

Q - CHESS USERS GUIDE

1. Introduction

Q-Chess 1.0 plays a game of chess using the KIM-1 microcomputer with 8 Kbyte additional memory and a TV output. No additional I/O is required. The human players moves are entered on the KIM-1 self contained keyboard. The computers responses are indicated on a chessboard displayed on the TV screen. A slight program modification will permit the user to run Q-Chess on a KIM-1 with 8 K additional memory but without TV output. In this case the build in LED display of the KIM-1 will be used as the exclusive output device. Small program modifications will permit the user to run Q-Chess on other 6502 based systems using different peripherals. All references in this users guide assume a KIM-1 with memory from 2000-3FFF and Don Lancaster's TVT-6 as described in the July 1977 issue of Popular Electronics. Section 1a explains how to interface Q-Chess to a 6502 with different I/O.

Q-Chess 1.0 employs minimax searching and alpha-beta pruning. A full width search is always performed 2 plies deep. A selective search may be performed in the case of captures and a few other occasions. It may go as deep as 8 plies.

Q-Chess 1.0 is able to castle, move en passant, promote pawns, and avoid stalemate. Credit is due to Peter Jennings, whose excellent documentation of Microchess for the naked KIM-1 provided the motivation to create Q-Chess.

2. Loading the Program

Within this users guide, /x/ denotes a key on the built-in KIM-1 keyboard. E.g., /RS/ denotes the Reset key, /4/ the key labeled 4, etc. The sequence ! xx xx xx ! denotes information displayed on the built-in KIM-1 7-segment display. E.g. ! 25 00 d8 ! shows storage location 2500 containing the data d8.

Q-Chess requires memory at addresses from 0000 - 03FF, 1780 - 17E3, and 2000 - 3FFF. To load the program, do the following:

1. Load cassette into cassette recorder
2. Enter these data:

Address	Data
00F1	00
17F9	01
3. Enter 1873 and press the /GO/ key.
4. Start recorder
5. Wait until KIM displays ! 00 00 xx !
6. Press the /RS/ key
7. Initialise/start Q-Chess by entering address **2380** and pressing the /GO/ key. The TV screen will light up, showing a chessboard with all pieces in their starting position.

3. Q-Chess Notation

The player communicates with Q-Chess via the standard KIM-1 keyboard. Each square on the chessboard is represented by a letter (a...h) followed by a digit (1...9). This is the chess notation supported by the International Computer Chess Association, see figure 1. Moving White's King Pawn two squares from its starting position (P-K4) is represented as e2-e4.

a8	b8	c8	d8	e8	f8	g8	h8
a7	b7	c7	d7	e7	f7	g7	h7
a6	b6	c6	d6	e6	f6	g6	h6
a5	b5	c5	d5	e5	f5	g5	h5
a4	b4	c4	d4	e4	f4	g4	h4
a3	b3	c3	d3	e3	f3	g3	h3
a2	b2	c2	d2	e2	f2	g2	h2
a1	b1	c1	d1	e1	f1	g1	h1

Figure 1

Since the KIM-1 keyboard has no keys labelled G and H, use these keys instead:

to enter letter	use key labelled	KIM display will show
G	9	9
H	0	H

4. Q-Chess Command Keys

The following keys are used as commands while playing chess :

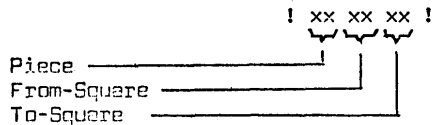
/GO/ This key is pressed immediately after loading the tape in order to initialise Q-Chess (cold start, address 2380), or to restart the program after a temporary exit. (warm start, address 2500). After Q-Chess execution begins, the key has no effect. A few utility routines also use the /GO/ key.

/ST/ This key is used to leave the TVT-6 display mode and to enter Q-Chess in order to make the next move. Only when the computer is displaying a position on the TV screen is it permissible to press the /ST/ key.

- /AD/** This key clears the internal chessboard and resets it to begin another game. The board is set up with the computer playing white. ! AA AA AA ! is displayed to indicate that the board has been reset.
- /DA/** This key exchanges the computers pieces with the human players pieces. The actual position of the board remains unchanged. If /AD/ is pressed followed immediately by /DA/, the board will be set up with the computer playing black. ! EE EE EE ! will be displayed after pressing /DA/ .
- /+/** This key is used to move the piece on the FROM-square to the TO-square. Both the computers and the players pieces may be moved. The display will show FF, in the leftmost two digits to confirm that the piece has been moved.
- /PC/** This key instructs the computer to play chess. The computer analyses the current position and formulates his answer. The KIM-1 display will darken and flash occasionally while the TV screen will show random noise until the move has been decided. Upon completion the move is displayed on the TV screen.

5. KIM-1 Display

Each move entered via the KIM-1 keyboard is displayed on the KIM-1 display in this format:



The left two digits indicate the piece which occupies the FROM-square. The first digit is a 0, if it is one of the computers pieces. It is a 1, if it is one of the players pieces. It is an F, if the field is unoccupied. The second digit is encoded according to figure 2.

0 - King	4 - King Bishop	8 - K R Pawn	C - K B Pawn
1 - Queen	5 - Queen Bishop	9 - Q R Pawn	D - Q B Pawn
2 - King Rook	6 - King Knight	A - K N Pawn	E - Q Pawn
3 - Queen Rook	7 - Queen Knight	B - Q N Pawn	F - K Pawn

Figure 2

The remaining digits of the KIM-1 display indicate the FROM and TO squares using the international Chess Notation shown in figure 1. For example, the

display ! of E2 E4 ! indicates that the King Pawn is to be moved from King Pawn 2 to King Pawn 4 . (This assumes that the computer is playing white).

(If the KIM-1 display is used as the Q-Chess output device, indicating the computers move, the same format is used.)

6. Entering a move

To enter a move, first press the /ST/ key on the KIM-1 keyboard. The TV screen will go blank and the KIM-1 display will lighten up indicating the last move the computer made. Now enter your move via keys 0...F on the KIM-1 keyboard, using the International Chess Notation shown in figure 1 . Remember to use a /9/ to represent a G, and /o/ to represent an H . It is not necessary to enter the type of piece being moved, just the FROM square and the TO square locations.

The computer verifies the input by indicating in the left two digits the piece located on the FROM-square. If you have made an error at this point just continue to press the appropriate keys. The numbers will scroll from right to left until the correct move is displayed.

For example, if you punch E7 E5 and see the display ! 1F E7 E5 !, the 1F indicates that the FROM-square (E7) is occupied by the players King Pawn and that you are preparing to move it to the square E5 .

When you have entered and verified the move, depress the /+/ key to register the move on the internal chess board. The first two digits of the KIM-1 display will be changed to FF, to indicate that the FROM-square is now unoccupied. If the TO square had been occupied, the previous occupant will have been captured automatically.

You may make as many moves in this manner as you wish, moving either your own pieces or the computer's. No verification of the legality of the moves is carried out. Illegal moves are accepted and executed as easily as legal moves. Care should be taken, that you do not move accidentally in an illegal manner.

7. Special Moves

Castling You may castle by making two moves in succession in the normal manner. First move the King to its new square, then move the Rook. Remember to depress /+/ after each move.

En Passant In order to capture en passant you must break the move into two separate components. First, move your pawn laterally to capture the Computer's pawn. Then, move your pawn forward to its appropriate final square. Do not forget to depress /+/ after each move.

Promoting Pawns If you want to push a pawn to the eighth rank, it will be necessary to manually set up an officer on that square. Because of the internal representation that Q-Chess uses, it is only possible to have one Queen per side at a time. Therefore, if you have already one, you will have to choose another officer (Rook, Bishop, Knight) instead. To replace the Pawn with an Officer, the following steps have to be carried out:

- 1) Do not move the Pawn from its FROM-square on the 7 th rank to the desired TO square on the 8 th rank.
- 2) Use the /RS/ key to exit from the Q-Chess program and return control to the KIM-1 monitor.
- 3) Q-Chess includes a special routine called MANUAL to manually change the chessboard. This routine may be also used for promoting Pawns. To use it, enter address 3890 and depress the /GO/ key.
- 4) Enter the FROM square on the 7 th rank that the Pawn still occupies.
- 5) Enter a two digit identification of the officer to which the pawn is to be promoted. The first digit has to be a "1" (one of your own pieces). The second digit has to be selected according to figure 2. E.g., entering "11" instructs the computer to promote your pawn to a queen.

The left two digits of the KIM-1 display should now indicate the Pawn being promoted, e.g.:

! 1d C2 11 !

If you made an error in entering your promotion at this point, just continue to press the appropriate keys. The numbers will scroll from right to left, until the correct promotion is displayed.

- 6) Now depress the /+/ key to register the promotion. The leftmost two digits of the KIM-1 display will be changed to FF, indicating that the pawn has been removed from the board.
- 7) Press the /AD/ key to verify that your Pawn has been replaced by the selected officer. The TV screen will display the chessboard. The selected officer will still be on the 7 th rank.
- 8) Press the /ST/ key to enter the Q-Chess program again.
- 9) Move the (former) pawn from its FROM square to its TO square (procedure as usual) , e.g. C2-C1 . This completes your move.

(The routine MANUAL at address:3890 is useful for the alternate purpose of setting up a unique board position. Pressing the /DA/ key will clear the board of all pieces. Using the procedure explained in paragraph 5) you now may place as many pieces on the board as you like .)

8. Q-Chess output, displaying the computers move

While the computer "thinks" (calculates his next move), the TV screen will show random noise. The KIM-1 display will be dark, but will briefly flash each time the computer has finished evaluating one of several alternatives.

As soon as the computer has calculated its next move the TV screen will light up. It will show a chessboard and the new position including the move the computer just made. Below the chessboard some text will appear, e.g

```
YOUR LAST MOVE WAS: P E7 - E5  
I MOVE: N G1 - F3
```

indicating that the computer moved its King side Knight from K Kn1 to K B3 .

To enter your next move, push the /ST/ key on the KIM-1 keyboard.

The computer indicates King side castling by O - O and Queen side castling by O - O - O in the lower right corner of the TV display. It indicates en passant capturing by moving the capturing pawn to the correct TO-square and by automatically removing the captured pawn.

9. Level of Play

The quality of play depends on the time Q-Chess spends on each move. There are several ways to influence both the computers response time and the computers quality of play.

9.1 To shorten the response time, change the byte at address 2609 from 06 to 00 . This will instruct Q-Chess not to look for forks and pins. Few if any moves will take more than a minute, and most moves will take only a few seconds.

9.2 To improve the quality of play you may do any of the changes indicated in figure 3 . As a consequence, Q-Chess will consume more thinking time. If you are not careful, the average response time may increase to many minutes or even hours per move.

To implement any change; do the following:

Press /RS/, then /AD/ . Enter the desired address and press /DA/ . Enter the new data and press /AD/, followed by /ST/ Resume the play. You may implement a change each time the computer has finished calculating a move, but not while the computer is "thinking".

Change, alternative	address	old data	new data	effect
1	X 29E7	FC	FA	deeper maximum search when capturing pieces. Not too time consuming
2	00C4 00C3	08 08	10 10	improvement in the case of pawn captures
3	29E7 00C2 00C1	FC 08 08	FA 10 10	further improvement in the case of pawn captures
4	X 2750 X 2753 X 2754	15 10 11	04 30 0E	analyses cases, where a players pawn attacks a computers officer
5	29A6 26F7	12 02	23 05	will do mate in two
6	29A6 2A09 26F7 2611	12 01 02 FF	23 FE 05 FD	will do mate in three

Figure 3

Explanation of alternatives 5 and 6 :

Changing address 26F7 from 02 to 05 instructs Q-Chess to extend search in the case of checks to 3 plies.

Changing address 2611 from FF to FD instructs Q-Chess to extend search in the case of checks to 5 plies.

Changing address 29A6 from 12 to 23 instructs Q-Chess to perform a full width search 3 plies deep.

Changing address 2A09 from 01 to FE in addition to the last change instructs Q-Chess to perform a full width search 4 plies deep. Changing it to FD will generate a 5 ply full width search.

1c. Other I/O configurations

Base KIM-1 with 8 K additional memory If your KIM-1 has no TV output, change :

address	old data	new data
2370	4C AD 17	C 00 25

Use Q-Chess as described before. The computer response will appear on the built-in KIM-1 7-segment display. If the computer castles, the response will be:

King castling	! 00 FH HF !
Queen castling	! 00 FH HH !

The computer resigns by displaying ! FF FF FF ! .

Different output device than the TVT-6

The computer assembles its response in a 768 Byte output buffer, located at addresses 0180 through 03FF. This output buffer is organised as 20 lines of 32 alphanumeric characters each (ASCII). The top line (line 1) starts at address 0180 ; the bottom line (line 20) starts at address 03E0 .

If your system uses a different output device than the TVT-6 , do the following : - Change the JMP instruction at address 2370 to jump to an output routine you will have to provide yourself. Your output routine should move the content of the output buffer 0180 - 03FF to your output device, e.g. a printer or display.

When Q-Chess branches to address 2370, the stack pointer has been previously set to 7F . Do not use the upper half of page 1, and neither page 0 , in your output routine. If your output routine needs page 0 space, save that area somewhere else in main store, and restore it to page 0 at the end of your output routine. Terminate your output routine with a Jump to the Q-Chess main start address at 2500 , e.g.

```
4C 00 25    JMP    WSTART
```

Since you no longer use the TVT-6, you may utilise the space occupied by the TVT-6 scan program, e.g. for storing your output routine. To do this, replace

address	old data	new data
2AE0	D8 A2 68	4C EC 2A

You may now use the space at addresses 2b00 - 2b64 and 1780 - 17E4 for other purposes.

Using an ASCII keyboard Change the JMP instruction at address 2376 to jump to a keyboard input routine you will have to provide yourself. This routine should load a single character into the accumulator and terminate with RTS. Because of the internal representation it will be necessary to translate ASCII characters into their KIM-1 keyboard equivalent, as shown in figure 4. Inspect the code at addresses 2500 - 2548 for better understanding.

character on your keyboard	ASCII equivalent	translate to hex	KIM-1 keyboard equivalent
1	31	01	/1/
2	32	02	/2/
3	33	03	/3/
4	34	04	/4/
5	35	05	/5/
6	36	06	/6/
7	37	07	/7/
8	38	08	/8/
A	41	0A	/A/
B	42	0B	/B/
C	43	0C	/C/
D	44	0D	/D/
E	45	0E	/E/
F	46	0F	/F/
G	47	09	/9/
H	48	00	/0/
S	53	10	/AD/
R	52	11	/DA/
B	50	14	/PC/
Q	51	12	+

Figure 4

Other 6502 than the KIM-1 All branches to the KIM-1 monitor are routed through a jump table

address	data
2370	4C AD 17
2373	4C BF 39
2376	4C 6A 1F
2379	4C 1F 1F

For changing the JMP instructions at addresses 2370 and 2376, see above. The JMP instructions at addresses 2373 and 2379 will have to point to a user written routine that outputs the content of addresses 00FB, 00FA, and 00F9 (in that sequence) to the output device of your system (in their present form they effect illumination of the KIM-1 7-segment display). Do not forget to change hex data into ASCII .

Your copy of Q-Chess contains some unused space, for example at locations

25D0 - 25DF?
2780 - 28FA?
3280 - 32EF?
3510 - 353F
3A90 - 3ADF x

Page zero has free space from 0020 to 00AF , that may however get updated during cold start routine execution.

Have fun ! ! ! ! !

400C

NOP NOP NOP

E8 E4 E4

Patches of Q-chess

4070

A9 0C	LDAIM 0C	Clear screen.	
20 A0 1E	JSR OUTCH.	LDYIM \$FF	A0 FF
A9 00	LDAIM \$80	DEY	88
85 00	STA 00	BNE DEL	00 FD.
A9 01	LDAIM \$01		
85 01	STA \$01	4095	TSX
loop A0 00	LDYIM \$00		STX 40A0
B1 00	LDAIY \$00		LDXIM \$20
20 A0 1E	JSR OUTCH		TXS
E6 00	INC \$00		JSR CRTDIS
D0 02	BNE NOH1		LDX 40A0
E6 01	INC \$01.		TXS
A9 00	LDYIM \$00		
C9 00	LDA \$00		
D0 ED	CMPIM \$00		
A9 01	BNE LOOP		
C9 04	LDA \$01		
D0 E7	CMPIM \$04		
JSR	BNE LOOP		
20 2F 1E	JSR		
60	JSR CRLF		

40 →

4035	20 70 40	JSR SHOW
4031	C9 0E	