MOS

MICROCOMPUTERS

KIM HINTS

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Since you and your KIM-1 are relative strangers, we'd like to help you get better acquainted. The material in this pamphlet will answer questions that are frequently asked by a new KIM-1 user.

ANSWERS TO POPULAR KIM SYSTEM QUESTIONS

1. IS IT POSSIBLE TO OUTPUT DIGITS OTHER THAN HEX TO THE 6 OUTPUT LED'S?

Since the 6502 is doing all segment decode and multiplex, it is possible to display data other than hex on a 7-segment readout. A pseudo alphabet has been developed and is displayed in the 7-segment display of the KIM in a scrolling manner.

2. WHEN HANDLING THE BOARD, WOULD THE STATIC HAZARD BE RELIEVED IF ALL EDGE CONNECTORS WERE SHORTED TOGETHER?

The static problems are not as serious once the devices are installed in the P.C. board. Just be sure to use grounded tools and to discharge yourself to ground before touching KIM or the connected circuits.

3. WHAT TYPE OF LED READOUT IS USED ON KIM-1 FOR U18, etc? GENERAL COMMON ANODE OR CATHODE?

USE MAN-72 Type displays, available from many manufacturers. General common anodes should work, although you may find intensity differences between them.

4. WHERE CAN I GET MORE 44-PIN EDGE CONNECTORS FOR KIM?

The connector is a standard part – you can order a Vector No. R644 from most electronic supply houses. The connector is also carried by most Radio Shack stores as Part No. 276-548.

5. ARE THERE ANY INTERFACES OR PROM PROGRAMMERS AVAILABLE WITH KIM TO PROGRAM EPROMs OR TO DUPLICATE PROMs?

No, not yet.

6. IS THERE AN I/O EXPANSION BOARD AVAILABLE?

Not yet . . . soon, we hope.

7. IS THERE A BOARD AVAILABLE TO MAKE USE OF MEMORY ADDRESSES 0400-13FF?

Check the **"Kilobaud"** article (issue #4, April 1, 1977, page 74) entitled "KIM Memory Expansion."

8. HOW DO I SET UP MY KIM FOR AUDIO CASSETTE RECORDING AND PLAYBACK?

A number of KIM-1 customers have reported difficulty in achieving correct results for the sample problem shown in Sec. 2.4 of the KIM-1 User Manual. In addition, some customers have experienced problems in recording or playback of audio cassettes. (Sec. 2.5 of the KIM-1 User Manual). In all cases, the problems have been traced to a single cause: the inadvertent setting of the DECIMAL MODE.

The 6502 Microprocessor Array used in the KIM-1 system is capable of operating in either binary or decimal arithmetic mode. The programmer must be certain that the mode is selected correctly for the program to be executed. Since the system may be in either mode after initial power-on, a specific action is required to insure the selection of the correct mode.

Specifically, the results predicted for the sample problem (Sec. 2.4) are based on the assumption that the system is operating in the *binary* arithmetic mode. To insure that this is the case, insert the following key sequence prior to the key operations shown at the bottom of Page 11 of the KIM-1 User Manual.

AD
0 0 F 1
DA 0 0

This sequence resets the decimal mode flag in the Status Register prior to the execution of the sample program.

The same key sequence may be inserted prior to the key operations shown on pages 14 and 15 for audio cassette recording and playback. These operations will not be performed correctly if the decimal mode is in effect.

In general, whenever a program is to be executed in response to the GO key, the programmer should insure that the correct arithmetic mode has been set in the status register (00F1) prior to program execution.

9. HOW DO I SOLVE AUDIO CASSETTE INTERFACE PROBLEMS?

A. Insure that memory location 00F1 has been set to a value of 00 before recording or playing back the tape. This is the source of 90% of all cassette problems.

B. Mis-adjustment of the variable resistor (VR1) in the cassette circuitry is almost *never* a problem. Any setting near the center of its rotation will work fine.

C. Make sure that +12V is connected during playback. NOTE: +12V is not required for recording, so a lack of +12V will result in good recording but no playback.

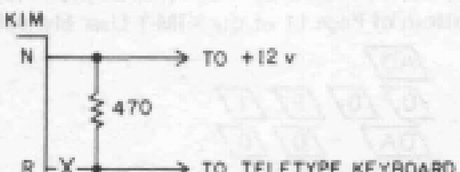
D. If the display frequently relights showing FFFF, the fault is probably in the tape unit itself — not the KIM. Using poor quality cassettes is usually to blame. Some cassette recorders have such poor power filtering circuits that they will work fine on batteries, but will not work with an AC adapter because of hum induced during record or playback. Tapes should always be rewound before removal from the machine, as a fingerprint on the tape will result in errors on playback.

E. Make sure that only a single ground line is run from the KIM ground to the barrel of the microphone input of the cassette recorder. Leave the barrel of the earphone output ungrounded. The shield around the line to the earphone should be attached to ground on KIM.

F. Problems of playing a tape recorded on one KIM system back on another system or a different cassette player can usually be solved by adjusting the head adjustment screw on the new cassette recorder. Play back a cassette recorded on the old deck on the new machine and adjust the head screw on the new machine for maximum volume. This adjustment is especially critical when using the SuperTape program.

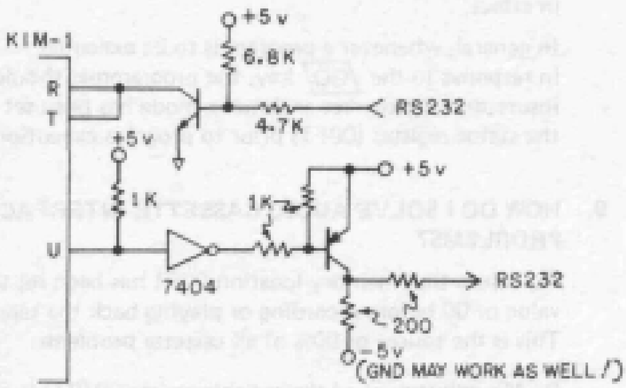
10. HOW DO I SOLVE TELETYPE PROBLEMS?

A. The most common problem is that the system does not respond to a reset-rubout sequence with a model 33 Teletype. This can be fixed by removing the wire connected to pin R on the KIM application connector, connecting a 470 ohm resistor to that wire, and connecting the other end of the resistor to the +12V supply at pin N.



B. No information is available on connecting other Teletype models (14, 28, 32) to KIM.

C. Schematics for interfacing KIM to an RS232C port are in the April, 1976 "Byte" magazine and in the first issue of the KIM user notes. (Reproduced below):



D. Other common sources of Teletype problems are a short circuit in C5 or a burned-out Q7. Signal tracing with a 'scope should reveal these problems.

11. HOW DO I SOLVE PAPER TAPE PROBLEMS?

A. KIM-1's having a date code in 1975 on the 6502 will not read paper tape correctly. These CPU's will be replaced by MOS without charge. Tom Pittman's TINY BASIC will not work on these machines either. The problem occurs because early versions of the processor did not set the zero flag correctly on TXA, TYA, TAX, or TAY instructions.

B. When using a Texas Instruments Silent 700 data terminal equipped with digital cassettes or other higher-speed paper tape devices, a Q (paper tape dump) may be performed at any speed acceptable to the data terminal, but playback (through the L command) must be at 10 cps.

12. WHAT DO I DO ABOUT OTHER PROBLEMS?

A. If the RESET on KIM causes only a single digit or segment to light on the display, the KIM must be returned for repair.

B. When in doubt, check all power supply voltages *on the KIM board*, not at the power supply terminals.

C. When software works strangely or erratically, decimal/binary mode problems may be involved.

D. There is an error in the KIM Resident Assembler manual regarding the addresses for the symbol table vectors. The vector locations are DF, E0, E1, E2. The text is incorrect, the example is correct.

E. Problems with KIM-2/3's which fail the memory test program can almost always be traced to excessive cable length between the KIM-1 and the KIM-2/3. Any cable should be 6" in length or less.

13. WHAT ARE THE KIM SYSTEM POWER SUPPLY REQUIREMENTS?

KIM 1 — Microcomputer Board:

Recommended: 1.2A +5V ±5%
100 mA +12V ±5%

The actual power measured ranges 700 mA to 1A at +5V and the schematic indicating 3A at transformer is incorrect.

KIM 3A — 8K RAM Memory Board:

Recommended: +5V, 3A

Average consumption calculated is about 2.4A. Board has +5V regulator accepting unregulated +8 to +10V DC.

KIM 4 — Mother Board:

Consumption about 200mA. Board has +5V regulator accepting unregulated +8 to +10V DC and +12V regulator accepting unregulated +15V DC to support both KIM1 and KIM 4. KIM 4 has 6 slots for memory expansion with KIM2 and KIM3 and hence a total power supply requirement is a cumulative value dependent on KIM-System configuration.

14. WHAT SOFTWARE IS AVAILABLE?

The following software is available for use with the KIM-1 and/or other 6502-based systems:

1. Tiny BASIC — runs in 2K. $5 for paper tape from:
   Tom Pittman
   Box 23189
   San Jose, California 95153
2. Many games and other information in the KIM-1 User Group Newsletter, $5 for 6 issues:
   Eric Rehnke
   109 Centre Avenue
   W. Norriton, PA 19401
3. An excellent Chess playing program which runs in 1K. $10
   MICRO CHESS
   27 Firstbroke Rd.
   Toronto, CANADA M 4E 2L2
4. A good group of games plus an intermediate-level language called PLEASE for KIM-1 — $15 from:
   THE COMPUTERIST
   Post Office Box 3
   S. Chelmsford, MA 01824
5. The 6502 Program Exchange
   2920 Moana
   Reno, NV 89509
6. Micro Software Specialists
   2024 Washington Street
   Commerce, TX 75428
7. KIMATH, a complete floating-point math package including both source and object code is available from MOS Technology for $15.
8. A 4K version of FOCAL, a BASIC-like interpreter, and a 6K Resident assemble/text Editor, both with source listings and object code on KIM cassette or paper tape are available from:
   ARESCO
   314 Second Ave.
   Haddon Heights, NJ 08035

   The FOCAL is $50 and the assembler/Editor is $70. A complete information package is $2.
9. An 8K version of BASIC for KIM is available for $99 from:
   Johnson Computing
   123 W. Washington St.
   Medina, Ohio 44256
   (215) 725-4568
10. "FIRST BOOK OF KIM" is a collection of games, utility programs, hints and kinks, etc. (180 pgs). $9.00 plus 50¢ postage from:
   ORB
   P.O. Box 311
   Argonne, ILL 60439

INTERVAL TIMER OPERATION

1. OPERATION

a. Loading the timer

The divide rate and interrupt option enable/disable are programmed by decoding the least significant address bits.

KIM SUBROUTINES

CALL	ADDRESS	ACTION	ARG.	RESULT	NOTES
JSR AK	1EFE	Check for key depressed	—	A	A = 0 = Key down A ≠ 0 = No Key down X & Y lost
JSR GETKEY	1F6A	Get key from keyboard	—	A	A > 15 illegal or no key
JSR SCANS	1F1F	Display F9, FA, FB	F9, FA, FB	—	A, X, Y are lost
JSR GETCH	1E5A	Put character from TTY in A	—	A	X preserved Y = FF
JSR PRTBYT	1E3B	Prints A as 2 Hex Char.	A	—	A preserved X preserved Y = FF
JSR PRTPNT	1E1E	Prints Contents of FB & FA on TTY	FB, FA	—	A lost X preserved Y = FF
JSR OUTCH	1EA0	Print ASCII char in A on TTY	A	—	X is preserved Y = FF A = FF
JSR OUTSP	1E9E	Print a space	—	—	A = FF X preserved Y = FF

The starting count for the timer is determined by the value written to that address.

Writing to Address	Sets Divide Ratio To	Interrupt Capability Is
1704	1	Disabled
1705	8	Disabled
1706	64	Disabled
1707	1024	Disabled
170C	1	Enabled
170D	8	Enabled
170E	64	Enabled
170F	1024	Enabled

b. Determining the timer status

After timing has begun, reading address location 1707 will provide the timer status. If the counter has passed the count of zero, bit 7 will be set to 1, otherwise, bit 7 (and all other bits in location 1707) will be zero. This allows a program to "watch" location 1707 and determine when the timer has timed out. Note that reading 1707 provides an entirely different function from writing the same location.

c. Reading the count in the timer

If the timer has not counted past zero, reading location 1706 will provide the current timer count and disable the interrupt option; reading location 170E will provide the current timer count and enable the interrupt option. Thus the interrupt option can be changed while the timer is counting down. Note that you read 1706 or 170E regardless of which location (1704-0F) was written to start the timer.

If the timer has counted past zero, reading either memory location 1706 or 170E will restore the divide ratio to its previously programmed value, disable the interrupt option and leave the timer with its current count.

d. Using the interrupt option

In order to use the interrupt option described above, line PB7 (application connector, pin 15) should be connected to either the $\overline{IRQ}$ (Expansion Connector, pin 4) or $\overline{NMI}$ (Expansion Connector, pin 6) pin depending on the desired interrupt function. PB7 should be programmed as an *input* line (it's normal state after a RESET).

NOTE

If the programmer desires to use PB7 as a normal I/O line, the programmer is responsible for disabling the timer interrupt option (by writing or reading address 1706) so that it does not interfere with normal operation of PB7. Also, PB7 was designed to be wire-ORed with other possible interrupt sources; if this is not desired, a 5.1K resistor should be used as a pull-up from PB7 to +5v. (The pull-up should NOT be used if PB7 is connected to NMI or IRQ.)

2. CAPABILITIES

The KIM Interval Timer allows the user to specify a preset count and a clock divide rate by writing to a memory location. As soon as the write occurs, counting at the specified rate begins. The timer counts down at the clock frequency divided by the divide rate. The current timer count may be read at any time. At the user's option the timer may be programmed to generate an interrupt when the counter counts down past zero. When a count of zero is passed, the divide rate is automatically set to 1 and the counter continues to count down at the clock rate starting at a count of FF (−1 in two's complement arithmetic). This allows the user to determine how many clock cycles have passed since the timer reached a count of zero. Since the counter never stops, continued counting down will reach 00 again then FF, and the count will continue.

3. INTERVAL TIMER AND KEYBOARD OPERATION

The following three programs show the use of the interval timer, keyboard and seven segment displays in user programs.

The first program loads a value of 50 in the timer and waits for it to time out, repeats the process and then increments the count in the display register (00FA and 00FB) and calls the display subroutine SCANS. The process then repeats.

The second program performs the same function as the first, but uses the timer to provide interrupts, rather than watching the timer status register (1707). Thus this program is constantly cycling through the display program SCANS except when the timer generates an interrupt. When an interrupt occurs the interrupt service routine (starting at location 010C) resets the timer, increments the display register and returns to the display program. Note that the LED display is brighter when using this program because most of the computer's time is spent displaying rather than watching the timer.

The third example program demonstrates the use of the keyboard and display. Any key depressed will appear in the rightmost digit of the display and will be shifted to the left with each successive keyboard entry.

Notice that the SCANS routine not only displays the contents of 00F9, 00FA and 00FB but also returns with the Z flag set to Ø if a key is currently depressed. The GETKEY routine is then called to determine which key has been depressed. Since the SCANS subroutine takes several milliseconds, a call to this routine can be used to "waste time" and let any keybounce stop.

INTERVAL TIMER

```
LOC     CODE                DEFINITION OF COMMONLY USED LOCATIONS

                  DA        =$1700               DATA REG A
                  DDA       =$1701               DATA DIREC REG A
                  DB        =$1702               DATA REG B
                  DDB       =$1703               DATA DIREC REG B

                            TIMERS (WRITE TIME TO)

                  C1D       =$1704               DIV BY 1     DISABLE INT
                  C8D       =$1705               DIV BY 8     DISABLE INT
                  C64D      =$1706               DIV BY 64    DISABLE INT
                  C1024D    =$1707               DIV BY 1024 DISABLE INT

                  C1E       =$170C               DIV BY 1     ENABLE INT
                  C8E       =$170D               DIV BY 8     ENABLE INT
                  C64E      =$170E               DIV BY 64    ENABLE INT
                  C1024E    =$170F               DIV BY 1024 ENABLE INT

                  TRD       =$1706               READ TIME DISABLE INT
                  SR        =$1707               READ INT STAT
                  TRE       =$170E               READ TIME ENABLE INT
                            WHEN THE INTERRUPT STATUS IS READ
                            THE INTERRUPT IS NEITHER DISABLED
                            OR ENABLED. BIT 7 IS A ONE IF TIME
                            OUT HAS OCCURRED. BIT 7 IS ZERO IF
                            TIME OUT HAS NOT OCCURRED. BITS 0-6
                            ARE ALL ZERO

                            WHEN THE TIMER TIMES OUT THE
                            DIVIDER IS SET TO A DIV BY ONE AND
                            THE TIMER CONTINUES TO COUNT AT
                            CLOCK RATE

                            WHEN THE TIMER IS READ THE DIVIDER
                            IS RESTORED TO ITS ORIGINAL VALUE
                            AND THE INTERRUPT IS RESET

                  SCANS     =$1F1F               EXTERNAL SUBROUTINES
                  INCPT     =$1F63
                  GETKEY    =$1F6A

                            TO USE INTERRUPT PB7 MUST BE
                            EXTERNALLY WIRED TO IRQ
```

Program 1

```
                                 THIS EXAMPLE DOES NOT USE
                                 INTERRUPTS – THE DISPLAY WILL
                                 DIM AS A RESULT OF SLOW SCANNING

                    COUNT     =2                   COUNT DOWN 2 TIMES
                    DELAY     =50                  EACH DELAY 50 CYCLES
0000                          *=$0000              ORG AT 0
0000    A2 02       START1    LDX  =COUNT
0002    A9 32                 LDA  =DELAY
0004    8D 06 17    AGAIN     STA  C64D            DIV BY 64 DISABLE INT
0007    2C 07 17    WAIT      BIT  SR              READ STATUS DISABLE INT
000A    10 FB                 BPL  WAIT            BIT 7 = 1 TIME OUT COMPLETE
000C    CA                    DEX
000D    D0 F5                 BNE  AGAIN           LOOP ON COUNT
000F    20 63 1F              JSR  INCPT           MONITOR UTIL INC FA,FB
0012    20 1F 1F              JSR  SCANS           MONITOR UTIL DISP F9,FA,FB
0015    4C 00 00              JMP  START1
```

INTERVAL TIMER (Continued)

```
CARD = LOC      CODE                  CARD

                          Program 2

                            THIS EXAMPLE USES INT
                            WIRE PB7 TO IRQ EXTERNALLY

0018                        *=$0100                 ORG AT HEX 100
0100    58        START 2   CLI                     CLEAR INT MASK
0101    A9 FF               LDA   =$FF
0103    8D 0F 17            STA   C1024E            THIS ENABLES TMR INT
                                                    FIRST TIME
0106    20 1F 1F  DISP      JSR   SCANS             THIS IS AN ENDLESS LOOP THAT
0109    4C 06 01            JMP   DISP              DISPLAYS CONTENTS OF F9,FA,FB

                            INTERRUPT SERVICE ROUTINE

010C    A9 FF     INTSVC    LDA   =$FF              SET DISPLAY TO 255 CPS PR INT
010E    8D 0F 17            STA   C1024F
0111    20 63 1F            JSR   INCPT
0114    40                  RTI

0115                        *=$17FE                 ORG AT IRQ VECTOR
17FE    0C 01     IRQT      .WORD INTSVC            SET = TO INT SERVICE RTN

                          Program 3
                            THIS EXAMPLE DESCRIBES USE OF
                            KEYBOARD AND DISPLAY

1800                        *=$0200
                  INH       =$F9                    LSD'S
                  PTL       =$FA                    THESE 3 BYTES ARE DISPLAY BVF
                  PTH       =$FB                    MSD'S
0200    58        START 3   CLI
0201    D8                  CLD
0202    20 1F 1F            JSR   SCANS             IF KEY IS DEPRESSED WAIT FOR
0205    D0 F9               BNE   START3            ITS RELEASE
0207    20 1F 1F  DISP1     JSR   SCANS             WAIT FOR KEY DEPRESSED
020A    F0 FB               BEQ   DISP1             WHEN DEPRESSED GO TO VALIDATION
020C    20 1F 1F  VALIDT    JSR   SCANS             THIS USED AS DEBOUNCE
020F    20 6A 1F            JSR   GETKEY            MONITOR UTIL WHICH GETS KEY VAL
0212    C9 15               CMP   =$15              IF MPU IN DEC MODE THEN GET KEY
0214    10 EA               BPL   START3            GETS DECIMAL VALUE A=10
0216    2A                  ROL   A                 LEFT JUSTIFY KEY VALUE
0217    2A                  ROL   A
0218    2A                  ROL   A
0219    2A                  ROL   A
021A    A0 04               LDY   =4                SET UP LOOP COUNT=4
021C    2A        V1        ROL   A
021D    26 F9               ROL   INH               SHIFT ALL DIGITS 1 PLACE LEFT
021F    26 FA               ROL   PTL
0221    26 FB               ROL   PTH
0223    88                  DEY
0224    D0 F6               BNE   V1                DO THIS ONE BIT AT A TIME
0226    4C 00 02            JMP   START3            FOR 4 BITS
                            .END

END OF MOS/TECHNOLOGY 650X ASSEMBLY VERSION 4
NUMBER OF ERRORS =     0, NUMBER OF WARNINGS =     0
```