Radio Shack®

Technician Series
Diagnostics Software

TRS-80®

1/0 PORT TESTER

OWNERS & SERVICE
MANUAL

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I/O Port Tester Service Section

IOTEST3/CMD

Model III & 4 I/O
Port Tester

Introduction:

This is to acquaint you with the use of the Model III/4 I/O Port Tester,
a device quite useful in troubleshooting the parallel I/O port on a Model
III/4. It will help in verifying the proper operation of the I/O port
without the customer bringing in their hard disk or other external
devices.

Set Up:

First, connect the ribbon cable provided with the tester to the 5∅ pin
connector on the back of the tester with the cable dressed down. This is
the plug on the left as you look at the tester from the back. Next, hook
the cable into the I/O port on the computer with the cable dressed out to
the rear. Connect the power pack provided, to the tester. Power up the
computer first, then turn on the tester. This sequence is important to
avoid false errors. The two LED's on the port tester should be illuminated
at this time. If this is the first time this tester is being used then
proceed to the alignment section.

Executing IOTEST3/CMD:

You should type in: IOTEST3 <ENTER>

You should initially see:

        *************** MODEL III I/O PORT TEST ***************

                            VERSION 2.4
                            AUG 3, 1983
                    COPYRIGHT 1983 TANDY CORPORATION
                          ALL RIGHTS RESERVED

        ****

                        PRESS ANY KEY TO CONTINUE

The next prompt after this will be:

        DO YOU WANT TO TEST THE "RESET" SIGNAL ? (Y/N OR <ENTER>)

If you elect to use this portion of the test you will be required to use
the <RESET> button. This will necessitate having to re-install the
program. Resetting should turn off both of the LED's at this time because
the "RESET" signal clears the D latches that power the LED's. The RESET
TEST should always be done the first time a unit is checked.

The next prompt after the RESET TEST will be:

ENTER THE CONTROL PORT VALUE IN HEX (<ENTER> = CF HEX)

Use the default value for this test.

The menu should now appear:

```
                    MENU

              (A) AUTO TEST MODE
              (L) LOOP TEST MODE
              (S) SINGLE TEST MODE
              (P) CHANGE PORT VALUE
              (Q) QUIT TO OPERATING SYSTEM


    ********************************************

              (1) ADDRESS & DATA SIGNAL TEST
              (2) ADDRESS SIGNAL ONLY TEST
              (3) FORCED INTERRUPT TEST
              (4) "WAIT" SIGNAL TEST

         SELECT TEST MODE ? (A/L/S/P/Q)
```

You must first select the Mode that is to be used, then test number
desired. <BREAK> will get out of any test, and return to the menu.

Test Descriptions:

(A) AUTO MODE: This test will automatically proceed to the ADDRESS & DATA
    SIGNAL TEST. If this test passes, then it will skip ADDRESS ONLY TEST
    and go to the INTERRUPT and WAIT tests. If test (1) fails then the
    ADDRESS ONLY TEST becomes an option by the user to help trace the
    error.

(S) SINGLE TEST MODE: If this mode is selected then any test (1-4) will be
    executed once.

(L) LOOP TEST MODE: This test will continually loop through any selected
    test (1-4). LOOP TEST is quite useful when troubleshooting with an
    oscilloscope because all signals are repetitive. You can exit LOOP
    TEST by hitting <BREAK>.

(Q) QUIT TO OPERATING SYSTEM: Returns to TRSDOS.

Detailed Test Descriptions:

(1) ADDRESS & DATA SIGNAL TEST: This test exercises the A∅-A7, D∅-D7, OUT*, IN*, and EXTIOSEL ports. In this test, data is written out and certain ports are avoided. Data is read back to test for any change. Errors are displayed on the screen. If the RESET test was not done previously, this test will fail the first time through. In AUTO or SINGLE modes only eight errors can be displayed. In LOOP the first eight are shown, then it waits for any key to be depressed to continue the test. All data written out in LOOP is only one bit set at a time.

(2) ADDRESS ONLY TEST: This test generates (OUT ∅CFH) and (OUT ∅3∅H) signals to toggle the two LED's on and off. Test points and instructions are also displayed.

(3) INTERRUPT TEST: Data signal, (OUT ∅CFH), is fed into EXTIOBUS* port which causes the interrupt. A software flag tests as to whether the interrupt servicing routine has ever been accessed, and displays result.

(4) "WAIT" SIGNAL TEST: This test generates the prompt, PLEASE WAIT 3 SECONDS. The one shot signal is generated periodically and fed to the WAIT* line. The CPU is forced into a WAIT state during the one shot.

Port Analysis:

"xF"   Each write to this port will generate a "wait". This will cause LED A to change states.

Bit ∅   A "1" written to this bit will generate an interrupt.

Bit 1   Not Used.

Bit 2   A "1" written to this bit will generate a DRQ pulse

Bit 3-7   Not Used.

"x∅"   Each write to this port will cause LED B to change states.

Bit ∅   Not Used.

Bit 1   A "1" written to this bit will enable the RAMS.

Bit 2   Not used.

Bit 3   A "1" written to this bit will enable the DATA buffer.

Bit 3-7   Not Used.

I/O PORT TESTER SERVICE SECTION

Alignment, Troubleshooting, and Theory

If this is the first time that this tester has ever been used, it will
probably require some calibration. The one shot, which is used in the WAIT
test will have to be set to 1ms. Use your oscilloscope on Pin 4 of U11.
The INTERRUPT or WAIT test set for LOOP mode will provide continuous
pulses from the one shot. Adjust R8, the pot next to the Dip Switch, until
a 1ms pulsewidth is obtained. WAIT also checks if a 1ms wait will cause
RAM refresh problems, so if there are problems with the program getting
lost, shorten the one shot duration and run the test again.

Portions of U12 and U14 are used to light the LED's. If the LED's do not
go off when doing the RESET test, look at Pin 13 on U12 or Pin 1 on U14
and hit <RESET>. These pins should go low, resetting the latches and
turning off the LED's.

U3 is a bi-directional data buffer, a low on Pin 11 permits data flow in,
a high switches it to data out. This IC would be a good suspect if the
tester doesn't respond to the computer.

U1 and U2 are 2114 RAM's used to temporarily store data while testing. U16
and 1/2 of S1 are used as decoders for "3x" data, U13 and the other half
of S1 are decoders for the "Cx" data. RAM Enable is controlled by 1/2 of
U15.

1/2 of U9 is a one shot used in the WAIT SIGNAL TEST. It is the adjustable
one shot mentioned previously. 1/2 of U12 and an inverting buffer in U11
are also used in conjunction.

The 'CF' decoder consists of U1Ø, U7, and U5. The '3Ø' decoder is U5, U6,
U7, and U1Ø. Refer to schematic for specific sections and pinouts used.

This is a table of address equivalents that can be set by the Dip Switches.

	S1					S2			
"xF"	1	2	3	4	"xØ"	5	6	7	8
ØF	on	on	on	on	ØØ	on	on	on	on
1F	off	on	on	on	1Ø	off	on	on	on
2F	on	off	on	on	2Ø	on	off	on	on
3F	off	off	on	on	3Ø	off	off	on	on
4F	on	on	off	on	4Ø	on	on	off	on
5F	off	on	off	on	5Ø	off	on	off	on
6F	on	off	off	on	6Ø	on	off	off	on
7F	off	off	off	on	7Ø	off	off	off	on
8F	on	on	on	off	8Ø	on	on	on	off
9F	off	on	on	off	9Ø	off	on	on	off
AF	on	off	on	off	AØ	on	off	on	off
BF	off	off	on	off	BØ	off	off	on	off
CF	**on**	**on**	**off**	**off**	CØ	on	on	off	off
DF	off	on	off	off	DØ	off	on	off	off
EF	on	off	off	off	EØ	on	off	off	off
FF	off	off	off	off	FØ	off	off	off	off

Construction Notes

S4 is a 14 pin socket in a 2Ø pin position, pin 1 matches pin 1

R1Ø is connected from U11 pin 12 (at the feed thru) to +5 vdc (at 'C7')

W1 connects the 2 8pin holes on the PCB near J1 and J2. The holes are numbered in order and hole 1 is on the same end in each set. The holes are connected 1-1, 2-2, ..., 8-8.

W2 connects pin 1 of U8 (at the feed thru) to pin 2 of U4

W3 connects pin 1 of U4 to pin 1Ø of U7

J3 is the Model III connector and J1 is the Model II connector

Testing

Set dip switch S1 to 1,2,7, &8 on and 3,4,5,&6 off. Turn R8 and R9 to the center position. The Power supply should be plugged into P1. The 5Øpin cable should then be plugged into J2 on the I/O port tester and into the expansion buss on the Model III. The Model III and the I/O port tester are then turned on. The diagnostic disk should then be booted. Run the program 'IOTEST3'. Do not test reset, default the port address to CF, and proceed to the AUTO test. If the tester is functioning properly, all four tests should pass.

5 VDC
SUPPLY
VR1, VR2

DATA
BUFFER
U3

DØ~D7

MEMORY
U1, U2
2114

INTERRUPT
GENERATOR
U12, U11

WAIT
GENERATOR
U9, U11, U12,
DS1

DRQ
GENERATOR
U9, U11, U15

DØ

D2

RAM ENABLE
U15

D1

INTERRUPT
ACKNOWLEDGE
U5, U8

"CF" DECODER
U10, U7, U5

"3Ø" DECODER
U5, U6, U7, U10

LED "B"
DRIVER
U14, U11, DS2

RAM BUFFER
ENABLE
U14

IORQ
M1

D3

"CX" DECODER
U13, S1

"3X" DECODER
U16, S1

EXT I/O
SELECT
U4, U7, U11

A4~A7

AØ~A3

A4~A7
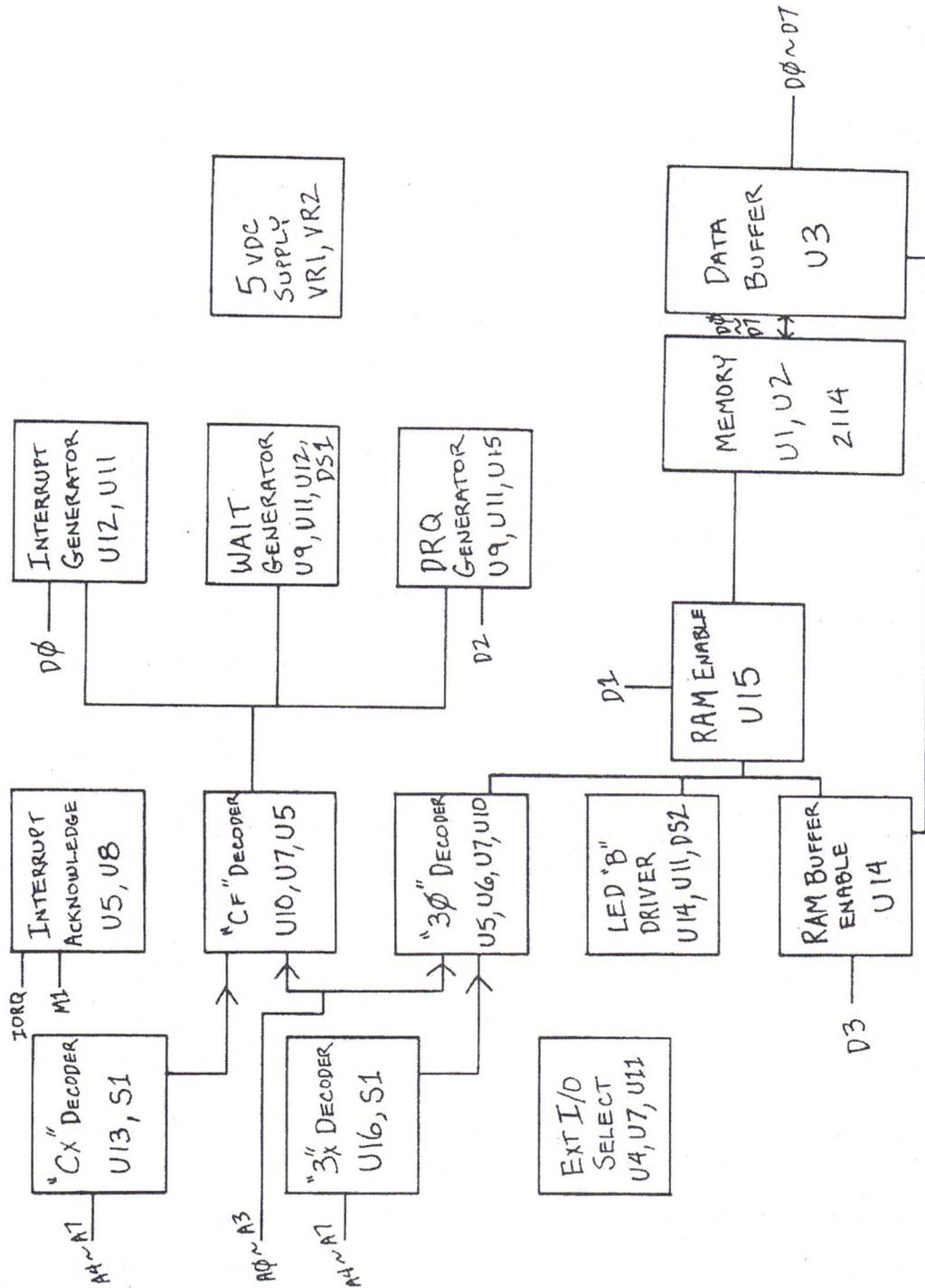
BLOCK DIAGRAM

I/O PORT TESTER PARTS LISTING

Parts list for the I/O port tester

SYM	Name	Part No.	Vendor
–	PC Board	17ØØ22Ø	Tech Supp

Connectors

P1	Connector 5-pin din	8519ØØ2	Tandy inst
J1	Connector 5Ø-pin	8519117	Tandy inst.
J2	Connector 5Ø-pin	8519117	Tandy inst.

Wires

W1	6" 8 cond wire		Tandy W & C
W2	3" #3Ø KYNAR		Generic
W3	3" #3Ø KYNAR		Generic
W4	2' 5Ø cond cable		Tandy W & C

Power supply

T1	Network III type power supply	879ØØØ2	Tandy Dist. prod.

Mechanicial parts

VR2	Heat sink, top	8549ØØ3	Tandy inst.
VR2	Heat sink, bottom	8549ØØ4	Tandy inst.
1Ø	Case top	8719191	Tandy app.
1Ø	Case bottom	871919Ø	Tandy app.
2Ø	Rubber foot, rear 1/4"	859Ø119	Tandy app.
2Ø	Rubber foot, front 7/16"	8589ØØ5	Tandy app.
6Ø	Screw 4 X 1/2 (PC board)	8569151	Tandy app.
4Ø	Screw #4 X 3/4 (case)	8569149	Tandy app.
1Ø	Nut keep #4-4Ø	8579ØØ3	Tandy app.
1Ø	Screw #4-4Ø X3/8"	8569ØØ2	Tandy app.

Capacitors

C21   capacitor, .01uf 50V 10% mono   8383104   Tandy inst.

C19   capacitor, .02uf 100V 20% poly 8353225   Tandy inst.
C20   capacitor, .02uf 100V 20% poly 8353225   Tandy inst.

C1   capacitor, .1uf 50V mono rad.   8384104   Tandy inst.
through
C16   capacitor, .1uf 50V mono rad.   8384104   Tandy inst.

C18   capacitor, 22uf 16V Elec. rad. 8326221   Tandy inst.
C17   capacitor, 470 uf 35V elec rad   Home computers

Switches

S2   Switch, PWR ON/OFF   8489036   Tandy inst.
S1   Switch, 16-pin dip spst   8489004   Tandy inst.

Resistors

R1   resistor, 220 ohm 1/4 W 5%   8207122   Tandy inst.
R2   resistor, 220 ohm 1/4 W 5%   8207122   Tandy inst.

R4   resistor, 470 ohm 1/4 W 5%   8207147   Tandy inst.
R10   resistor, 470 ohm 1/4 W 5%   8207147   Tandy inst.

R3   resistor, 5.1k ohm 1/4 W 5%   8207251   Tandy inst.
R7   resistor, 5.1k ohm 1/4 W 5%   8207251   Tandy inst.

R6   resistor, 47k ohm 1/4 W 5%   8207347   Tandy inst.
R5   resistor, 4.7k ohm 1/4 W 5%   8207247   Tandy inst.

RP1   resistor, 4.7k ohm sip 8-pin   8292246   Tandy inst.
RP2   resistor, 4.7k ohm sip 8-pin   8292246   Tandy inst.

IC sockets

S4	Socket, 14-pin	8509008	Tandy inst.
S5	Socket, 14-pin	8509008	Tandy inst.
S6	Socket, 14-pin	8509008	Tandy inst.
S7	Socket, 14-pin	8509008	Tandy inst.
S8	Socket, 14-pin	8509008	Tandy inst.
S10	Socket, 14-pin	8509008	Tandy inst.
S11	Socket, 14-pin	8509008	Tandy inst.
S12	Socket, 14-pin	8509008	Tandy inst.
S14	Socket, 14-pin	8509008	Tandy inst.
S15	Socket, 14-pin	8509008	Tandy inst.
S9	Socket, 16-pin	8509003	Tandy inst.
S13	Socket, 16-pin	8509003	Tandy inst.
S16	Socket, 16-pin	8509003	Tandy inst.
S1	Socket, 18-pin	8509006	Tandy inst.
S2	Socket, 18-pin	8509006	Tandy inst.
S3	Socket, 20-pin	8509009	Tandy inst.

IC's

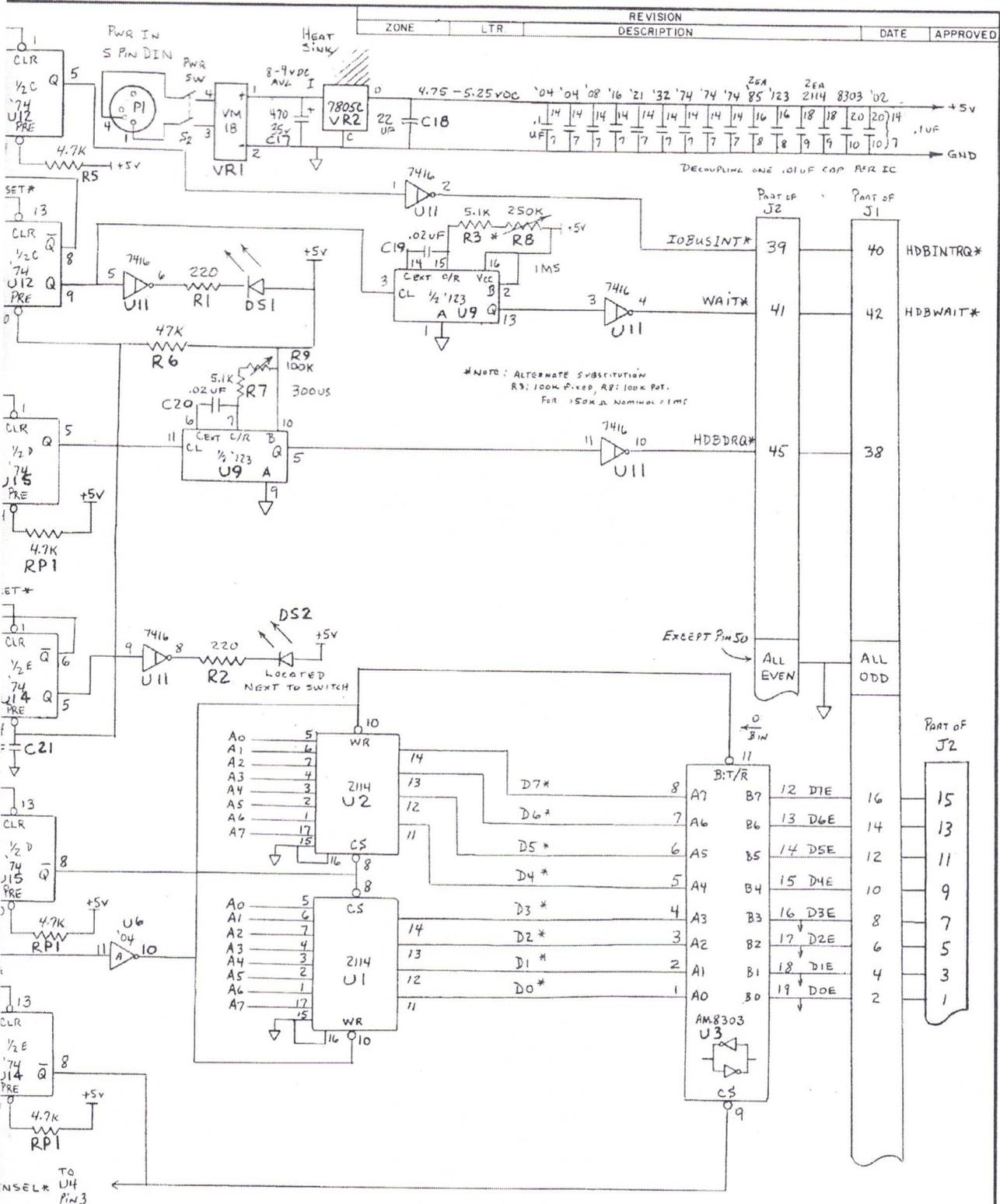|			
U11	IC 7416 Hex inverter	8000016	Tandy inst.
U13	IC 74S85 Comparator	9010085	Tandy inst.
U16	IC 74S85 Comparator	9010085	Tandy inst.
U6	IC 74LS04 Hex inverter	8020004	Tandy inst.
U8	IC 74LS04 Hex inverter	8020004	Tandy inst.
U7	IC 74LS08 Quad 2-in AND	8020008	Tandy inst.
U5	IC 74LS32 Quad 2-in OR	8020032	Tandy inst.
U12	IC 74LS74 Flip-Flop	8020074	Tandy inst.
U14	IC 74LS74 Flip-Flop	8020074	Tandy inst.
U15	IC 74LS74 Flip-Flop	8020074	Tandy inst.
U4	IC 74LS02 Nor gate	8020002	Tandy inst.
U9	IC 74LS123 Multivibrator	8020123	Tandy inst.
U3	IC AM8303 BUS tranceiver	8060303	Tandy inst.
VR2	Voltage Regulator 7805 1.5A	8050805	Tandy inst.
U1	RAM 2114	8042114	Tandy app.
U2	RAM 2114	8042114	Tandy app.
VR1	Bridge rectifier VM28		Home comp

Leds

DS1	LED, red assy	8469012	Tandy inst.
DS2	LED, red assy	8469012	Tandy inst.

SCHEMATIC DIAGRAMS
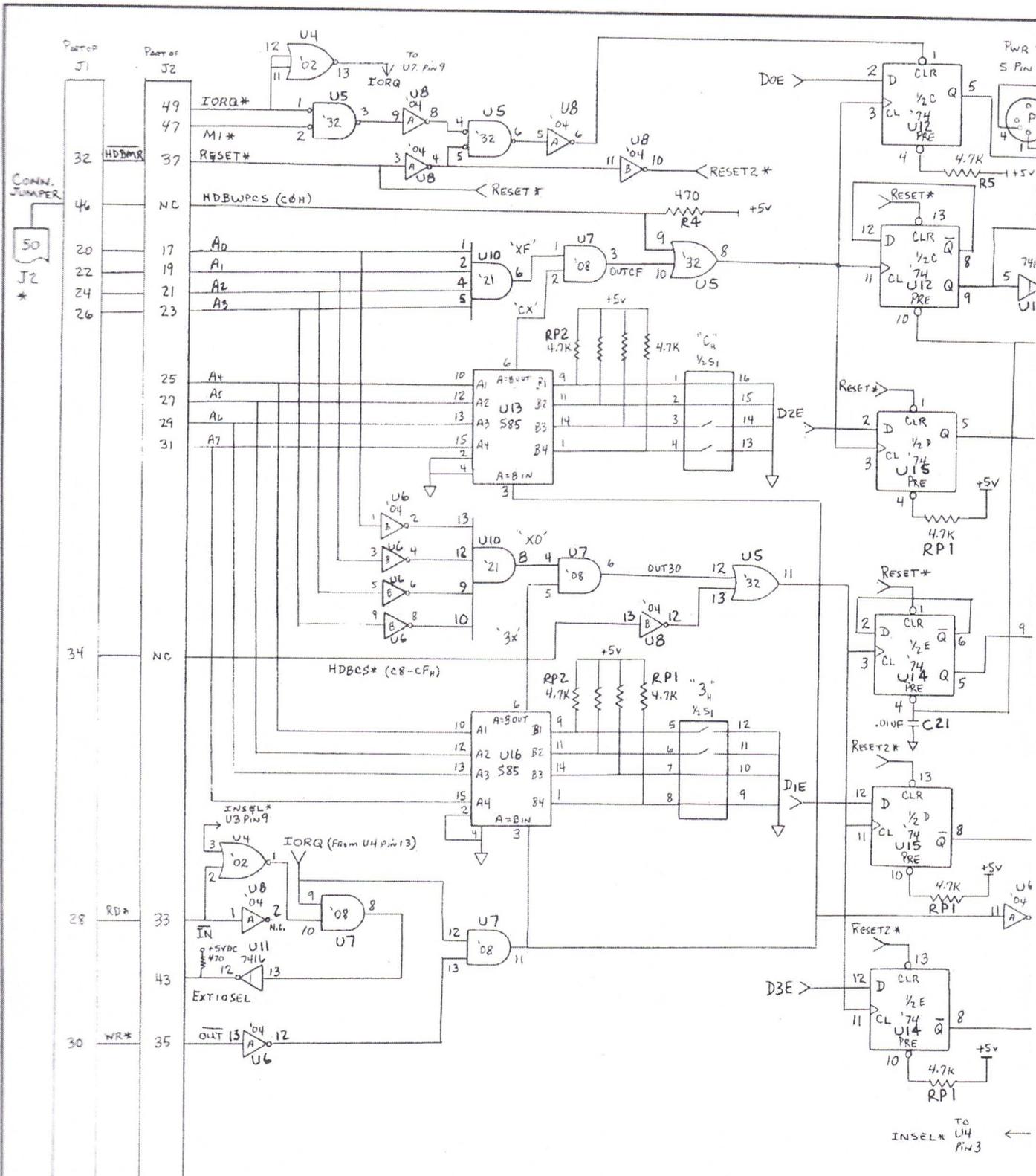
NOTE: J2 PIN 50 is ISOLATED FROM GROUND ON THE PCB & CONNECTS TO GROUND THROUGH J2 PLUG TO GROUND.

Part of J1
Part of J2

CONN. JUMPER
50
J2 *

32   HDBMR
46   NC
20   17   A0
22   19   A1
24   21   A2
26   23   A3

49   IORQ*
47   M1*
37   RESET*
NC   HDBWPCS (C6H)

25   A4
27   A5
29   A6
31   A7

34   NC

28   RD*   33
43
30   WR*   35

U4 '02
IORQ   To U7 PIN 9

U5 '32   U8 '04 A   U5 '32   U8 '04 A
U8 '04 A   U8 '04 B   RESET2*
RESET*

470 R4   +5V

U10 'XF' '21   U7 '08   OUTCF   U5 '32
U10 'X0' '21   U7 '08   OUT30   U5 '32
'CX'   '3X'

U6 '04   U6 '04   U6 '04 B   HDBCS* (C8-CFH)

RP2 4.7K   '4' '½S1
U13 '585   A1=BOUT B1 B2 B3 B4   A=BIN

RP2 4.7K   RP1 4.7K   '3H' ½S1
U16 '585   A1=BOUT B1 B2 B3 B4   A=BIN

INSEL* U3 PIN9
U4 '02   IORQ (From U4 Pin13)
U8 '04 A   N.C.   U7 '08
IN   U11 741L   +5VDC 470
EXTIOSEL
OUT U6 '04 A

U7 '08

DOE   D   CLR Q   ½C '74 U12   CL   PRE
4.7K R5   +5V
RESET*
D   CLR Q̄   ½C '74 U12   CL   PRE Q
741...

RESET*   D   CLR Q   ½D '74 U15   CL   PRE   +5V 4.7K RP1
D2E

RESET*   D   CLR Q̄   ½E '74 U14   CL   PRE Q   .01UF C21
RESET2*   D   CLR   ½D '74 U15   CL   PRE Q̄   +5V 4.7K RP1
D1E   '04

RESET2*   D3E   D   CLR   ½E '74 U14   CL   PRE Q̄   +5V 4.7K RP1

INSEL*   TO U4 PIN3

PWR
5 PIN
P...

PWR IN
5 PIN DIN

HEAT SINK

8-9 VDC AVL.

4.75 – 5.25 VDC

DECOUPLING ONE .01 UF CAP PER IC

'04 '04 '08 '16 '21 '32 '74 '74 '74 '85 '123 '2114 8303 '02

+5V
.1 UF
GND

CLR ½ C '74 U12 PRE Q 5

4.7K R5 +5V

SET*

CLR ½ C '74 U12 PRE Q

7416 U11 5 6 220 R1 DS1 +5V

47K R6

5.1K 250K R3* R8 +5V

.02 UF C19

Cext C/R Vcc ½ '123 A U9 Q 1MS

7416 U11 3 4 WAIT*

IOBUSINT* 39

*NOTE: ALTERNATE SUBSTITUTION
R3: 100K FIXED, R8: 100K POT.
FOR 150KΩ NOMINAL ± 1MS

R9 100K

5.1K R7 300US
.02 UF C20

Cext C/R B ½ '123 U9 A Q 5

7416 U11 11 10 HDBDRQ* 45

CLR ½ D '74 J15 PRE Q

4.7K RP1

SET*

CLR ½ E '74 J14 PRE Q

7416 U11 9 8 220 R2 DS2 +5V
LOCATED NEXT TO SWITCH

Part of J2   Part of J1

39 40 HDBINTRQ*
41 42 HDBWAIT*
45 38

EXCEPT PIN 50

ALL EVEN   ALL ODD

Part of J2

A0 5 A1 6 A2 7 A3 4 A4 3 A5 2 A6 1 A7 17 15 2114 U2 WR 14 CS 13 12 11
D7* D6* D5* D4*

CLR ½ D '74 J15 PRE Q 8

4.7K RP1 U6 '04 11 A 10

A0 5 A1 6 A2 7 A3 4 A4 3 A5 2 A6 1 A7 17 15 2114 U1 CS 8 14 13 12 11 WR 16 10
D3* D2* D1* D0*

B:T/R̄ 11
A7 8 A6 7 A5 6 A4 5 A3 4 A2 3 A1 2 A0 1
B7 12 D7E
B6 13 D6E
B5 14 D5E
B4 15 D4E
B3 16 D3E
B2 17 D2E
B1 18 D1E
B0 19 D0E
AM8303 U3 CS 9

16 15
14 13
12 11
10 9
8 7
6 5
4 3
2 1

Part of J2

CLR ½ E '74 J14 PRE Q 8

4.7K RP1 +5V

NSEL* TO U4 PIN 3

REF: DRILL PLAN 1700220

DRAFT	DATE	TITLE
CHECK	DATE	MOD III, IV & MOD II/16
DESIGN K. STEELE	DATE 11/1/82	I/O PORT TESTER
APPD REV A K. STEELE	DATE 12/14/82	
APPD	DATE	6-13-83

tandy

DWG NO. 8000180	SIZE C
SCALE	SHEET 1 OF 1

PC BOARD LAYOUT

Wire

U4 pin 1 — U7 pin 10

U4 pin 2 — U8 pin 1

V+ — U4 pin 12

PC BOARD TOP VIEW
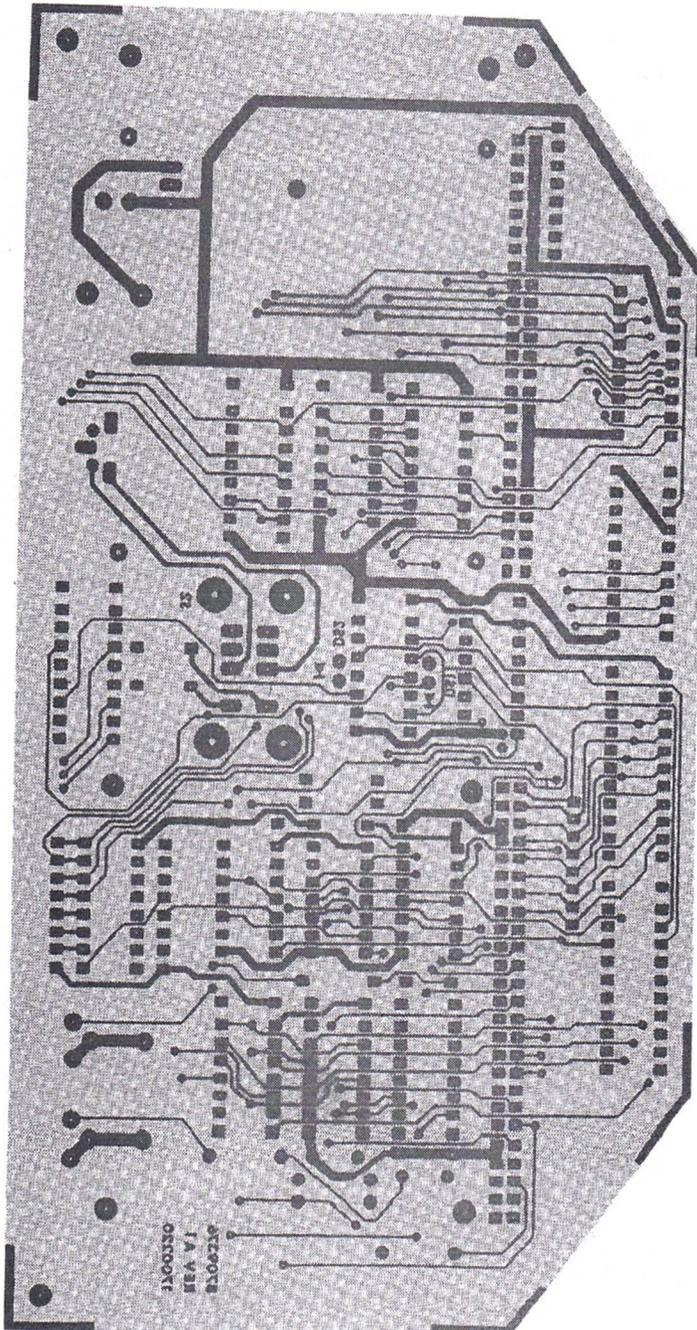
PC BOARD BOTTOM VIEW

Troubleshooting Hints:

The Address & Data Signal Test is the most complete test of the I/O bus. If you get an error, execute the Address Only Test. This will isolate it to one of the two busses by checking the address but not the data bus. If no errors are found on this test then it would be a good guess that the data bus is the source of the errors on the A & D Signal Test. Use your oscilloscope to check for data (or lack of it) on the suspect bus.

In troubleshooting a failure on the interrupt test, it would be best to start at the I/O Port connector and step back through the interrupt circuitry using the oscilloscope to follow the signal. Use LOOP mode to get continuous interrupts.

Troubleshooting for failures on the WAIT Test should be done using the same techniques as on the interrupt test, check back through the wait circuitry to the Z-80.

SERVICE POLICY

Radio Shack's nationwide network of service facilities provides quick, convenient, and reliable repair services for all of its computer products, in most instances. Warranty service will be performed in accordance with Radio Shack's Limited Warranty. Non-warranty service will be provided at reasonable parts and labor costs.

Because of the sensitivity of computer equipment, and the problems which can result from improper servicing, the following limitations also apply to the services offered by Radio Shack:

1. If any of the warranty seals on any Radio Shack computer products are broken, Radio Shack reserves the right to refuse to service the equipment or to void any remaining warranty on the equipment.

2. If any Radio Shack computer equipment has been modified so that it is not within manufacturer's specifications, including, but not limited to, the installation of any non-Radio Shack parts, components, or replacement boards, then Radio Shack reserves the right to refuse to service the equipment, void any remaining warranty, remove and replace any non-Radio Shack part found in the equipment, and perform whatever modifications are necessary to return the equipment to original factory manufacturer's specifications.

3. The cost for the labor and parts required to return the Radio Shack computer equipment to original manufacturer's specifications will be charged to the customer in addition to the normal repair charge.