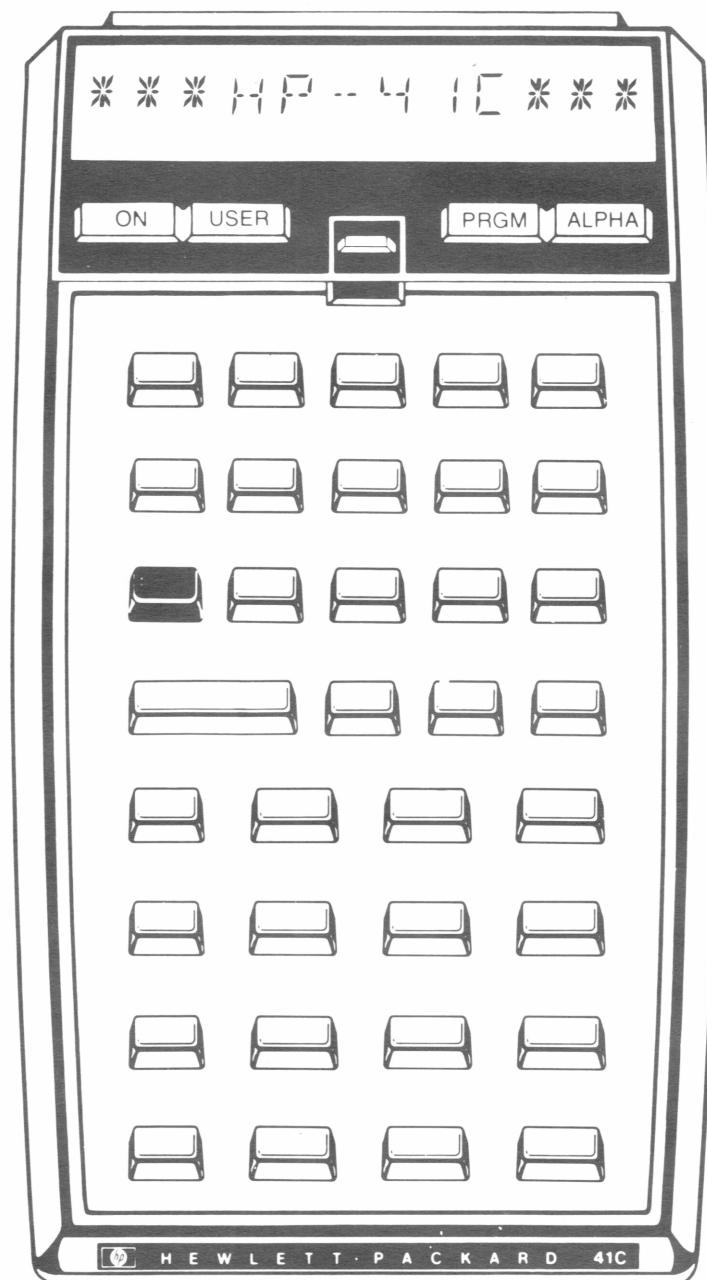
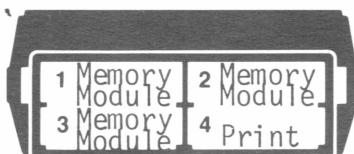
STEP/ LINE	KEYCODE (67/97 only)	COMMENTS	STEP/ LINE	KEYCODE (67/97 only)	COMMENTS
117	X<0?	HP move for you	176	RCL 01	
118	GTO 08		177	X=0?	End test
119	XEQ 12	Test position	178	RTN	
120	FC?C 04	Legal move?	179	CF 04	
121	GTO 14		180	>" PLAY "	
122	"ILLEGAL"		181	RCL 00	Display move
123	AVIEW		182	17	
124	TONE 09		183	-	
125	GTO 00		184	ARCL X	
126	LBL 12		185	AVIEW	
127	SF 04	Occupied square	186	FC? 01	
128	17	flag	187	FC? 03	
129	+		188	BEEP	
130	STO 00		189	PSE	
131	RCL IND 00		190	"FLIP "	
132	X#0?	Square occupied?	191	ARCL 01	
133	RTN	Return	192	>" PCES"	
134	CF 05	Empty Square	193	AVIEW	
135	STO 01	Initialize empty	194	PSE	
136	8.015	square test	195	FC? 02	Print board?
137	STO 02		196	GTO 06	
138	RCL 09		197	FS? 03	HP's move?
139	FC? 03		198	GTO 12	
140	CHS		199	LBL 06	
141	STO 04		200	FC? 55	If no printer,
142	LBL 01		201	GTO 12	skip printing
143	RCL 00	Is there a	202	ADV	routine
144	RCL IND 02	flippable	203	31	
145	+	neighbor piece?	204	STO 00	
146	STO 03		205	45	
147	RCL IND X		206	STO 01	Initialize for
148	RCL 04	Neighbor not	207	79	board printing
149	X#Y?	flippable	208	STO 02	routine
150	GTO 12		209	2.01	
151	LBL 03	Test the rest of	210	STO 03	
152	LASTX	the pieces in	211	8	
153	ST+ 03	the row	212	SKPCOL	
154	RCL IND 03		213	49.056	
155	RCL 04		214	STO 04	
156	X=Y?		215	LBL 02	
157	GTO 03		216	RCL 13	Print horizontal
158	CHS		217	SKPCOL	labels 1-8
159	X#Y?	Space?	218	X<>Y	
160	GTO 12	Next direction	219	ACCHR	
161	STO IND 00		220	ISG X	
162	LBL 04	Flip pieces	221	GTO 02	
163	LASTX		222	PRBUF	
164	ST- 03		223	28.035	
165	RCL 00		224	STO 05	
166	RCL 03		225	LBL 09	Print playing
167	X=Y?		226	RCL 04	board row by row
168	GTO 12		227	ACCHR	
169	RCL 08		228	RCL 15	
170	ST* IND Y		229	SKPCOL	
171	ST- 01		230	SF 12	
172	GTO 04		231	LBL 10	Accumulate row
173	LBL 12		232	RCL IND 05	characters for
174	ISG 02	Increment flip	233	RCL 09	printing
175	GTO 01	test counter	234	+	

STEP/ LINE	KEYCODE (67/97 only)	COMMENTS
235	RCL IND X	
236	ACCHR	
237	RCL 03	
238	SKPCOL	
239	ISG 05	
240	GTO 10	
241	PRBUF	
242	ST+ 05	
243	CF 12	
244	ISG 04	
245	GTO 09	
246	ADV	
247	FS? 03	
248	GTO 12	
249	ADV	
250	ADV	
251	LBL 12	Move counter
252	DSE 07	
253	RTN	
254	FC? 02	
255	GTO 12	
256	FS?C 03	
257	XEQ 06	
258	LBL 12	
259	32	
260	"GAME IS OVER"	
261	28.105	
262	AVIEW	
263	0	
264	LBL 07	Total scores
265	RCL IND Y	
266	+	
267	ISG Y	
268	GTO 07	
269	2	
270	/	
271	X<>Y	
272	RDN	
273	ST- Z	
274	+	
275	ADV	
276	"HP: "	Display scores
277	ARCL X	
278	>, YOU: "	
279	ARCL Y	
280	AVIEW	
281	BEEP	
282	ADV	
283	PSE	
284	X=Y?	
285	STOP	
286	"I"	
287	X<Y?	
288	"YOU"	
289	>" WON"	Who won?
290	PROMPT	
291	END	

REGISTERS, STATUS, FLAGS, ASSIGNMENTS

DATA REGISTERS		STATUS			
01 to 07	Scratch	SIZE 117 ENG DEG	TOT. REG. 213 FIX RAD	SCI GRAD	USER MODE ON OFF XX
08 to 15	Directions array	FLAGS			
16 to 27	Constants array to Board 17 116 (Constants array and Board overlap)	# INIT S/C	SET INDICATES	CLEAR INDICATES	
		01	HP playing your pieces		
		02	Only 1 board	Both boards	
		03	Move tested legal		
		04	Move not yet legal		
		05	Set before sequence of board positions is tested. If the flag is set at the end of the sequence, none of the positions tested are valid.		
		12	Double wide print	Single wide print	
		23	Alpha input	No alpha input	
		29	Decimal point	Suppress Decimal	
			Flag 29 is also set to indicate the first move of the game.		
		55	Printer exists	No printer	
ASSIGNMENTS					
FUNCTION	KEY	FUNCTION	KEY		

KEYBOARD

SYSTEM
CONFIGURATION

CARD

