

HAVE YOU BEEN ON THE BUS?

The 'Neatest Development of the Year' award has got to go to the COMMODORE PET computer for its use of the IEEE 488 (GPIB) General Purpose Interface Bus for all communication I/O. Although the bus is somewhat difficult to understand, at first, the real advantage of utilizing this method of I/O handling becomes apparent when you consider that only one piece of interface hardware and one software driver routine can handle up to 15 different devices at varying data transfer rates.

This clearly indicates what we can expect in future 'personal' computers as it fits in so neatly with the concept of distributed intelligence in system design.

I feel certain that other equipment manufacturers will follow suit and adopt this bus into new gear, but, in any case, it will be quite interesting to see what develops in this area.

Has anyone interfaced KIM to the IEEE Bus? Would you be interested in a tutorial article on the basic concepts of the bus? If I can find the time, I'll try to get something together for the next issue.

ERIC

A FLOPPY DISC FOR KIM.....(finally)
-the editor-

I used to dream of the day when I'd be able to hook KIM up to a floppy disc! Now, at work anyway, my dream has come true!!!

A company called HDE in New Jersey has interfaced KIM to a SYKES disc/controller combination and has written some neat software to make the whole thing work together like a system, not like a bunch of parts thrown together.

The operating system is file oriented (like some high-class mag-tape systems you've probably heard about) and includes a version of the MOS assembler/editor as an integral part. Assembly language programmers will really appreciate the ability to work with named object and source files. The ability to load a 6K source file in less than a half a second really made it clear what a time saver this system could be. (Without the disc, it works out to about one-third to one-fourth time being wasted just waiting for slow taps being read or written to)

The Editor has actually been spruced up a bit from its original form and makes the system quite easy to operate as well as being quite powerful in function.

FODE, as it's called requires the top 8K of RAM for its storage, and is bootstrapped in via a short program that is easily loaded in via taps.

For more info contact:HDE, box 120, Allamuchy, NJ 07820
(phone 201-852-9268) or Johnson Computer, box 523, Medina, Ohio
(phone 216-725-4560)

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MEMORY-PLUS FROM THE COMPUTERIST

Sooner or later, the question of memory expansion enters the minds of most KIM users. Here's another alternative from the same folks who brought us PLEASE (a play package), HELP (a work package), and MICRO (a newsletter dedicated entirely to machines of the 6502 genre).

The thing that really interested me was the way this board was configured. Besides having an 8K block of RAM, MEMORY-PLUS includes sockets for 8K of Intel 2716 EPROM, a complete programming facility for the 2716, and the MOS Technology 6522 VIA (Versatile Interface Adaptor). I prefer to call it the VVIA (VERY VERSATILE INTERFACE ADAPTOR). I'm sure you'd agree after studying the 24 page spec sheet that accompanies this device.

But back to MEMORY-PLUS....

The built-in 2716 programmer requires the user to supply +25 volts, but this can be gotten easily from three 9 volt transistor batteries hooked up in series. The programming software is, of course, included as is a memory test program and a 60 page manual.

Since MEMORY-PLUS is the same size and shape as KIM, it can be mounted directly beneath the KIM by means of 1" stand-offs. Hardware was provided for this purpose, but it proved unsatisfactory so suitable stand-offs were found elsewhere. Rubber feet are included to protect the bottom of the board and an optional set of pre-wired connectors is available to speed up assembly time. By the way, MEMORY-PLUS comes fully assembled, tested and includes a 90 day warranty, (just like KIM). All IC's are socketed and battery backup of the RAM is provided for, if needed.

It's really quite impressive to have all this power in so small a package. The next step is to get an assembler/editor and extended I/O monitor "burned" into a few 2716's and turn this two-board machine loose as a low-cost development system.

About the only negative comment I can make about MEMORY-PLUS is that further memory expansion could be slightly difficult. Definitely not just a matter of plugging in another board. This may not be a disadvantage in certain applications, but should be considered.

MEMORY-PLUS costs \$245.00 and is available from:
The COMPUTERIST, P.O. Box 3, S. Chelmsford, Ma. 01824
617-256-3649. Get their catalog of other KIM products.

ALL THE PROGRAMS FROM THE FIRST BOOK OF KIM ARE NOW AVAILABLE ON A

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SPACE WARS PHASER SOUND from Ron Kussner, 3108 Addi Ct., Cornwel Htr., PA. 19020

The following program utilizes the now famous driver circuit on page 57 of the Kim User's Manual. Although it is set up to provide the sound of four phaser bursts, it can easily be modified in a number of ways to provide all kinds of neat sounding effects.

Location 201 sets no. of repeats (00 to FF).

Location 207 in conjunction with 209 set the length of tone before increment/decrement 207 (00 to FF); 209 (04 to 07).

One interesting variation is to load: 203 with FF
21d with c6 (dec)
22d with 00

Among other sounds you should be able to make a "Bomb Drop Whistle" and a "Red Alert" condition.

The program is relocatable and uses one page zero location (EE). The program could also easily be converted to a subroutine leaving you no excuse for not adding sound effects to your next program.

R2D2-Eat your heart out!

200	A0	04		LDY #04	
202	A9	00		LDY #00	
204	85	EE		STA EE	
206	A9	01	(4)	LDA #01	
208	8D	06	17	STA 1706	
20B	A9	01		LDA #01	
20D	8D	01	17	STA 1701	
210	EE	00	17	INC 1700	
213	A6	EE		LDX (EE)	
215	CA		(1)	DEX	
216	D0	FD		BNE 1	
218	2C	07	17	BIT 1707	
21E	10	F3		BPL 2	
21D	E6	EE		INC (EE)	
21F	A5	EE		LDA EE	
221	C9	FF		CMP #FF	
223	F0	02		BEQ 3	
225	D0	DF		BNE 4	
227	88		(3)	DEY	
228	F0	02		BEQ 5	
22A	D0	DA		BNE 4	
22C	4C	4F	1C	(5) JMP 1C4F	

EDITOR'S NOTE; I've been having great fun with this routine. All kinds of sounds are possible and the program can be easily integrated into most any game program-see Butterfield's SKEET SHOOT program elsewhere in this issue.

SKEET SHOOT September/77 Jim Butterfield, Toronto

Start the program and you'll see targets racing across the screen from right to left. You don't have to fire at any of them .. but if you do, remember that you must 'lead off' your shot to give the bullet time to reach the target. You have 20 shots: shoot by hitting any numbered button. You'll see the bullet move from right to left, too. If you hit the target, you'll see the explosion. After 20 shots, KIM will tell you the number of hits you made; then you can press G0 for another game.

0200	A2	00	START	LDX #0	reset hit counts
0202	86	F9		STX HITS	
0204	86	FA		STX POINTL	
0206	86	FB		STX POINTH	
0208	A9	13		LDA #13	19+1 shots
020A	85	D0		STA SHOTS	
020C	CA			DEX	set X=\$FF
020D	86	D1		STX BULLET	..no bullet, and
020F	86	D2		STX TARGET	..no target
0211	A5	D2	MAIN	LDA TARGET	is there a target?
0213	10	0D		BFL FLIGHT	yes, continue
0215	AD	04	17	LDA TIMER	no, make random target
0218	29	3F		AND #3F	not too slow..
021A	09	0C		ORA #30C	..and not too fast

2

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021C 85 D3      STA SPEED
021E 29 0B      AND #$3B      place off screen
0220 85 D2      STA TARGET    ..in random position
0222 C6 D4      FLIGHT DEC TARSPD count down delay
0224 D0 06      BNE SIGHT     time to move target?
0226 A5 D3      LDA SPEED     yes, restore count down
0228 85 D4      STA TARSPD
022A C6 D2      DEC TARGET    move the target
022C A5 D1      SIGHT  LDA BULLET is bullet in flight?
022E 30 06      BNE CLEA      no, skip bullet move
0230 C6 D5      DEC BULSPD    count down delay
0232 D0 06      BNE CLEAR     time to move bullet?
0234 C6 D1      DEC BULLET    yes, move it
0236 A9 08      CLEA  LDA #$8  reset..
0238 85 D5      STA BULSPD    ..countdown
023A D8          CLEAR CLD
023B 20 40 1F   JSR KEYIN     directional registrs
023E 20 6A 1F   JSR GETKEY    test keyboard
0241 C5 D6      CMP LAST      same key?
0243 F0 12      BEQ TRIG      yes, skip key action
0245 85 D6      STA LAST      keep new key ID
0247 C9 10      CMP #$10      numeric key?
0249 B0 0C      BCS TRIG      no, skip key action
024B A5 D1      LDA BULLET    bullet already in flite?
024D 10 08      BPL TRIG      yes, don't fire
024F A2 06      LDX #6        position bullet right
0251 86 D1      STX BULLET
0253 86 D7      STX STRIKE    no hit yet
0255 C6 D0      DEC SHOTS     one less shot left
0257 A9 7F      TRIG  LDA #$7F set direct registrs
0259 8D 41 17   STA PADD
025C A2 05      LDX #5        show six digits
025E A0 13      LDY #$13      set digit #6
0260 A9 00      LITE  LDA #0    start with digit blank
0262 E4 D1      CPX BULLET    ..if bullet in this spot
0264 D0 03      BNE NOBUL
0266 BD B0 02   LDA BTAB,X    ..put in in segment
0269 E4 D2      NOBUL CPX TARGET ..if target in this spot
026B D0 02      BNE NOTARG
026D 49 21      EOR #$21      add target segments
026F C9 20      NOTARG CMP #$20 a hit?
0271 D0 10      BNE SHINE     no, skip ahead
0273 A5 D7      LDA STRIKE    have we counted it?
0275 30 0C      BMI SHINE     yes, skip
0277 F8 18      SED CLC      no, count it
0279 A5 F9      LDA HITS
027B 69 01      ADC #1        .. in decimal
027D 85 F9      STA HITS
027F A9 FF      LDA #$FF      explosion display
0281 85 D7      STA STRIKE    .. set counted flag
0283 8D 40 17   SHINE STA SAD
0286 8C 42 17   ZAP  STY SBD
0289 C6 D8      DEC ZIP
028B D0 FC      BNE ZAP
028D 88 88 CA   CA  DEY DEY DEX
0290 10 CE      BPL LITE      more digits?
0292 C9 FF      CMP #$FF      explosion?
0294 D0 04      BNE ENTES     no, skip next
0296 A5 D4      LDA TARSPD    delay..
0298 85 D5      STA BULSPD    ..display
029A A5 D1      ENTES  LDA BULLET shot complete, and..
029C 25 D0      AND SHOTS     ..last shot?
029E 30 03      BMI QUIT      yes, show score
02A0 4C 11 02   JMP MAIN      no, keep going
02A3 20 1F 1F   QUIT JSR SCANDS show score;
02A6 20 6A 1F   JSR GETKEY    test keyboard for
02A9 C9 13      CMP #$13      ..GO key
02AB D0 F6      BNE QUIT      if not keep going
02AD 4C 00 02   JMP START     if GO start over
02B0 01 40 08   BTAB .BYTE 1,$40,8,8,8,8
02B3 03 08 08
02B6 end

```


"KIM D-BUG" by Lew Edwards

Want to eliminate the job of replacing an opcode with a BRK instruction, looking at each register separately, doing a conversion on the "P" register to find out which flags are set and how to change them, then restoring the opcode and setting a new break in place? "KIM D-BUG" can eliminate all that hassle for you! It lets you see the X, Y, & ACC registers at a single glance and select the one you want to alter with the stroke of a single key. Another keystroke shows all the flags in binary form, and permits toggling individual flags with the keys A thru F. You can jump from "KIM D-BUG" to KIM monitor and back at your pleasure, with full access to all monitor functions. "KIM D-BUG" automatically inserts the BRK opcode and then restores the original opcode when the break has executed, making a simple operation of the whole business.

To use "KIM D-BUG", start at 0100 and press "GO". Nothing happened? The IRQ and NMI vectors have been changed to the ones "KIM D-BUG" needs and you are now back in the monitor. Put your starting address into 00EF & 00F0 (low order first as usual), press "PC" and verify that this address is now in the program counter. Press "ST" and you will see KIM substitute 00 for the opcode at that address, then restore the original. You are now in the "KIM D-BUG" mode and will have a new set of responses to the keys. Press "DA" and you will see X register contents on the left, Y register contents in the center, and ACC register contents on the right. You may now alter the contents of the ACC register via the HEX keys. If you press "+" or "GO", the display will remain the same, but the HEX keys will now alter the Y or X register respectively. Press "PC" and the display will switch to 1's and 0's indication flag conditions in order from left to right C,Z,V,I,N,D. Keys A thru F will set or reset the flags in the same order.

OK, got your initial values keyed in? Now press "AD", which causes a switch to KIM's monitor. Key in the address you want the break to occur and press "ST". You will see your START address displayed briefly, and then your BREAK address. Your program has now run from the first location to the second. If you want to return from the monitor to "KIM D-BUG" instead, you simply press the "PC" key, then "ST". The START and STOP will be the same and your program will stop before it gets started (KIM D-BUG runs from PCL,H to POINTL,H), but you would be in "KIM D-BUG" mode.

Let "KIM D-BUG" help you find those elusive BUGS-----HAPPY HUNTING!

0100 A9 01	START	LDA #01	initialize interrupt vectors
0102 8D FB 17		STA NMIIH	
0105 8D FF 17		STA IRQH	
0108 A9 15		LDA #15	
010A 8D FA 17		STA NMIL	
010D A9 34		LDA #32	
010F 8D FE 17		STA IRQL	
0112 4C 16 1C	NOGO	JMP NOSAV	jump to monitor here
0115 A5 P9	NMIGO	LDA INH	"ST" key starts things here
0117 F0 P9		BEQ NOGO	won't run with BRK opcode
0119 85 ED		STA CODE	save valid breakpoint opcode
011B A9 00		LDA #00	
011D A8		TAY	no offset for index
011E 91 FA		STA POINT,Y	substitute BRK opcode
0120 85 EE		STA HOLD	delay count
0122 A5 EF		LDA PCL	move 'from' address to window
0124 85 FA		STA POINTL	
0126 A5 F0		LDA PCH	
0128 85 FB		STA POINTH	
012A 20 19 1F	LOOK	JSR SCAND	show it and stall a bit
012D C6 EE		DEC HOLD	
012F D0 F9		BNE LOOK	
0131 4C C8 1D		JMP GOEXEC	then run program
0134 85 F3	IRQGO	STA ACC	BREAK TIME!
0136 68		PLA	save the registers in standard
0137 85 F1		STA PREG	locations just like KIM
0139 68		PLA	
013A 85 EF		STA PCL	
013C 68		PLA	
013D 85 F0		STA PCH	
013F 84 F4		STY YREG	
0141 86 F5		STX XREG	
0143 BA		TSX	
0144 86 F2		STX SPUSER	
0146 A8 02		LDY #02	

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0148 A5 EF      BAK2    LDA PCL      back up PC 2 counts
014A D0 02      BNE NOPAGE skip next if not page border
014C C6 F0      DEC PCH
014E C6 EF      NOPAGE  DEC PCL
0150 88         DEY
0151 D0 F5      BNE BAK2
0153 A5 ED      LDA CODE      put opcode back where it belongs
0155 91 EF      STA PCL,IY
0157 A5 EF      STOP    LDA PCL      transfer PC address to POINTER
0159 85 FA      STA POINTL
015B A5 F0      LDA PCH
015D 85 FB      STA POINTH
015F D8         CLD          binary mode for keys
0160 20 19 1F   JSR SCAND      show break address
0163 20 6A 1F   JSR GETKEY     & get keyboard input
0166 C9 14      CMP #14       PC key?
0168 F0 2B      BEQ FLAGS     yes, show flags
016A B0 EB      BCS STOP      too high, try again
016C C9 10      CMP #10       AD key?
016E F0 A2      BEQ NOGO      KIM takes over
0170 90 E1      BCC STOP      hex, try again
0172 85 FD      STA INDEX     use DA, + or GO as index value
0174 A2 03      MOVE    LDX #03
0176 B5 F2      MOVLP   LDA REG,X  move X, Y, & ACC registers
0178 95 F8      STA POINT,X to window
017A CA         DEX
017B D0 F9      BNE MOVLP
017D 20 BF 01   JSR PUSH      show 'em & get a key
0180 C9 10      CMP #10       not a hex key?
0182 B0 D3      BCS STOP      change mode
0184 A6 FD      LDX INDEX     which register?
0186 16 E2      ASL REG,X     update it
0188 16 E2      ASL REG,X
018A 16 E2      ASL REG,X
018C 16 E2      ASL REG,X     shift out the old
018E 15 E2      ORA REG,X     add in the new
0190 95 E2      STA REG,X
0192 38         SEC
0193 B0 DF      BCS MOVE      & put it in the window
0195 A5 F1      FLAGS    LDA PREG   load flags
0197 4A         LSR          shift C flag to carry
0198 29 67      AND #67       mask unwanted bits
019A 90 02      BCC BICON
019C 09 10      ORA #10       replace the carry flag in new location
019E A2 03      BICON    LDX #03
01A0 48         PHA          save accumulator
01A1 29 11      AND #11       2 flags at a time in binary
01A3 95 F8      STA POINT,X  stick 'em in the window
01A5 68         PLA          recover accumulator
01A6 4A         LSR A        next pair
01A7 CA         DEX
01A8 D0 F6      BNE BILP     til done
01AA 20 BF 01   LITE    JSR PUSH   show & key time
01AD C9 10      CMP #10      hex key?
01AF B0 A6      BCS STOP     no, change mode
01B1 C9 0A      CMP #0A      decimal?
01B3 90 F5      BCC LITE     keep trying
01B5 AA         TAX          alpha, use as index value
01B6 BD C3 01   LDA TABLE,X bit to flip in PREG
01B9 45 F1      EOR PREG     flip it
01BB 85 F1      STA PREG
01BD B0 D6      BCS FLAGS    & to the window

SUBROUTINE "PUSH"
01BF 20 1F 1F   PUSH    JSR SCANDS  key down?
01C2 D0 FB      BNE PUSH     wait
01C4 20 1F 1F   KEY     JSR SCANDS  next key?
01C7 F0 FB      BEQ KEY      no, keep looking
01C9 20 6A 1F   JSR GETKEY  yes, which one?
01CC 60         RTS          take it back

TABLE "BIT FLIPPERS"      reference address 01C3
01CD 01 02 40 04 80 06   BYTES

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How about a graphics output device for KIM? Roy is also working on some games (LIFE, STAR TREK etc.) and an analog input circuit. NEAT!!!...ERIC

GRAPHICS INTERFACE from...Roy Flacco, Drexel Univ., Physics Dept.,
32nd & Chestnut Ave., Phila. PA 19104

Here's the graphics interface I told you about. It has gone through a number of revisions (hence the delay in getting it to you) but I think it is worth it. The whole thing sets up with plenty of room on a 4x6 perfboard, hardly loads the KIM lines at all (everything is buffered), outputs to almost any standard oscilloscope, and costs well under \$30.

Basically the interface accepts two 8-bit parallel words (one at a time from FA0-FA7), latches them alternately into two 8-bit data buffers (U1,U2), converts them into two positive analog voltages (via U3,U4) which are directly proportional to the data words so that 00hex= 0.0 volts, and FFhex= 2.56 volts, and presents these voltages for presentation as an X-Y point on a scope CRT.

PB0 is used to latch the data—a positive transition latches the data into the X buffer, a negative transition latches the data into the Y buffer. The best way to do this is initialize PB0 to a 1 and then alternately DEC and INC PBD. This latches Y, then X.

In order to avoid the slewing of the DACs from causing a smeared display, the trailing edge of the X strobe generated by U5 initiates an unblanking pulse which turns on the CRT beam for a time set by VR1. The rest of the time the beam is blanked (turned off) by the normally-high output of U6. This convention is dictated by the type of scope; some scopes have a Z-axis (intensity mod.) which works in reverse, namely a positive level turns the beam on. In this case, merely use the Qoutput of U6 instead of the Q as shown on the schematic.

If your scope is AC-coupled on the Z-axis you may have to make some minor changes in the blanking pulse in order to avoid hot spots where the beam sits for long periods of time. One such change would be to trigger U6 from Q1 the same as U5 (use one of the A inputs on the 74121) and use the pulse to blank the beam only during the latching process. This requires some experimentation and will also depend on how you write your software.

The heart of the circuit is of course the DACs, which are type ZN425E available from Ferranti Electric Inc., East Bethpage Rd., Plainview, NY 11803. They go for \$8 each. Ferranti, incidentally, is a great company to deal with—excellent turn-around, very helpful, friendly people, and they make really fine parts. Anyway, the chip is a 16-pin DIP containing an R/2R resistor ladder, bipolar switches, a precision 2.56 volt reference, and an 8-bit counter (which we don't use in this case). The counter is used in ADC applications and for generating ramps and such. The biggest advantage to using this chip is that the output is already converted to a voltage, as opposed to most DACs which have a current output. This means the usual I/V op-amp converter may be eliminated. Also the inclusion of an on-chip reference makes it extremely easy to use. If you want a different full-scale output voltage you may either add an op-amp at the output, or more interestingly, you may apply an analog voltage at the input of the R/2R ladder instead of the internal reference. This allows you to effectively multiply your analog voltage by your digital word. The useful range of this external voltage is 0 to +3.0 volts. For more info write for the data sheet.

Also, because of the dual-function aspect of the chip, it should be possible to construct an ADC/DAC using only a few more parts than this output-only DAC. The applications to games and graphics-sketching are too numerous to list in detail, but for example, how about a throttle for the Lunar Lander, or a chase game displayed on the CRT? I'm going to design one using a joystick over the next few weeks after I get Life up and running using this present interface.

One last thing about the scope you use; if it has AC-coupling on either the vertical or horizontal channels you are in for a smeared display due to the tendency of the beam to travel back to the origin. This is difficult or impossible to correct short of rebuilding your amplifiers or getting a newer scope. If the Z-axis is AC-coupled or non-existent, take heart, though. I have successfully converted my Tektronix 317 to DC-coupled blanking using a high-voltage level-shifting circuit, and would gladly pass it along if anybody needs it, or help designing another.

As a demonstration of the graphics, I wrote (and include) a little program which produces some of the prettiest pictures you ever saw. It resides entirely in page zero and uses less than half the page. The first time you run it you'll see why I named it Starburst; depending on the mask at 0011 and the initial points at 0075 and 0076 you can get hundreds of different fascinating displays which spin, explode, flash, and otherwise dazzle.

The use of an algorithm to generate the new point from the previous one exempts you from using much memory, since only a few coordinates are stored at any one time. The algorithm FULGEN is a variation on the ellipse-drawing one used in Aug. 77 BYTE, using 8-bit arithmetic. All overflow, underflow, and truncation errors are ignored, hence the rapidly moving display, which seems at times to bounce off the edges of the display screen and wrap around on itself. Using 16-bit arithmetic and taking care of over and under flow would help considerably toward stabilizing the picture, but frankly I like it more as it is.

HAFGEN calculates the proper coordinates for display in the four X-Y quadrants, since FULGEN works only on the first, and DISPLAY picks up the proper combination of halves and sends them to PROC which offsets them by 80,80 to center the origin. I found it was necessary to include a DELAY loop between points to slow the motion down to a reasonable speed; changing this produces dramatic changes in the appearance. Note also that replacing the JMP at 0054 with the proper branch should make the program relocatable (there is a lot of flab in the program, like the LDX at 0043). I left it in to make it easier to see the program flow.

In writing your own software, bear in mind the basic format is LDA Ycoord./STA FAD/DEC PBD; then LDA Xcoord./STA PAD/INC PBD. Be sure to initialize PADD, PBDD, and PB0 at the start. Adjust RV1 for the brightest display without smearing.

```

                                STARBURST GRAPHICS
00 A9 FF      START      LDA #$FF
02 8D 01 17    STA FADD    Set FA for all outputs
05 A9 01      LDA #$01
07 8D 03 17    STA PBDD    Set PB0 for output
0A 8D 02 17    STA PBD     Set PB0-1
0D A5 76      FULGEN     LDA FULY    Generate new point FULX,FULY
0F 4A          LSR
10 49 FE      EOR #$FE     try other masks; 7F,FD,etc.
12 38          SEC
13 65 75      ADC FULX
15 85 75      STA FULX    new FULX
17 4A          LSR
18 18          CLC
19 65 76      ADC FULY
1B 85 76      STA FULY    new FULY
1D 4A          LSR      HAFGEN
1E 85 78      STA HPY     scale-down into quadrants
20 49 FF      EOR #$FF    new half-Y
22 38          SEC
23 69 00      ADC #$00
25 85 7A      STA NHY     new negative half-Y
27 A5 75      LDA FULX
29 4A          LSR
2A 85 77      STA HPX     new half-X
2C 49 FF      EOR #$FF

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2E 38          SEC
2F 69 00      ADC #000
31 85 79      STA NHI
33 A0 01      LDY #01
35 A6 77      DISPLAY LDX HFX
37 A5 78      LDA HFX
39 20 57 00    JSR PROC
3C A6 79      LDX NHI
3E A5 78      LDA HFX
40 20 57 00    JSR PROC
43 A6 79      LDX NHI
45 A5 7A      LDA NHI
47 20 57 00    JSR PROC
4A A6 77      LDX HFX
4C A5 7A      LDA NHI
4E 20 57 00    JSR PROC
51 88          DEY
52 10 E1      BPL DISPLAY
54 40 0D 00    JMP PULGEN
57 18          CLC
58 69 80      ADC #80
5A 8D 00 17    STA PAD
5D CE 02 17    DEC PBD
60 8A          TXA
61 18          CLC
62 69 80      ADC #80
64 8D 00 17    STA PAD
67 EE 02 17    INC PBD
6A A9 03      DELAY LDA #03
6C 8D 05 17    STA 8T
6F 2C 07 17    LOOP BIT 1KT
72 10 FB      BPL LOOP
74 60          RTS

```

new negative half-X
number of display repeats

Quadrant one: +X,+Y

Quadrant two: -X,+Y

Quadrant three: -X,-Y

Quadrant four: +X,-Y

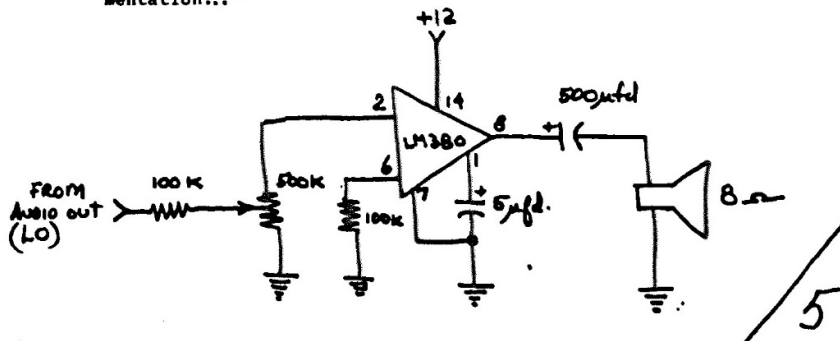
Done displaying?
No, do it again
Yes, generate a new point
Processing and display

Latch Y-coord./blank CRT beam

Latch X-coord./unblank CRT beam
Waste time between points
Load timer for 32 usec.
Test for timer done

Here's a circuit that looks useful to us cost-conscious KIM freaks from... James H. Van Ornum, 55 Cornell Dr., Hazlet, NJ 07730

... Finally, a circuit idea which is an aid for the cassette interface plus an output port for simple music programs. If you look at the audio tape interface schematic for KIM-1, you will notice PB7, audio out (hi) as well as audio out (lo) all have some form of the cassette signal during both record and playback. A high input impedance audio amplifier, using any of the audio IC chips readily available, provides a useful audio monitor during cassette IO as well as a single bit music port. The enclosed schematic provides the circuit details for my particular implementation..."



RPN CALCULATOR INTERFACE TO KIM-1 (nom...James Wood, 58 Hilltop Park,
State College, PA 16801

In the last couple of issues of the KIM-1/6502 User Notes, Eric has mentioned the MM57109 "Number Cruncher Unit" (NCU) manufactured by National, and has noted that it should be easy, from a hardware and software standpoint, to interface to the KIM-1. Well, for those with the chip and the curious, here are the schematics and software listings of the interface that I am currently using to get the NCU and KIM-1 to parlie with each other. Also, I've included the details of my I/O expansion hardware (I've multiplexed peripheral port A) to complete the package of information.

Application I/O Interface

Hardware:

To start things out, we should first look at the Application I/O interface shown in Fig. 1. Peripheral port B is used by the interface to choose the appropriate input or output port. Below is the assignment of the bits of port B. Three bits are devoted

0	1	2	3	4	5	6	7
I	O	O	O	O	O	N/A	I
Input	Output	Port Select	#	N/A	IRQ		

*used as a keyboard request signal in my system to port selection; thus, you can potentially have up to 8 ports. In practice only 7 ports are used since the eighth port is used as a dummy I/O port (see below and subroutine OTSL). Typical input port and output port hardware are shown in Fig. 2. It should be noted that each port is either an input or an output not both, as one will find in an 8080 (8008) microprocessor system.

The two lower bits of port B are used as the input and output for the KIM-1 from and to, the sense inputs and auxiliary outputs respectively. The two multiplexed I/O bits were intended to serve as the handshake I/O lines, but their use is not limited to this application. One need only to remember that the two bits are inverted by the multiplexing chips and that the auxiliary outputs are normally low (active high). You will see that these two bits are extensively used by the NCU interface.

Software:

Three simple subroutines are all that you need to drive the Application I/O interface. They are INIT (Initialize data direction registers), INSL (Select an input port) and OTSL (Select an output port). I won't discuss the details of each subroutine, per se, since they are all well documented, except to state how they are used and a couple of precautions. To use OTSL and INSL, you just load the accumulator with the port # desired in bits 2(LSB), 3 and 4(MSB) with all other bits zero (bit 1 may be an exception), then jump to the appropriate subroutine. A word of caution: Never select an input port with OTSL, the results could be catastrophic since the 6530 outputs of the KIM-1 would be trying to drive the 74125 outputs. You should also be aware that port 7 should not be used since it is used by OTSL to allow a glitch free clearing of the chosen output port, i.e. no undefined states; consequently, the chosen output is always initialized to zero by OTSL.

After the mode (I or O) and port are selected, you need only execute a LDA 1700 or STA 1700 to complete the operation.

NCU Calculator Interface

Hardware:

The hardware that connects directly to the MM57109 is shown in Fig. 3.

There is nothing unique about this part of the interface since all the suggestions given by National in the NCU data sheets were followed. In brief, though, all outputs from the NCU are buffered with a 74LS367 gate with the appropriate pull-down resistor to V_{pp} on the gate's input. All TTL compatible inputs to the NCU have pull-up resistors to V_{33} (V_{CC}). The clock has a frequency of approx. 400 KHz and uses a 74C04 run at 9V since the oscillator input as well as the HOLD and POR inputs are not TTL compatible.

The interface between the 74LS367's and the Application input buss is shown in Fig. 4. Again this interface follows closely the suggestions of National. Outputs DO1, DO2, DO3 and DO4 are latched into a 7475 by the R/W strobe which also sets a 7476 flip-flop. The BR output, if strobed, also will set a 7476 flip-flop. These flip-flops are reset by an auxiliary output signal from the Application interface after the KIM-1 has read the port. The ERR and RDY outputs of the NCU are also made available to the KIM-1.

The interface between the 74100 instruction latch and the Application output buss is shown in Fig. 5. This is a multi-purpose interface. Not only does it interface to the NCU circuitry, but it also interfaces with a "Beer Budget Graphics Interface" (BYTE, 1, 15, Nov., 1976). The circuitry for the latter is omitted but I shall explain the remaining circuitry pertinent to the NCU interface. Bits 06 and 07 are decoded to perform the instruction latching and hold function required in the NCU driving software. Briefly, 01XXXXXX (X=instruction bit) latches the instruction into the 74100, then 1XXXXXX brings the HOLD line low and the NCU commences the execution of the instruction. When the sense input #1 detects RDY=1 the KIM outputs 00XXXXXX and waits for RDY=0. More on this when we look at the driving software.

The last piece of hardware is the power supply. The NCU requires +5V and -4V. The +5V supply uses a 7805 and is self-explanatory. The -4V supply is derived from a -5V IC regulator whose output is further regulated to -3.9V with a zener diode. It should be noted that the capacitor of the size chosen on the output of the -5V regulator is necessary for the proper operation of the regulator.

This interface, as well as all the others, was constructed on Vector phenolic board. I used point-to-point wiring with a Vector wiring pencil. Sockets were used for the MM57109 and 74C04. The circuit worked the first time and has been running for about 6 months.

Software:

There are three basic subroutines which comprise the minimum needed to drive the NCU. They are CRST(Clear and reset NCU), EXEC (Execute a single word of an instruction) and OUTC(Get output from NCU). To fully utilize the capabilities of the NCU, you would need a jump, jump on condition, store and recall instruction subroutines, all of which would be similar in format to the OUTC subroutine. As it stands, the program MAIN allows you to write and execute a linear program (i.e. no jumps) and use only the registers in the NCU for storage.

To write a program for the NCU, you first write out the program in mnemonics, then translate the mnemonics into hexadecimal opcodes (See enclosed list of NCU opcodes). Then you load the encoded program into memory starting at 0300 (hex) up to a maximum of 255 steps. The last byte of the program must be FF to indicate to the KIM the end of the program. To start the program press AD 0200, the reset switch for the NCU, and then GO. After it is finished, the program will return to the KIM monitor and the output will be located in memory locations B0 to BC in one of two formats, described in the NCU data sheets, depending on whether the NCU is in scientific or floating point mode.

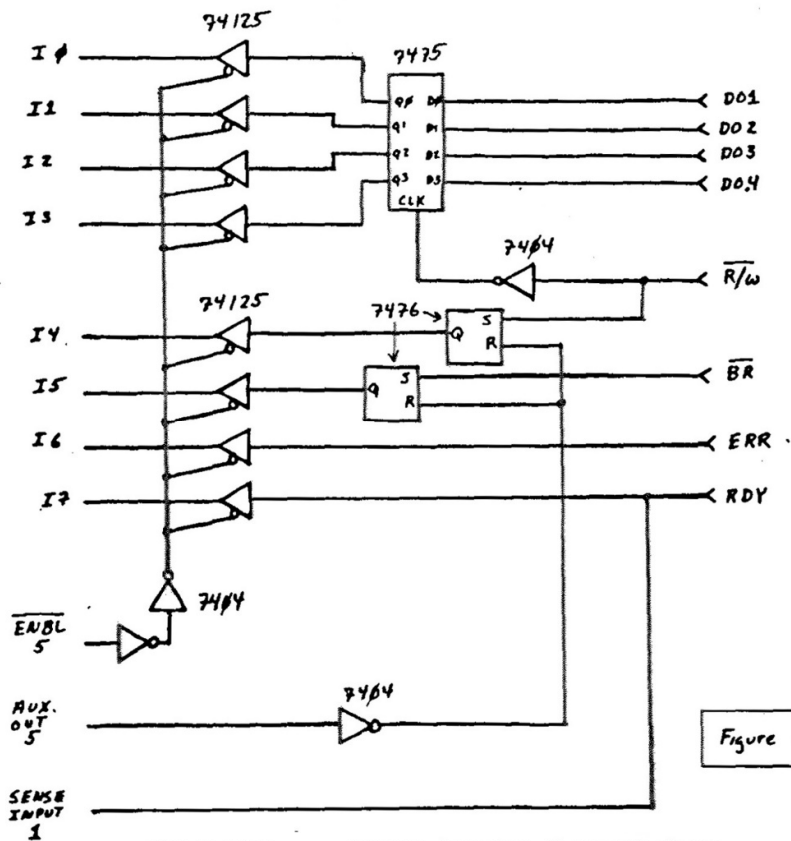


Figure 5

CALCULATOR CHIP SOFTWARE

0200 4C AF 02	JMP MAIN	Enter here if you want all NCU registers cleared
0203 4C B2 02	JMP CNTU	Enter here if you want registers undisturbed
0206 A9 00	INIT LDA 00	
0208 8D 01 17	STA 1701	Set data direction registers
020B A9 3E	LDA 3E	for Port A
020D 8D 03 17	STA 1703	and for Port B
0210 60	RTS	
0211 48	INSL PHA	Save port #
0212 20 06 02	JSR INIT	Set data direction registers
0215 68	PLA	Get port #
0216 8D 02 17	STA 1702	Select input port
0219 60	RTS	
021A 48	OTSL PHA	Save port #
021B 20 06 02	JSR INIT	Set data direction registers
021E A9 1E	LDA 1E	Select port 7
0220 8D 02 17	STA 1702	
0223 A9 FF	LDA FF	Set Port A data direction
0225 8D 01 17	STA 1701	register for all bits as output
0228 A9 00	LDA 00	
022A 8D 00 17	STA 1700	Clear Port A (all bits zero)
022D 68	PLA	Get output port #
022E 8D 02 17	STA 1702	Select output port
0231 60	RTS	

```

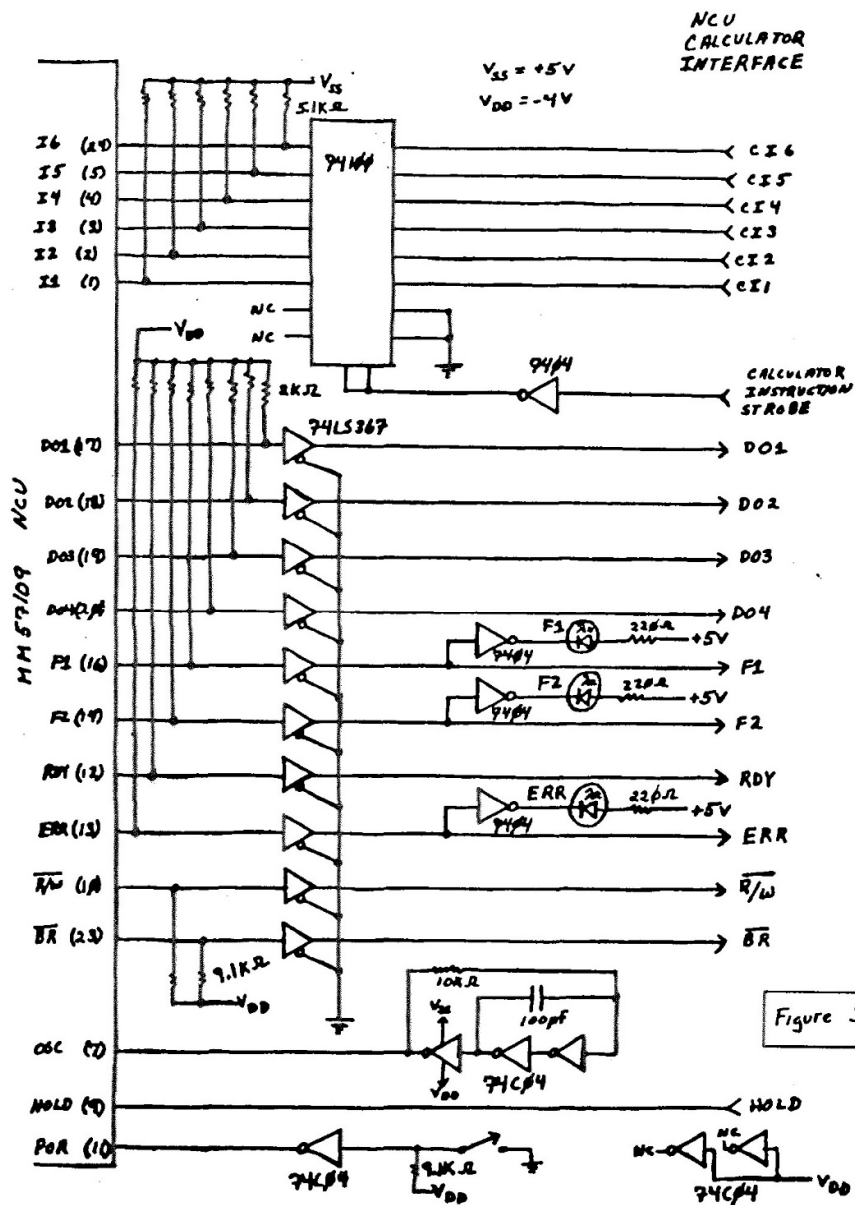
0232 20 06 02 CRST JSR INIT Set data direction registers
0235 A2 05 LDX 05 Load accumulator with a NOP
0237 A9 3F LDA 3F instruction for NCU and
0239 20 54 02 JSR EXEC do it 5 times so that
023C CA DCX NCU is now reset if reset
023D D0 F8 BNE CRST+5 switch was pressed.
023F A9 2F LDA 2F
0241 20 54 02 JSR EXEC Execute a MCLR instruction
0244 A9 14 LDA 14
0246 20 11 02 JSR INSL Select port 5 (input)
0249 A9 16 LDA 16 Pulse Auxiliary output 5
024B 8D 02 17 STA 1702 to reset R/W and BR
024E A9 14 LDA 14 data latches
0250 8D 02 17 STA 1702
0253 60 RTS
0254 48 EXEC PHA Save instruction
0255 A9 04 LDA 04
0257 20 1A 02 JSR OTSL Select port 1 (output)
025A AD 02 17 EXC1 LDA 1702 Check if
025D 4A LSR A RDY=1
025E B0 FA BCS EXC1 (RDY=0)
0260 68 PLA Get and
0261 48 PHA Store instruction
0262 09 40 ORA 40 Put instruction in
0264 8D 00 17 STA 1700 instruction latch
0267 09 80 ORA 80
0269 8D 00 17 STA 1700 Set HOLD=0
026C AD 02 17 EXC2 LDA 1702 Check if
026F 4A LSR A RDY=0
0270 90 FA BCC EXC2 (RDY=1)
0272 68 PLA
0273 8D 00 17 STA 1700 Set HOLD=1
0276 60 RTS

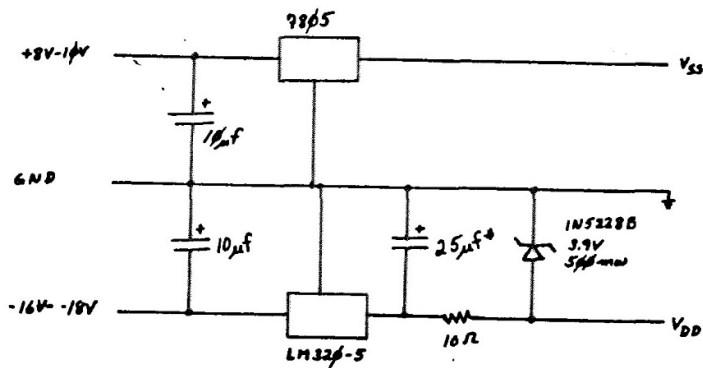
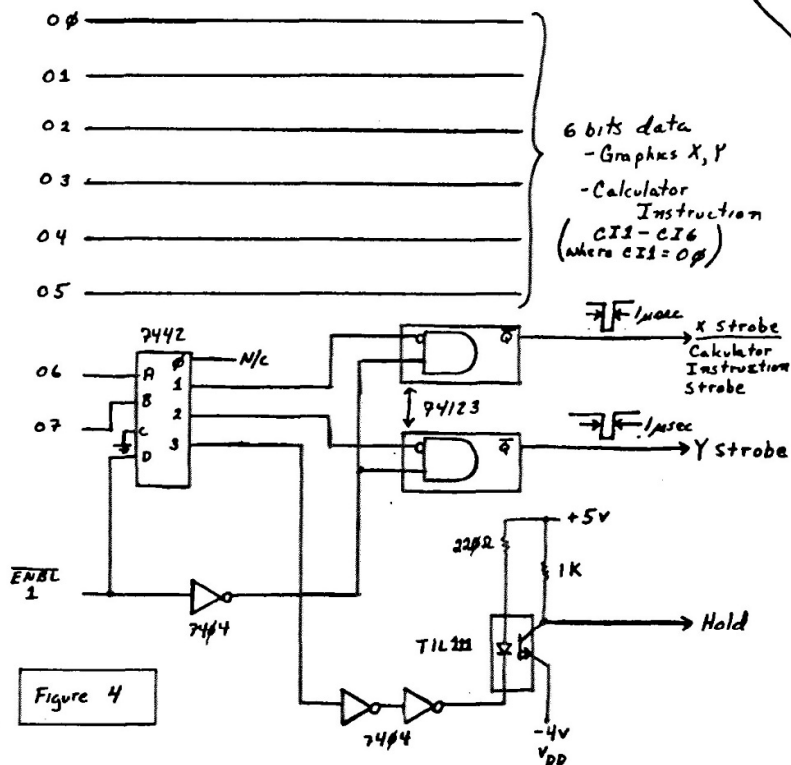
0277 A9 16 OUTC LDA 16 Do an OUT instruction
0279 20 54 02 OUT1 JSR EXEC
027C 20 54 02 JSR EXEC Second byte is ignored by NCU
027F A2 00 LDX 00 Initialize output buffer pointer
0281 A9 14 LDA 14
0283 20 11 02 JSR INSL Select port 5 (input)
0286 2C 00 17 OUT2 BIT 1700 Check for no more data
0289 30 0F BMI OUT3 (RDY=1)
028B AD 00 17 LDA 1700
028E 29 10 AND 10 Check for R/W flag set
0290 F0 F4 BEQ OUT2
0292 AD 00 17 LDA 1700
0295 29 0F AND 0F Load and
0297 95 B0 STA B0,X Store digit
0299 E8 INX Bump buffer pointer
029A A9 16 OUT3 LDA 16
029C 8D 02 17 STA 1702 Clear R/W Flag
029F A9 14 LDA 14
02A1 8D 02 17 STA 1702
02A4 2C 00 17 BIT 1700 Check if done (RDY=1)
02A7 10 DD BPL OUT2
02A9 8A TXA Store buffer pointer
02AA 09 80 ORA 80 with bit 7 set to 1
02AC 95 B0 STA B0,X
02AE 60 RTS

02AF 20 32 02 MAIN JSR CRST Clear NCU registers
02B2 A0 00 CNTU LDY 00 Initialize program pointer
02B4 B9 00 03 LOOP LDA 0300,Y Get instruction
02B7 C9 FF CMP FF Is it end of program?
02B9 F0 07 BEQ END -if so output # in NCU X register
02BB 20 54 02 JSR EXEC -if not, do it
02BE C8 INY Bump program pointer
02BF 4C B4 02 JMP LOOP Do next instruction
02C2 20 77 02 END JSR OUTC Output X register of NCU
02C5 4C F4 1C JMP MONITOR Back to KIM

```

7





*Necessary for proper operation of regulator

Figure 6

Closing Notes

Figure 1

Figure 1

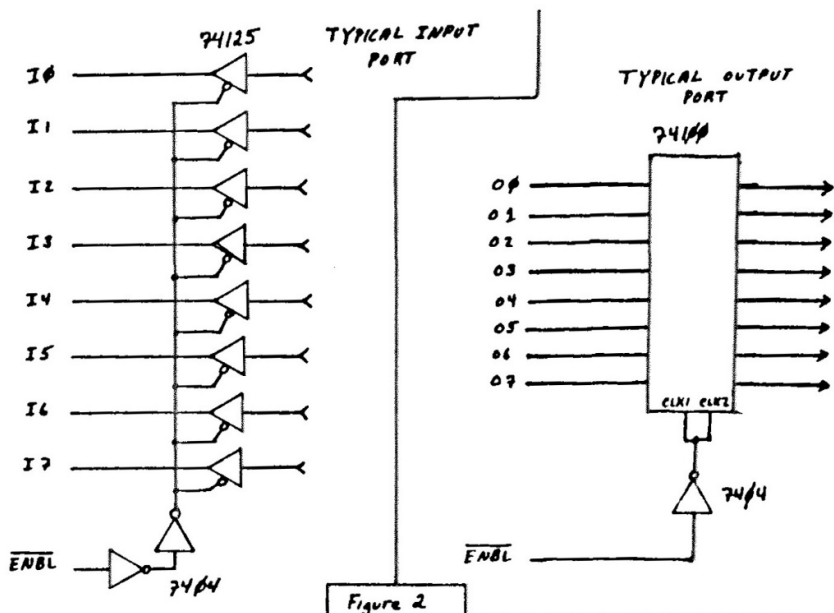


Figure 2

00	0	10	TJC	20	INV	30	XET
01	1	11	TX=0	21	EN	31	*x
02	2	12	TXC	22	TOCH	32	10x
03	3	13	TXF	23	ROLL	33	x2
04	4	14	TEAR	24	SIN (SIN ⁻¹)	34	√x
05	5	15	JMP	25	COS (COS ⁻¹)	35	1/x
06	6	16	OUT	26	TAN (TAN ⁻¹)	36	LOG
07	7	17	IN	27	SFI	37	1/x
08	8	18	SDDC	28	PF1	38	y ⁺
09	9	19	IBNZ	29	PF2	39	+
0A	DP	2A	DBNZ	2A	PF2	3A	-
0B	EE	2B	XEM	2B	ECLR	3B	x
0C	CS	2C	MS	2C	RTD	3C	*
0D	PI	2D	MR	2D	DTR	3D	PRU
0E	ATN	2E	LSH	2E	POP	3E	PRZ
0F	HALT	2F	RSH	2F	MCLR	3F	NOP

HEXADECIMAL OPCODES FOR NCU INSTRUCTIONS

\$5 2708 \$5
 EPROM PROGRAMMING FOR
 KIM 1 OWNERS
 * SEND ERASED 2708 IN ANTI-STATIC CARRIER WITH KIM COMPATIBLE CASSETTE.
 * PLEASE SUPPLY ID# AND ADDRESS INFO. WITH CASSETTE.
 * ENCLOSE \$4.00 PLUS \$1.00 NON-REFUNDABLE HANDLING CHARGE FOR EACH EPROM
 * HEX DUMP - FREE!!
 - CASSETTES ARE RETURNED WITH ORDER-FAST TURN-AROUND!
 PYRAMID DATA SYSTEMS
 6 TERRACE, NEW EGYPT, NJ 08533

'HEXADAISY' BY E&L PFEIFFER COMPUTER PRODUCTS

Perhaps the biggest pain in hand-assembly and most prone to errors is the calculation of relative branches. I've had more programs bomb out from this problem than any other. Texas Instruments has introduced a programmers calculator that nicely handles the problem, but at \$50.00, the price/performance ratio is nowhere near where it should be unless you were going to use it for alot more than just branch calculations. KIM could, of course, be programmed to compute it's own relative branches but that would mean having a computer close-by at all times. And, as we all know, that just isn't possible. (Just ask Jim Butterfield).

If you're still reading, then chances are that you would be interested in hearing about 'HEXADAISY'. Picture two circular vinyl discs held together by a centered rivet and you'll have a good idea of what this hex calculator looks like. The instructions describes how to do hex arithmetic with 'HEXADAISY', but I feel that its branch calculating ability is by far more important and makes it well worth the \$3.95 price tag. The price/performance ratio of this device is also more realistic. 'HEXADAISY' is available for \$3.95 (postpaid in USA) from:

E&L PFEIFFER COMPUTER PRODUCTS, Box 2624, Sepulveda, CA 91343
(Cal. residents add sales tax)

PREPROGRAMMED PROMS AND D/A CHIPS are available from Peter Bertelli, 5262 Yost Place, San Diego, CA 92109. Peter mentioned that he stocks the TVT-6 Scan PROM (\$3.25) and the Motorola 3408 DAC chip (\$3.50).

FINALLY!
EPROM FOR KIM-1/KIM-4

Now available from JOHNSON COMPUTER:

Model KMBKRO, EPROM board.
Same dimensions as KIM-2/3 memory.
Plugs directly into KIM-4
Completely assembled, tested, ready to use.
Accepts 8 2708 EPROMS for 8K total.
Easily converted for 2716 for 16K total.
Sockets installed for EPROMS.
Draws less than 1 watt, fully loaded.
Complete documentation includes KIM-1 software for programming on popular programmers.
Industrial grade construction throughout.

Order: Model KMBKRO (EPROMs not included)
Price: \$195.00 Each - F.O.B. JOHNSON COMPUTER
Availability: STOCK

Note: OAE Model PP-2708/16 Programmer Available - \$295.00
Adaptor card for using PP2708/16 with KIM - \$23.95

JOHNSON COMPUTERS PO BOX 523, MEDINA, OH 44256 216/725-4560

HAMS, TAKE NOTE----If you get turned by the MICROPROCESSOR/CONTROLLED KEYBOARD in the January 1978 issue of HAM RADIO, then you'll be glad to know that a p.c. board is now available for that project. In case you didn't.....it uses a 6304 CPU, a couple of 1702A EPROMS, four 6111's, a 6530-003 and other misc. TTL and provides about all the flexibility you could ever expect in a CW keyboard. (Love those micro's!!!).

Anyway, like I was saying, the p.c. boards are now available from PYRAMID DATA SYSTEMS, DEPT A., 6 Terrace Ave., New Egypt, NJ. 08533. For \$25.00 you get the board and documentation. Include an extra \$1.50 if you want a reprint of the Ham Radio article.

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RIVERSIDE ELECTRONIC DESIGN is still alive and well. They can be reached at 716-873-5306 in the evenings. Eugene Zunchak, one of the owners, said that they are still making the video and KIM expansion boards. I saw these boards at the CLEVELAND COMPUTERFEST and they looked well thought out and constructed.....ERIC

FORETHOUGHT PRODUCTS is now making a power supply available to power their "KIM-1" and similar machines. All outputs are unregulated and include +8 volts at 12 Amps, +16 volts at 1 Amp and -16 at 1 Amp. Input is either 110 VAC or 220 VAC. Price is \$69.50 in kit form or \$89.00 assembled. Get more info on this and their other KIM products at: FORETHOUGHT PRODUCTS, P.O. Box 8066, Coburg, Or 97401 503-485-8575

CONNECTICUT MICROCOMPUTER has announced immediate availability of an RS-232 ADAPTOR FOR KIM. In its present configuration, the adaptor converts current-loop to RS-232 (and vice-versa) but can easily be modified to convert TTL to RS-232 (and vice-versa). ADA, as it's called, comes completely assembled for \$24.50 with drilled, plated-through solder pads for all connections, or, for \$29.50 with barrier strips and screw terminals. Contact them at: Pocono Rd., Brookfield, CT., 06804

MICRO-2 ELECTRONIC SYSTEMS has a version of MICRO-SOFT BASIC available for KIM. This 9K package sells for \$100.00, is recorded on a standard KIM cassette, and comes with a 70 page manual on how to use Microsoft BASIC with KIM. Get in touch with Micro-2 at Box 2426, Rolling Hills, CA 90274, or call them at 213-377-1640.

THE 6502 PROGRAM EXCHANGE, 292C Meana, Reno, NV 89509 has announced a number of new software packages for the 6502. These include an extended version of FOCAL, a 4K resident assembler, and a mini text editor.

The new FOCAL (FCL65E) offers 8 to 9 digit accuracy, 8-level priority interrupt handling, string variables and functions, and greater flexibility in its FOR, SET, and DO commands. The EXCHANGE indicates they have a FOCAL version of STAR TREK as well as other programs available.

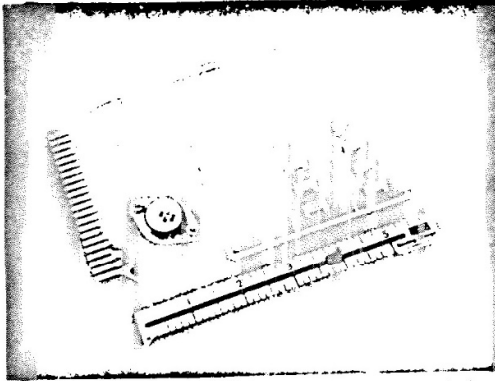
More information, prices, and list of other software (floating-point arithmetic package, disassemblers, games, and utility programs) may be obtained by sending \$1.00 to the 6502 Program Exchange.



Box 120 Allamuchy, N.J 07820
Phone: 201-852-9268

NEED A KIM-3?

- THE HDE DM 816-M8-8K IS KIM BUS COMPATIBLE
- TAKES LESS POWER AND IS LESS THAN ONE-HALF THE SIZE



FEATURES

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- FACTORY REPAIR AT MODERATE COST FOR KITS OR OUT-OF-WARRANTY BOARDS
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DM 816-M8	8K	\$289.00
DM 816-M8	4K	\$179.50

CARD GUIDES FOR KIM-4 USE \$1.50 PER SET
ADD \$3.00 PER BOARD SHIPPING AND HANDLING
NEW JERSEY RESIDENTS ADD 5% SALES TAX
PRICES AND SPECIFICATIONS SUBJECT TO CHANGE
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AVAILABLE JANUARY 15
A FILE-ORIENTED DISK SYSTEM (FODS) FOR KIM

SOFTWARE REVIEW

BY THE EDITOR

"XIM" BY PYRAMID DATA SYSTEMS

As soon as I hooked a terminal to KIM, it became apparent that the built-in TTY monitor was only a bare-bones approach and a more elegant program development tool was sorely needed. The functions that were most necessary included a more convenient way of entering and dumping HEX data, as well as a move routine and maybe a BREAK processor for debugging purposes. Luckily though, before I got too far into working up these routines for myself, a copy of something called "XIM" came to my attention. Basically "XIM" stands for Extended I/O Monitor and is a 1K extension of the KIM monitor. 17 commands are included in its arsenal (4 of which are user definable) including such niceties as block move, search, and compare; hex dump and entry; a breakpoint routine; a relative branch calculator; etc.

"XIM" has been "ediot-proofed" very nicely and provides the operator feedback necessary for user-confidence. This feature has been sorely lacking in a number of software packages I have seen. SOFTWARE WRITERS TAKE NOTE.

The documentation is very complete, gives examples for each of the 17 commands, and provides a well-commented source listing of the program for ease of understanding.

"XIM" is available for \$10.00 (manual and paper tape) or \$12.00 (manual and KIM cassette) postpaid in USA from PYRAMID DATA SYSTEMS, Dept 'A', 6 Terrace Ave, New Egypt, NJ 08533.

MORRISON ELECTRONICS INC. announces availability of their 4K RAM board designed especially for KIM. According to the flyer, the assembled and tested board sells for \$165.00 and is configured to mount directly below KIM on standoffs. Get more info from them at 3539 Lacon Rd., Hilliard, Oh 43026 (614-876-4408).

WORD PROCESSING NEWSLETTER

If you're into WP (or getting into WP) then you'll want to subscribe to a really nifty newletter that's specializing in this fascinating portion of the computer field. Hard copy devices, computer hard and software and many other topics are covered in this monthly publication. Subscription rates are \$12.95 for 12 issues (available only in the U.S. and within the Pan American Postal Union) from BOOKMAKERS, BOX 158, San Luis Rey, CA 92068. (They also publish a 2650 user group newsletter).

OPTIMAL TECHNOLOGY announces a 2708/2716 PROM PROGRAMMER for KIM. Price of the EP-2A is \$59.95 (assembled and tested) or \$49.95 for the kit. Either way, you get the hardware, KIM software, and a circuit board connector. Write to them for more data at: OPTIMAL TECHNOLOGY INC., Blue Wood 127, Earlysville, VA 22936



...And this next good number let's thank Timothy Bennett,
309 Mary St., Westerville, Ohio 43081
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ON VERIFYING PROGRAMS IN RAM

Ken Niessen
Ottawa

Ever had a program go wild and you're left wondering what got destroyed as a result? CHEK is a handy utility you can use to identify destroyed programs. CHEK calculates the checksum over a block of memory defined by BEG and FIN (inclusive).

I suggest that programs published in the KIM-1 USER NOTES have a checksum at the end so that readers can verify whether they've entered them into memory correctly.

To find the checksum for a program starting at 1780 and ending at 17A4 (e.g. CHEK), run CHEK with BEG=80,17 and FIN=A4,17. The display will show 17A6 FA, where FA is the checksum which must be entered at location 17A5.

Now to see if the program is intact, run CHEK with BEG=80,17 and FIN=A5,17. If the display shows 17A6 00, the program between 1780 and 17A4 and the checksum at 17A5 are intact.

```

1780 A900      ; CHECKSUM CALCULATOR
1782 A8        ; Put memory block start addr in E0,E1
1783 18        ; Put memory block end addr in E2,E3
1784 71E0      ; Processor must be in binary mode
1785 E6E0      ; 17FE,17FF must contain address=1000
1786 D002      ; CHEK modifies the contents of E0,E1
1787 E6E1      CHEK LDA # $00      ; Initialize A (sum),
1788 A6E1      TAY                ; Y,
1789 A6E1      CH1 CLC            ; and C to zero.
1790 D0F1      ADC (BEG),Y        ; Add to sum.
1791 A6E2      INC BEG            ; Increment
1792 E4E1      BNE CH2            ; memory
1793 A6E1      INC BEG+1          ; address.
1794 E4E1      CH2 LDH FIN+1      ; Check to
1795 D0F1      CPI BEG+1          ; see if
1796 A6E2      BNE CH1            ; current
1797 E4E1      LDH FIN            ; memory address
1798 D0E8      CPI BEG            ; equals the last
1799 18        BNE CH1            ; memory address.
1800 18        CLC
1801 71E0      ADC (BEG),Y        ; Add in the last byte.
1802 85F5      STA $F5            ; Calculate
1803 98        TIA                ; the
1804 38        SEC                ; checksum:
1805 E5F5      SBC $F5            ; 0 - sum.
1806 8D6117    STA CH3            ; Store for display.
1807 00        BRK                ; Exit to Monitor.
1808 FA        SUM .BYTE $FA     ; Checksum over CHEK.
1809 00        CH3 .BYTE $00     ; Checksum for display.
1810 00        BEG = $E0 ;Memory block start address.
1811 00        FIN = $E2 ;Memory block end addr (L,R).

```


How 'bout some TTY graphics?.....can you expand on this?

GREETING CARD GENERATOR from Hardy Pottinger, 13 Pauline Ln.
Rolla, Missouri 65401

This is a program written in 6502 assembly language for the KIM-1 microcomputer system. It is designed to accept a message from a console teletype terminated by a carriage return (\$0D) and then interpret a simple list of picture descriptors to repeat the message in a desired pattern. The program as currently written has room for a 10 character message (including terminator). The pattern descriptor size is limited only by KIM's memory. The program resides in locations \$200 through \$26F. The message follows the program, and the pattern descriptor is entered at \$279. Locations \$263 and \$264 are the descriptor table's low and high address bytes. The contents of these two locations may be changed if desired to allow a longer message text.

The descriptor is composed of a list of 7-bit counters of the form:

Ms,Mm,Ma,...,Mn,Mm,Ma,...,FF

where Ms is a 7-bit space count, and Mm is a 7-bit message count. A new line is signaled at any time by a count with a 1 in bit 0. Any count can be 0. A \$FF marks the end of the descriptor and a return is made to the KIM monitor via a BRK instruction. The message is repeated if necessary to fill out each field of Mm bytes. Each line begins with an 18 space margin. This is arbitrary and can be changed by modifying the contents of location \$212. This value must be at least 1.

Example:

```
80 80 80 80
00 05 05 05 05 85
00 05 05 05 05 85
00 05 05 05 05 85
00 05 05 05 05 85
05 05 05 85
05 05 05 85
05 05 05 85
05 05 05 85
00 05 05 05 05 85
00 05 05 05 05 85
00 05 05 05 05 85
00 05 05 05 05 85
80 80 80 FF
```

Produces a checkerboard pattern as shown on the sample runs.
Note that if the message is too long to fill a field it is continued in the next field or on the next line.

```
1      ; GREETING CARD GENERATOR
2      ; DRAW A FIGURE COMPOSED OF TEXT FROM A USER GENERATED
3      ; MESSAGE
4      ; POINTER STORAGE
5      ;
6      CMPTR EQU 0
7      LPTR EQU 1
8      COUNT EQU 2      ; 'COUNT' FROM LIST
9      MCNT EQU 3      ; 7-BIT COUNT FROM 'COUNT'
10     GETCH EQU $1E5A   ; GET CHAR ROUTINE
11     OUTSP EQU $1E9E   ; OUTPUT SPACE ROUTINE
12     OUTCH EQU $1EA0   ; OUTPUT CHAR ROUTINE
13     ;
14     . LOC $200
15     ;
16     0200 A2 00      START LDX  #000   ; CLEAR X REG
17     0202 86 00      STX  CMPTR   ; RESET POINTERS
18     0204 86 01      STX  LPTR
```

```

19      0206 20 5A 1E      ;
20      0209 9D 6F 02      MSGQ JSR GETCH ; GET CHAR FROM TTY
21      020C E8             STA MSG.X ; STORE IN MESSAGE AREA
22      020D C9 0D             INX      ; INCR X REG
23      020F D0 F5             CMP     ##0D ; = CR?
24      0211 A2 12             BNE     MSGQ ; GET MORE IF NOT CR
25
26      ; OUTPUT OFFSET # OF SPACES FOR LEFT MARGIN
27
28      0211 A2 12      LMRG LDX #18
29      0213 20 9E 1E  LMRG1 JSR OUTSP ; DO LEFT MARGIN
30      0216 CA             DEX
31      0217 D0 FA             BNE     LMRG1
32
33      ; GET COUNT OF SPACE FIELD
34
35      0219 20 5E 02      SLIST JSR GCNT
36      021C AA             TAX      ; COUNT TO X REG
37      021D F0 06             BEQ     SP2 ; GO TO SP2 IF COUNT=0
38      021F 20 9E 1E      SP1 JSR OUTSP
39      0222 CA             DEX
40      0223 D0 FA             BNE     SP1
41      0225 A9 00      SP2 LDA ##00
42      0227 24 02             BIT     COUNT ; TEST COUNT FOR END FLAG
43      0229 D0 26             BNE     ENDSO ; END OF DESCRIPTOR
44
45      ; GET COUNT AND DO MESSAGE FIELD
46
47      022B 20 5E 02      JSR GCNT
48      022E F0 1B             BEQ     MSGO
49      0230 85 03             STA MCNT ; SAVE COUNT IN MCNT
50      0232 A6 00      MS1 LDX CMPTR ; GET CURRENT MESSAGE POINTER
51      0234 BD 6F 02      MS2 LDA MSG.X ; GET CURRENT MESSAGE BYTE
52      0237 C9 0D             CMP     ##0D ; TEST FOR CR
53      0239 D0 06             BNE     MS3 ; NOT A CR
54      023B A2 00             LDX     ##00 ; CLEAR X
55      023D 86 00             STX     CMPTR ; RESET MESSAGE POINTER
56      023F F0 F3             BEQ     MS2
57      0241 E8             MS3 INX
58      0242 20 A0 1E      JSR OUTCH
59      0245 E6 00             INC     CMPTR
60      0247 C6 03             DEC     MCNT ; TEST COUNT
61      0249 D0 E7             BNE     MS1 ; DO MORE IF NOT ZERO
62
63      ; END OF MESSAGE FIELD
64
65      024B A9 00      MSGO LDA ##00
66      024D 24 02             BIT     COUNT ; TEST FOR END OF LINE
67      024F F0 C8             BEQ     SLIST ; DO NEXT SPACE FIELD
68
69      ; END OF DESCRIPTOR (LINE)
70
71      0251 A9 0D      ENDSO LDA ##0D ; DO CR/LF
72      0253 20 A0 1E      JSR OUTCH
73      0256 A9 0A      LDA ##0A
74      0258 20 A0 1E      JSR OUTCH
75      025B 4C 11 02      JMP     LMRG
76
77      ; GCNT
78      ; GET COUNT FROM LIST
79      ; ORIGINAL COUNT IN 'COUNT' AND A
80      ; 7-BIT COUNT IN ACC
81
82      025E A6 01      GCNT LDX LPTR ; GET CURRENT LIST POINTER
83      0260 E6 01             INC     LPTR ; BUMP IT
84      0262 BD 79 02      LDA LBASE.X ; GET CURRENT LIST ELEMENT
85      0265 C9 FF             CMP     ##FF ; TEST FOR END OF LIST
86      0267 D0 01             BNE     GCNT1 ; NOT END
87      0269 00             BRK      ; END OF LIST
88      026A 85 02      GCNT1 STA COUNT ; SAVE ORIGINAL COUNT

```

```

89 026C 29 7F      AND    #57F    ; MASK OFF BIT0
90 026E 60          RTS          ; RETURN
91
92                MSG     .RMB    10    ; MESSAGE AREA
93                LBASE   .RMB     1    ; CARD DESIGN DESCRIPTION GOES H
94
95                END
0  UNDEFINED SYMBOLS **

```

HERE'S AN EXAMPLE.....

```

KIM      *
0000 06 200
0200 A2 612345

```

```

12345    12345    12345
12345    12345    12345
12345    12345    12345
12345    12345    12345
          12345    12345
          12345    12345
          12345    12345
          12345    12345
12345    12345    12345
12345    12345    12345
12345    12345    12345
12345    12345    12345

```

end

Here's some interesting comments and a neat idea from Ian Thurston
22 Concord Ave., Dundas, ONT, Canada (L9H 1R6)....

Right now, I'm using my KIM to train music students to recognise different musical intervals, and the results are fantastic ! One student who didn't know a diminished fifth from an empty beer bottle a few weeks ago has made really good progress, largely because he enjoys using the KIM trainer program.

I'm working on a game now which looks promising. The premise is that you, the player, are in a submarine represented on the display by a vertical line. You can control your depth, which is fortunate, because every now and then, a sub-hunter quickly appears on the left side of the display (the surface), drops a depth charge, and scoots. If you happen to be at the position where the depth charge explodes (unpredictably, of course !), tough cheese ! Otherwise, the game continues. On the other hand, if you launch a torpedo quickly enough, you may sink the sub-hunter, and win .

In the meantime, though, I thought you might be interested in the enclosed note on how I use a voice-operated-relay with my KIM as an input device.
VOCAL INPUT TO KIM

Try using a simple Voice-Operated-Relay (VOR) circuit as an input device. With a little ingenuity, you can use a VOR not only as a go/no-go input, but also as a variable input.

I hooked a VOR kit I had lying around (Radio Shack 28-131) to application pin 8 (PA 7). Now, using the NMI and BPL instructions, I'm able to poll the relay. For example, the following routine polls the relay for about 2 seconds. If there is no voice command, it exits with A = 00; if a voice command closes the relay, the routine exits within 1/2 second with A = 01.

```

TIMES    LDX #009    A2 09    Load counter for 8 1/2 sec. intervals .
          LDA #009    A9 09    Set A = 009 in case of no response
          DEX         CA      1/2 sec. counted .
          BPL EXIT    30 11    If all done, leave with A = 00 ;
          LDA #00FF    A9 FF    if not, load timer
          STA 1707     8D 07 17 to time about 1/2 sec.
TIME      LDA 1707     AD 07 17 Poll timer
          BPL TIME    10 FB    until done,
          LDA PAD      AD 00 17 then check Data Port A .
          BMI TIMES    30 EC    Keep timing unless relay closed,
          LDA #0001    A9 01    in which case, set A = 01
EXIT      (RTS        60, or continue)

```

This program assumes a relay connected in the normally-open mode, with a closure of at least 1/2 second.

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Not bad, for under \$10, but there are more possibilities. Here's one application that allows variable inputs using a VOR. How? Simply by timing how long the VOR remains closed.

	LBR \$300	A2 \$0	Initialize counter.
	STX PADD	8E \$1 17	Set Data Direction to Input
SETTYT	LDA PAD	AD \$0 17	Check Data Reg. A
	BMI SETTYT	30 F0	until voice begins ;
DELAY	LDA \$3FF	A9 FF	then load timer
	STA 1707	8D \$7 17	to time about 1/2 sec.
TIMER	LDA 1707	AD \$7 17	Check timer
	BPL TIMER	10 F0	until done,
	INX	E8	then increment 1/2sec. counter.
	LDA PAD	AD \$0 17	Check that relay is still on .
	BPL DELAY	10 F0	If so, go time some more.
	? ?	XX XX	If not, leave with count in X reg.

With a little experimentation, you'll find it's possible to control the length of time the relay stays closed by controlling what you say. With my set-up, I've found that quickly saying "one" produces a count of \$1 in the X register. Saying "one-two" produces a count of \$2, and so on. Of course, the system isn't elegant, nor is it 100% reliable. But it sure is fun! (And incidentally, a good way of answering those smart alecks who ask you if your computer can talk yet!)

NOTE: To make the above routine work with my VOR, I had to disable an RC network that latched the relay "on" for a few seconds.

end

Do you remember what day you were born on? Here's an interesting diversion from ...Harvey Heinz, 9730 Townline Diversion, Surrey, B.C. V3V 2T2 Canada
This program will compute the day of the week for any date between Sept.14, 1752 (the start of the Gregorian calendar in the British colonies) and Dec.31, 1999.

Enter 2 digits for month in loc.0001.-- 2 digits for date in 0002.
Century in location 0003, and 2 digits for year in 0004.

Press + and GO. Answer will appear in location 0000 as a 2 digit number .
01=Sunday, 02=Monday,03=Tuesday, etc.,to 00=Saturday.

0000	xx ?? ?? ?? ?? F8 38 A9 00 85 00 85 A0 85 B3 AA	EXAMPLE:
0010	A5 04 C9 00 F0 18 C9 04 90 14 A8 8A 18 69 01 AA	Dec 7, 1941
0020	98 38 E9 04 D0 F0 A5 01 C9 03 B0 02 C6 B3 A5 03	\$0001 = 12
0030	C9 20 B0 67 C9 19 F0 2C C9 18 90 06 A9 02 85 00	\$0002 = 07
0040	D0 22 C9 17 90 55 A5 04 C9 53 90 06 A9 04 85 00	\$0003 = 19
0050	D0 12 C9 52 D0 45 A5 01 C9 09 90 3F A5 02 C9 14	\$0004 = 41
0060	90 39 B0 E8 8A 18 65 00 65 02 A6 01 75 A0 24 B3	+ GO
0070	F0 03 38 E9 01 18 65 04 90 02 C6 A0 38 B0 02 E9	
0080	07 C9 07 B0 FA 24 A0 10 07 E6 A0 18 69 01 D0 EF	
0090	85 00 A9 00 85 FA 85 FB 4C 4F 1C A9 88 D0 F1 xx	
00A0	xx 01 04 04 00 02 05 00 03 06 xx xx xx xx xx xx	
00B0	01 04 06 xx	
00B4	last location + 1	

If you attempt to enter a date outside of the limits, the program will put 88 in location 0000.

The program uses this equation:

$$W \equiv M + D + C + 1/4 Y \pmod{7}$$

W= day of the week (01 = Sun.,02 = Mon., etc., 00 = Sat.)
M= special number for month
D= Date (day of the month)
C= special number for century
Y= year (of century)

end

HERE'S A KLUGE-HARP LOADER FOR YOU MUSIC FREAKS, FROM:

R. S. McEvoy
46 Browallia Crescent
Loftus 2232 N.S.W.
Australia

"Ron Kushnier's Harp in #6 is a real improvement but lacks the ability to take rests-silence is important in real music. I'm sending you a simple patch which treats code #FF as a rest.

Also included is a Kluge Harp Loader which uses a TVT as an input terminal. Not elegant but it does allow direct loading from sheet music to memory W/O all the table look-up.

Possibly the most important feature is the note codes - they're right, by tuning fork & frequency meter. Now you can play duets with KIM.

Upcoming projects include a music transcriber to automatically take care of sharps & flats in going from one key to another. Also, a hardware multiplexed bus system to allow KIM to play chords. How about some articles on music or sound in general".

0300 A2 00	LDX #00	INDEX TO SCORE START
02 A0 00	LDY #00	SET FOR LOW OCTAVE
04 8C E0 03	STY TEMPY	
07 20 5A 1E	JSR GETCH	GET KB INPUT
0A C9 00	CMP #0	IF IT IS '0' KEY, INDEX
0C D0 00	BNE ①	BACK ONE COUNT, DISPLAY
0E CA	DEX	NEW INDEX AND
0F 8A	TXA	RETURN
10 20 3B 1E	JSR PRTRYT	
13 20 EC 03	JSR LFCR	
16 4C 02 03	JMP NSTART	-OR-
19 C9 1F	CMP #1	IF IT IS '1' KEY, INDEX
1B D0 00	BNE ②	FORWARD ONE COUNT,
1D E8	INX	DISPLAY NEW INDEX
1E 8A	TXA	AND RETURN
1F 20 3B 1E	JSR PRTRYT	
22 20 EC 03	JSR LFCR	
25 4C 02 03	JMP NSTART	-OR-
28 C9 7F	CMP #7	IF IT IS 'P' KEY, NEXT
2A D0 07	BNE ③	2 KEY INPUTS ARE LOADED
2C 20 9D 1F	JSR GETBYT	DIRECTLY TO INDEXED LOC.
2F D0 57	BNE ④	
31 F0 55	BEQ ④	-OR-
33 C9 6B	CMP #B	IF IT IS 'H' KEY, NEXT
35 D0 00	BNE ④	LOCATION WILL LOAD FROM
37 A0 0D	LDY #0D	HIGH OCTAVE
39 8C E0 03	STY TEMPY	
3C 20 5A 1E	JSR GETCH	-OR-
3F AC E0 03	LDY TEMPY	
42 C9 61	CMP #A	COMPARE TO 'A' KEY, IF A MATCH
44 F0 3F	BEQ ⑤	LOAD 'A' CODE. OTHERWISE,
46 CB	INY	INC. INDEX FOR NEXT NOTE.
47 C9 41	CMP #A	ETC. FOR ALL POSSIBLE
49 F0 3A	BEQ ⑤	NOTES.
4B CB	INY	
4C C9 62	CMP #B	
4E F0 35	BEQ ④	
50 CB	INY	
51 C9 63	CMP #C	
53 F0 30	BEQ ④	

55	C8	INX	
56	C9 43	CMP 'C'	
58	F8 2B	BEQ ⑤	
5A	C8	INX	
⑤35B	C9 64	CMP 'D'	
5D	F8 26	BEQ ⑤	
5F	C8	INX	
60	C9 44	CMP 'D'	
62	F8 21	BEQ ⑥	
64	C8	INX	
65	C9 65	CMP 'E'	
67	F8 1C	BEQ ⑥	
69	C8	INX	
6A	C9 66	CMP 'F'	
6C	F8 17	BEQ ⑥	
6E	C8	INX	
6F	C9 46	CMP 'F'	
71	F8 12	BEQ ⑥	
73	C8	INX	
74	C9 67	CMP 'G'	
76	F8 0D	BEQ ⑥	
78	C8	INX	
79	C9 47	CMP 'G'	
7B	F8 0B	BEQ ⑥	
7D	C8	INX	
7E	C9 72	CMP 'R'	
80	F8 03	BEQ ⑤	
82	20 02 03	JMP HSTART	
85	09 50 02	LDA NOTE, Y	
88	0D 00 00	STA TUNE, X	
8B	A9 20	LDA 'SP'	
8D	20 A0 1E	JSR OUTCH	
90	8A	TXA	
91	20 3B 1E	JSR PRBYT	
94	20 EC 03	JSR LFCR	
97	E8	INX	
98	20 5A 1E	JSR GETCH	
9B	A0 00	LOX # 00	
9D	C9 31	CMP '1'	
9F	F8 34	BEQ ⑦	
A1	C8	INX	
A2	C9 21	CMP '1.'	
A4	F8 2E	BEQ ⑦	
A6	C8	INX	
A7	C9 32	CMP '2'	
A9	F8 2A	BEQ ⑦	
AB	C8	INX	
AC	C9 40	CMP '2.'	
AE	F8 25	BEQ ⑦	
B0	C8	INX	
⑤3B1	C9 34	CMP '4'	
B3	F8 20	BEQ ⑦	
B5	C8	INX	
B6	C9 24	CMP '4.'	
B8	F8 1B	BEQ ⑦	
BA	C8	INX	
BB	C9 38	CMP '8'	
BD	F8 16	BEQ ⑦	
BF	C8	INX	
C0	C9 2A	CMP '8.'	

COMPARE TO 'REST' KEY. IF
MATCH, WILL LOAD PFC
NOT VALID KEY, KEEP TRYING
GET NOTE NAME FROM TABLE
AND STORE IN SCORE
PUT A SPACE ON CRT

THEN OUTPUT PRESENT
LOCATION
DO CRIF AND SCREWING UP R
ADVANCE TO NEXT SCORE LOC.
GET KB INPUT
SET TIME INDEX
COMPARE TO 'WHOLE NOTE' KEY.
IF A MATCH, LOAD '1' CODE
OTHERWISE, INC INDEX FOR
NEXT TIME SIGNATURE
ETC FOR ALL LISTED
TIME SIGNATURES.

C2 F0 11	BEQ ①	
C4 C8	INY	
C5 C9	CMP 'G'	(1/16)
C7 F0 0C	BEQ ②	
C9 C8	INY	
CA C9 5E	CMP 'G.'	(1/16)
CC F0 07	BEQ ③	
CE C8	INY	
CF C9 33	CMP '3'	(TRIPLET)
D1 F0 02	BEQ ④	
D3 00 C3	BNE ⑤	
D5 B9 70 02	LDA TIME, Y	GET TIME VALUE FROM TABLE
D8 A9 20	STA TUNE, X	AND STORE IN SCORE
DB A9 20	LDA 'SP'	PUT A SPACE ON SCREEN.
DD 20 A0 1E	JSR OUTCH	
E0 8A	TXA	THEN OUTPUT PRESENT
E1 20 3B 1E	JSR PRBYT	STORAGE LOCATION.
E4 20 EC 03	JSR LFCR	
E7 E8	INX	ADVANCE TO NEXT LOC.
E8 20 02 03	JMP NSTART	THEN START AGAIN.
EB XX	TEMP Y	
EC A9 0A	LDA LF	SUB TO OUTPUT LFCR
EE 20 A0 1E	JSR OUTCH	W/O EFFECTING X.
F1 A9 00	LDA CR	
F3 20 A0 1E	JSR OUTCH	
F6 00	RTS	

...AND NOW, THE NOTE TABLE---

0250 DF	NOTE	A	02 70 20	TIME	1/1
51 03	A#		71 30		1/1
52 C6	B		72 10		1/2
53 BA	C		73 18		1/4
54 B1	C#		74 08		1/4
55 A6	D		75 0C		1/4
56 9C	D#		76 04		1/8
57 93	E		77 06		1/8
58 8A	F		78 02		1/16
59 83	F#		79 03		1/16
5A 7B	G		7A XX		TRIPLET
5B 74	G#				
5C FF	REST				
5D 6E	A				
5E 67	A#				
5F 61	B				
60 5C	C				
61 56	C#				
62 51	D				
63 4C	D#	HIGH OCTAVE			
64 48	E				
65 44	F				
66 40	F#				
67 3C	G				
68 38	G#				
69 FF	REST				

PATCH TO RONALD KUSHNIER'S KLUGE HARP
TO INCORPORATE 'RESTS'

16

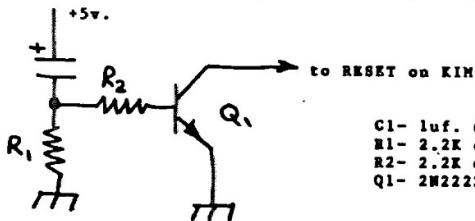
0221 A9 00	LDA 00	RESET POSSIBLE PREVIOUS REST
8D 12 02	STA 0212	
C8	INY	
C8	INY	
B9 00 00	LDA 00, Y	TEST NOTE FOR END OF SCORE
C9 00	CMP #00	
F0 C6	BEG 0202	YES: PLAY IT AGAIN, KIM
C9 FF	CMP #FF	IS IT A REST?
D0 C4	BNE 05	NO: CONTINUE PLAYING
A9 02	LDA #02	YES: SILENCE PA OUTPUT
8D 12 02	STA 0212	
D0 BD	BNE 05	UNCONDITIONAL JMP(continue)

NOTES ON USING KLUGE HARP LOADER

1. LOAD NOTES USING KEYS A-G.
2. LOAD TIME VALUES W/ FOLLOWING KEYS:

WHOLE - 1	EIGHTH - 8	
HALF - 2	SIXTEENTH - 6	TRIPLAT - 3
QUARTER - 4	REST - R	
3. TO SHARPEN A NOTE, SHIFT IT.
4. TO EXTEND A TIME VALUE BY 1/2 (DOT IT), SHIFT IT.
5. STEP FORWARD W/ → KEY, BACKSTEP W/ ←
(IF YOUR KB LACKS THESE KEYS, ANY KEYS WILL DO)
6. FOR HIGH OCTAVE, HIT THE 'H' KEY BEFORE NOTE KEY.
7. TO ENTER ODD VALUES, I.E.: A NOTE OUTSIDE 2 OCTAVES,
A HALF NOTE TIED TO A DOTTED HALF ETC.
USE THE 'D' KEY. THE FOLLOWING TWO KEY
ENTRIES LOAD AS A BYTE INTO OPEN LOCATION.

Here's a POWER ON RESET CIRCUIT for KIM from Leonard Crane,
FORETHOUGHT PRODUCTS, P.O. Box 386, Coburg, Ore, 97401



C1- 1uf. @15v.
R1- 2.2K ohm
R2- 2.2K ohm
Q1- 2N2222 (or equiv.)

KIM Program: DICKY Jan/77 Jim Butterfield, Toronto

This program rolls dice. Quietly. If you have an urge to play a dice game like Yahtzee at 3 a.m. you won't wake the household. You can specify how many dice in COUNT, address 029E; from one to six - five are used in the program listing.

To roll all dice, hit GO. To roll selected dice only, hit keys 1 to 6 to indicate which ones you want, then hit GO. Many games need this kind of selective roll: Yahtzee, Poker Dice, Ship/Captain/Crew.

Ship/Captain/Crew, for example, allows you three rolls per play, using five dice. A six is your ship; if you don't have one, you must roll all dice again. Once you have a ship, look for a five, which is your captain; if you don't have him, roll everything except the ship. When you have both ship and captain the total of the remaining dice is your crew, which is your score. You may try to improve your crew if you have any rolls left.

0200 D8	START	CLD	
0201 20 40 1F		JSR KEYIN	directional register
0204 20 6A 1F		JSR GETKEY	test key input
0207 AE 9E 02		LIX COUNT	how many dice?
020A CA		DEX	minus one for loop counter
020E 86 90		STI CNT	
020D C9 13		CMP #13	GO key?
020F D0 30		BNE NOGO	no, skip Roll procedure
0211 B5 A0	VUE	LDA FLAG,X	yes, test ...
0213 D0 0A		BNE RUN	any dice rolling?
0215 CA		DEX	
0216 10 F9		BPL VUE	
0218 A6 90		LIX CNT	
021A F6 A0	VEX	INC FLAG,X	no; roll 'em all
021C CA		DEX	
021D 10 FB		BPL VEX	
021F A4 90	RUN	LDI CNT	random values for each die
0221 38	ROLL	SEC	..whether used or not
0222 A5 97		LDA RND+1	
0224 65 9A		ADC RND+4	
0226 65 9B		ADC RND+5	
0228 85 96		STA RND	new random value
022A A2 04		LDX #4	
022C B5 96	RIP	LDA RND,X	
022E 95 97		STA RND+1,X	
0230 CA		DEX	
0231 10 F9		BPL RIP	
0233 29 07		AND #307	change these lines...
0235 C9 06		CMP #6	.. for n-sided dice
0237 B0 E8		BCS ROLL	reject this number?
0239 99 A6 00		STA NUMB,X	store new roll
023C 88		DEX	
023D 10 E2		BPL ROLL	
023F 30 45		BMI PLACE	
0241 AA CA	NOGO	TAX DEX	test input key
0243 5C 9E 02		CPI COUNT	legal?
0246 B0 04		BCS NOKEY	no, ignore
0248 A9 01		LDA #1	set "roll" flag
024A 95 A0		STA FLAG,X	
024C A9 7F	NOKEY	LDA #7F	open display
024E 8D 41 17		STA SADD	
0251 A2 05		LDX #5	six digits
0253 A9 00		LDA #0	blank unwanted dice
0255 A0 13		LDY #13	right-hand digit
0257 EC 9E 02	LITE	CPI COUNT	stay blank?
025A B0 08		BCS DARK	yes, skip next part
025C B5 A0		LDA FLAG,X	
025E F0 02		BEQ PLITE	
0260 F6 AC		INC WINDOW,X	roll display

```

0262 B5 AC FLITE LDA WINDOW,X
0264 8D 40 17 DARK STA SAD
0267 8C 42 17 STY SBD
026A C6 91 STALL DEC ZIP
026C D0 FC BNE STALL
026E 88 88 CA DEY DEY DEY
0271 10 E4 BPL LITE
0273 A5 92 LDA TIMER are we rolling?
0275 F0 89 BEQ START no, test keys
0277 C6 92 DEC TIMER time out the roll
0279 D0 D1 BNE NOKEY not time yet?
027B A6 93 LDX DIE which die stops?
027D B4 A6 LDY NUMB,X what number is rolled?
027F B9 E8 1F LDA TABLE+1,X change to segments
0282 95 AC STA WINDOW,X and put into display window
0284 D6 A0 WIPE DEC FLAG,X clear flag
0286 D0 FC BNE WIPE ..for sure
0288 A2 00 PLACE LIX #0
028A B5 A0 PLAY LDA FLAG,X search for..
028C D0 08 BNE NEXT ..next rolling die
028E E8 INX
028F EC 9E 02 CPI COUNT
0292 D0 F6 BNE PLAY
0294 F0 B6 BEQ NOKEY none rolling; quit
0296 A9 50 NEXT LDA #50 timing
0298 85 92 STA TIMER
029A 86 93 STX DIE record next roller
029C D0 A8 BNE NOKEY and keep going
029E 05 COUNT .BYTE 5 5 dice

```

TEASER (Shooting Stars) - Jumbo version Jim Butterfield, Toronto

Same rules as for Bob Albrecht's original Teaser; but with a random starting pattern. The object is to invert the starting pattern; so if the board starts out with all nine positions lit, your mission is to turn them all off. If you happen to start with only one position lit, you must try to light all the others.

```

1 2 3
4 5 6
7 8 9

```

When you accomplish this, the display will signal that you've won. Pressing GO will then give you a new, random, game. If you press GO before you've won, it will take you back to the start of the game you were doing.

Identity of the various positions is shown in the chart at upper right. The usual rules apply: you can select only lit positions, and they will invert all segments in their field of influence. For example, position 5 inverts 2, 4, 5, 6, and 8; position 2 inverts only 1, 2, and 3.

If you want to play a particular board, you can set it up in "segment" form in locations BORD to BORD+2 (addresses 0080 to 0082) and then start the program at BEGIN, location 0217.

```

0200 E6 83 START INC SEED scramble random number
0202 20 40 1F JSR KEYIN ..while GO key is down
0205 D0 F9 BNE START
0207 A2 02 LIX #2 for each digit position..
0209 A5 83 LDA SEED set random..
020B 48 IP1 PHA
020C 29 49 AND #49 ..horizontal segments
020E 95 80 STA BORD,X ..into board
0210 68 PLA
0211 4A LSR A recall random number
0212 09 80 ORA #80 and shift
0214 CA DEY setting bit 7
0215 10 F4 BPL IP1

```

17

more
TENSER

```

; enter here if BORD is pre-set
0217 A9 06 BEGIN LDA #6
0219 85 84 STA WINDOW create a frame
021E A9 30 LDA #30 for the board
021D 85 88 STA WINDOW+4
021F A5 84 GO LDA WINDOW has this game been won?
0221 C9 06 CMP #6
0223 D0 DD BNE START yes, make new board
0225 A2 02 LDX #2 no, copy board into window
0227 B5 80 LPS LDA BORD,X
0229 95 85 STA WINDOW+1,X
022B CA DEX
022C 10 F9 BPL LPS
022E A0 11 TOP LDY #11 initial digit pointer
0230 A2 04 LDX #4 five digits
0232 A9 7F LDA #7F directional register
0234 8D 41 17 STA PAD
0237 B5 84 LITE LDA WINDOW,X
0239 8C 42 17 STY SBD
023C 8D 40 17 STA SAD
023F A9 7F LDA #7F delay
0241 E9 01 ZIP SEC #1
0243 D0 FC PNE ZIP
0245 8D 42 17 STA SPD store zero to clear display
0246 88 88 DEY DEY set up next ..
024A CA DEX .. display position
024F 10 EA BPL LITE
024D 20 40 1F JSR KEYIN set directnl reg to input
0250 D8 CLD
0251 20 6A 1F JSR GETKEY key depressed?
0254 C9 13 CMP #13 GO key?
0256 F0 C7 BEQ GO yes, do GO procedure
0258 C9 0A CMP #10A no key or greater than 9?
025A B0 D2 PCS TOP yes, return to display
025C AA CA TAX DEX set X=key - 1
025E 30 CE BMI TOP zero key? skip.
0260 B5 89 STX TEMP = value 0 to 8
0262 A0 03 LDY #3
0264 88 KEY DEY divide X by 3 to give:
0265 CA CA CA DEX DEX DEX
0268 10 FA BPL KEY
026A B9 9E 02 LDA MASK,Y ..segment ID in Y
026D 35 88 AND WINDOW+4,X ..digit ID in X (negtv)
026F F0 BD BEQ TOP illegal move - return
0271 A5 89 LDA TEMP Ready to make move:
0273 0A ASL A Multiply (key-1) by 3
0274 65 89 ADC TEMP to set Move Table pointer
0276 A8 TAY into register Y
0277 A9 49 LDA #49 Set up flag for win test
0279 B5 89 STA TEMP
027B A2 02 LDX #2 Make move by..
027D B5 85 CRN LDA WINDOW+1,X
027F 59 A1 02 EOR TABL,Y ..EOR'ing move table
0282 95 85 STA WINDOW+1,X ..into display
0284 55 80 EOR BORD,X
0286 25 89 AND TEMP Update win-test flag
0288 05 89 STA TEMP
028A C8 CA INY DEX on to the next digit
028C 10 EF BPL CRN
028E A5 89 LDA TEMP Now test for win
0290 C9 49 CMP # 49 all segments OK?
0292 D0 9A BNE TOP nope, return
0294 05 84 ORA WINDOW Add win signal to display
0296 85 84 STA WINDOW
0298 A9 79 LDA #79
029A B5 88 STA WINDOW+4
029C D0 90 BNE TOP
029E 08 40 01 MASK .BYTE 8,40,1
02A1 00 41 41 01 01 01 41 41 00 TABL .BYTE 0,41,41,1,1,1,41,41,0,0,0,49
02AA 00 00 49 40 49 40 49 00 00 40,49,40,49,0,0,0,46,48,
02B3 00 48 48 08 08 08 48 48 00 8,8,8,48,48,0
02BC end

```

Notes on Jumbo TEASER (Shooting Stars)

18

Bored by regular TEASER, now that you've figured out the moves? Jumbo TEASER gives you a new problem every time. And each problem is tough - maybe you've forgotten how hard the original game was until you memorized the solution.

Every position generated by the program is solvable, although some are devilishly hard to get. Make a note of the original board diagram - it's easy to forget - together with the desired winning pattern, like this:

```
Original board:  * * *      Win on:  * * *
                 * * .      * * *
                 * . *      * * .
```

The example above can be solved in five moves ... but you can poke around for hundreds of moves trying to find that combination!

To set up the original game of teaser, if you want it, the following coding will do:

```
(anywhere in memory)  A9 40      LEA #340
                      85 81      STA BORD+1
                      A9 00      LEA #0
                      85 80      STA BORD
                      85 82      STA BORD+2
                      4C 17 02    JMP BEGIN
```

If you locate the above coding at 0200 to 020C, the program will play only the "standard" game. Locate it elsewhere, and the first game will be standard; after that, anything goes!

For those who have forgotten the moves, here are the areas of influence for each key:

```
1 * . * 2 * . * 3 * . . * . * . . * . . . . .
* . . . . * . * 4 . . * 5 * . . 6 * . . . . * .
. . . . . . . . * . . * . . * 7 * . * 8 * . * 9
```

Here are some interesting comments from John Crossley...

"...I've been going to the Sacramento Microcomputer Users Group meetings for several months but last month I found at least four 6502 people. I told them about you and one told me that he has already sent in a subscription. It's nice not to be alone.

I sent away to the 6502 Program Exchange and got FOCAL-65 and a really nice disassembler. The disassembler is one of the slickest pieces of software that I've seen, well worth the 35\$. FOCAL-65 is an interesting language to use. The only problem is that the execution speed is slow. The June Kilobaud published a comparison of the speed of various BASICS and FOCAL was six times slower than the slowest. The nice features are the one dimensional arrays and the fact that the commands can be abbreviated to one letter.

I've got my KIMSI!! It came in the mail one day and was running the next. The reason that it wasn't running that night is the not-soldered joint. My only reservation is the way that they handle the I/O

ports. First they use F000-FFFF which means that I can't use the KIMATH without relocating the whole program. Secondly, since some S-100 I/O boards use the upper 8 bits of address, the KIMSI has 7 ports at F200, F400, ... ,FE00. It would seem more logical to put the I/O in page 21 or thereabouts and gating the lower 8 bits onto the upper 8. This way any I/O board would work and some use would be made of that hole in the KIM memory map. The KIMSI is still a very good deal and I recommend it to anyone interested in cheap, S-100 memory, I/O etc.

Included with the KIMSI was a note proposing KIMSI Notes. They hope to get enough material together about the KIMSI to fill a newsletter. I think that they should have given you a try and announced the new Notes after they had the material. Besides, they want another \$6.

While I was waiting for the KIMSI, I was using a nice 8k board hooked directly to the KIM. This requires no permanent change to either board.

1. Connect the KIM address bus to the S-100 bus.
2. Connect the KIM data bus to the S-100 data in and out bus.
3. Connect RAM R/W (EZ) to pin 8 on IC 78.
4. Connect R/W (EV) to S-100 pin 47.
5. Connect DECODE ENABLE (AK) to pin 5 on IC 75.
6. Remove IC 74 and bend pin 4 out. Replace it so that pin 4 doesn't touch anything.

I wired steps 3 and 5 through unused pins on the S-100 connector. It worked fine with 6 inches of ribbon cable. Perhaps I should mention the board I used. It was the LOGOS-1 from Advanced Microcomputer Products and cost \$219. When I got the KIMSI I removed the two jumpers and straightened the IC pin and it worked just fine...

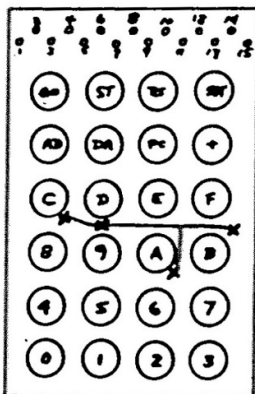
Here's a cure for a KIM problem you may not have even known about from George Wells and Alex Engel at Jet Propulsion Laboratory, 4800 Oak Grove Dr., Pasadena, CA 91103.....

A bug appears in the TTY software of both KIM and TIM which makes it difficult or impossible for either of these devices to receive TTY data at the maximum character rate for any baud rate other than 110 baud. For example, a paper tape loader running at 10 cps (110 baud) will load correctly into KIM but at 30 cps (300 baud) a cross assembler on another computer has trouble loading the op codes into KIM.

The problem stems from the fact that there are two stop bits required for each character at 110 baud but only one stop bit for all other baud rates; and KIM and TIM were both written with the assumption that there will always be two stop bits per character.

Take a look at the "GETCH" (Get Character) subroutine located at 1E5A in KIM and you will see that it calls the 1 bit delay subroutine (JSR DELAY) 9 times and the half-bit delay subroutine (JSR DEHALF) twice for a total of 10 bits of delay. At 110 baud, since there is an extra stop-bit, KIM has at least 9 milliseconds to process the character; but at any other baud rate, KIM has no margins and may eventually lose sync depending on the length of the message, the baud rate, the baud rate drift, the character rate, and other factors which commonly come under the classifications of "gremlins", "noise", or "bad days".

HAVING BOUNCY KEY PROBLEMS with your 'old' style keyboard? You'll be interested in this fixit from ROBERT DAHLSTROM, Harry Diamond Labs, 2800 Powder Mill Rd., Adelphi, MD 20783. This works!



KIM-1 KEYBOARD MODIFICATION

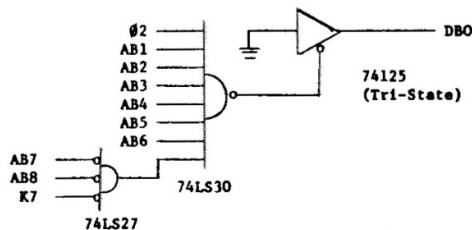
The keyboard on my KIM-1 had the "bouncy" key problem mentioned in User Notes #6. The problem is due to the use of the outer edge of the snap-action discs to jump over the center contact line on the keyboard pc. Since the discs are only held against the pc board with tape, the contact is poor. There are five of these jump-overs in series for the "C" key (four for the "9" key) thereby compounding the problem. To check for the problem, measure the resistance from keyboard pin 3 to pin 15 (numbered from left to right as shown) with the "C" key depressed. It should be less than about 10 ohms.

Fortunately, this problem can be easily corrected. My solution was to solder a thin wire jumper across these poor contacts as follows. Disassemble the keyboard by first removing the four screws on the back of the keyboard at the corners. Then remove the two remaining screws that hold the keyboard to the KIM-1 (note for reassembly that they are longer) being careful not to pull the keyboard pc board away from the KIM-1 board--it's only hanging by the solder at one end. With the KIM-1 up-side-down, separate the black keyboard panel from the keyboard pc board. (Mine snapped off suddenly when gently pried with my fingernail--then I picked up the keys from the floor). After cutting four small holes through the clear tape at the locations indicated by an X in the figure, the lines from "C" to "9", "D" to "9", "A" to "7" and the line to "B" are exposed. Connecting these points by soldering a thin wire between them routed as shown is sufficient to bridge the five potentially poor contacts. Good luck!

HERE'S AN IDEA FROM LEW EDWARDS (NJ)

A tip on using SST function to check out branches. Key FF into 00F1, then test all the BCS, BEQ, BMI & BVS branches. Next key in 00 and check out all the BCC, BNE, BPL & BVC branches. Seems obvious, but if you are like me it might not occur to you.

If this sounds like a familiar problem to you and you're not satisfied with changing the TTY DELAY values at addresses 17F2, 3 (see issue #6, page 8 and 11) try this solution. It would be nice to fix KIM by eliminating the offending JSR DEHALF at address 1E7E. But since we can't do that, we'll do the next best thing which is to change it from a JSR DEHALF to a JSR DEHALF-1 which gives an immediate return from the subroutine. Note that DEHALF is located at 1EEB and at DEHALF-1 (1EEA) there is an RTS from the end of the previous routine. All we need to do is add some hardware to KIM to decode the second byte of the JSR DEHALF instruction and jam the LSB of the data bus to zero at that time. We have used the following circuit to perform this fix.



As mentioned before, TIM has the same problem except that it has a total delay of 10 1/2 bits. However since we are unfamiliar with the operation of TIM we have not tried to fix it.

USER NOTES DEBUG SECTION

*****DEBUG*****DEBUG*****DEBUG*****DEBUG*****DEBUG*****DEBUG*****

Issue 7 & 8, page 16-----pin 14 of the 74193 counters should go ground rather than Vcc.

Issue 7 & 8, page 2-----column 2, line 37 should read "To do this, set \$039C to \$01".

*****DEBUG*****DEBUG*****DEBUG*****DEBUG*****DEBUG*****DEBUG*****

SOME CORRECTIONS FOR THE TVT-6 CIRCUIT

The first comment comes from David Byrd, State Tech. Inst., 5983 Macon Cove, Memphis Tenn 38134

We just interfaced one of PAIA Electronics' TVT-6 video display kits (upper case letters only) to a Kim. While following Popular Electronic's debugging instructions, we noticed that our video monitor was displaying letters which were not complete because they were crowded together. Signal tracing turned up the fact that the LOAD signal was okay but the CLOCK signal presented only 3 cycles per micro-second instead of the specified 6 cycles. I tried replacing C5 (2200 pF) in the clock circuit with a smaller cap. The display looked better but it still needed improvement. After some "cut and try" we ended up with a 390 pF cap and a perfect video display.

Anyone who runs into a similar problem with one of these video display units might want to take note of our experience.

Also from Cass Lewart (12 Georgian Dr., Holmdel, NJ 07733)
"...I have built Don Lancaster's TVT. It works perfectly except that I changed C5 to 62 pF and R11 to a 500 ohm pot. You may want to mention that we noticed a missing step in our program MINI DIS (First Book Of Kim). Step #364 should be 68 PIA.".....
Mr. Lewart also mentioned that he would be interested in setting up a program exchange for TVT programs. All you TVT-6 users should get in touch with him if you are interested.

From: Tim Bennett, 309 Mary St, Westerville, Ohio 43081

DOUBLE YOUR RAM. ADD 1 K, ON-BOARD, TO YOUR KIM-1.

All decoding and buffering is already available on your standard KIM-1 except that "K1" must be ORed with "KO" to enable inverter U16 pin 1. This requires 2 etch cuts, the addition of 2 diodes, 2 resistors, and a jumper along with 8 21L02 ram chips.

The 8 rams will be paralleled with your existing 6102 rams (U5-U12) except for pin 13 (Chip Enable). They could be soldered piggyback ~~directly to the~~ 6102's, however I was afraid this might cause overheating during operation. I chose to use sockets to lift my new rams from the existing to allow for air circulation. Normal chip DIP sockets are too bulky to permit soldering, thus Molex break-away connectors were used and they were perfect for this application.

Some special soldering techniques are required for a neat job on the RAMs. A 16 pin header or DIP socket (not the wire wrap kind) is used as a guide and holder for the molex connectors while soldering. Slip an 8 pin Molex section on each side of the socket with the break-away strip to the outside. Now tin each of the Molex pins with a little solder where contact will be made with existing RAMs, leaving a tail of solder on the outside of the pins.

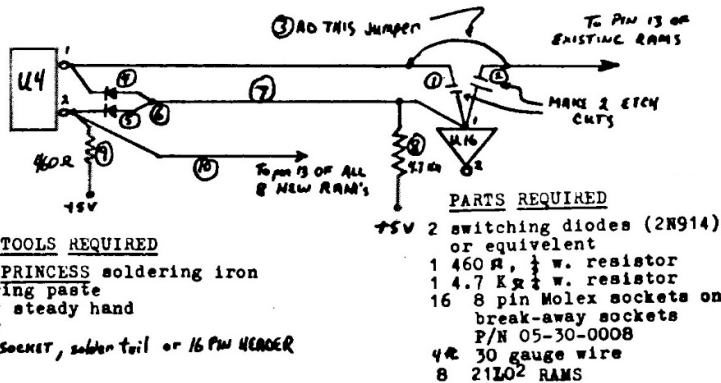
Dab a little soldering paste on each of the pins of the existing RAMs where contact will be made. Fit your socket assembly over an existing RAM. NOTE: don't solder pin 13 in the following step. If your assembly was properly prepared, a quick touch with an UNGAR PRINCESS iron will make a secure connection of each pin. Solder each pin (except pin 13) in this manner. Soldering will be easier if the chisel tip is bent to 45°. Carefully unplug the the guide and detach the break-away strips by twisting back and forth at the scribe mark. Insert a 21LO2 in your new socket keeping pin registration the same as the original 6102. Repeat this procedure for the remaining 7 RAMs. Verify that pin 13 of the 21LO2's do not make contact with the 6102's.

Now implement the following changes to your "chip select" logic:

1. Cut etch at pin 1 of U16 on component side of pcb.
2. Cut etch at pin 1 of U16 on back side of pcb.
3. Jumper pin 1 of U4 (K0) to pin 13 of U5.
4. Solder cathode (the end with the band) of one of your diodes to pin 1 of U4.
5. Solder cathode of other diode to pin 2 of U4.
6. Connect the anode end of the two diodes together.
7. Wire the anode end of the two diodes to pin 1 of U16
8. Connect a 4.7K Ω resistor from the anode of the diodes to a +5V etch.
9. Connect a 460 Ω resistor from pin 2 of U4 to +5V.
10. Jumper pin 2 of U4 (K1) to pin 13 of all 8 21LO2's
11. I brought +5V and GROUND in through both the application and the expansion connectors to carry the extra load.

The address of your second K of ram will be from 0400 to 07ff

I happen to have a supply of Molex strips. For a SASE and \$2.00 I'll send enough for this modification + a few extra. Mail to Tim Bennett, 309 Mary st. Westerville, Ohio 43081.



TOOLS REQUIRED

UNGAR PRINCESS soldering iron
Soldering paste
A very steady hand
Solder
1 DIP SOCKET, solder tail or 16 PIN HEADER

Some comments and corrections from John P. Oliver (Dept of Physics,
University of Florida, Gainesville, Florida 32611)

I have some comments and three corrections for my SUPERDUMP/LOAD routines published in Issue 7/8. a) Following the comment by James Davis in KUN #4, I have found that setting NPUL=\$03 and TIMG+1=\$02 greatly improves the reliability. I have had 100% success on Radio Shack SuperTape certified using Marchants routines from KUN#6. b) The program listing sent to you left out transmission of an EOT character. The instructions LDA #04, JSR OUTCHT should be inserted after the JSR OUTBT at \$016A. This insertion unfortunately changes all the subroutine entry addresses. I will send a complete corrected listing to anyone who sends me a stamped, legal sized envelope. Without the EOT, SUPERLOAD sometimes will not return until the recorder is manually stopped. c) Most users will have recognized that the opcode 60 should be entered at \$029D corresponding to the JSR instruction. My current version has the following code at the end: F0 04 BEQ EXIT This addition results in the error flag being returned C6 CB ERROR DEC LFLG in the accumulator as well as being left at LFLG. Please note. SUPERDUMP/LOAD do not save the A,X,Y registers A5 CB EXIT LDA LFLG and the user is responsible for being sure that his flank 60 RTS is protected. This is not the best programming practice but I was trying for minimum subroutine length. I now have these routines in a more proper form stored in a 2708 EPROM which I have mounted on the KIM-1 board. The address lines are paralleled with those of the 6102's, the data lines are paralleled with the DATAOUT lines of the 6102's. No buffering is needed. I had to replace the inverter in the RAM data buffer enable with a 4-input NAND gate combining X0,X1,X2,X3. I have also 'piggy backed' a set of 2102's on top of the 6102's, daisy chaining the CE's to K1, paralleling all other leads. I am trying to write a short article on this and other modifications I have used on our KIM's to give us KIM-E's (KIM Enhanced). I am not prepared to enter into correspondence on these changes at this time as I am trying to get ready for a 3 month visit to Warsaw for research. I am enclosing listings of START/STOP/WAIT which operate a high current, transistor driven relay in the recorder to start and stop it under program control. WAIT gives a 0.50 second delay which is adequate for my recorder. I only switch the motor power, leaving the electronics on, otherwise more than one second was needed at startup while capacitors charged in the amplifier. Finally, BEEP operates a loudspeaker driven from bit 4 of PED. Entered with \$00 in the A reg. one gets a sliding tone similar to that used for Phaser operation in the APPLE II Star Trek, with \$FF one gets an opposite slide.

;BEEP ROUTINES FOR SPICA2

LOC	OP	DPND	VALU	STMT	SOURCE	STMT
				0002	NAM ;BEEP ROUTINES FOR SPICA2	
				0003	; **** SUPER BEEP ROUTINE ****	
				0004	; '0' IN ACC GIVES 'PHASER', 'FF' IN ACC GIVES BEEP	
			1702	PBD EQU \$1702	;DATA REGISTER B	
			1703	PBDD EQU \$1703	;DATA DIRECTION REGISTER B	
			00FD	TMPX EQU \$00FD	;USED FOR TEMP STORE OF ACC	
			0000	ORG \$1200		
1200			00FD	BEEP STA TMPX	;SAVE ACC	
1201			0010	TXA	;SAVE X	
1202	25	FD	0011	PHA		
1203	48		0012	TYA	;SAVE Y	
1204	9F		0013	PHA		
1205	48		0014	LDA #0	;SET UP OUTPUT PORT ...	
1206	A9 10	0010	0015	CEA PBDD	... WITHOUT CHANGING ...	
1208	00 0317	1703	0016	STA PBDD	... OTHER LINES	
1209	AD 00	0000	0017	LDY #000		
1210	98		0018	BEEP1 TYA		
1211	AA		0019	TAX		
1212	24 FD	00FD	0020	BIT TMPX	; 'FF'?	
1214	30 05	121B	0021	BMI BEEP3	; YES	
1216	E8		0022	INX		
1217	D0 FD	1216	0023	BNE BEEP2		
1219	F0 03	121E	0024	BEQ BEEP4		
121B	CA		0025	DEX		
121C	D0 FD	121B	0026	BNE BEEP3		
121E	AD 0217	1702	0027	LDA PBD	; INVERT OUTPUT BIT	
1221	A9 10	0010	0028	ECR #0		
1223	80 0217	1702	0029	STA PBD		
1226	8E		0030	CFY		
1227	D0 E7	1210	0031	BNE BEEP1		
1229	EA		0032	PLA		
122A	A9		0033	TAY	;RESTORE Y	
122D	EA		0034	PLA		
122E	AA		0035	TAX	;RESTORE X	
122F	A5 FD	00FD	0036	LDA TMPX		
	60		0037	RTS	;RETURN	

START/STOP/WAIT ROUTINE

LOC	OP	OPND	VALU	STMT	SOURCE	STMT
				0002	NAME	START/STOP/WAIT ROUTINE
				0003	ROUTINES	FOR MAG TAPE ****
		1702		0004	PEO	EQU \$1702
		1703		0005	PDD	EQU \$1703
		0000		0006	DPG	\$11C0
11C0				0007	START	
11C1	48			0008	PHA	SAVE ACC
11C2	AD 0717	1703		0009	LDA PDD	SET UP OUTPUT FOR ...
11C3	09 20	0020		0010	ORA #520	... MAG TAPE CONTROL
11C4	9D 0717	1703		0011	STA PDD	
11C5	AD 0217	1702		0012	LDA PDD	PUT '0' ON PORT ...
11C6	29 DF	00DF		0013	AND #0F	... WITHOUT CHANGING ...
11C7	AD 0217	1702		0014	STA PDD	... OTHER LINES
11D1	68			0015	PLA	RESTORE ACC
11D2	70 0C	11F0		0016	BNE WAIT	WAIT 0.500 SECONDS
11D4	F0 0A	11E0		0017	BFD WAIT	
11D6	48			0018	STOP	SAVE ACC
11D7	AD 0217	1702		0019	LDA PDD	PUT '1' ON PORT ...
11D8	09 20	0020		0020	ORA #520	... WITHOUT CHANGING ...
11D9	9D 0217	1702		0021	STA PDD	... OTHER LINES
11E0	68			0022	FLA	SAVE ACC
11E1	8A			0023	PHA	SAVE X
11E2	48			0024	TXA	SAVE Y
11E3	9E			0025	PHA	
11E4	48			0026	TXA	
11E5	A0 C9	00C9		0027	LDY #5CB	WAIT 195 *255 LOOPS
11E7	A2 00	0000		0028	LDX #500	
11E9	2A			0029	RCL	
11EA	2A			0030	RCL	
11EB	2A			0031	RCL	
11EC	CA			0032	DEX	
11ED	D0 FA	11F9		0033	BNE WAIT1	
11EF	88			0034	BNF WAIT1	
11F0	D0 F7	11F9		0035	PLA	
11F2	68			0036	TXA	RESTORE Y
11F3	A0			0037	PLA	
11F4	68			0038	TXA	RESTORE X
11F5	AA			0039	FLA	RESTORE ACC
11F6	68			0040	RTS	RETURN
11F7	60			0041		

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