SBC88
Hardware Manual

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Operation and setup

Terminal

If you have purchased a Vesta power supply and CRT cables, simply connect the supply to the SBC88 with a 16 pin DIP jumper, connect the CRT to P1 noting pin 1 orientation. Set your terminal for no or mark parity and apply power. Type a space bar and the system will respond with a signon message. You are ready to start programming.

Connector types

The mating RS-232 connector is Panduit type CE100F28-3 or any other 3 contact .025" post female connector. TxD is the signal FROM the computer TO your terminal. RxD is the signal TO the computer FROM your terminal.

Input/output connections can be made with Ansley 16 pin DIP connectors (PN 609M165).

Power connections

If you are not using the Vesta power supply, make sure your power connector (J5) establishes the following connections:

J5 PIN	CONNECTED TO	J5 PIN	CONNECTED TO
1	gnd	9	open
2	open	10	open
3	gnd	11	open
4	gnd	12	open
5	Vpp for EPROM	13	open
6-7-8	gnd	14-15-16	+5 VDC supply

Using a voltmeter, check that pins 6 through 8 are power ground and 14 through 16 are +5 VDC +/- .25 VDC. No other pin should have a voltage on it. Double check the board for the correct orientation of plug/socket J5.

Please note that for proper operation of the real time clock and the Basic ONTIMER statements, a positive going pulse must be provided at pin 3. This pulse should be at least 12 microseconds, but not longer than 50 microseconds in duration. This signal normally has a period of 1/120 seconds (derived from AC zero crossing), but any other stable signal can be used. The minimum frequency is one Hertz, the maximum frequency is several hundred Hertz.

Microcomputer as terminal

If you are using a microcomputer as a smart terminal, the mass storage and printer capabilities of the micro can be exploited if you have the correct terminal emulation/communication program. In this case you will write your program as a file in the micro, download it to the SBC88 and run it or ROM it there. All editing and printing will be done on the micro. When ready to run the program, it is downloaded into the SBC88 with the DOWNLOAD command. The micro is then used as a terminal to communicate with the SBC88 to RUN the program. Check your micro's schematics for the proper connections of TxD and RxD. Some micro computers are wired as terminal devices, some as computer devices.

Input/Output Resources

General Description

The SBC88 has the following onboard control functions:

1) Two 8 bit input ports
2) Two 8 bit output ports
3) Seven individually addressable inputs
4) Seven individually addressable outputs
5) An 8 channel 8 bit A/D converter

Eight Bit Input Ports

The two 8 bit input ports are read at I/O addresses 10H and 20H. Each input bit is an LSTTL input. These inputs are available at connector J2 and J3 pins 8 to 1 corresponding to D0 to D7.

Eight Bit Output Ports

The two 8 bit output ports are written to at I/O addresses 10H and 20H. Each output is a latched LSTTL output. These outputs are available at connector J2 and J3 pins 9 to 16 corresponding to D0 to D7.

Address 10H
Socket J2

Pin	I/O	Pin	I/O
1	I,D7	16	O,D7
2	I,D6	15	O,D6
3	I,D5	14	O,D5
4	I,D4	13	O,D4
5	I,D3	12	O,D3
6	I,D2	11	O,D2
7	I,D1	10	O,D1
8	I,D0	9	O,D0

Address 20H
Socket J3

Pin	I/O	Pin	I/O
1	I,D7	16	O,D7
2	I,D6	15	O,D6
3	I,D5	14	O,D5
4	I,D4	13	O,D4
5	I,D3	12	O,D3
6	I,D2	11	O,D2
7	I,D1	10	O,D1
8	I,D0	9	O,D0

Input/Output Resources, cont.

Individual Inputs

The 7 individual inputs are located at I/O addresses 0 to 6. Each input is an LSTTL input. Input data is presented to the microprocessor on data line D7. This facilitates testing by allowing a single test of less than 128 or greater than 127. These inputs are available at socket J4 pins 9 to 15 corresponding to ports 0 to 6.

High Current Outputs

The 7 individual outputs are written to at I/O addresses 0 to 6. Notice that I/O address 6 is used by the BSR transmitter. Data written to the output ports is taken from the DO data line. Thus writing a "1" to output port 0 will set the output of the output latch high. These logic true outputs are available at U4 pins 1 to 7. U4 inverts the logic and provides high current output capability. Each output of U4 can sink up to 500 mA and withstand up to 40 V. The internal protection diode of U4 outputs are available at J4 pins 1 to 7. The output protection diode is available at pin 16 and ground is connected to pin 8.

Socket J4, I/O addresses 0 to 6

Pin	1	2	3	4	5	6	7	8
	00	01	02	03	04	05	06	gnd
	9	10	11	12	13	14	15	16
	IO	I1	I2	I3	I4	I5	I6	Diode

Pin 16 of J4 is returned to the unregulated +12 VDC supply, the highest voltage supply in the system. If a separate power supply is used to drive inductive loads, the connection should be broken to the SBC88 +12 VDC supply and the protective diodes connected to the highest voltage supply in the system (not over +45 VDC). The darlington driver outputs are rated at 500 mA, 50 VDC. Package power should be limited to 2 Watts.

Input/Output Resources, cont.

Analog to Digital Converter

A/D conversion is accomplished by writing the address to output port 10H for the analog input MUX. Conversion is initiated by writing to the A/D converter located at I/O location 30H. The result is read from I/O location 30H 200 microseconds later. Analog inputs should be connected to J1 pins 1 to 8 corresponding to channels 0 to 7.

Span and Vref

The reference voltage used is one half of the supply voltage for ratiometric measurements. If absolute measurements are required, the input voltage to pin 14 J1 can be forced. The converter will digitize an input to one part in 256 over a range of twice the voltage on this pin. Thus, with one half of the supply voltage, the converter will resolve inputs between 0 and 5.0 volts to within 20 mV. The reference voltage can be used as a sensivity control. If a reference of 0.5 volts is selected, the converter will resolve inputs from 0.0 to 1.0 volts to within 4 mV.

Zero

The A/D converter used is a differential type. The common inverting input is available at pin 13 of J1. This input can be used to bias the inputs so that conversion over a limited range can be made. For example, if Vref is 1.0 volts and the input to the inverting input is 1.5 V, then the A/D converter will digitize inputs between 1.5 and 3.5 V.

Analog Ground

Analog ground is available at pin 10 and 11 of J1. It is normally connected to digital ground, however separate connections can be made.

Input/Output Resources, cont.

Digital to Analog Conversion

D/A conversion can be effected by using the A/D converter to read the voltage stored in an RC integrating network and software to control this RC network. Provisions are included on the board for this. Components R2, R5, R6, C1 and CR2 are intended to be selected by the user for optimal loop response in the system.

Optional configurations

Memory decoding

There are 4 bytewide sockets in user memory space. Normally these sockets will occupy either 2k or 8k bytes each. The memory mapping of these sockets is shown.

Socket	Address (2k devices)	Address (8k devices)	
U12	0000 - 07FF	0000 - 1FFF	(always RAM)
U10	0800 - 0FFF	2000 - 3FFF	(RAM or ROM)
U13	1000 - 17FF	4000 - 5FFF	(RAM or ROM)
U14	1800 - 1FFF	6000 - 7FFF	(ROM or EPROM pgmr)

Jumper bank "A" determines the block size for memory sockets U10, 12-14. You may select 2k, 4k or 8k decoding for these sockets. The table below shows the "make/break" combinations that are required to set up various decoding schemes.

Connect	Break	Memory size, type
A3-A1	A3-A5	2K, 2016 RAM, 2716 EPROM
A4-A2	A4-A6	
A3-A5	A3-A1	8K, 6264 RAM, 2764 EPROM
A4-A6	A4-A2	
A3-A2	A3-A1	4K, No available RAM, 2732 EPROM
A4-A5	A4-A2	

Optional Configurations, cont.

Each individual socket has optional connections to adapt it to suit various memory devices. In general, having selected a block decoding size from the chart above, the jumpers will be changed on each memory socket to coincide with the block size. This is not mandatory, if 2k devices are inserted into a socket mapped for 8k devices, there will simply be 4 memory images created. This approach can be cost effective in your target application. For example, one that requires a minimum run-time RAM and maximum applications ROM space might map for 8k decoding with a 2k RAM in the first socket and 2764's in the remaining 3 sockets.

Sockets U12, U10 and U13 are configured with jumper blocks "C", "D" and "B" respectively.

Connect only one	Line	Function
1-2	All	Install for 8k memory devices
3-4	Vpp (+5 vdc)	Install for 2716 EPROM
5-6	WR	Install for 2k RAM (2016 type)

Note: Connection 3-4 ties the 2716 line "Vpp" to +5 vdc. In most cases, 2716 EPROMs can be inserted into RAM sockets (Vpp tied to WR) and function reliably, however, this connection will insure proper operation.

Optional Configurations, cont.

EPROM programmer and memory socket U14

2716, 2732 and 2764 EPROMs can be read and programmed in this socket. The following table shows the connections for each device.

Device	"H"	"J"	"K"	Function
2716	1-2	1-2	2-3	Read and write
2732	2-3	1-2	1-2	Read only
	2-3	2-3	1-2	Write only
2764	2-3	1-2	1-2	Read and write

Notice that the 2732 EPROM requires a jumper change depending on whether the device is being programmed or read. Vesta EPROM programming algorithm requires that each byte be verified after programming. In order to program 2732 EPROM, change R9/C14 to produce a 40 to 50 mS pulse (10k/10uF). Write a software procedure to copy the desired number of bytes into the EPROM without reading the device during programming.

In general, to convert the SBC88 from a configuration which uses 2Kx8 memory devices and burns 2716 EPROMs to one which uses 8Kx8 memory devices and burns 2764s make the following jumpers changes:

BREAK	MAKE
A1-A3	A3-A5
A2-A4	A4-A6
B5-B6	B1-B2
C5-C6	C1-C2
D5-D6	D1-D2
H1-H2	H2-H3
K2-K3	K1-K2

EEPROM devices

Several EEPROMs have been used successfully in the SBC88. The Seeq 52B33 may be programmed in socket U14 by performing the following modifications; remove R13 (5 VDC programming voltage), replace C14 with 1.0 uF (10 mS programming time). The Xicor X2864 will also work with these modifications, or, alternatively, will work in sockets U13 and U10 without modifications if care is taken during programming not to write to the device while it is storing previously written data.

Optional configurations, cont.

System ROM

Normally the system ROM socket will not require alteration, however, provisions have been included to configure this socket for 2, 4, 8 or 16k EPROMs. This socket occupies 32k of memory space (always) so no remapping of the socket is required.

Connect	Break	Function
E4-E6	E4-E2	2716 EPROM
E4-E2	E4-E6	2732, 2764 or 27128 EPROM
E3-E5	E3-E1	2716, 2732 or 2764 EPROM
E3-E1	E3-E5	27128 EPROM

Analog to Digital converter

The National Semiconductor ADC0804 8 bit A/D converter allows several options in selection of the reference voltage and the zero reference. These are selected with jumper block "F".

Jumper	Function
F6-F5	Select external reference voltage at J1 pin 14. If open, ratiometric reference is selected using 1/2 of the supply voltage.
F3-F1	Select non-grounded zero. This connection allows analog zero to be between 0 and +5 vdc.
F2-F4	External analog ground. This allows selection of analog ground different from digital ground.

The National Semiconductor ADC1001 10 bit A/D converter can be substituted for the ADC0804. The 10 bits are read as two sequential bytes of data after conversion is complete.

Optional Configurations, cont.

Interrupt Source

Jumper banks "L" and "G" allow customization of interrupt sources. Vesta operating systems and high level languages do not allow reconfiguration of interrupts. Both interrupts are fully utilized, the NMI is used for real time clock signal and the INT is used to signal the uP that an incoming RS-232 signal requires service.

Printer Connections

A "Centronics" parallel printer can be driven by Port 1 or Port 2. The printer should be connected as shown in the following chart.

Printer Connector (cable end view):

```
1  ----------  18
19 ----------  36
```

Printer	16 pin DIP Plug	Direction	Function
11	8	In	Busy
32	7	In	Not Error
16	ground	Out	ground
2	9	Out	Data 1
3	10	Out	Data 2
4	11	Out	Data 3
5	12	Out	Data 4
6	13	Out	Data 5
7	14	Out	Data 6
8	15	Out	Data 7
9	ground	Out	Data 8
1	16	Out	Strobe

Printer Connections, cont.

All other connections marked "ground" should be returned to ground. Ground is not available at ports 1 or 2. This connection must be made at J1, J4 or the power supply.

The variable IOBYTE must be set to 1 or 2 corresponding to the port number the printer is plugged into. At power on IOBYTE is set to zero.

Testing

If you suspect your computer is not operating correctly, please follow the following test sequence. Remove all memory chips except the system ROM (U9) and the first RAM chip (U12). Remove U1 through U7. After final visual inspection, connect your terminal to the RS-232 connector P1. Set your terminal for 4800 baud, no parity, 7 or 8 data bits, full duplex operation. Apply +5VDC power to the board, hit the space bar and you should see the signon message printed on your CRT screen. Type the following commands:

```
NEW%400

OK
NEW

OK
10 PRINT " HELLO "
20 GOTO 10

RUN
```

The Basic interpreter responds with OK after your commands. At this point the computer system is operational. Any additional I.C.s may now be inserted (after first turning off power).

Troubleshooting

1) Observe the waveform on pin 19 of the 8088. This must be 4.00 megahertz. This test insures that proper power and ground is being supplied to the SBC88 and your test equipment.

2) Observe the outgoing RS-232 line. Approximately 4 seconds after application of power, the outgoing pulse train should be observed. This indicates that the signon message is being sent. The voltage levels required are at least 3 volts positive and at least 3 volts negative. Check your terminal setting for correct reception.

3) Observe U8 pin 8 while typing on the terminal. You should see a series of incoming TTL level signals. If these are not present, your terminal is probably not in the online mode.

Repair

Vesta will repair without charge any assembly or design defects returned to us within 12 months of the original date of shipment. Testing and repair of user damaged units, or units with expired warranties will cost $35.00. Additional charges will be applied if major components require replacement.

Warranty

Products manufactured by Vesta Technology will be covered for a period of 12 months from the date of original shipment. Seller will repair or replace, without charge, devices found upon inspection to be defective in material and workmanship. This warranty is valid only if the unit has not been tampered with by unauthorized persons and not misused or abused, and if it has been used in accordance with the furnished instructions and within expressed or implied ratings. This sale is made upon the express understanding that there is no implied warranty that the goods shall be fit for any particular purpose. Buyer acknowledges that he is not relying on the Seller's skill or judgement to select or furnish goods suitable for any particular purpose. Buyer or claims of Buyer's customers or other third parties shall not in any event be entitled to, and Seller shall not be liable for indirect, special, incidental or consequential damages of any nature including, without being limited to, loss of revenue, loss of use of goods, cost of capital, promotional or/and manufacturing expenses, products irrespective of the nature of the claim, whether in contract, tort, warranty, or otherwise.

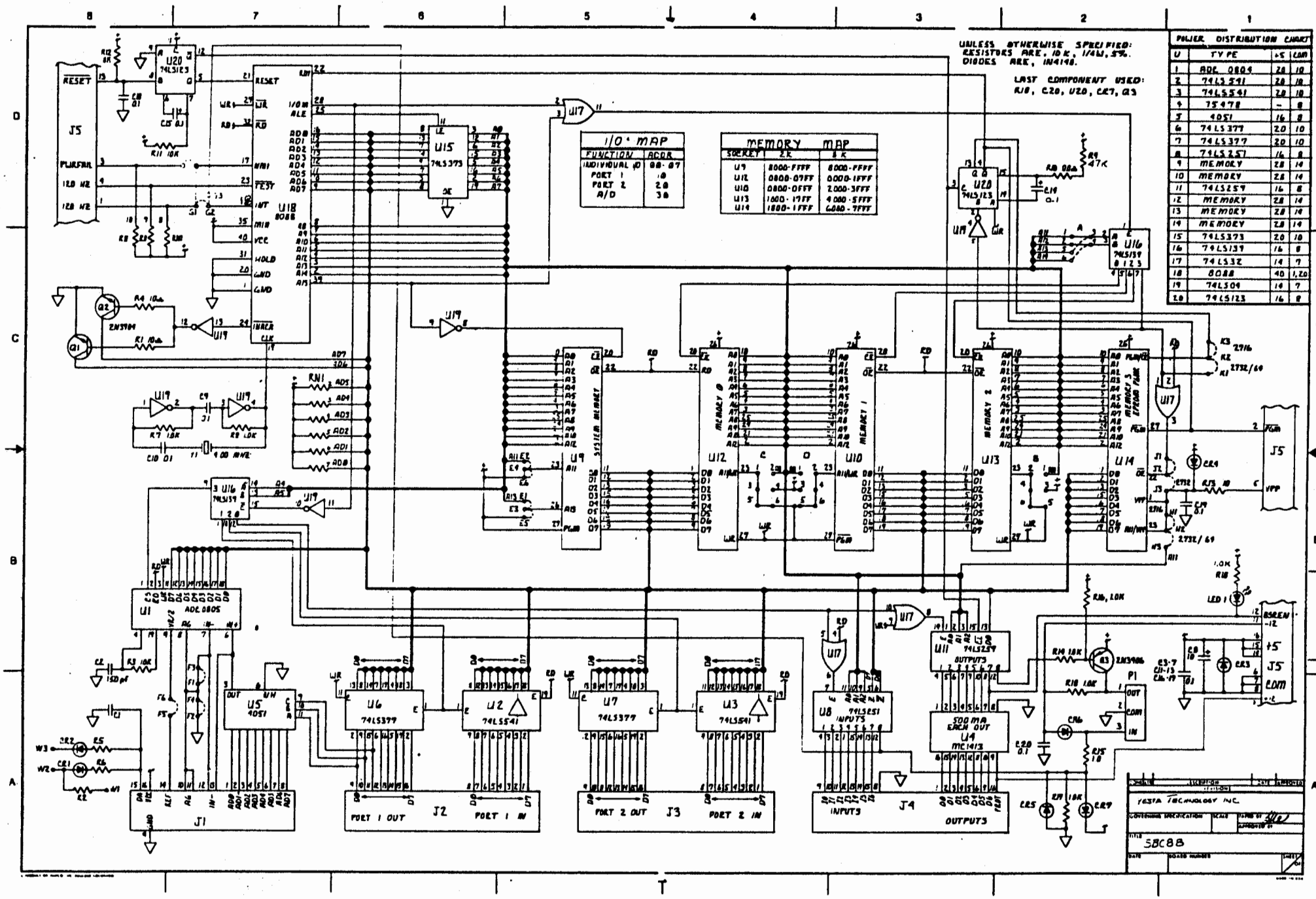
With respect to materials which are not manufactured by Seller the only warranty in effect shall be those as given by the manufacturers covering the usage of their product.

Technical Advice

Seller's warranty as herein above set forth shall not be enlarged, diminished or affected by and no obligation or liability shall arise or grow out of Seller's rendering of technical advice or service in connection with Buyers order or the products furnished.

SBC88 PARTS LIST APRIL 4, 1985

DESIG	DESCRIPTION
U1	ADC0804
U2,U3	74LS541
U4	ULN2003, F9667, MC1413
U5	4051
U6,U7	74LS377
U8	74LS251
U9	OPERATING SYSTEM ROM
U10	2K x 8 STATIC RAM (OPTIONAL)
U11	74LS259
U12	2K x 8 RAM OR ROM (2116)
U13	2K x 8 RAM OR ROM (OPTIONAL)
U14	EPROM TO BE PROGRAMMED (OPTL)
U15	74LS373
U16	74LS139
U17	74LS32
U18	8088
U19	74LS04
U20	74LS123
Q1,Q2	2N3904 (OR EQUIVALENT)
Q3	2N3906 (OR EQUIVALENT)
CR3 TO CR7	DIODE 1N4148 (OR EQUIVALENT)
CR1,CR2	OPTIONAL, NOT SUPPLIED
LED 1	T1 LED
Y1	4.00 MHz CRYSTAL
P1	3 x 0.025" POST CONNECTOR
C2	100 pF CAPACITOR
C15	10 uF, 16 VDC
C1	OPTIONAL NOT SUPPLIED
ALL OTHER(17)	0.1 uF CAPACITOR
RN1	RESISTOR NETWORK (10K)
R1,4,,13	10 OHM RESISTOR
R2,5,6	OPTIONAL NOT SUPPLIED
R3	15k OHM RESISTOR
R7,8,14-19	1.0k OHM RESISTOR
R10	NOT INSTALLED
R11,12	10k OHM RESISTOR
R9	47k OHM RESISTOR
S1(1)	40 PIN SOCKET
S2(5)	28 PIN SOCKET
S3(6)	20 PIN SOCKET
S4(11)	16 PIN SOCKET
S5(2)	14 PIN SOCKET


UNLESS OTHERWISE SPECIFIED:
RESISTORS ARE, 10 K, 1/4W, 5%.
DIODES ARE, IN4148.
LAST COMPONENT USED:
R18, C20, U20, CR7, Q3
I/O MAP
FUNCTION ADDR
INDIVIDUAL I/O 00-07
PORT 1 08
PORT 2 20
A/D 38
MEMORY MAP
SOCKET 2K 8K
U9 8000-FFFF 8000-FFFF
U12 0800-07FF 0000-1FFF
U10 0800-0FFF 2000-3FFF
U13 1000-17FF 4000-5FFF
U14 1800-1FFF 6000-7FFF
PRINTER DISTRIBUTION CHART
U TYPE LOC COM
1 ADC 0804 28 10
2 74LS241 20 10
3 74LS541 20 10
4 75478 - 8
5 4051 16 8
6 74LS377 20 10
7 74LS377 20 10
8 74LS257 16 8
9 MEMORY 28 14
10 MEMORY 28 14
11 74LS259 16 8
12 MEMORY 28 14
13 MEMORY 28 14
14 MEMORY 28 14
15 74LS373 20 10
16 74LS139 16 8
17 74LS32 14 7
18 8088 40 1,20
19 74LS04 14 7
20 74LS123 16 8
RESET
PWRFAIL
12.8 MHZ
128 MHZ
PORT 1 OUT
PORT 1 IN
PORT 2 OUT
PORT 2 IN
INPUTS
OUTPUTS
500 MA EACH OUT
TESTA TECHNOLOGY INC.
5BC88