

# KIM-I BREAKPOINT ROUTINES Plain & Fancy

Dear Mr. Warren,

Sept. 13, 1976

I received all seven issues of your publication at one time, one week ago. Talk about an information explosion! Your *Dr. Dobb's Journal* is really dynamite.

Since I now own a KIM, the article on a Breakpoint Routine for the 6502 in the March, 1976 issue caught my eye. As soon as I realized how useful such a routine would be for debugging, I decided to try it out on my KIM. I am enclosing a listing of my version, as I was able to reduce the size of the routine from 224 to 124 bytes. Since memory space on the basic KIM is not large, some of your readers might be interested in a smaller version. I have also enclosed a slightly larger version which makes the output of the routine more readable by prefacing each register display with an identifying character string.

The listing of the breakpoint routines was generated using a cross assembler I have written. I wrote this assembler program because I got fed up with hand assembling stuff for my KIM and because I have free access to an IBM 360/40. Currently, the assembler recognizes only the 6502 instruction set, but I plan to add the 8080 and 6800 instruction sets and the ability to print machine code in either hex or split octal.

A trick I picked up from *Radio-Electronics* may be of interest to your readers who have both a KIM and a TTY. You can use the paper tape load routine to enter programs into memory using the keyboard instead of the paper tape reader. Refer to Appendix F of the *KIM-1 User Manual* for the paper tape format. Don't worry about calculating the check sum, just enter four zeros. The TTY will print "ERR KIM", but what you entered will be in memory. The count of bytes can be any value, not just the hex 18 specified in Appendix F. For example, to enter the character string "KIM" into location 100, type the following: L;0301004B494D0000

Now that you've printed all this neat software, I guess I'll have to go buy more memory to put it in.

Very truly yours,  
Willi Kushe

P.O. Box 115  
Haddonfield, NJ 08033

P.S. Since I wrote this, I have reduced the 6502 lunar lander you published to KIM size. Would you want my version??  
[Sure! - Jim]

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KIM BREAKPOINT ROUTINE -- MINIMUM
LOC   CODE   SOURCE STATEMENT
;
;   SAVE AREAS ARE DEFINED BELOW KIM MPU REG. SAVX AREA IN PAGE 0
;
0000   *=$E8
00E8   SAVEP  *$*1
00E9   SAVES  *$*1
00EA   SAVEY *$*1
00EB   SAVEX *$*1
00EC   SAVEA *$*1
00ED   PCLO  *$*1
00EE   PCHI  *$*1
;
;   BREAKPOINT ROUTINE BEGINS HERE
;
;
00EF   BRKPT  *$388
0388   STA   SAVEA
0389   STX   SAVEX
038A   PLA   STY   SAVY
038B   PLA   STA   SAVEP
038C   PLA   STA   PCLO
038D   PLA   STA   PCHI
038E   TSX   SAVES
038F   CLD
0390   JSR   CRLF
0391   LDA   PCLO
0392   BNE  ALTI
0393   DEC  PCHI
0394   DEC  PCLO
0395   BNE  ALTI
0396   DEC  PCHI
0397   DEC  PCLO
0398   LDA   PCHI
0399   JSR   PRBYP
039A   LDA   PCLO
039B   JSR   PRBYP
039C   LDA   PCHI
039D   JSR   PRBYP
039E   LDA   PCLO
039F   JSR   PRBYP
03A0   LDA   PCHI
03A1   JSR   PRBYP
03A2   LDA   PCLO
03A3   JSR   PRBYP
03A4   LDA   PCHI
03A5   JSR   PRBYP
03A6   LDA   PCLO
03A7   JSR   PRBYP
03A8   LDA   PCHI
03A9   JSR   PRBYP
03AA   LDA   PCLO
03AB   JSR   PRBYP
03AC   LDA   PCHI
03AD   JSR   PRBYP
03AE   LDA   PCLO
03AF   JSR   PRBYP
03B0   LDA   PCHI
03B1   JSR   PRBYP
03B2   LDA   PCLO
03B3   JSR   PRBYP
03B4   LDA   PCHI
03B5   JSR   PRBYP
03B6   LDA   PCLO
03B7   JSR   PRBYP
03B8   LDA   PCHI
03B9   JSR   PRBYP
;
;   THE FOLLOWING LOOP WILL PRINT A ONE CHARACTER ABBREVIATION
;   FOR EACH FLAG IN THE MPU STATUS REGISTER IF THAT FLAG IS SET
;   IF THE FLAG IS NOT SET (EQUAL TO ZERO), NOTHING WILL BE PRINTED
;
03BB   LDX   #8
03BC   SHFTL B0L  A
03BD   SHFTL B0C  DECRX
03BE   PHA
03BF   LDA   CHTBL-1,X
03C0   JSR   OUTCH
03C1   LDA   PCHI
03C2   JSR   OUTCH
03C3   LDA   PCLO
03C4   JSR   OUTCH
03C5   LDA   PCHI
03C6   JSR   OUTCH
03C7   LDA   PCLO
03C8   JSR   OUTCH
;
;   INITIALIZE FOR 8 TIMES THROUGH LOOP
;   ROTATE RIGHTMOST FLAG TO CARRY
;   IF CARRY SET
;   THEN HOLD SHIFTED A ON STACK
;   AND LOAD A WITH CHAR. CORRES. TO FLAG
;   PRINT FLAG ABBREVIATION CHARACTER
;   RESTORE A FOR 'ROL' OF NEXT FLAG
;   DECREMENT LOOP CONTROL
;
03C9   BNE  SHFTLP
;   IF X NOT = 0, LOOP AGAIN
;
;   THE FOLLOWING LOOP PRINTS THE ACCUMULATOR, X AND Y REGISTERS
;   AND THE STACK POINTER
;
03CA   LDX   #4
03CB   JSR   OUTSP
03CC   LDA   SAVES-1,X
03CD   JSR   PRBYP
03CE   DEX
03CF   DEX
03D0   BNE  PRLP
03D1   JSR   CRLF
03D2   JSR   GETBYT
03D3   LDA   #0
03D4   STA  (PCLO,X)
;
;   REPLACE 'BRK' INST. WITH OPCODE JUST READ
;

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