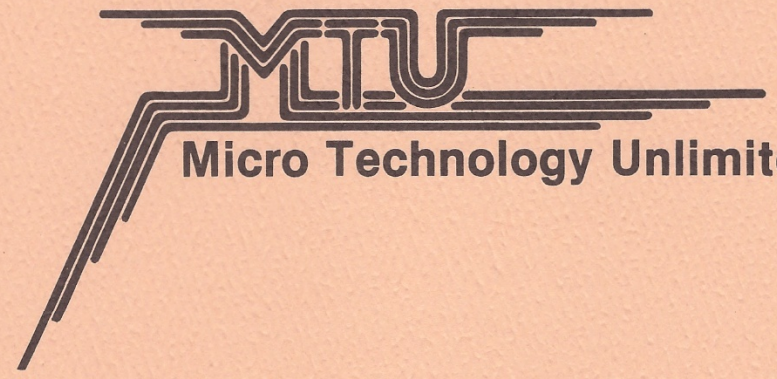

Micro Technology Unlimited

K-1005 CARD FILE AND 5 SLOT MOTHERBOARD FOR EXPANSION OF 6502 BASED MICROCOMPUTERS USING THE KIM/MTU BUS

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Micro Technology Unlimited
841 Galaxy Way
PO Box 4596
Manchester, NH 03108

INSTALLATION

Currently the K-1005 motherboard comes in four versions for the four different processors it supports. Although electrical differences are small, it is very important that the PET version (K-1005A-P) not be used with other processors. Plugging in a KIM, SYM, or AIM board can lead to damage. Mechanical differences are more substantial. The following paragraphs describe how each processor should be installed and wired to the power supply.

KIM-1

First unpack the K-1005-K and verify that you have received the correct version. There should be an assembled motherboard with 5 edge connectors mounted "inside" the large rectangular cutout at the back left of the U-shaped metal frame. There should also be a sixth edge connector mounted at the top of the other large cutout with three small guage wires connecting it to the motherboard.

First remove the long L-shaped mounting bracket. With the three mounting screws supplied, mount the bracket to the bottom of the KIM board so that the corner of the L wraps around the corner of the KIM where the keyboard is located. Standoffs pressed into the bracket should keep any printed circuit traces from touching the bracket but it is wise to check this possibility anyway. Do not tighten the screws yet.

Next carefully plug the KIM into the two sockets at the top of the card file. If may be necessary to stand it upright on a folded towel to overcome the spring tension of the socket contacts. Be careful not to bend the connector contacts on the back side. After verifying that the KIM is plugged in straight and fully seated, attach the mounting bracket to the card file frame with the three screws supplied. Tighten these first and then tighten the screws installed earlier which mount the KIM. At this point the KIM is mounted and the keyboard should feel solid to the touch.

The final task is to connect the power supply to the terminal strip. At bare minimum the KIM needs +5 volts at a little over 1.0 amp to power it. Operation of the audio cassette interface requires 100MA of +12 volts as well. Operation of most MTU expansion boards needs unregulated +8 and +16 to be connected to the terminal strip. All of these requirements may be met by the K-1000 power supply. Carefully examine the motherboard etch around the terminal strip to identify the connections (they are in the same order as the K-1000 terminal strip and the +12 connection is not identified). Keep the wires short and use the largest practical wire size. In particular, the ground wire should be #14 or #16 especially if one of the MTU K-1002 series audio DAC's or ADC's will be used.

It is best to try the system first with just the KIM-1 in place. In order to do this, ground K on the application connector and turn on the power. The KIM should function normally. If it does not, carefully inspect the motherboard for shorts between bus lines, shorts to the ground plane, or bent connector pins shorting to ground or each other. If all is well at this point, TURN THE POWER OFF, remove the ground on A-K and plug in an MTU or equivalent expansion board. All MTU bus interface boards generate DECODE ENABLE and VECTOR FETCH for the KIM so that full address decoding is implemented. At this point the manual for the particular board should be consulted for the checkout procedure.

KIM-1 con't

In the KIM version of the K-1005, +5 volt power is supplied through pin 21 on the expansion connector instead of pin A on the application connector. Ground is likewise connected to the KIM through expansion pin 22 instead of application pin 1. +12 volt power is run from the motherboard through one of the wires to pin N on the application connector. The other two wires route VECTOR FETCH from the motherboard pin 19 to K7 (application pin J) and DECODE ENABLE (motherboard pin 20) to application pin K.

SYM-1

First unpack the K-1005-S and verify that you have received the correct version. There should be an assembled motherboard with 5 edge connectors mounted "inside" the large rectangular cutout at the back left of the U-shaped metal frame.

Next remove the long L-shaped mounting bracket. Mount two of the stick-on rubber feet (supplied with your SYM-1) to the backside of the SYM close to the two large holes at the corner of the board opposite the edge with the three sets of edge fingers. With the two mounting screws supplied, mount the long bracket to the bottom of the SYM board so that the corner of the L wraps around the corner closest to the AA connector. The rubber feet mounted earlier should serve to separate the board from the bracket and thus prevent shorts. Do not tighten the screws yet.

If the AA connector is to be used take a low profile 22/44 pin edge finger connector and cut all of the pins to 1/16 inch (cut just above the retaining dimple). Make the needed connections between this socket and the user's peripheral device using small guage insulated wire such as #30 wire-wrap wire. Plug this socket onto the SYM's AA connector and route its cable close to the edge of the board and through the card file cutout.

Next carefully plug the SYM into the "expansion" edge connector at the top of the motherboard. It may be necessary to stand it upright on a folded towel to overcome the spring tension of the connector contacts. BE CAREFUL NOT TO BEND THE CONNECTOR PINS STICKING OUT THE BACK SIDE. After verifying that the SYM is plugged in straight and fully seated, attach the mounting bracket to the card file frame with the two screws supplied. Tighten these first and then tighten the screws installed earlier. Do not tighten the SYM board screws too much or the board will warp from pressure against the rubber feet. At this point the SYM is mounted and the keyboard should feel solid to the touch.

The final task is to connect the power supply to the terminal strip. Note that power connections are made to the terminal strip on the K-1005 rather than to the small power connector edge fingers on the SYM. For most applications the SYM only needs +5 volts at a little over 1.0 amp to power it. The + and -12 volt supplies are needed only for RS-232 operation of the serial interface. Operation of most MTU expansion boards needs unregulated +8 and +16 to be connected to the terminal strip. All of these requirements (except -12 volts) may be met by the K-1000 power supply. Carefully examine the motherboard etch around the terminal strip to identify the connections. The unidentified terminal (+12 volts) is not used. Keep the wires short and use the largest practical wire size. In particular, the ground wire should be #14 or #16 especially if one of the MTU K-1002 series audio DAC's or ADC's will be used.

SYM-1 con't

It is best to try the system first with just the SYM-1 in place. After applying power the SYM should function normally. If it does not, carefully inspect the motherboard for shorts between bus lines, shorts to the ground plane, or bent connector pins shorting to ground or to each other. If all is well at this point, remove power and plug in an MTU expansion board. At this point the manual for the particular board should be consulted for the checkout procedure.

On the K-1005-S, +5 volt power is supplied through pin 21 on the expansion connector instead of through the power connector. Ground is likewise connected to the SYM through expansion pin 22 instead of the power connector. If +12 and -12 volt power is needed, jumper wires can be added to the SYM to bring these points to pins 19 and 20 on the expansion edge fingers. The user can then connect the voltages to these pins on the motherboard which are isolated from the rest of the system. Although no cutout for the AA connector is provided, a low profile socket can be modified to fit between the SYM and the card file with enough clearance for a cable exit.

AIM-65

First unpack the K-1005-A and verify that you have received the correct version. There should be an assembled motherboard with 5 edge connectors; 4 mounted in the large rectangular cutout at the back left of the U-shaped metal frame and 1 connector (on motherboard) protruding up over the top of the card file. There should also be 2 keyboard support plates and mounting hardware.

First mount the two sloping keyboard support plates to the outside surfaces of the sides of the card file. The two support panels should be mounted so that the sloping keyboard mounting wings point to the left when facing the card file. The right plate (when motherboard on opposite side from you) has a notch in the bottom flange to allow it to mate with the card file "U" frame.

Next disconnect the keyboard from the AIM and mount it to the keyboard support panels with the two screws supplied. The threaded standoffs and rubber spacers on the mounting surfaces should provide a secure mount for a firm keyboard feel.

Now carefully plug the AIM into the socket at the top of the card file. The AIM should rest against two rubber spacers on the top surface of the card file. Secure the AIM in place to the two pressed in threaded standoffs on the keyboard plate top surfaces (2 screws supplied for this). Connect the keyboard to the AIM with the short ribbon cable supplied by Rockwell. At this point the AIM is mounted and the keyboard should feel solid to the touch. If the application connector on the AIM is to be used, we suggest using a single connector plugged onto the AIM or the MTU K-1005-AP application backplane with edge finger connectors and 24 pin sockets for mating with external device cables.

The final task is to connect the power supply. Note that power connections are made both to the terminal strip on the K-1005 and the terminal strip on the AIM. +24 volts, +12 volts, and -12 volts (+ and -12 volts are needed only for RS-232 serial interface operation) are connected to the AIM terminal strip that is behind the printer. Ground and +5 volts are connected to the K-1005 terminal strip. Operation of MTU expansion boards needs unregulated +8 and +16 to be connected to the K-1005 terminal strip as well. All of these requirements (except + and - 12 volts) may be met by the K-1000-5 power supply. Carefully examine the motherboard etch around the K-1005 terminal strip to identify the connections (the unidentified terminal is unused). Keep the wires short and use the largest practical wire size. In particular, the ground wire should be #14 or #16 especially if one of our K-1002 audio DAC's or ADC's will be used.

AIM-65 con't

It is best to try the system first with just the AIM-65 in place. After applying power the AIM should function normally. If it does not, carefully inspect the motherboard for shorts between bus lines, shorts to the ground plane, or bent connector pins shorting to ground or to each other. If all is well at this point, TURN OFF THE POWER and plug in an MTU expansion board. At this point the manual for the particular board should be consulted for the checkout procedure.

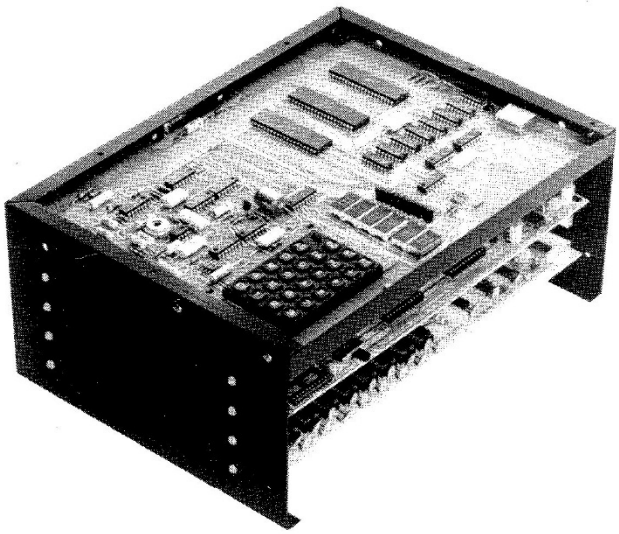
On the K-1005-A, +5 volt power is supplied through pin 21 on the expansion connector instead of through the AIM terminal strip. Ground is likewise connected to the AIM through expansion pin 22 instead of the AIM terminal strip. Plus 24 volts for the printer however is routed through the AIM terminal strip. If +12 and -12 volt power is needed for RS-232 operation, they are connected to the AIM terminal strip as well.

PET-2001

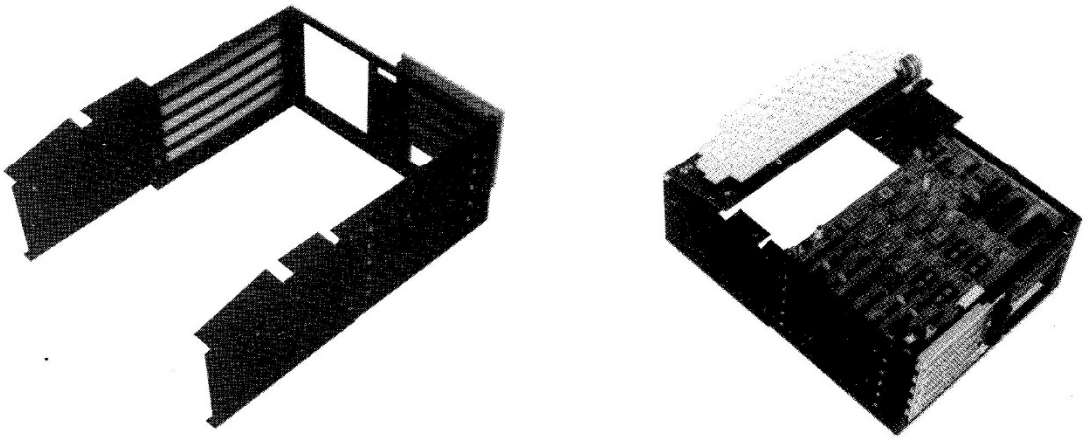
Use of the K-1005 is extremely simple with the PET. First unpack the K-1005-P and verify that you have received the correct version. There should be an assembled motherboard with 5 edge connectors mounted entirely within the large rectangular cutout at the back left of the U-shaped metal frame. The other cutout should be empty. There should be 5 jumper wires on the back of the motherboard from the top connector to the second down connector (see # on pin list). The K-1007-1 or K-1008-6 boards provide all of the power needed for up to 4 expansion boards plugged in. The terminal strip is not present on the motherboard of this model as it is not necessary.

It is best to try the system first with just the K-1007-1 or K-1008-6 in place. In order to do this, just plug the K-1007-1 into one of the slots (they are all equivalent) although the top slot affords the easiest access to the display selection switch on the K-1007-1. After PET power is turned on the PET should function normally. If it does not, TURN OFF THE PET POWER and carefully inspect the motherboard for shorts between bus lines, shorts to the ground plane, or bent connector pins shorting to ground or to each other. If all is well, TURN OFF THE PET POWER and plug in an MTU expansion board. At this point the manual for the particular board should be consulted for the checkout procedure.

On the K-1005-P, connections are established to the CPU (top) slot for +8 and +16 unregulated power, and the three video signals. From the point of view of all MTU boards, all 5 of the slots are identical. Please note that the K-1005-P cannot be used to hold a KIM, SYM, or AIM processor because of the +8 and +16 volt power is wired to the CPU slot. In order to use one of these processors, the 5 jumper wires on the back of the motherboard will have to be removed.



ASSEMBLED K-1005-K WITH KIM-1 (K-1005-S SAME APPEARANCE)



ASSEMBLED K-1005-A WITH AIM-65

BUS STANDARD PIN CONNECTIONS

PIN	KIM-1	SYM-1	AIM-65			MTU
E-1	SYNC	SYNC	SYNC			SYNC
E-2	RDY	RDY	RDY	*	#	VM VIDEO
E-3	PHASE 1	PHASE 1	PHASE 1	*		(not assigned)
E-4	IRQ	IRQ	IRQ			IRQ
E-5	SET OVERFLOW	SET OVERFLOW	SET OVERFLOW			SET OVERFLOW
E-6	NMI	NMI	NMI			NMI
E-7	RESET	RESET	RESET			RESET
E-8	DATA BUS 7	DATA BUS 7	DATA BUS 7			DATA BUS 7
E-9	DATA BUS 6	DATA BUS 6	DATA BUS 6			DATA BUS 6
E-10	DATA BUS 5	DATA BUS 5	DATA BUS 5			DATA BUS 5
E-11	DATA BUS 4	DATA BUS 4	DATA BUS 4			DATA BUS 4
E-12	DATA BUS 3	DATA BUS 3	DATA BUS 3			DATA BUS 3
E-13	DATA BUS 2	DATA BUS 2	DATA BUS 2			DATA BUS 2
E-14	DATA BUS 1	DATA BUS 1	DATA BUS 1			DATA BUS 1
E-15	DATA BUS 0	DATA BUS 0	DATA BUS 0			DATA BUS 0
E-16	K6	30	-12 VOLTS REG.	*	#	VM HORIZ SYNC
E-17	SINGLE STEP OUT	DB OUT	+12 VOLTS REG.	*	#	VM VERT SYNC
E-18	(N.C.)	POWER ON RESET	CS8	*	#	+7.5 UNREG
E-19	(N.C.)	(N.C.)	CS9	*		VECTOR FETCH
E-20	(N.C.)	(N.C.)	CSA	*		DECODE ENABLE
E-21	+5 VOLT REG.	+5 VOLT REG.	+5 VOLT REG.			+5 VOLT REG.
E-22	GROUND	GROUND	GROUND			GROUND
E-A	ADDR BUS 0	ADDR BUS 0	ADDR BUS 0			ADDR BUS 0
E-B	ADDR BUS 1	ADDR BUS 1	ADDR BUS 1			ADDR BUS 1
E-C	ADDR BUS 2	ADDR BUS 2	ADDR BUS 2			ADDR BUS 2
E-D	ADDR BUS 3	ADDR BUS 3	ADDR BUS 3			ADDR BUS 3
E-E	ADDR BUS 4	ADDR BUS 4	ADDR BUS 4			ADDR BUS 4
E-F	ADDR BUS 5	ADDR BUS 5	ADDR BUS 5			ADDR BUS 5
E-H	ADDR BUS 6	ADDR BUS 6	ADDR BUS 6			ADDR BUS 6
E-J	ADDR BUS 7	ADDR BUS 7	ADDR BUS 7			ADDR BUS 7
E-K	ADDR BUS 8	ADDR BUS 8	ADDR BUS 8			ADDR BUS 8
E-L	ADDR BUS 9	ADDR BUS 9	ADDR BUS 9			ADDR BUS 9
E-M	ADDR BUS 10	ADDR BUS 10	ADDR BUS 10			ADDR BUS 10
E-N	ADDR BUS 11	ADDR BUS 11	ADDR BUS 11			ADDR BUS 11
E-P	ADDR BUS 12	ADDR BUS 12	ADDR BUS 12			ADDR BUS 12
E-R	ADDR BUS 13	ADDR BUS 13	ADDR BUS 13			ADDR BUS 13
E-S	ADDR BUS 14	ADDR BUS 14	ADDR BUS 14			ADDR BUS 14
E-T	ADDR BUS 15	ADDR BUS 15	ADDR BUS 15			ADDR BUS 15
E-U	PHASE 2	PHASE 2	PHASE 2			PHASE 2
E-V	READ/WRITE	READ/WRITE	READ/WRITE			READ/WRITE
E-W	READ/WRITE	READ/WRITE	READ/WRITE			READ/WRITE
E-X	PLL TEST	AUDIO TEST	AUDIO TEST	*	#	+16 VOLT UNREG.
E-Y	PHASE 2	PHASE 2	PHASE 2			PHASE 2
E-Z	RAM R/W	RAM R/W	RAM R/W			RAM R/W

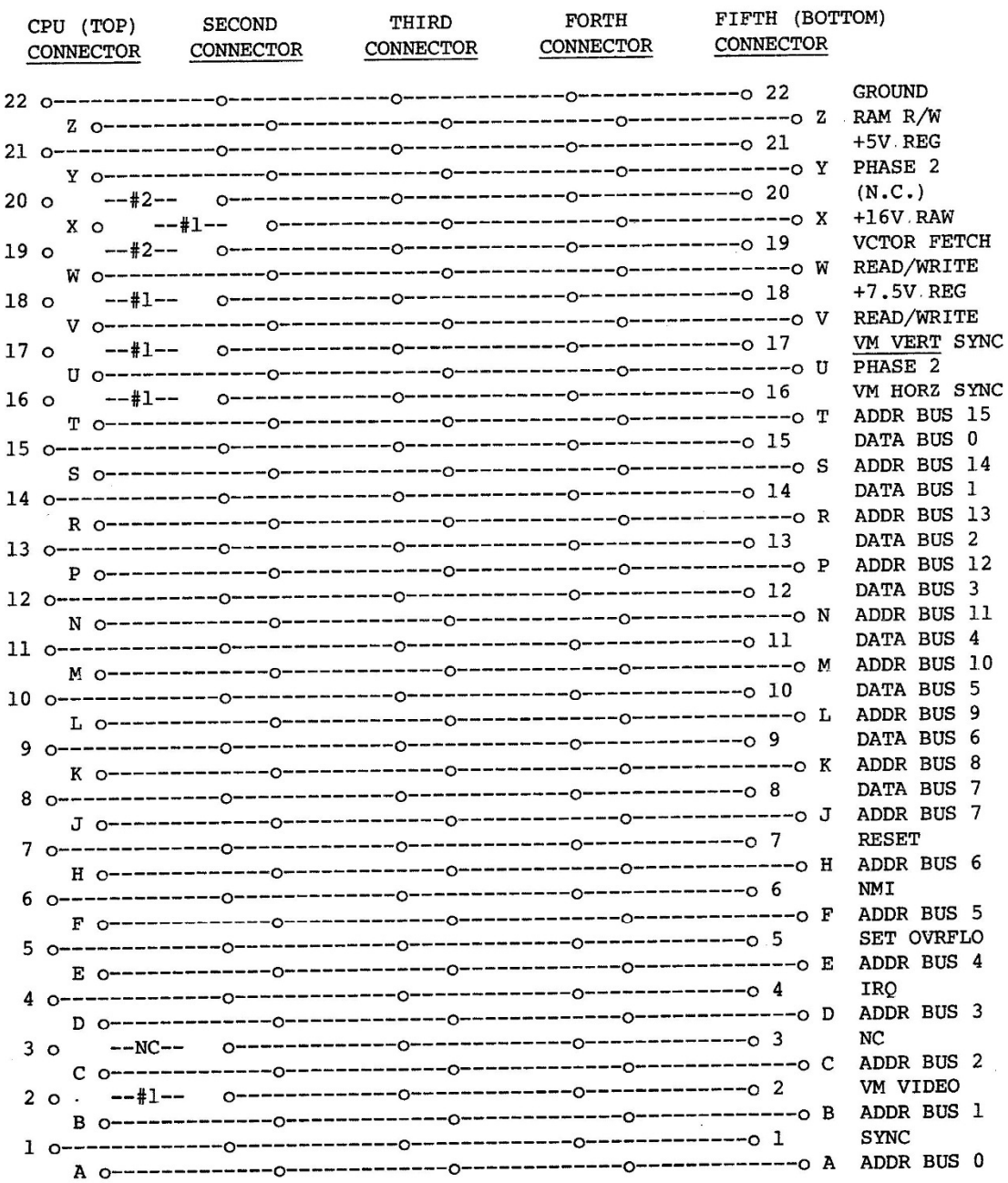
* These signals are NOT bussed to the CPU slot on newer verisons of the K-1005 motherboard.

\# These signals are bussed to the CPU slot on the K-1005-PET motherboard.

NOTE **********

DO NOT PLUG A KIM-1, AIM-65 or SYM-1 INTO A PET CARD FILE!!! THE +7.5 VOLTS AND +16 VOLTS UNREGULATED (PINS 18 and X) WILL DAMAGE THE PROCESSOR.

K-1005 MOTHERBOARD SCHEMATIC WIRING



NOTES :

#1 are wires placed on K-1005-P PET version only
#2 are wires placed on K-1005-K KIM version only
NC means no connect on any versions

PRINCIPLES OF OPERATION

Actually there is not much theory behind the operation of 5 edge connectors, 44 parallel wires and a terminal strip. What can be discussed however is the philosophy behind the K-1005 series of card files and its associated KIM/MTU bus. The Commodore KIM-1 single-board microcomputer was first released in 1976 and is the grandparent of the Synertek SYM-1 (formerly the VIM-1) and Rockwell AIM-65 microcomputers. Even the Commodore PET shows some KIM-1 influence. These processors cover the vast majority of 6502 based systems in use today and are the ones supported most vigorously by MTU.

WHY THE KIM BUS?

The original KIM-1 was a well thought-out product that hit on just the right tradeoff between system resources and selling price. Some amazing things have been done in its 1K memory such as the first generally available microcomputer chess program, the first 4 voice all software music synthesis program, Tiny BASIC, and others. However at some point every system needs to be expanded and the KIM and its relatives are no exception.

Commodore's answer for expansion was the KIM-4 expansion bus and KIM-3 memory board. Independent manufacturers introduced similar expansion bus boards while others offered expansion systems based on the Altair (S-100) bus. The S-100 bus adapters were more successful because there was a multitude of expansion boards from which to choose. One pitfall in the S-100 technique is that not all S-100 boards would work properly with 6502 timing signals. The main common fault with the mechanical implementation of these products is their open-air construction which offers little protection for the boards and eliminates portability.

MTU's first KIM expansion product was the K-1008 Visible Memory. The idea behind the VM was to have a board at the price of a plain 8K memory which would also show a high resolution video image. The goal was to capture both the KIM add-on memory and video display market with a single product. In deciding how it should connect to the KIM we had several factors to consider. First, it seemed like a poor idea to produce a board to plug into a bus (KIM-4) that few potential customers had. On the other hand an S-100 environment would have prohibited our use of 6502 timing properties to produce a totally transparent memory and snow-free display. In the final analysis it seemed desirable to produce a board that required no motherboard or bus at all to connect and thus be available at a much lower "installed" price. The logical conclusion was simply direct parallel connection to the KIM-1 Expansion connector!

The KIM BUS, which is the signals on the KIM's expansion edge connector, for the most part uses the actual signals from the 6502 microcomputer itself. Furthermore the SYM-1 and AIM-65 Expansion connector busses are for practical purposes identical to the KIM-1 bus. The combined number of these processors sold makes the KIM bus one of the most widely used and to date has suffered less from compatibility problems than any other multi-vendor personal computer bus structure.

We have since designed and manufactured 4 additional expansion boards that may be used alone in the same manner. In order to support those customers who wish to use several of our expansion boards, we designed the K-1005 motherboard/card file which is simply a convenient method of connecting several boards to the processor's expansion connector along with the necessary mechanical support provisions.

PLAIN OR BUFFERED?

Probably the most frequently asked question regarding the K-1005 is "Why is the bus not buffered?". The basic answer is that buffering is not needed for only 4 expansion boards. The next question then is "Why not buffer it anyway to reduce microprocessor loading, provide noise immunity, and improve signal rise times?". The answer to that is somewhat more technical but in a nutshell buffering has some of its own problems and it is not necessarily true that it improves system operating margins when the unbuffered equivalent does not violate any loading rules.

The KIM bus address and data lines are simply the corresponding microprocessor busses brought out to edge fingers. The various control signals (PHASE 2 and READ/WRITE) are indeed buffered by TTL gates on the processor board. The unbuffered address and data lines are rated by the microprocessor manufacturer to drive 1.7MA of DC loading and 170pF of capacitance. This figures out to 5 low power Schottky TTL (74LS series) inputs (MOS inputs such as to memory IC's have no DC load) and about 35 circuit connections at 5pF per connection. The processor board itself uses one low power schottky load and about a dozen connections (more connections on SYM and AIM processors). This leaves 4 low power shottky inputs and over a dozen connections for the external bus which is adequate for implementing a 4 slot expansion bus. This is the main reason the K-1005 has 5 slots including processor.

Probably the most misunderstood aspect of buffering is noise generation and immunity. In theory low impedance TTL or TRI-STATE bus drivers should be able to "short out" noise spikes much better than high impedance MOS outputs can. This may be true, but in practice TTL or high power TRI-STATE bus buffers generate so much noise when they switch that almost nothing can absorb it. The problem is most acute in large systems (such as minicomputers and S-100 computers) where as many as 24 buffers with 100MA surge capability and nanosecond rise times can switch simultaneously thus placing a 2.5 amp reaction current surge through the GROUND leads of the bus. It is not unusual to see over a half volt differential in GROUND voltages between driving and receiving boards in such a system. In practice such spikes interfere with the bus CONTROL signals which results in unpredictable occurances such as spurious writing into memory or falsely triggering an I/O device. Seldom are address and data bus signals themselves read wrong even though they cause the noise because they are ignored while changing (under the direction of control signals). indicate that all changing must have ended and the data be stable at it's "0" or "1" state. It is instructive to note that minicomputer busses (such as the DEC UNIBUS and the NOVA bus) specify the use of filter and delay circuits on control signal lines received by interface boards. In addition, these systems typically have multilayer backplanes with ground planes to shield and shunt noise.

With unbuffered MOS and low power (8 MA) 74LS TTL bus drivers, such noise is almost completely absent. The author has had considerable experience in designing and troubleshooting bus systems and the unbuffered KIM bus is among the quietest encountered. With respect to rise time, 8MA is sufficient to swing 170PF (which is actually a rather heavy bus load) from logic zero to one or vice-versa within 65NS which is quite adequate for 1MHz 6502 operation. Note that this time has already been factored into the 6502 timing specifications. Remember also that bus buffers do have their own propagation delay times.

PLAIN OR BUFFERED? con't

One other big problem with a bus buffer is deciding what addresses or "enabling signals" it should respond to. Ideally it should drive or receive data only when a board on the buffered bus responds to an address. Unfortunately microcomputer boards don't tell anyone when their address has been detected so buffered motherboard designers usually resort to a range of dedicated addresses which unconditionally activate the buffers. This action can cause problems with further system expansion.

In any bus system there is one potentially serious problem - electrical vulnerability. This means that if an "accident" on the bus occurs, such as application of negative or high positive voltages to a bus line, it can damage all components tied to that particular bus line. This usually occurs by unplugging or plugging in a board with the power on OR not fully decayed to zero. When this occurs, usually all board components tied to the line in question are damaged. Since the KIM-1, AIM-65 and SYM-1 processor boards do not have bus buffers, an "accident" will usually damage the processor, or memory IC's. Static electricity is not usually a problem with assembled IC's unless a strong spark actually jumps to a bus line. The general rules are to take your time when plugging/unplugging boards and to discharge yourself to the power supply before touching bus lines when the humidity is low.

IS FOUR BOARDS ADAQUATE?

We have found that for most of our customers the ideal expanded KIM, SYM, or AIM system would have less than 4 expansion boards. Four boards would give the user a K-1008 Visible Memory for display, a K-1016 16K RAM memory for data storage, a K-1012 PROM/IO board for instant startup and peripheral interfacing, and a K-1013-1 disk controller with 16K memory onboard for the operating system and additional memory. This collection of boards neatly fits the 4 slots.

If more expansion is needed, it may be accomplished by buffering the bus. One possibility is to use a K-1020 prototyping board and construct a bus buffer on it. We have done this at MTU for memory burnin racks where a bank switching technique is used to address up to 256K worth (16 K-1016's) of memory boards for testing. For those interested in the details of this technique, request application note AN-5, Bus Control and Expansion.

WHY LOCAL VOLTAGE REGULATION

Although the KIM/MTU bus has a line for regulated +5 volts, we recommend use of the unregulated +8 volt and +16 volt bus lines for expansion board power. This offers system power line noise isolation and less expensive central power supplies. It gives the board designer tightly regulated, noise-free power for the circuitry, one less thing to worry about while troubleshooting. Perhaps a disadvantage of local regulation is the additional heat dissipated on the logic board instead of in the power supply. Modern logic however requires very little power to run so both the logic and the regulator dissipation is quite low. In addition, distributed heat disipation does not require forced air cooling as a concentrated heat disipating power supply does (look at S-100 systems).

Occasionally a negative voltage is needed for a MOS or linear IC. If the power drain is small (50MA or less) a charge pump circuit can be used to generate an unregulated -10 volts from the +16 volt supply. The K-1008 or K-1016 manual can be consulted for a low power (5MA) charge pump and the K-1012 for a 50MA design.

KIM BUS -VS- KIM/MTU BUS

As the reader may have guessed, the bus implemented on the K-1005 motherboard is not strictly a KIM-1 bus. If it were, all 44 lines would be run strictly parallel up and down the board. The MTU modification amounts to assigning the top slot to the CPU (except for the PET version where all slots are equivalent) and not connecting some of the pins to the expansion bus below. This then frees up several lines on the expansion bus for other functions that do not relate to the CPU or computer bus operation.

Two of the pins are used to provide unregulated +8 and +16 volt power to the expansion boards, which the CPU's do not use. Two more pins are used for the DECODE ENABLE and VECTOR FETCH signals that KIM-1 systems require (unnecessary for AIM-65 and SYM-1). An additional three pins are used (in PET systems only) to carry separated Vertical, Horizontal and Video signals to a separate sync video monitor. Finally there is one spare set aside for future use. The following page lists the signals of each processor and those of the KIM/MTU bus used on the K-1005.

In providing these expansion bus signals, some signals from the CPU are not available on the bus. The most significant of these are READY and PHASE 1. PHASE 1 is equivalent to PHASE 2, the inverse of PHASE 2 which is available on the bus. Modern memories are fast enough so that wait states are not needed, thus the READY signal is of no use. Besides, the 6502 will not wait during a write cycle anyway.

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*********************************************************************************
*                                                                               *
*       NOTE  THAT ON THE  K-1005-PET CARD  FILE VERSION, UNREGULATED  POWER IS *
*   ROUTED  TO THE PROCESSOR TOP SLOT.   THIS WILL  DESTROY A KIM-1,  AIM-65 OR *
*   SYM-1 IF ONE OF THEM IS PLUGGED INTO A PET CARD FILE.  THIS IS WHY MTU HAND *
*   WIRES THE 5 PET ADDED WIRES (# INDICATORS ON FOLLOWING PAGE) TO  ALLOW EASY *
*   CONVERSION BY THE USER IF DESIRED.                                          *
*                                                                               *
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