SLICER

T.M.

SYSTEM EXPANSION BOARD

IMPORTANT !!!! READ THIS FIRST !!!!!

=====================================

On the first version of the SLICER SYSTEM EXPANSION BOARD there are some slight modifications which must be made to the circuit board. These affect the operation of the Real Time Clock and must be done before that circuit is installed.

Two traces which go to the READ and WRITE of the clock chip were accidentally reversed in the tape-up process. The correct wiring is shown on the schematic, page 4 of 4. In order to make this correction cut the following traces on the circuit board:

Cut trace from U53 pin 6 to U42 pin 17
Cut trace from U53 pin 8 to U42 pin 15

Then add the following jumpers:

Jumper from U53 pin 6 to U42 pin 15
Jumper from U53 pin 8 to U42 pin 17

In addition to these changes it is recommended that one additional change be made. This change reduces the loading on the DT/R signal and will also make your system compatible with upcoming SLICER products.

Cut trace leading to J1 pin 1 (EXP IN signal)

Jumper from J1 pin 1 to GROUND

Revision A boards will have these changes made permanently. We trust that these jumpers will not cause you any difficulty.

Thank-you,

SLICER COMPUTERS INC.

THE SLICER SYSTEM EXPANSION BOARD

Assembly Manual

2543 Marshall Str. N.E.

Minneapolis, MN 55418

(612) 788-9481

TABLE OF CONTENTS
===== == ========

EXPANSION BOARD ASSEMBLY INSTUCTIONS

Congratulations on your choice. The SLICER SYSTEM EXPANSION BOARD should prove a real plus to your already power-packed SLICER computer, after a short assembly time.

To begin, go over the parts in the kit and compare them with the items on the parts list. They should agree. Next, check the list of tools listed below against your stock pile. They are not all required but would make assembly easier in the long run.

Solder iron....25-40 watts with fine tip
Rosin core electronic solder
Volt\Ohm meter
Longnose pliers
Small screwdriver

Also useful:
A flat piece of soft 1" thick foam at least board size.
(This will be used to place under your board while inserting components. The leads simply penetrate the foam.

And:
A flat piece of wood, metal or other material at least as large as your SYSTEM EXPANSION BOARD. Place this on top of your "stuffed" board when you are ready to turn it over to solder.

Pay particular attention to notes. They point out the assembly difference between the EXPANSION FULL, PORT and MEMORY kits.

Bare Board Checkout

Begin your assembly with a careful visual inspection of your board. Look for shorts and broken traces, checking with the ohm meter when in doubt. If needed, consult the schematics to verify any connections. Once the visual check is complete, use the ohm meter to check that there are no shorts between the power input connections at the location for the power connector J14. Your first check with an ohm meter should be between J14 pin 2 and J14 pins 1,3 and 4. These should read open.

Diodes, Resistors

[] Insert diodes: 1N4148. OBSERVE POLARITY!
Locations: D1,D3 *EXPANSION and FULL kits only!

[] Insert zener: 1N4691. OBSERVE POLARITY!
Location: D2 *EXPANSION and FULL kits only!

[] Insert resistors: 33 ohms (orange, orange ,black)
Locations: R1,R8

[] Insert resistors: 22Ø ohms (red, red, brown)
Locations: R2, R3

[] Insert resistors: 1ØK ohms (brown, black, orange)
Locations: R4, R5, R13

[] Insert resistors: 4.7K ohms (yellow, violet, red)
Locations: R6, R7, R14, R15

[] Insert resistor: 22M ohms (red, red, blue)
Location: R9

[] Insert resistor: 47ØK ohms (yellow, violet, yellow)
Location: R1Ø

[] Insert resistor: 1K ohms (brown, black, red)
Location: R11

[] Insert resistors: 1ØØ ohms (brown, black, brown)
Locations: R12, R16

[] Solder and trim components

Sockets

When installing IC sockets, it is important to match the socket orientation with that of the circuit board silkscreen legend. It is also important to use good soldering techniques to avoid solder bridges and cold solder joints, both of which will provide headaches later. Try not to use too much or too little solder. If you are in doubt as to your ability to solder, please seek out a locate electronics guru or friend for some tips on the art.

If you ever find it necessary to remove a soldered socket, do not go to any great length to remove the socket undamaged. It is preferable to destroy the socket and not the board in the removal process.

[] Insert 14 pin sockets
Locations: U6, U7, U16, U19, U2Ø, U29, U3Ø, U31, U33, U44, U53, U54

[] Insert 16 pin sockets
Location: U18   *EXPANSION FULL,PORT and MEMORY!

Locations: U8...U15, U18, U21...U28, U34...U41, U34...U41, U45...U52
*For EXPANSION FULL and MEMORY kits only!

[] Insert 2Ø pin sockets
Locations: U1...U4, U43

[] Insert 24 pin socket
Location: U42

[] Insert 4Ø pin sockets
Locations:U5, U17

Location: U32   *EXPANSION FULL kits only!

Put the flat piece of material on top of the assembly to stop the sockets from falling out, turn the board over and solder the sockets.

[] Take a break. Fatigue causes errors.

Capacitors

[] Insert: .1Mfd cap (104)
Locations: C1, C3, C5...C9, C11, C12, C21, C30...C53, C55, C57, C59, C61, C63, C65, C67, C71, C73, C74, C79, C80, C81, C85, C87...C89

[] Insert: 10 Mfd tantalum cap (OBSERVE POLARITY !!!!)
Locations: C2, C4, C10, C54, C56, C58, C60, C62, C64, C66, C68

[] Insert: 220 pfd cap (221)
Locations: C13...C20, C22...C29, C75...C78, C82...C84, C86

[] Insert: trimmer cap
Location: C69

[] Insert: 20pfd cap
Location: C70

[] Insert: .005 Mfd cap
Location: C72

[] solder and trim components

Resistor Pack, Dip Switch, Crystal and Battery

[] Insert: 10 pin 1K resistor network
Location: RP1 (Make sure pin 1 in orientated properly in board)
NOTE:
This component may be replaced by discrete components. Nine 1K resistors each with one common end to pin 1 and the other end to each of the nine holes in the board.

[] Insert: 8 position dip switch
Location: SW1

[] Insert: 32.768Khz crystal
Location: xtal *EXPANSION FULL and PORT kits!

[] Insert: DS3SD Battery - note orientation.

[] Solder and trim components

[] Take a break!

Connectors, Jumpers

Varying numbers of dual headers have been supplied with your kit depending on the type. These headers may be cut to appropiate length with an Exacto knife. If errors are made cutting them, don't despair. Smaller pieces may be used to make up larger headers. Suggestion: You may want to solder these to the board as you insert them one by one.

[] Insert: J1, trim to 40 positions

[] Insert: J2, trim to 50 positions

[] Insert: J3, trim to 2 positions (single header)

[] Insert: J4, trim to 6 positions

[] Insert: J5, trim to 10 positions

[] Insert: J6, J7, J10, J11, trim to 26 positions
*EXPANSION PORT and FULL kits only!

[] Insert: J8, trim to 8 positions

[] Insert: J9, trim to 4 positions

[] Insert: J12, trim to 4 positions

[] Insert: J13, trim to 34 positions
*EXPANSION PORT and FULL kits only!

[] Insert: J14 Power connector

[] Insert: JB1...JB6, trim to 6 positions
*EXPANSION PORT and FULL kits only!

[] Insert: JB7...JB12, trim to 6 positions
*EXPANSION FULL kit only!

[] Insert: JX1, JX2, trim to 14 positions
*EXPANSION FULL kit only!

[] Solder

[] Go grab a cup of coffee!!!

==

STOP

==

DO NOT INSERT ANY COMPONENTS BEFORE PERFORMING THE FOLLOWING CHECKS ! ! ! ! !

Well rested? Then you are ready to start your initial check out.

Circuit Board Test With Power Supply

Begin by wiring the power supply according to manufacurer's recommemdations. Attach the correct power supply outputs to the screw terminal portion of J14 and unplug the connector from the board. The power inputs are marked on the silkscreen and are as follows from left to right:

-12 volts, ground, +5 volts, +12 volts

No other connection need to be made to J14 at this time.

You are now ready forthe smoke test. Recheck your power connections to insure they are correct. Plug your power supply into the wall outlet and measure the outputs with a volt meter. Note: If you are using a switching power supply the voltages may not regulate properly when they are under no load. In most cases a load is needed on the +5V output to make the supply regulate properly. This may be done by using a resistor (about 100 ohms) between +5V and ground.

Unplug your supply from the wall outlet and plug J14 into the circuit board. Be sure that you have aligned it properly. Now you are ready to apply power to the EXPANSION board. Plug the power supply back into the wall and verify the voltages once again on J14 to make sure there are no shorts on the board.

Note: Never poke an oscilloscope probe or similar device into an IC socket. It will destroy the sockets ability to make good contact with the IC. Unfortunately this type of problem usually won't manifest itself until a days work is about to be saved on disk.

With the ground lead of your volt meter on the ground terminal of J14, measure the DC voltages on the following sockets:

Socket U42 pin 24 should read approximately +5.1VDC

Socket U17 pin 40 should read +5VDC

Socket U6 pin 1 should read -12VDC

Socket U6 pin 14 should read +12VDC

IC Insertion

A major source of problems with sockets is bent IC legs. They are difficult to spot and often make initial contact only to fail at the most awkward moment, as mentioned above. To avoid this problem, make sure IC pins are aligned. Adjust them to proper spacing (ICs usually come with their pins spread apart). You may want to open up the contacts of the sockets: CAREFUL! Use only a tool like a needle with a diameter not larger than an IC leg. Push it into the contacts of the socket without overstressing them. This will also show you if there is too much solder in a contact. The socket has to be removed if that is the case. The plastic body of some types of sockets can be removed from the contacts. Then things are easy: Remove the contacts, individually, clean the holes and solder in a new socket.

Crunch the plastic body up if it does not come off. Remember, destroy the socket, not the board.

Insert the ICs gently. If it takes too much force you are probably bending something. Check what is going on, maybe a contact is soldered shut.

Insert chips in appropiate sockets as follows:

	FULL KIT	PORT KIT	MEMORY KIT
[] U1 74LS240	*	*	*
[] U2, U3 74LS245	*		*
[] U4 74LS245	*	*	
[] U5 SC 2681	*	*	
[] U6, U19 1488	*	*	
[] U7, U20 1489	*	*	
[] U8...U15, U21...U28, U34...U41, U45...U52 TMS 4164	*		*
[] U16 74LS32	*	*	*
[] U17 TMS 4500	*		*
[] U18 74LS139	*	*	*
[] U29 7407	*	*	*
[] U30 74LS04	*		*
[] U31 74LS32	*	*	
[] U32 Z 8530	*		
[] U33 1488	*		
[] U42 CDP 6818	*	*	
[] U43 74LS373	*	*	
[] U44 1489	*		
[] U53 74LS32	*	*	
[] U54 74LS74	*	*	

THEORY OF OPERATION

The SLICER system Expansion Board is an add-on board for the SLICER computer. It interfaces to the SLICER through the two expansion connectors on the SLICER computer board. The power for the board is not supplied through the SLICER expansion connectors, but through a power connector similar to that on the SLICER. The board has the following features:

1. Additional 256K DRAM using TMS4500 DRAM controller.
2. Battery backed-up Real Time Clock and RAM using MC146818 or CDP6818 circuits.
3. Parallel printer port for Centronics type parallel printer.
4. Two serial ports using the SC2681 with RS232 drivers and receivers. (as on the SLICER).
5. Two serial ports using the Z8530 (Zilog) with RS232 drivers and receivers, or other off-board drivers and receivers for synchronous or asynchronous comm.

INTERFACE TO THE SLICER

As mentioned previously the System Expansion Board interfaces to the SLICER through the SLICER's J2 and J3 connectors. The SLICER's J2 connector plugs into the System Expansion Board's J1 connector. This connects the data bus of the two boards. The grounds (zero volts) of the two boards are also connected through this connector. Two additional signals on this connector are of importance: BUFFER ENABLE and /EXP IN. BUFFER ENABLE controls the outputs of the 74LS245s on the SLICER. It must be low whenever data is to be transmitted or received from any peripheral or memory on the expansion board (or another type of add-on board). When the SLICER is reading from an off-board device BUFFER ENABLE must be low only during the portion of the bus cycle when data is allowed onto the bus. Thus BUFFER ENABLE is derived from a gating of the off-board chip selects and the DEN (data enable) signal from the microprocessor. BUFFER ENABLE is driven by an open collector driver so that more than one source may provide the signal.

The /EXP IN signal, when low, controls the direction of the 74LS245 data buffers on the SLICER according to the DT/R (data transmit /receive) control signal from the microprocessor. If /EXP IN is left open or high the data bus will always be in the "output" direction. When using the System Expansion Board or other expansion boards this signal is tied to GROUND. Note that when this is done the inverted DT/R signal is available as IN ALLOW on pin 39. This signal is not used by the System Expansion Board, but will be used in future designs.

The J3 connector on the SLICER provides the address bus and control signals for expansion, and is connected to the J2 connector on the System Expansion board. The entire address bus is used by the System Expansion board (this includes /BHE). Additional control signals are used as well... refer to the schematics for details.

MEMORY

The memory array on the System Expansion board is nearly identical to that on the SLICER. One major difference however, is that the DRAM chips are no longer stacked in the stacking sockets as used on the SLICER. This was done to ease assembly as well as lower the profile of the board.

The memory array is composed of up to 32 industry standard 64K by 1 dynamic ram chips. If only 128k of memory is required, the board may be partially populated with only 16 DRAM chips. If this is done it is recommended to make the memory continuous with that on the SLICER by placing chips in locations U8 thru U15 and U21 thru U28.

The DRAM array is controlled by the TMS4500 DRAM controller (U17) as on the SLICER. This circuit controls the RAS, CAS and multiplexed memory address for the DRAMs. The TMS4500 also refreshes the memory array periodically so that memory data is retained. The CAS signal is gated with /BHE and A0 by two OR gates (both on U16), to be sure that only the proper bank of memory is written to when a byte write operation occurs. The following table shows the various combinations of /BHE and A0 which effect byte and word operations.

A0	/BHE	OPERATION
0	0	WORD
0	1	BYTE - LOW
1	0	BYTE - HIGH
1	1	Undefined

For a byte operation, the bank which is not used receives a refresh cycle. Each DRAM has its DATA IN and DATA OUT tied together and buffered by a 74LS245 (U2 and U3). The outputs of the 74LS245s are connected directly to the expansion data bus. Outputs are enabled only during DRAM access, driven by the DRAM chip select signal. The direction of the buffers is derived directly from the DT/R signal.

Chip select for the SYSTEM EXPANSION BOARD memory is selectable for any range of 80186 addresses. However, only two address ranges are recommended. The first board should be jumpered so that it is selected for absolute addresses from 40000H to 7FFFFH. Jumpering in this way will make the memory contiguous with the 256K on the SLICER. If a second SYSTEM EXPANSION BOARD is added to the SLICER it should be jumpered to reside at absolute addresses from 80000H to CFFFFH. The memory map for the SLICER then looks like the following:

Absolute Address	Size	Contents
FFFFFH - F8000H	32K	ROM
F8000H - D0000H	224K	reserved
CFFFFH - 80000H	256K	SYS.EX.BD.-2
7FFFFH - 40000H	256K	SYS.EX.BD.-1
3FFFFH - 00000H	256K	SLICER RAM

The memory address range is decoded by one half of a 74LS139, U18, and is jumpered on the adjacent jumper, J8. Refer to the section of this manual on board jumpers for the details on this and other configuration jumpers.

Serial Ports 1 & 2

The first two serial ports on the SYSTEM EXPANSION BOARD are driven by the Signetics SC2681 Dual Universal Asynchronous Receiver and Transmitter (hereafter - the SC2681). The SC2681 (U5) is the same chip as is used on the SLICER and thus you are most likely familiar with its features. Briefly, it has two independent serial communication ports, each with its own baud rate generator, buffers, etc. The SC2681 is capable of interrupting the CPU on a number of conditions, all of which are programmable and which I will not detail here.

The baud rate clocks are derived from an externally generated 3.686 MHz clock. This clock is the same as that which is used on the SLICER serial ports.

The SC2681 is connected to RS232C drivers (U6, U19), and receivers (U7 and U20), which are, in turn, connected to jumper blocks JB1 thru JB6. These jumper blocks are outwardly similar to those on the SLICER, but have been slightly changed to allow signals to be "looped back" to the SC2681 without the use of external jumpers. JB1 thru JB3 are connected to port A on the SC2681 and JB4 thru JB6 are connected to port B. These jumper blocks are then connected to the serial header connectors, J6 and J7 for port A and port B respectively. The header connector have 26 pins each and are laid out identically to those on the SLICER.

Serial Ports 3 & 4

The second set of serial ports on the SYSTEM EXPANSION BOARD use the ZILOG Z8530 Serial Communications Controller. This LSI circuit is capable of performing synchronous as well as asynchronous communication at bit rates of over 1 million bits per second. Obviously, such bit rates are not suitable for RS232C type of transmission over any great length, so two expansion headers (JX1 and JX2) have been provided for user supplied serial personality cards. These expansion connectors have both receive and transmit serial clocks as well as +5V, +12V and -12V power supplies. JX1 is connected to port A of the Z8530 and JX2 is connected to port B.

In addition to the serial personality cards, standard RS232C type drivers (U19 and U33) and receivers (U20 and U44) have been included on board. Like ports 1 and 2 these drivers and receivers are connected to configuration jumper blocks (JB7 thru JB12). The configuration of these jumpers is identical to those on ports 1 and 2. Serial header J10 is connected to port A and header J11 is connected to port B on the Z8530.

The Z8530 has internal counter/timers which can be used to generate baud rate clocks for the two serial ports. The input to these counter /timers is the SLICER CPU clock divided by two. It will thus be either a 4MHz or 3MHz clock depending on the speed of your SLICER. The division of the CPU clock is done by a 74LS74, U54. Like the SC2681 the Z8530 is capable of interrupting the CPU in a variety of programmable conditions. The interrupt output is an open collector output and is tied to the interrupt output on the SC2681. A pull-up resistor (R5) is connected to this signal which is then led to an inverter (U30). The output of the inverter is then run to the interrupt header connector, J5. At this header the interrupt signal may be tied to either INT2 or INT3 interrupt inputs to the CPU.

To facilitate very high speed data rates on the Z8530 a feature which allows the processor to use string move type instructions has been built into the Z8538. When performing a string move (OUTS or INS for example) the Z8530 may be programmed to hold the processors WAIT line low until the next character is actually received or transmitted. This eliminates the need for polling the port and eliminates interrupt latency but must be used with extreme caution. For example, if the port is inadvertantly accessed while in this mode the CPU may be put into a continuous wait state from which only a reset can save you. For this reason this feature must be conciously added to your board by jumpering J9. Do not put jumpers here unless you intend to use this feature and have thoroughly tested your software.

Parallel Port

A parallel printer port has been provided to allow the use of low cost Centronics type parallel printers. The port is quite simple, being comprised mostly of simple TTL circuitry. The data is written to an 8-bit latch (U43), the output of which is connected to the parallel port data bits. When the data is written a flip-flop is set (U54) which will be reset by the printer when it acknowledges the data. The printer is informed of the presence of valid data by a strobe signal which is software generated by toggling OP7 of the SC2681. In addition, the state of the acknowledge flip-flop can be read through IP3 on the SC2681 as well as the FAULT signal in IP6. FAULT generally signals that the printer is out of paper or some other error condition.

Real Time Clock

The real time clock circuit is a CDP6818 CMOS part. It is second sourced by a number of manufacturers, so yours may be labelled MC146818 (Motorola) or HD146818 (Hitachi). This chip (U42) combines a complete time of day clock with 50 bytes of general purpose RAM registers. The clock works in either binary or BCD and has a built in 100 year calendar that even accounts for leap years. To access the timekeeping or RAM locations the address must first be written to the clock followed by the read or write of the data. When address bit A1 is low address information is latched into the clock circuit. When A1 is high data may be read or written to the clock.

The timekeeping oscillator is internal to the 6818 and uses the crystal (labelled XTAL) for accuracy. The frequency of the oscillator is adjustable via the trimmer cap, C69. The nominal value of the capacitor is 20pf. Trimming is best accomplished by observing the timekeeping of the clock over a period of several days and making small adjustments in the trimmer. A small adjustment may make a large difference in the timekeeping.

The ni-cad battery (big black box) provides battery back-up for the clock. The battery is charged from the +12V line through resistors R12 and R16 and diode D3. The zener diode, D2 is provided to regulate the supply voltage to the clock. When the power is off the battery will supply 3.6V to the clock which will maintain timekeeping and RAM functions.

Dip Switches

A set of dip switches is provided to identify to the CPU any desired information. Switches 1 thru 4 have been shorted for use by future software and thus their positions are irrelevant. The dip switches may be read by performing a read to the same address as the parallel port. The switch data will be returned on the upper half of the data bus, bits 8 thru 15.

Other

All of the peripheral devices on the board are on the lower half of the data bus except the dip switches. The lower half of the data bus is buffered by a 74LS245 (U4) for use by the peripherals. The direction of the circuit is controlled by DT/R and the output is enabled when the peripherals are selected.

Three different address ranges may be selected for the board peripherals using the programmable chip selects PCS4, PCS5 and PCS6. These are jumpered on J4. It is recommended that the first SYSTEM EXPANSION BOARD be jumpered to PCS4. If this is done to an un-modified SLICER the address range for the peripherals will be from 200H thru 27FH. The addresses of each peripheral are listed in the table below:

Address	Peripheral
200	Serial port 1 mode reg.
202	Serial port 1 status reg.
202	Serial port 1 baud rate
204	Serial port 1 command reg.
206	Serial port 1 data reg.
208	SC2681 IPCR (RD) and ACR (WR)
20A	SC2681 interrupt control
210	Serial port 2 mode reg.
212	Serial port 2 status reg.
212	Serial port 2 baud rate
214	Serial port 2 command reg.
216	Serial port 2 data register
21A	SC2681 input port
21A	SC2681 output config. reg.
21C	SC2681 set output command
21C	SC2681 reset output command
220	Clock address
222	Clock data
240	Serial port 4 control
242	Serial port 4 data
244	Serial port 3 control
246	Serial port 3 data
260	Parallel port data
261	Dip switches

These addresses are given in hexadecimal. If PCS5 is to be used merely add 128 (80 hex) to the above values. Likewise if PCS6 is used, add 256 (100 hex).

Jumpers

```
DMA request jumper:                        J3

                             O    SASI DMA request input

                             O    CPU DMA request
```

note: normally these must be jumpered to support DMA transfers from the SASI port.

```
Peripheral Address Selection Jumper:       J4

                     pin 1   Ø    O    O

                     pin 2   O    O    O
                             ^    ^    ^
                             |    |    PCS4
                             |    PCS5
                             PCS6

Interrupt Selection Jumper:                J5

                      pin 1   Ø    O    O    O    O

                      pin 2   O    O    O    O    O
                              ^    ^
                              INT2 INT3

Serial Port Headers:                       J6,J7,J8 & J9

          Same as on SLICER (see schematics page 3)

Serial Port Configuration Jumpers:         JB1 thru JB12

          Same as on SLICER (see schematics page 3)


Memory address selection jumper:           J8

                      pin 1   Ø    O    ØK thru 256K (reserved)

                              O    O    512K thru 768K

                              O    O    256K thru 512K (board 1)

                              O    O    768K thru 1M (reserved)
```

Synchronous Port Wait Jumpers: J9

```
pin 1     Ø    O

          O    O
          ^    ^
Z8530 wait A   wait B
```

note: DO NOT JUMPER THESE, unless you know what they're for!

Real Time Clock Battery Jumper: J12

```
pin 1     Ø    O

          O    O
          ^    ^
          ON   OFF
```

note: move the jumper to the OFF position when removing or installing the real time clock circuit- U42.

Parallel Port Header Connector: J13

See schematics page 4 for details

Power Connector: J14

```
pin 1  O     O     O     O     O     O     O     O
       ^     ^     ^     ^                 ^     ^
     -12V   GND   +5V  +12V            BATTERY  GND
```

note: this connector wiring differs slightly from that on the SLICER.

SOFTWARE

The following software is a listing of routines which may be incorporated into the SLICER bios. When this is done merely remove the old BLSTOUT and BLSTST and put an INCLUDE PARPTR in place of them. This software is very simple, and does not check for FAULT conditions or changes to the SC2681 initialization. After reassembling your new bios use GENCMD and DDT86 to create your new CPM.SYS file. Happy computing!!!

```
;------------------------------------------------------------------
;
;            PARALLEL PRINTER SOFTWARE EXAMPLE
;
;       For SLICER with SLICER SYSTEM EXPANSION BOARD
;
;                  Jumper J4 for PCS4
;
;                     March 1984
;------------------------------------------------------------------

        base    equ     200H    ;base address for board
        parport equ     base+60H
        stbon   equ     base+1CH
        stboff  equ     base+1EH
        inport  equ     base+1AH


;       LSTOUT sends a character to the parallel printer port
;       Character input in CL

BLSTOUT:
        PUSH    DX
        MOV     DX,INPORT
LST1:   IN      AL,DX           ;READ SC2681 INPUT BITS
        TEST    AL,1000B        ;TEST ACK SIGNAL
        JNZ     LST1            ;LOOP UNTIL ACK
        CALL    PAUSE
        MOV     AL,CL           ;PUT CHARACTER INTO AL
        MOV     DX,PARPORT
        OUT     DX,AL           ;OUTPUT CHARACTER TO PORT
        MOV     DX,STBON
        MOV     AL,80H
        OUT     DX,AL           ;ACTIVATE STROBE
        MOV     DX,STBOFF
        OUT     DX,AL           ;DE-ACTIVATE STROBE
        POP     DX
        RET
```

```
;       BLSTST checks if acknowledge has occured
;       Returns with AL=Ø Z=1 if not ready
;                       AL=1 Z=Ø if ready

BLSTST: PUSH    DX
        MOV     DX,INPORT
        IN      AL,DX           ;READ SC2681 INPUT PORT
        NOT     AL              ;INVERT DATA
        AND     AL,1ØØØB        ;TEST ACKNOWLEDGE
        JZ      LSTS1           ;JUMP IF NOT READY
        MOV     AL,1
LSTS1:  RET

;       PAUSE waits for a few moments then returns
;

PAUSE:  MOV     AX,1ØØ
PA1:    DEC     AX
        JNZ     PA1             ;LOOP UNTIL Ø
        RET
```

PARTSLIST
=========

ICs
===

	FULL	PORT	MEMORY
U1 74LS240	*	*	*
U2 74LS245	*	*	*
U3 74LS245	*	*	*
U4 74LS245	*	*	*
U5 SC 2681	*	*	
U6 1488	*	*	
U7 1489	*	*	
U8...U15 TMS 4164-15ns DRAM	*		*
U16 74LS32	*	*	*
U17 TMS 4500	*		*
U18 74LS139	*	*	*
U19 1488	*	*	
U20 1489	*	*	
U21...U28 TMS 4164-15ns DRAM	*		*
U29 7407	*	*	*
U30 74LS04	*	*	*
U31 74LS32	*	*	*
U32 Z 8530	*		
U33 1488	*		
U34...U41 TMS 4164-15ns DRAM	*		*
U42 CDP 6818 or MC146818	*	*	
U43 74LS373	*	*	
U44 1489	*		
U43...U52 TMS 4164-15ns DRAM	*		*
U53 74LS32	*	*	*
U54 74LS74	*	*	

CONNECTORS
==========

	FULL	PORT	MEMORY
J1 40 pin connector	*	*	*
J2 50 pin connector	*	*	*
J3 2 pin connector	*	*	*
J4 6 pin connector	*	*	*
J5 10 pin connector	*	*	*
J6 26 pin connector	*	*	*
J7 26 pin connector	*	*	*
J8 8 pin connector	*	*	*
J9 4 pin connector	*	*	*
J10 26 pin connector	*	*	*
J11 26 pin connector	*	*	*
J12 4 pin connector	*	*	*
J13 34 pin connector	*	*	*
J14 power connector	*	*	*
JB1...JB6 6 pin connector	*	*	
JB7...JB12 6 pin connector	*		
JX1,JX2 14 pin connector	*		

RESISTORS
=========

	FULL	PORT	MEMORY
R1 33 ohms	*	*	*
R2 220 ohms	*	*	*
R3 220 ohms	*	*	*
R4 10K ohms	*	*	*
R5 10K ohms	*	*	*
R6 4.7K ohms	*	*	*
R7 4.7K ohms	*	*	*
R8 33 ohms	*	*	*
R9 22M ohms	*	*	*
R10 470K ohms	*	*	*
R11 1K ohms	*	*	*
R12 100 ohms	*	*	*
R13 10K ohms	*	*	*
R14 4.7K ohms	*	*	*
R15 4.7K ohms	*	*	*
R16 100 ohms	*	*	*
RP1 10 pin 1K resistor network	*	*	*

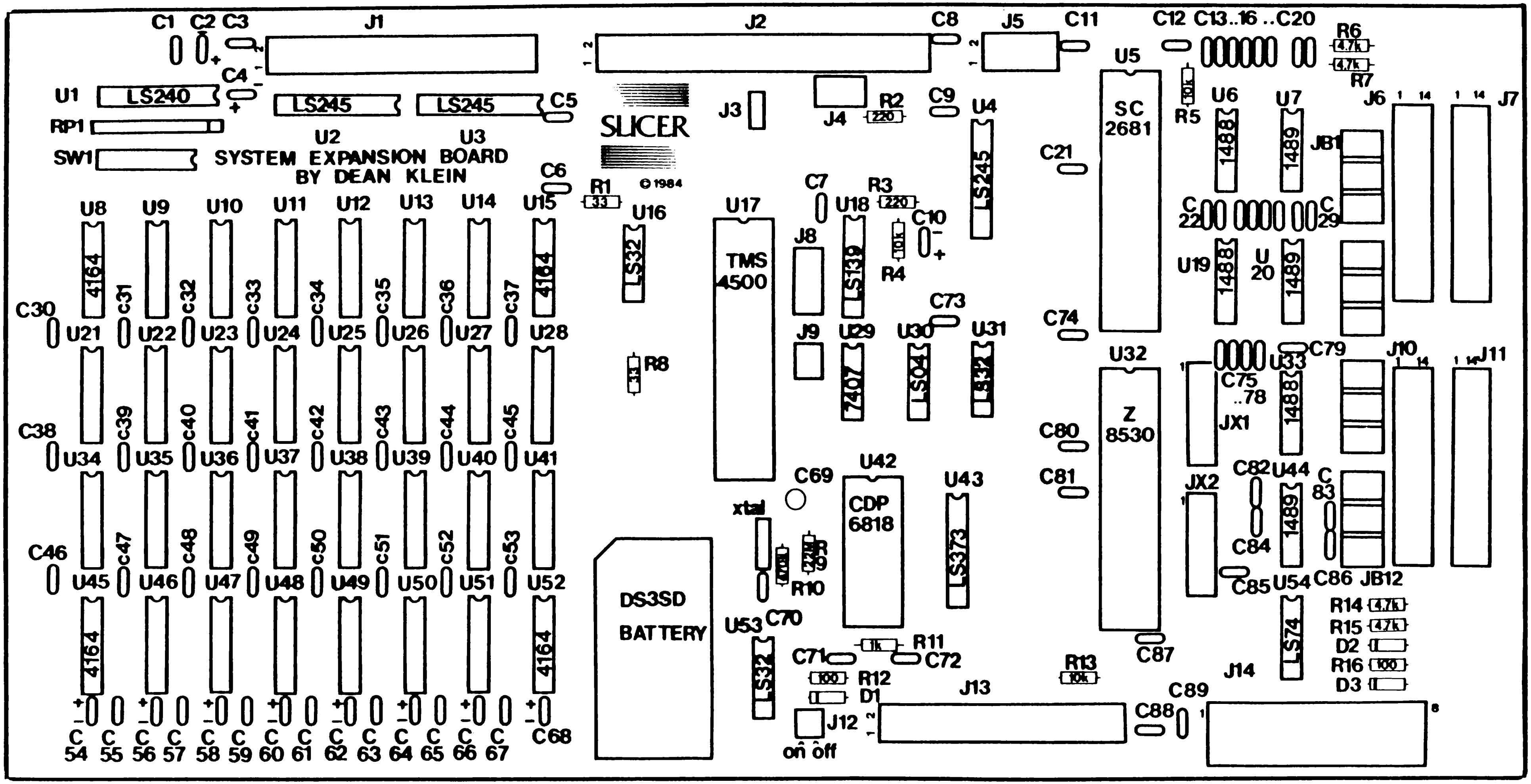
DIODES
======

	FULL	PORT	MEMORY
D1,D3 1N4148	*	*	
D2 1N4691	*	*	

CAPACITORS
==========

	FULL	PORT	MEMORY
C1 .1Mfd cer. capacitor	*	*	*
C2 10Mfd tant. capacitor	*	*	*
C3 .1Mfd cer. capacitor	*	*	*
C4 10Mfd tant. capacitor	*	*	*
C5...C9 .1Mfd cer. capcitor	*	*	*
C10 10 Mfd tant. capacitor	*	*	*
C11,C12 .1Mfd cer. capacitor	*	*	*
C13...C20 220 pfd capacitor	*	*	*
C21 .1Mfd cer. capacitor	*	*	*
C22...C29 220 pfd capacitor	*	*	*
C30...C52 .1Mfd cer. cap.	*	*	*
C53 10 Mfd tant. capacitor	*	*	*
C54 .1 Mfd cer. capacitor	*	*	*
C55 10 Mfd tant. capacitor	*	*	*
C56 .1 Mfd cer. capacitor	*	*	*
C57 10 Mfd tant. capacitor	*	*	*
C58 .1 Mfd cer. capacitor	*	*	*
C59 10 Mfd tant. capacitor	*	*	*
C60 .1 Mfd cer. capacitor	*	*	*
C61 10 Mfd tant capacior	*	*	*
C62 .1 Mfd cer. capacitor	*	*	*
C63 10 Mfd tant capacitor	*	*	*

C64 .1 Mfd cer. capacitor	*	*	*
C65 1Ø Mfd tant capacitor	*	*	*
C66 .1 Mfd cer. capacitor	*	*	*
C67 1Ø Mfd tant capacitor	*	*	*
C68 .1 Mfd cer. capacitor	*	*	*
C69 3.5 to 36pfd trimmer cap.	*	*	*
C7Ø 2Ø pfd cer. capacitor	*	*	*
C71 .1 Mfd cer. capacitor	*	*	*
C72 .Ø1 Mfd cer. capacitor	*	*	
C73,74 .1 Mfd cer. capacitor	*	*	*
C75...C78 22Ø pfd. cer. cap.	*	*	*
C79...C81 .1Mfd cer. cap.	*	*	*
C82...C84 22Ø pfd cer. cap.	*	*	*
C85 .1Mfd cer. capacitor	*	*	*
C86 22Ø pfd cer. capacitor	*	*	*
C87...C89 .1Mfd cer. cap.	*	*	*
xtal 32.768khz crystal	*	*	
DS3SD Battery	*	*	*

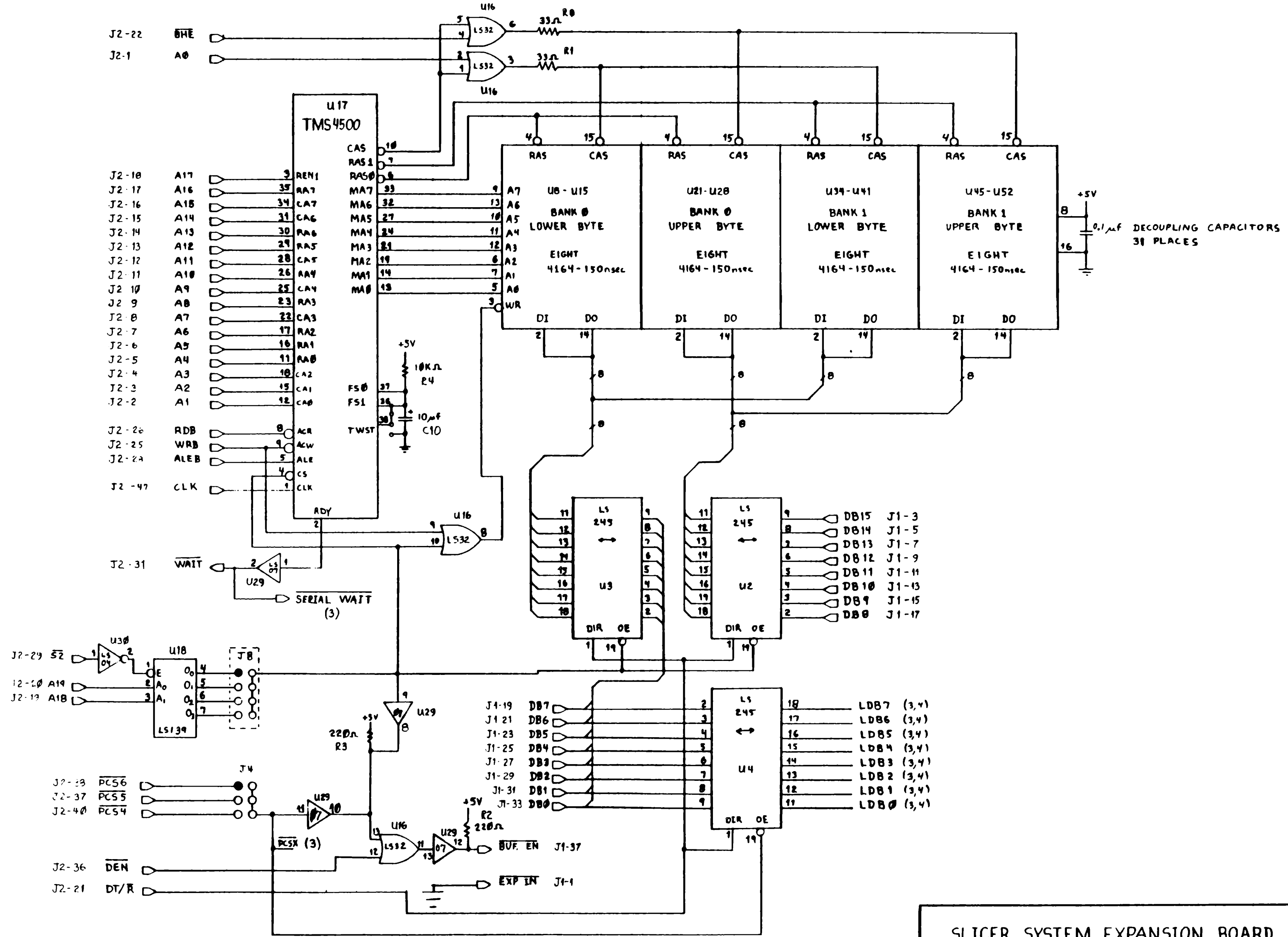


SLICER

SLICER SYSTEM EXPANSION BOARD

Page 1 of 4

D. Klein Nov. 10 1983

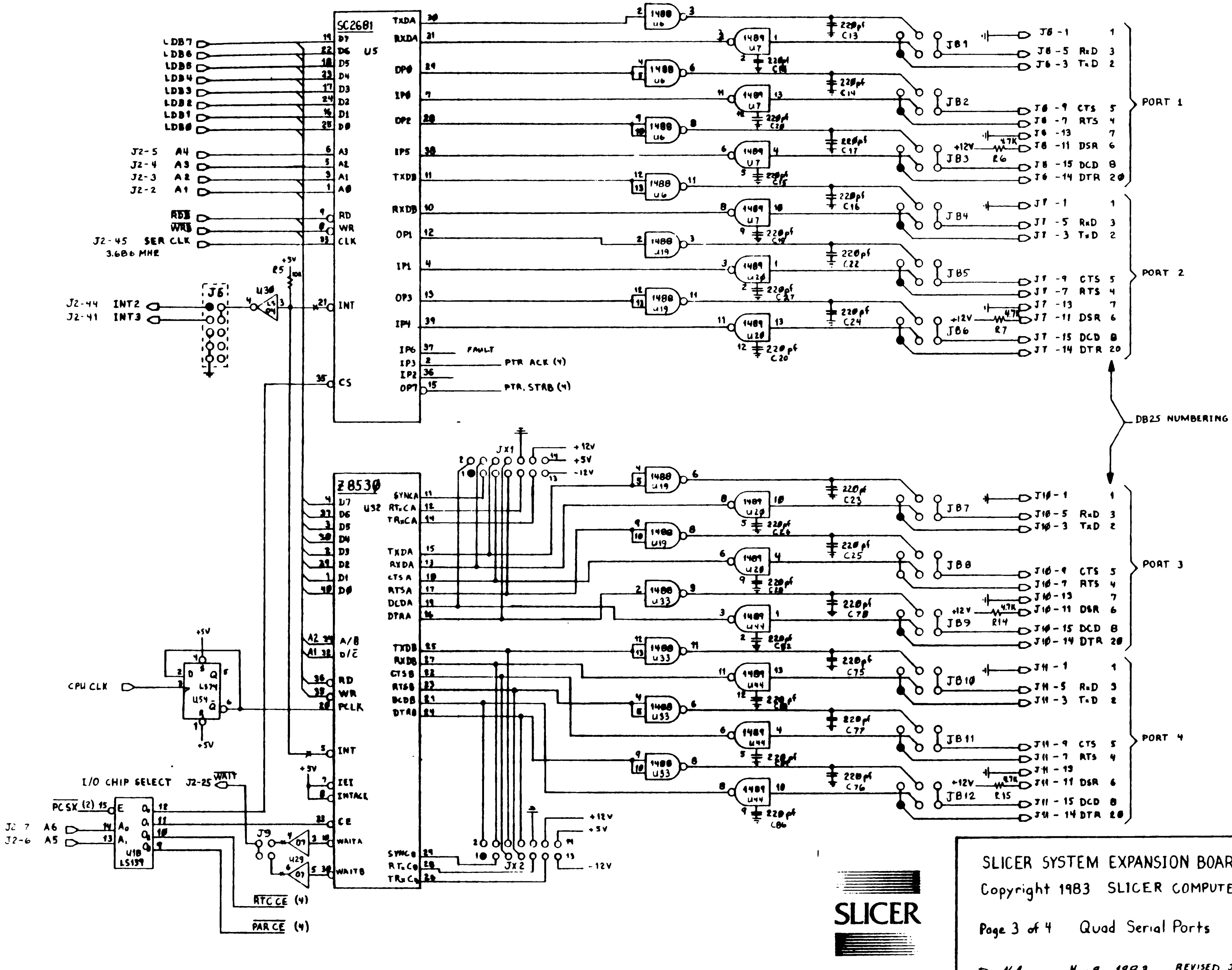


SLICER

SLICER SYSTEM EXPANSION BOARD

Page 2 of 4 256K DRAM Array

D. Kl— Nov. 8, 1983

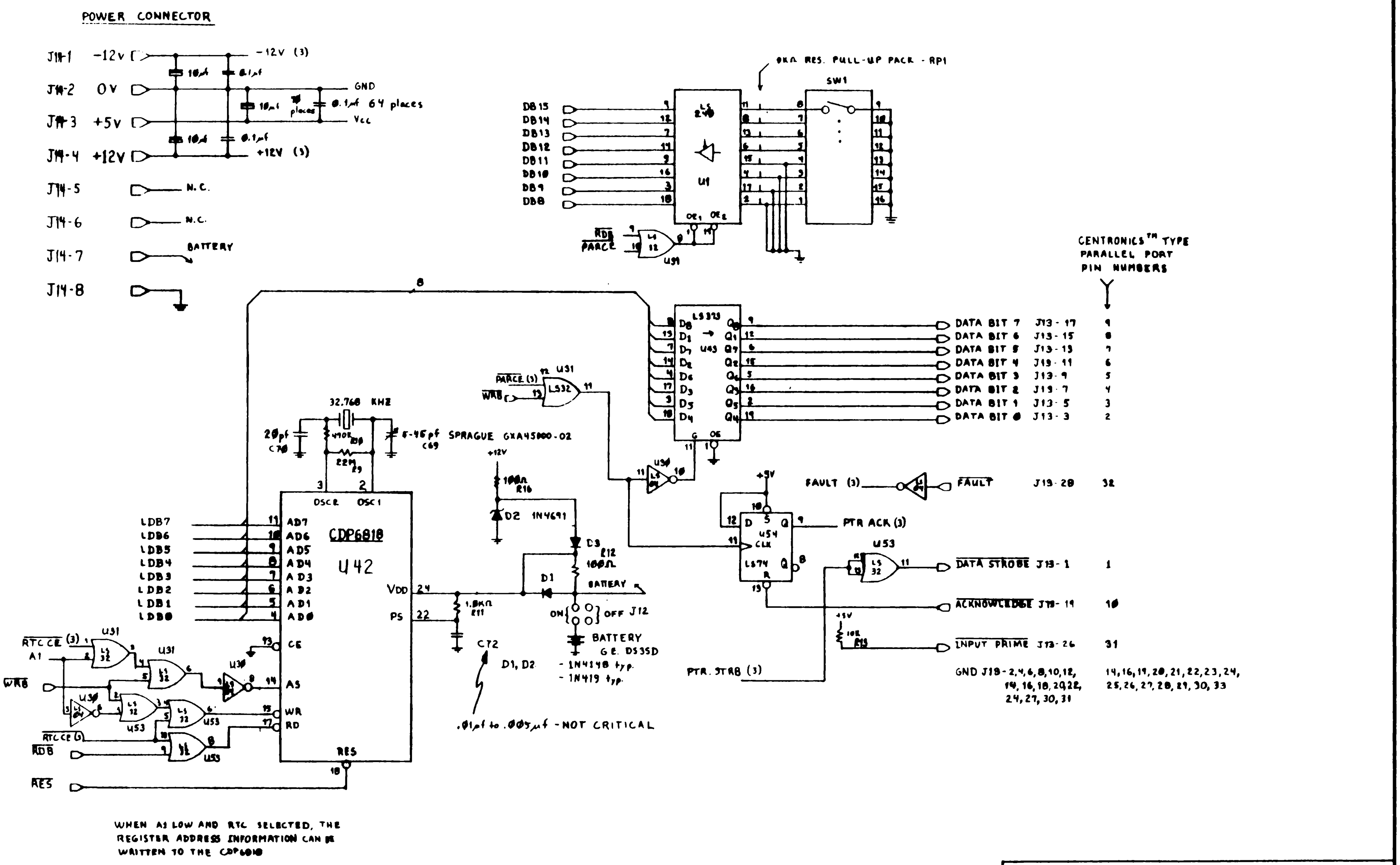


SLICER

SLICER SYSTEM EXPANSION BOARD

Page 3 of 4 Quad Serial Ports

D. Kl— Nov 9, 1983 REVISED JUNE 1, 1984 DK



SLICER

SLICER SYSTEM EXPANSION BOARD

Real-Time Clock and Parallel Printer Port

D. Klein Nov. 9, 1983