

SERVICE MANUAL
1571 DISK DRIVE

Preliminary

OCTOBER 1986 PN-314002-04

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COMMODORE 1571 DISK DRIVE

SPECIFICATIONS

GENERAL FEATURES

- 5-1/4" Floppy Disk Drive
- Supports Fast Data Transfer Rates
- Two Serial Ports for Adding Peripherals
- Software Disk Format Selectable
- Comes with Serial and Power Cables Compatible with Commodore 128, Commodore 64, and Plus/4 Computers

SYSTEM FEATURES

- Built-in 6502 Microprocessor
- 2K RAM
- 32K ROM
- Built-in DOS
- Program Load Transfer Rates
 - 300 cps under C64 Control
 - 5200 cps Max under C128 Control (Burst Rate)
 - 5200 cps Max under CP/M® Control (Burst Rate)

MEDIA CHARACTERISTICS

- Commodore Standard (GCR)
- Double Sided/Single Density
- 350K Storage Capacity (Formatted)
- Compatible with 1541 Disk Drive
- Supports Program, Sequential, Relative and User Files

- CP/M Compatible (MFM)
- Single or Double Sided/Double Density Formats
- Up to 410K Storage Capacity (Formatted)
- Read/Write Compatible with Kaypro®, Osborne®, IBM®, CP/M® 86, Epson® QX-10 and Numerous Other Formats
- Supports Most CP/M® Files

INPUTS/OUTPUTS

- Two Serial Ports
- Power Connector

POWER REQUIREMENTS

- 117 Volts AC, 60Hz, Less than 25 Watts

Specifications subject to change without notice.

CP/M is a registered trademark of Digital Research, Inc.

KayPro is a registered trademark of Kaypro, Inc.

Osborne is a registered trademark of Osborne Computer Corporation.

IBM is a registered trademark of International Business Machines Corp.

Epson is a registered trademark of Epson Corporation.

PARTS LIST

1571

PLEASE NOTE: Commodore part numbers are provided for reference only and do not indicate the availability of parts from Commodore. Industry standard parts (Resistors, Capacitors, Connectors) should be secured locally. Approved cross-references for TTL-chips, Transistors, etc. are available in manual form through the Service Department. Unique or non-standard parts will be stocked by Commodore and are indicated on the parts list by a "C".

TOP CASE ASSY

Top Case	C 310508-01
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BOTTOM CASE ASSY

Bottom Case	C 310509-01
PCB Assembly	C 310420-01
Power Supply Assembly	C 250772-01
Drive Assembly - Newtronics	C 252083-01
Drive Assembly - Alps	C 252092-01
PCB Shield	C 252069-01
PCB Insulation Sheet	C 252070-01

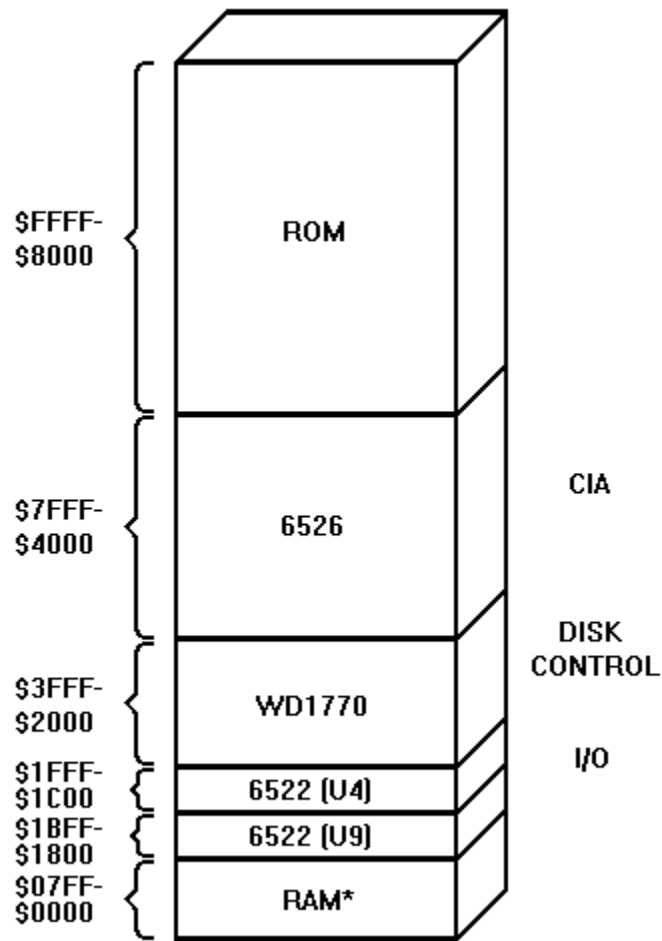
FRONT CASE ASSY

Front Bezel - Alps	C 252086-01
Front Bezel - Newtronics	C 310507-01
Disk Eject Lever	C 252050-01
LED Assembly	C 250754-04
LED Clip	C 252013-01
Nameplate	C 310411-01

ACCESSORIES

Users Manual	C 252095-01
Demo Disk	C 252093-01
Power Cord	C 252164-01 sub: C 903508-04
6-Pin Din Cable	C 252159-01 sub: C 1540027-01

MEMORY MAP



* ONLY 2K OF RAM SPACE AVAILABLE IN THE 1571
ADDRESS DECODING IS ACCOMPLISHED BY THE 64H157 GATE ARRAY.

20 PIN GATE ARRAY

1541B AND 1571

The 20 pin gate array used in the 1541B and 1571 disk drives is designed to work in conjunction with the 40/42 pin gate array also used in these drives. As illustrated in the block diagram, this I.C. controls 3 operations:

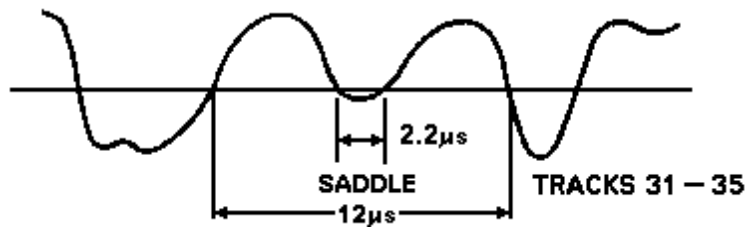
1. ADDRESS SELECTOR

The function of the address selector is to produce ROM, RAM and I/O chip select signals by decoding the addresses A10, A12, A13, A14 and A15. The system clocks are not gated with the address lines in this I.C. All chip select outputs are ACTIVE LOW.

Address Decode Map:	RAME	0000	--	07FF
	IO1	1800	--	1BFF
	IO2	1C00	--	1FFF
	CS1	2000	--	3FFF
	CS2	4000	--	7FFF
	ROME	C000	--	FFFF

2. SADDLE CANCELER

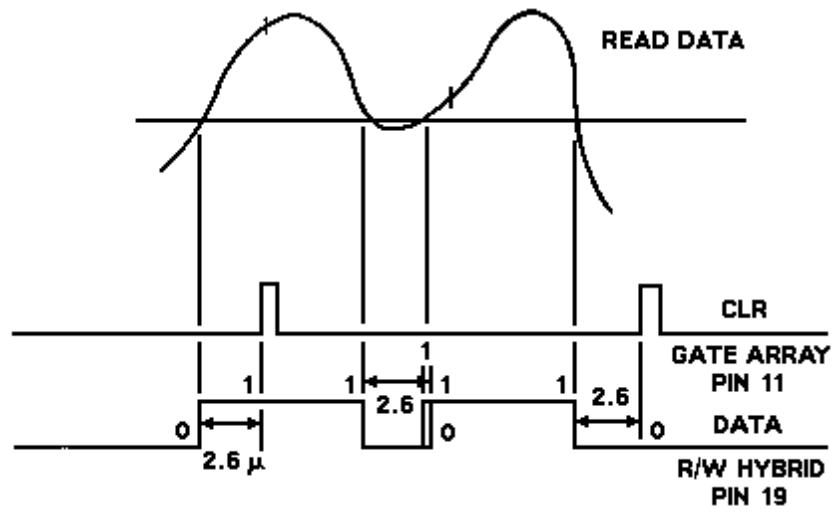
This correction signal is generated during the period that the data pattern is two consecutive zeros. With the Commodore GCR type recording format, a problem occurs in the waveform of the read signal. In the worst case pattern of 1001, a saddle condition will occur as illustrated below.



The worst case saddle will occur in tracks 31 to 35 and if not compensated for, will result in a read error. In the original 1541 drives, a one-shot was used to correct the condition; however, in this gate array it is corrected digitally.

The data output line, pin 19, of the R/W Hybrid's data comparitor is fed to the data input line, pin 3, of this gate array.

The data is then compared with the last data value which has been latched by the gate array, 2.6 usec after the rising or falling edge of the data line. If the current data value differs from the previous data value, the clear line is set to a high level for a duration of 63 nsec. If the values are the same, the clear line is not set.



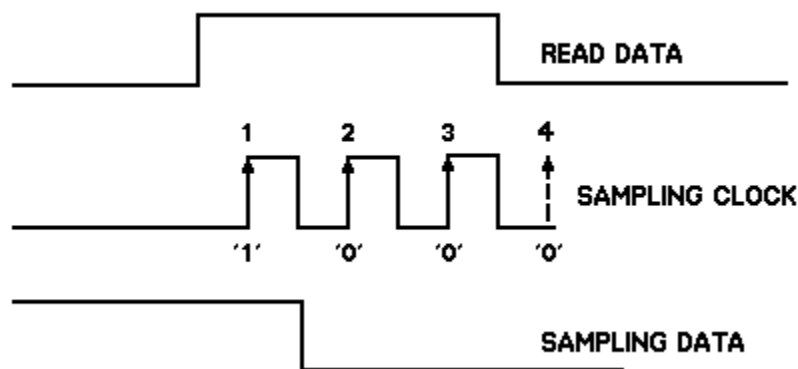
20 PIN GATE ARRAY (continued)

It takes 2.56 to 2.62 usec to cancel the saddle. If the saddle should be longer than this length of time, the saddle can not be corrected and will result in a read error. Also, if the time for correcting the saddle is set for a longer time interval, the clear signal will not be set when the data is equal to 11. Therefore, approximately 2.6 usec the most suitable time setting for saddle correction.

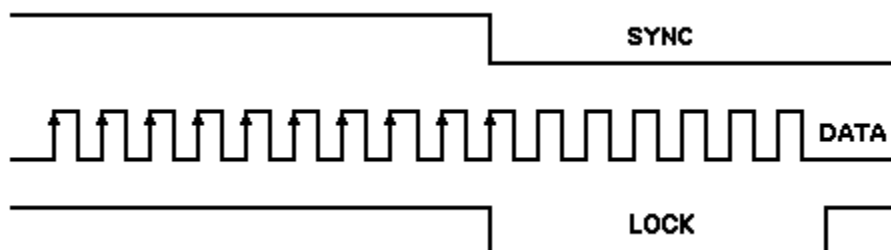
Note: The minimum bit rate for tracks 1 - 17 is equal to 2.6 usec. If this time should become less due to motor speed, the SYNC signal cannot be recognized on the outer tracks resulting in error.

3. MOTOR SPEED COMPENSATOR (PLL)

This gate array detects the motor speed and generates an internal data sampling clock signal that matches with the motor speed (see below).

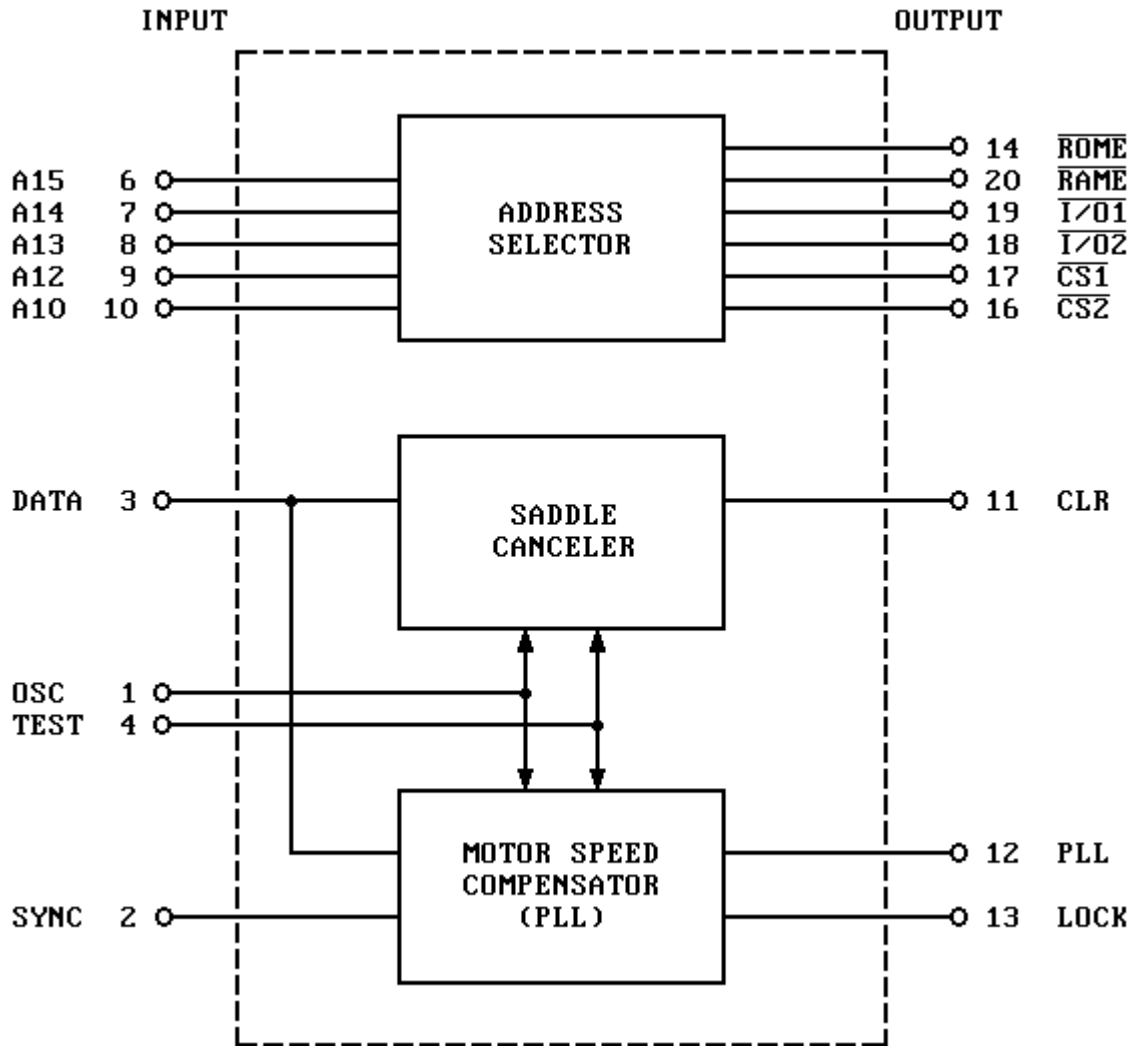


When the SYNC signal goes to the low level, the LOCK signal goes false and the sampling clock is switched to the internal clock signal of the gate array. Once the PLL has sampled the data one's, the LOCK signal will go high to indicate that the output of the PLL is valid. If the PLL cannot lock on, the internal clock signal will be used and the LOCK signal will remain at the low level. This can occur when the stepper is still moving or the spindle motor is not up to speed yet. In short, this allows the reading of data independent of motor speed within the lock on limits of the PLL.



The 1571 runs on the SYSTEM CLOCK and does not implement the LOCK signal.

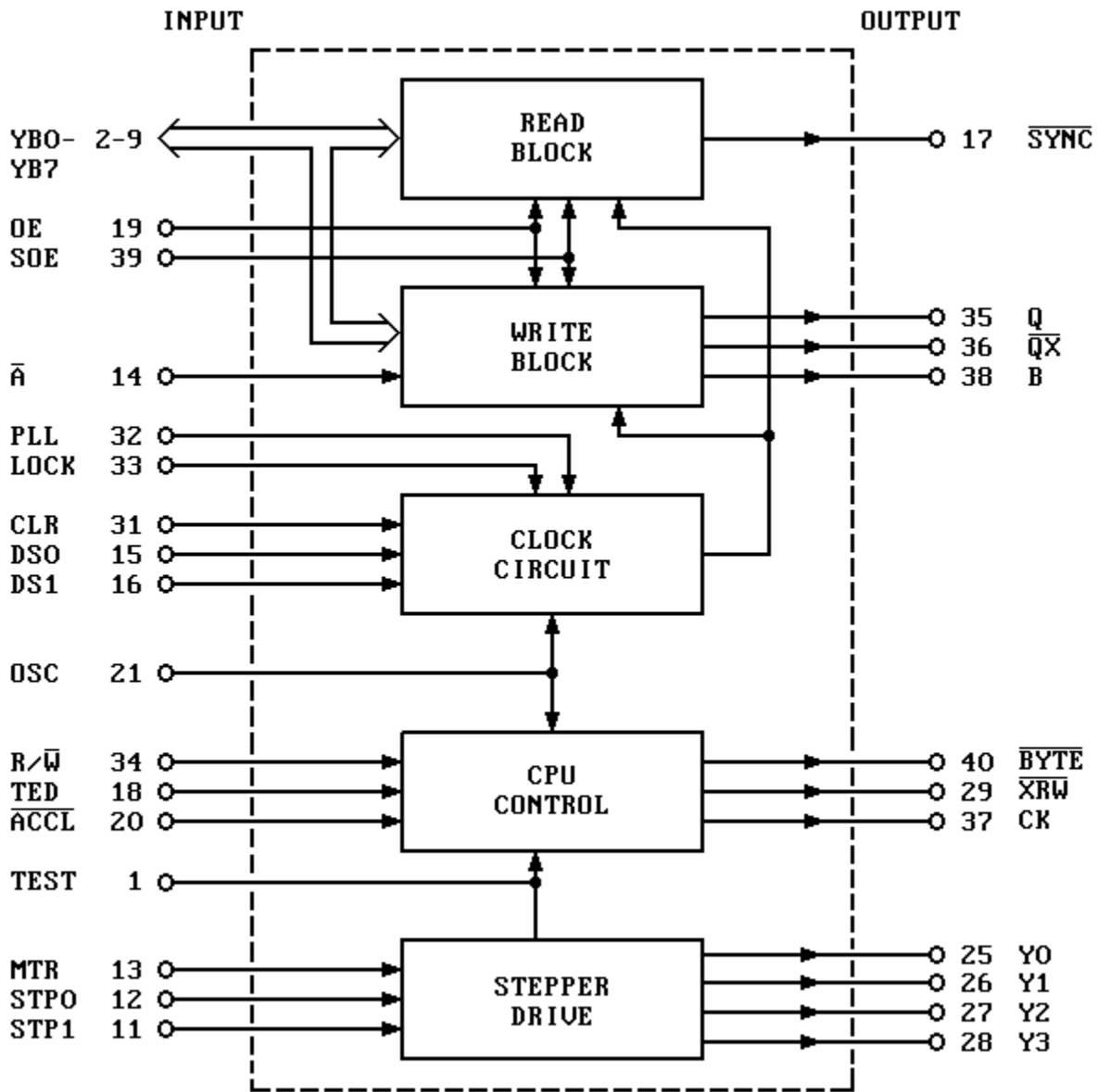
251829
BLOCK DIAGRAM
20 PIN GATE ARRAY FOR 1541B/1571



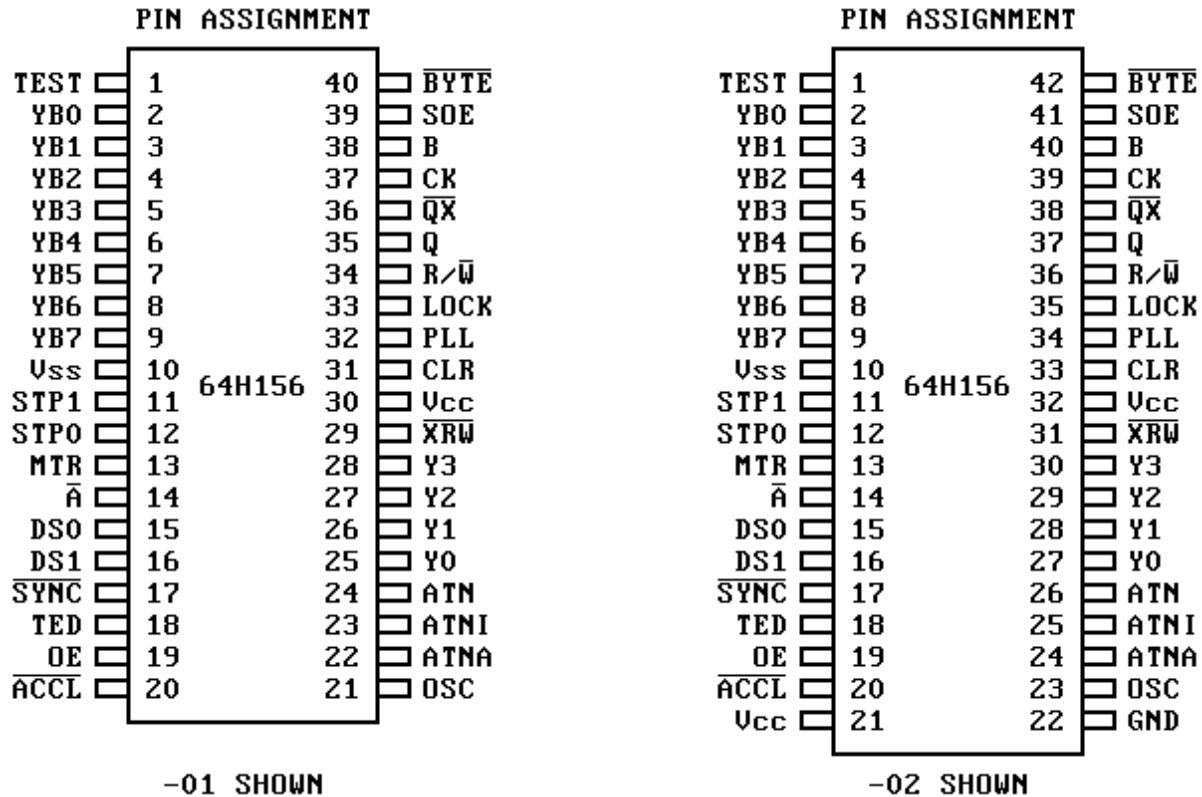
251828

BLOCK DIAGRAM

40/42 PIN GATE ARRAY FOR 1541B/1571



40/42 PIN GATE ARRAY

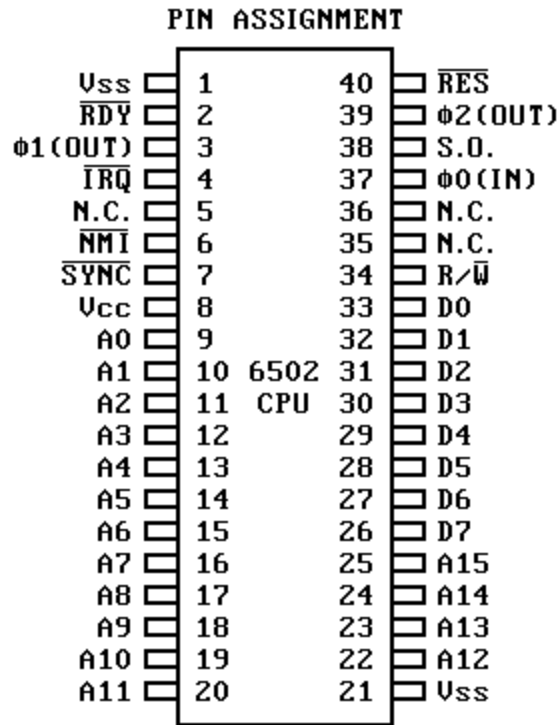


40 PIN	42 PIN	DESC	FUNCTION
1	1	TEST	Input used in design verification.
2-9	2-9	YB0-YB7	Data input/output lines for read/write operation.
10	10	Vss	Ground.
11,12	11,12	STP0,STP1	Input to stepper driver.
13	13	MTR	Control line used to activate the stepper motor.
14	14	A	Write protect input. Indicates disk is write protected.
15,16	15,16	DS0,DS1	Inputs used to produce the binary count for the frequency divide ratio.
17	17	SYNC	Sync output.
18	18	TED	A low input clears the BYTE line in 2 MHz mode. A high sets 1541 mode.
19	19	OE	Input to read/write block to set mode. 0 for Write, 1 for Read.
20	20	ACCL	Input select line for the CPU clock. 0 for 1541 - 1 MHz, 1 for 1571 - 2 MHz.
XX	21,22		N/C
21	23	OSC	16 MHz clock input.
22	24	ATNA	Attention acknowledge input.
23	25	ATNI	Attention line input from serial bus.
24	26	ATN	Attention data input from serial bus.
25-28	27-30	Y0-Y3	Control output lines for the 4 phases of the stepper motor.

29	31	XRW	RAM write enable output.
30	32	Vcc	+5VDC.
31	33	CLR	High input when the read data is logical 1.
32	34	PLL	Input from the 20 pin gate array. Clock compensation.
33	35	LOCK	Indicates the PLL LOCK status. When logical 1, PLL is locked. When 0, the internal clock is used for sampling data.
34	36	R/W	R/W select input.
35,36	37,38	Q,Qx	Write pulse outputs.
37	39	CK	Clock select output - 1 or 2 MHz.
38	40	B	Write enable output.
39	41	SOE	Enable byte input.
40	42	BYTE	Data latched output.

18	CLK	CLOCK	This input requires a free-running 50% duty cycle clock (for internal timing) at 8MHz \pm 1%.
19	RD	READ DATA	This active low input is the raw data line containing both clock and data pulses from the drive.
20	MO	MOTOR ON	Active high output used to enable the spindle motor prior to read, write or stepping operations.
21	WG	WRITE GATE	This output is made valid prior to writing on the diskette.
22	WD	WRITE DATA	FM or MFM clock and data pulses are placed on this line to be written on the diskette.
23	TR00	TRACK00	This active low input informs the WD1770 that the drive's R/W heads are positioned over Track Zero (internal pull-up).
24	IP	INDEX PULSE	This active low input informs the WD1770 when the physical Index Hole has been encountered on the diskette (internal pull-up).
25	WPRT	WRITE PROTECT	This input is sampled whenever a Write Command is received. A logic low on this line will prevent any Write Command from executing (internal pull-up).
26	DDEN	DOUBLE DENSITY ENABLE	This input pin selects either single (FM) or double (MFM) density. When DDEN = 0, double density is selected (internal pull-up).
27	DRQ	DATA REQUEST	This active high output indicates that the data register is full (on a READ) or empty (on a Write operation).
28	INTRQ	INTERRUPT REQUEST	This active high output is set at the completion of any command or reset or read of the status register.

6502 MICROPROCESSOR

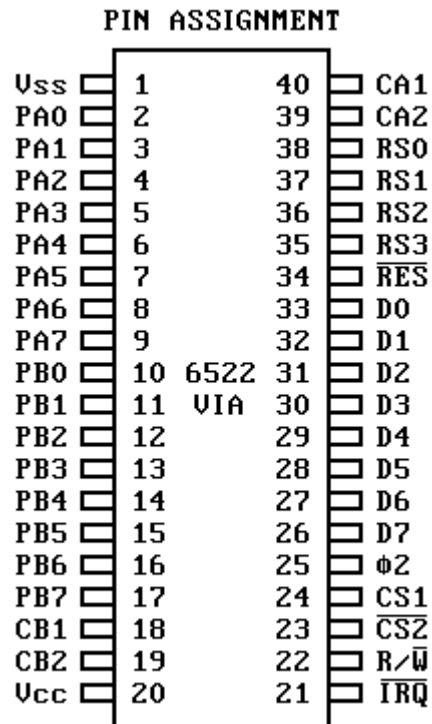


PIN	DESC	FUNCTION
1,21	V_{ss}	Ground.
2	\overline{RDY}	Ready. TTL level input, used to DMA the 6502. The processor operates normally while \overline{RDY} is high. When \overline{RDY} makes a transition to the low state, the processor will finish the operation it is an, and any subsequent operation if it is a write cycle. On the next occurrence of read cycle the processor will halt, making it possible to tri-state the processor to gain complete access to the system bus.
3	$\phi 1$	Phase 1 clock output.
4	\overline{IRQ}	The Interrupt Request input is a request that the processor initiate an interrupt sequence. The processor will complete execution of the current instruction before recognizing the request. At that time, the interrupt mask in the Status Code Register will be examined. If the Interrupt Mask is not set, the processor will begin an interrupt sequence. The Program Counter and the Processor Status Register will be stored on the stack and the interrupt disable flag is set so that no other interrupts can occur. The processor will then load the Program Counter from the memory location \$FFFE and \$FFFF.
6	\overline{NMI}	The Non-Maskable Interrupt Request is a negative-edge sensitive request that the processor initiate an interrupt sequence. The processor will complete execution of the current instruction before recognizing the request.
7	\overline{SYNC}	The \overline{SYNC} output is used in conjunction with \overline{RDY} to allow single instruction execution.
8	V_{cc}	+5VDC input.
9-20,22-25	A0-A15	Address bus outputs. Unidirectional bus used to address memory and I/O devices.

26-33	D0-D7	Bi-directional bus for transferring data to and from the device and the peripherals.
34	R/W	The read/write line is a TTL level output from the processor to control the direction of data transfer between the processor and memory, peripherals, etc. This line is high for reading memory and low for writing.
37	Phi0	Phase 0 clock input.
38	S.O.	Set Overflow flag. A negative going edge sets the overflow bit in the status code register.
39	Phi2	Phase 2 clock output.
40	RES	The Reset input is used to reset or start the microprocessor from a power down condition. During the time that this line is held low, writing to or from the microprocessor is inhibited. When a positive edge is detected on the input, the microprocessor will immediately begin the reset sequence. After a system initialization time of 6 cycles, the mask interrupt flag will be set and the processor will load the program counter from the contents of the memory location \$FFFC and \$FFFD. This is the start location for program control. After V_{CC} reaches 4.75 volts in a power up routine, reset must be held low for at least 2 cycles. At this time the R/W line will become valid.

6522

VERSATILE INTERFACE ADAPTOR (VIA)

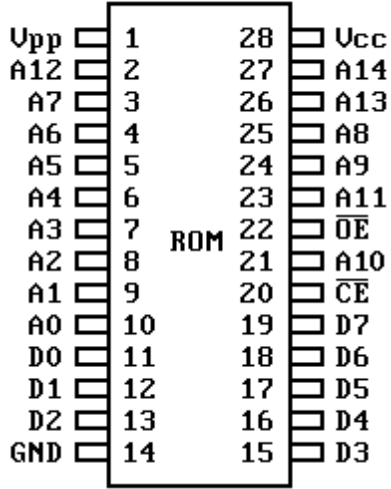


PIN	DESC	FUNCTION
1	V _{SS}	Ground.
2-9	PA0-PA7	Peripheral I/O Port A.
10-17	PB0-PB7	Peripheral I/O Port B.
18,19	CB1, CB2	Peripheral B Control Lines.
20	V _{CC}	+5VDC.
21	IRQ	Interrupt Request.
22	R/W	Read/Write.
23,24	CS1, CS2	Chip Select.
25	$\phi 2$	Phase 2 Internal Clock.
26-33	D0-D7	Data Bus.
34	RES	Reset Input, Low Active.
35-38	RS0-RS3	Register Select Inputs.
39,40	CA1, CA2	Peripheral A Control Lines.

20	Vcc	5V DC input.
21	IRQ	Interrupt output to microprocessor.
22	R/W	READ/WRITE input from microprocessor's R/W output.
23	CS	Chip select input. A low pulse will activate CIA.
24	FLAG	Negative-edge sensitive interrupt input. Can be used as a handshake line for either parallel port.
25	Phi2	Phase 2 clock input.
26-33	DB0-DB7	Bi-directional data bus.
34	RES	Low active reset input. Initializes CIA.
35-38	RS0-RS3	Register select inputs. Used to select all internal registers for communications with the parallel ports, time of day clock, and serial port (SP).
39	SP	Serial Port bi-directional connection. An internal shift register converts microprocessor parallel data into serial data, and visa-versa.
40	CNT	Count input. Internal timers can count pulses applied to this input. It is used for frequency dependent operations.

23256 32K x 8 ROM

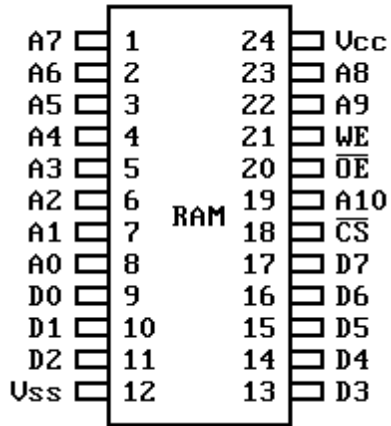
PIN ASSIGNMENT



PIN	DESC	FUNCTION
1	Vpp	5V DC
2-10,21,23-27	A0-A14	Address Bus Inputs.
11-13,15-19	D0-D7	Data Outputs.
14	GND	Ground.
20	CE	Chip Enable.
22	OE	Output Enable.
28	Vcc	5V DC Input.

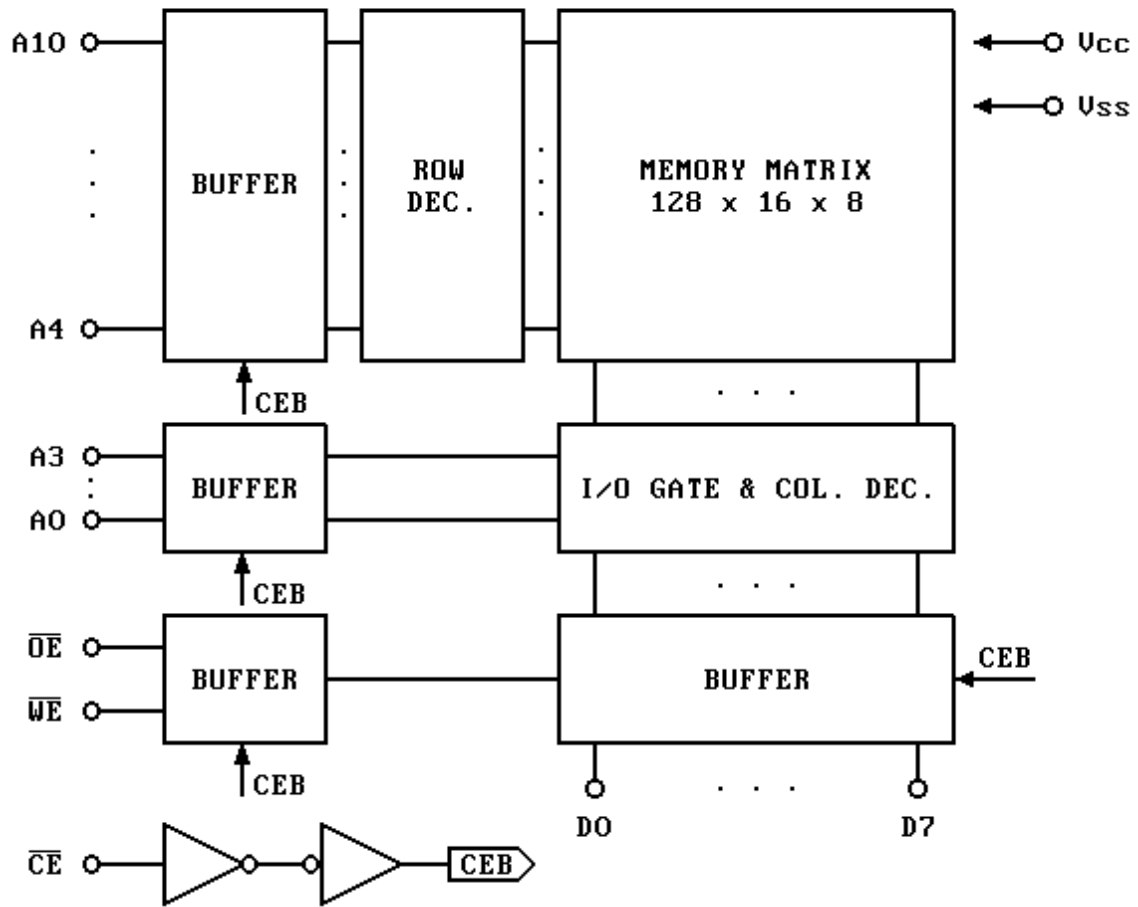
2016 2K x 8 STATIC RAM

PIN ASSIGNMENT



PIN	DESC	FUNCTION
1-8,19,22,23	A0-A10	Address Bus Inputs.
9-11,13-17	D0-D7	Common Data Input/Output Lines.
12	Vss	Ground.
18	CS	Chip Select Enable, Low Active.
20	OE	Output Enable, Low Active.
21	WE	Write (Input) Enable, Low Active.
24	Vcc	5V DC Input.

FUNCTIONAL DIAGRAM



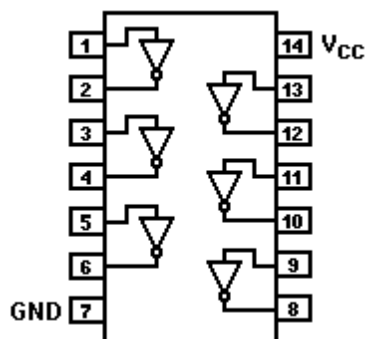
COMMON I.C.'S

PIN ASSIGNMENTS AND LOGIC

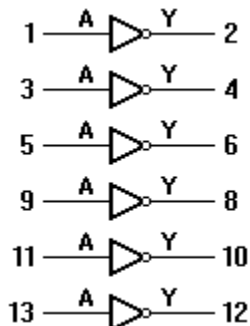
7406

HEX INVERTER BUFFER/DRIVER (OPEN COLLECTOR)

PIN ASSIGNMENT



LOGIC DIAGRAM



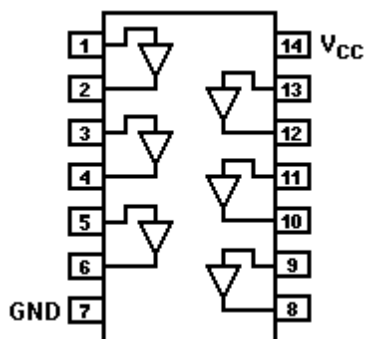
TRUTH TABLE

INPUT	OUTPUT
A	Y
H	L
L	H

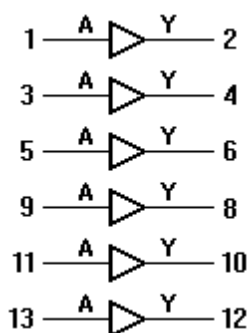
7407

HEX BUFFER/DRIVER (OPEN COLLECTOR)

PIN ASSIGNMENT



LOGIC DIAGRAM



TRUTH TABLE

INPUT	OUTPUT
A	Y
H	H
L	L

7414 • 74LS14 • 74F14

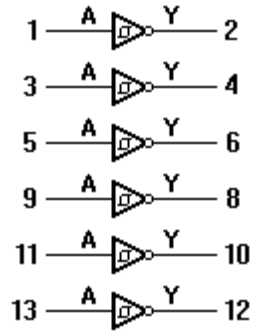
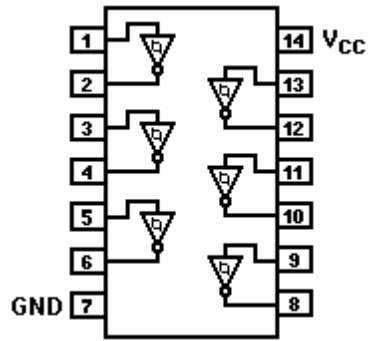
HEX INVERTER SCHMITT TRIGGER

PIN ASSIGNMENT

LOGIC DIAGRAM

TRUTH TABLE

INPUT	OUTPUT
A	Y

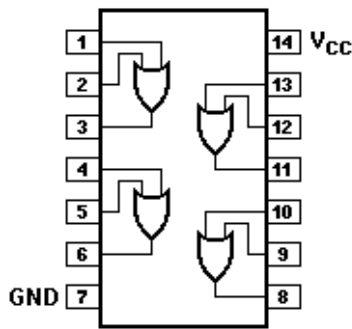


L	H
H	L

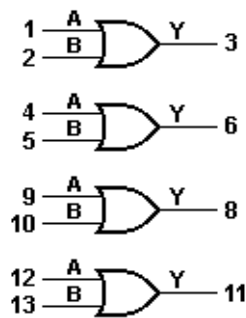
COMMON I.C.'S PIN ASSIGNMENTS AND LOGIC

7432 • 74S32 • 74LS32 • 74F32 QUAD 2-INPUT OR GATE

PIN ASSIGNMENT



LOGIC DIAGRAM



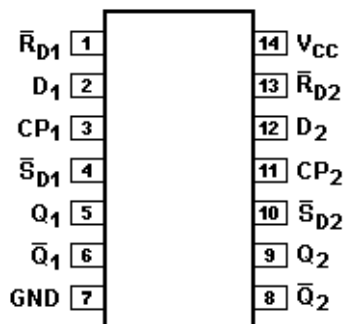
TRUTH TABLE

INPUTS		OUTPUT
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	H

H = HIGH voltage level
L = LOW voltage level

7474 • 74S74 • 74LS74 • 74F74 DUAL D-TYPE FLIP-FLOP (POSITIVE EDGE TRIGGERED)

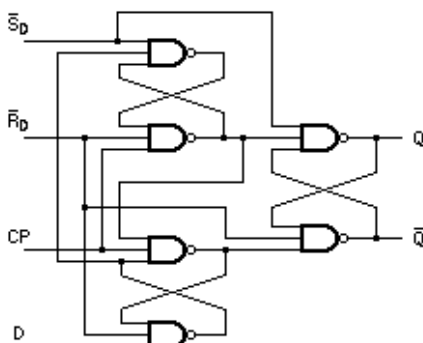
PIN ASSIGNMENT



TRUTH TABLE

OPERATING MODE	INPUTS				OUTPUTS	
	\bar{S}_D	\bar{R}_D	CP	D	Q	\bar{Q}
Asyn. Set	L	H	X	X	H	L
Asyn. Reset (Clear)	H	L	X	X	L	H
Undetermined (a)	L	L	X	X	H	L
Load "1" (Set)	H	H	↑	h	H	L
Load "0" (Reset)	H	H	↑	l	L	H

LOGIC DIAGRAM



H = HIGH voltage level steady state.

h = HIGH voltage level one setup time prior to the LOW-to-HIGH clock transition.

L = LOW voltage level steady state.

l = LOW voltage level one setup time prior to the LOW-to-HIGH clock transition.

X = don't care.

↑ = LOW-to-HIGH clock transition.

NOTE

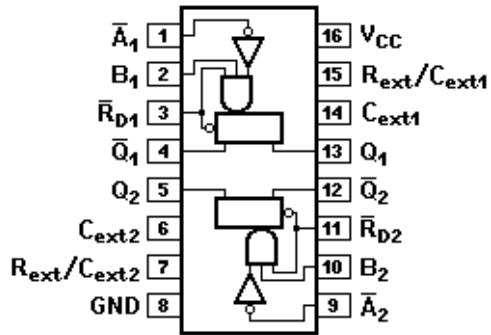
(a) Both outputs will be HIGH while both \bar{S}_D and \bar{R}_D are LOW.

But the output states are unpredictable if \bar{S}_D and \bar{R}_D go HIGH simultaneously.

74123 • 74LS123

DUAL RETRIGGERABLE MONOSTABLE MULTIVIBRATOR

PIN ASSIGNMENT

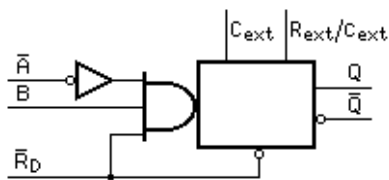


TRUTH TABLE

INPUTS			OUTPUTS	
\bar{R}_D	\bar{A}	B	Q	\bar{Q}
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↑	⌈	⌋
H	↓	H	⌋	⌈
↑	L	H	⌋	⌈

H = HIGH voltage level
 L = LOW voltage level
 X = Don't care
 ↑ = LOW-to-HIGH transition
 ↓ = HIGH-to-LOW transition
 ⌈ = One HIGH-level pulse
 ⌋ = One LOW-level pulse

LOGIC DIAGRAM



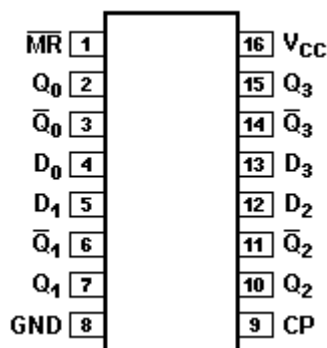
COMMON I.C.'S

PIN ASSIGNMENTS AND LOGIC

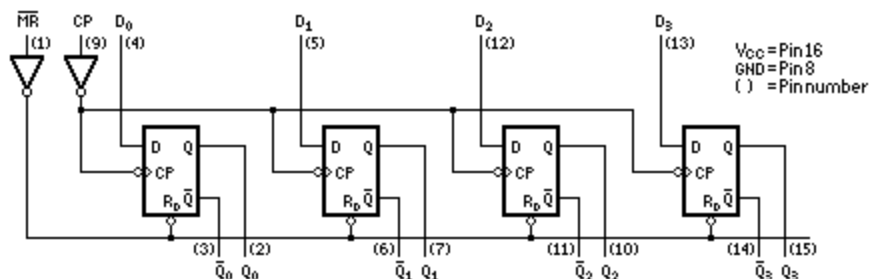
74175 • 74LS175 • 74F175

QUAD D-TYPE FLIP-FLOP

PIN ASSIGNMENT



LOGIC DIAGRAM



TRUTH TABLE

OPERATING MODE	INPUTS			OUTPUTS	
	\overline{MR}	CP	D_n	Q_n	\overline{Q}_n
Reset (clear)	L	X	X	L	H
Load "1"	H	↑	h	H	L
Load "0"	H	↑	l	L	H

H = HIGH voltage level steady state.
 h = HIGH voltage level one setup time prior to the LOW-to-HIGH clock transition.
 L = LOW voltage level steady state.
 l = LOW voltage level one setup time prior to the LOW-to-HIGH clock transition.
 ↑ = LOW-to-HIGH clock transition.
 X = don't care.

74LS241 • 74F241

OCTAL BUFFER, TRI-STATE

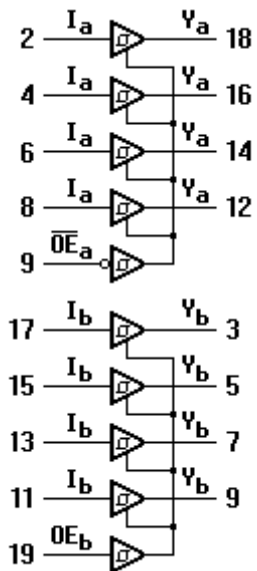
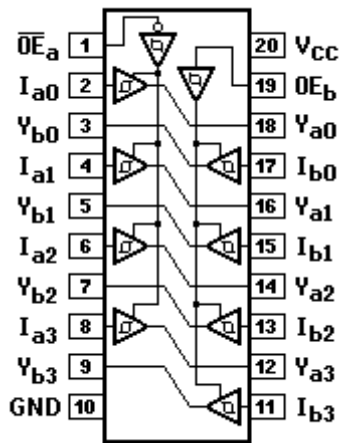
PIN ASSIGNMENT

LOGIC DIAGRAM

TRUTH TABLE

INPUTS				OUTPUTS	
\overline{OE}_a	I_a	OE_b	I_b	Y_a	Y_b
L	L	H	L	L	L
L	H	H	H	H	H
H	X	L	X	(Z)	(Z)

H = HIGH voltage level
 L = LOW voltage level

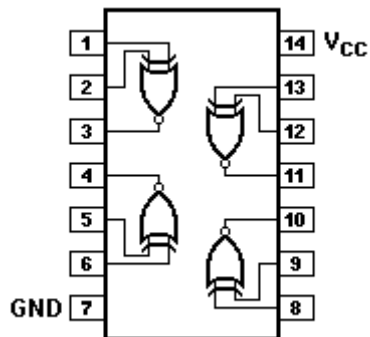


X = Don't care
(Z) = HIGH impedance (off) state

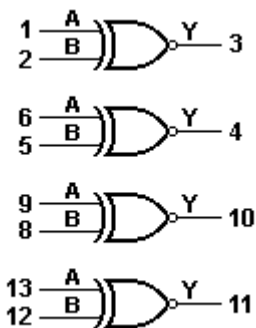
74LS266

QUAD 2-INPUT EXCLUSIVE NOR GATE (OPEN COLLECTOR)

PIN ASSIGNMENT



LOGIC DIAGRAM



TRUTH TABLE

INPUTS		OUTPUT
A	B	Y
L	L	H
L	H	L
H	L	L
H	H	H

H = HIGH voltage level
L = LOW voltage level

PARTS LIST

PCB ASSEMBLY #310420

Commodore part numbers are provided for reference only and do not indicate the availability of parts from Commodore. Industry standard parts (Resistors, Capacitors, Connectors) should be secured locally. Approved cross-references for TTL-chips, Transistors, etc. are available in manual form through the Service Department, order part #314000-01. Unique or non-standard parts will be stocked by Commodore and are indicated on the parts list by a "C". Vendor Name and part number have been provided for your convenience in ordering custom or unique parts.

INTEGRATED CIRCUITS	RESISTORS (Continued)
U1 6502 CPU C 901435-01	R14,15 2.7k
U2 23256 ROM C 310654-03	R16,17 4.7k
U3 2016 RAM 200 NS	R18,19 47
U4 65C22A VIA 2MHZ C 310653-01	R20 20k
U5 Gate Array 20 Pin C 251829-01	R21 4.7k
U6 Gate Array 40 Pin C 251828-01	R22 1k
U7 R/W Hybrid C 251853-01	R23 390
U8 7406	R24 47
U9 65C22A VIA 2MHZ C 310653-01	R25-28 2k
U10 74LS74	R29 4.7k
U11 WD 1770 Disk Control C 310651-01 sub:	R30 15k
WD 1772 Disk Control C 310651-02	R31 2k
U12 74F32	R32 4.7k
U13 74LS266	R33-35 2.7k
U14 7407	R36-38 1k
U15 74LS14	R39 43k
U16 7406	R40 4.7k
U17 74LS14	
U18 74LS175	
U19 74LS241	
U20 6526 CIA 2MHZ C 906108-02 sub:	
8520 CIA 2MHZ C 318029-02	
U21 PST 520C/D Volt Detector C 252034-02	
U22 74LS123	
TRANSISTORS	CAPACITORS
Q1 MPSU51 PNP	C1-20 Ceramic .1 μ F 16V
	C21 Electrolytic 10 μ F 25V
	C22,23 Ceramic .1 μ F 16V
	C24 NPO 100 pF 50V \pm 5%
	C27 Ceramic .1 μ F 16V
	C28 Electrolytic 47 μ F 10V +50%/-10%

Q2,3,7 2SC1815 NPN
 Q4 2SA673 PNP
 Q5 2SC945 NPN sub:
 2SC1685 R,S
 Q7 2SC1815 NPN

DIODES

CR3-8 Signal 1N914
 CR10 Signal 1N4002
 CR11 Zener 3.3V

RESISTORS - All are carbon 1/4 watt, 5%
 unless noted otherwise

R1-3 47
 R4 4.7k
 R5 390 1/2W ±5%
 R6 1.2k
 R7,8 1k
 R9-11 47k
 R12 150
 R13 390

C29 Electrolytic 10 25V
 μF
 C31 Electrolytic 1 μF 16V
 C32 Ceramic .01 50V
 μF
 C33 Tantalium 1 μF 35V ± 10%

MISCELLANEOUS

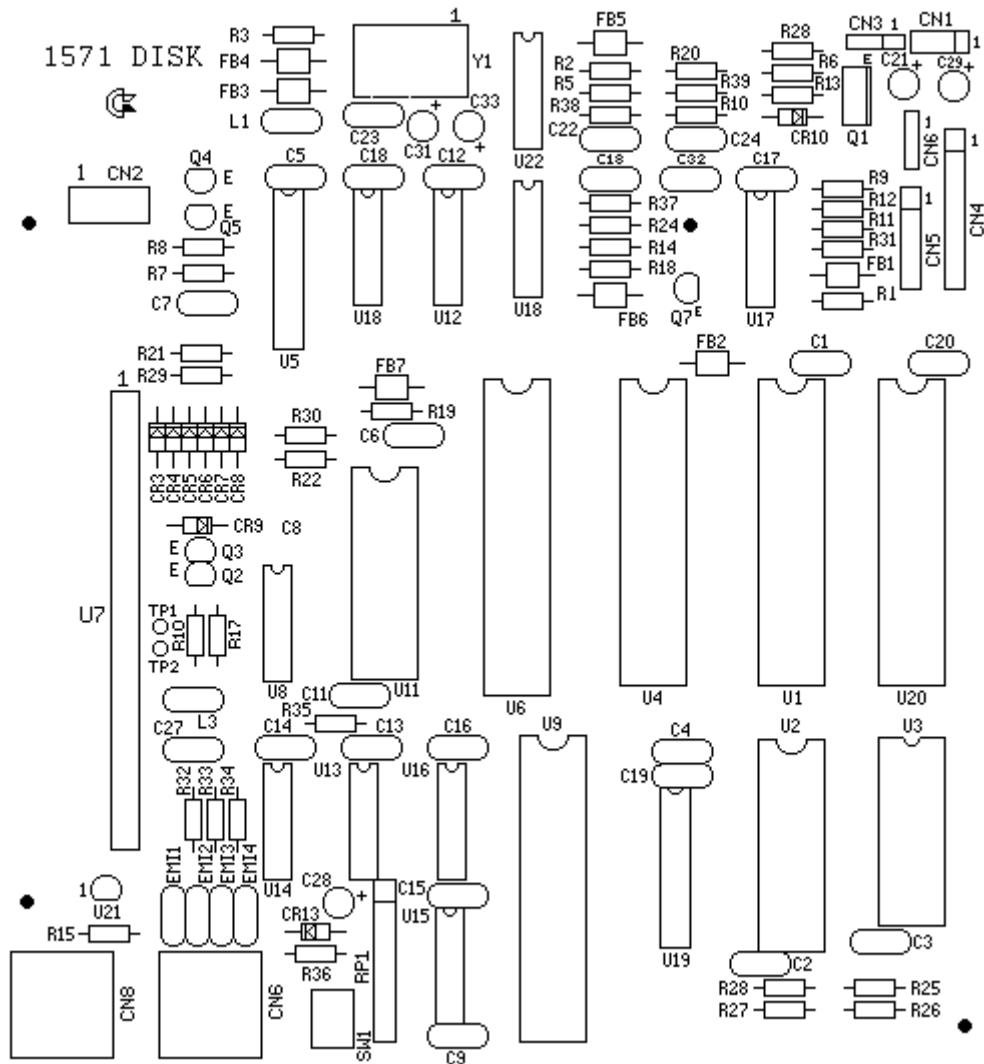
EMI
 1-4 Ferrite Bead
 FB 1-7 Ferrite Bead
 L1 Coil Inductor 2.2 μH
 L3 Coil Inductor 100 μH
 RP1 Resistor Pack 1k, 10Pin
 SW1 4 Pos Dip Switch C 252144-02
 Y1 Crystal Module 16MHZ C 325566-01

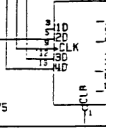
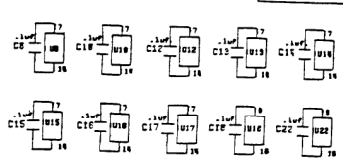
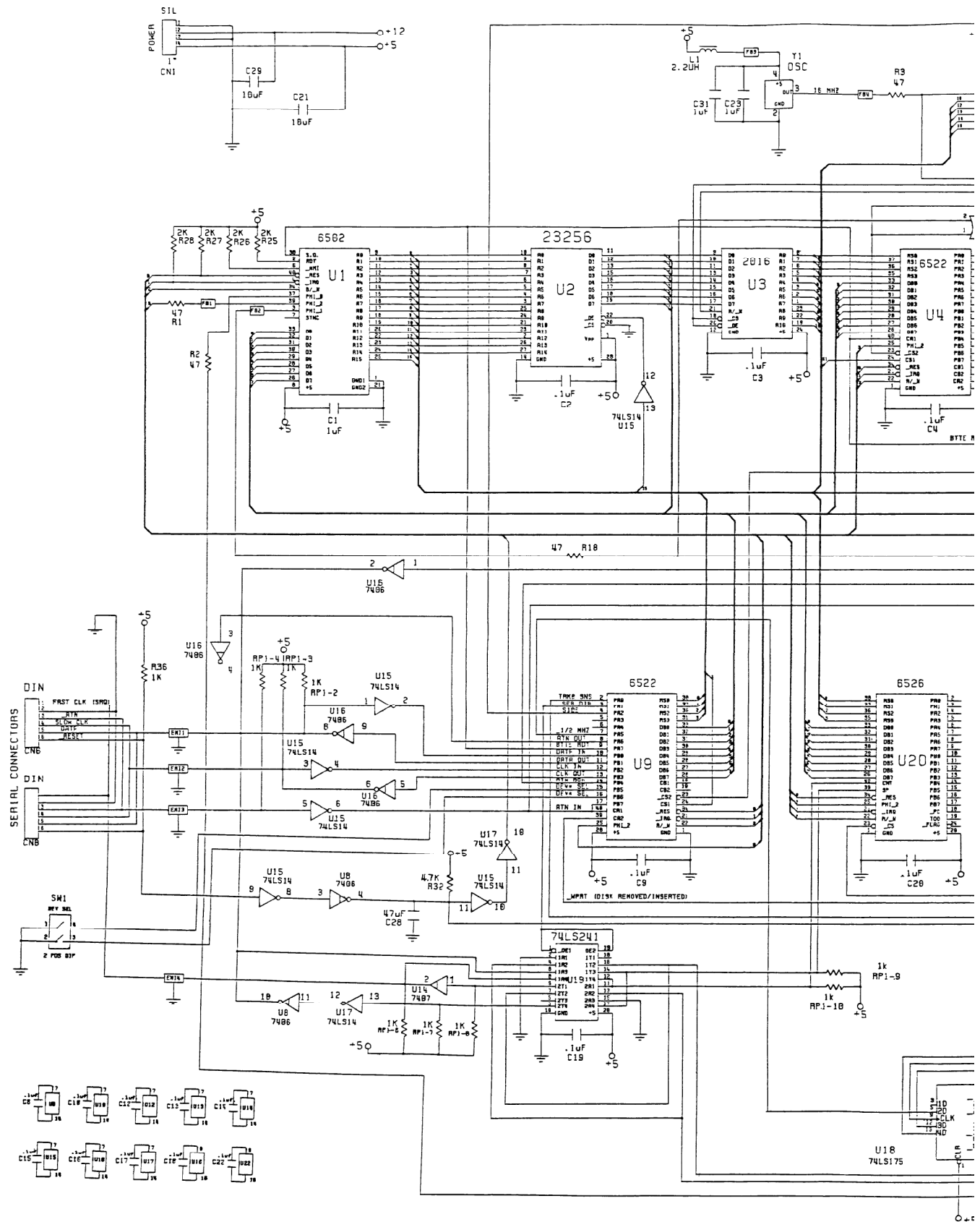
CONNECTORS

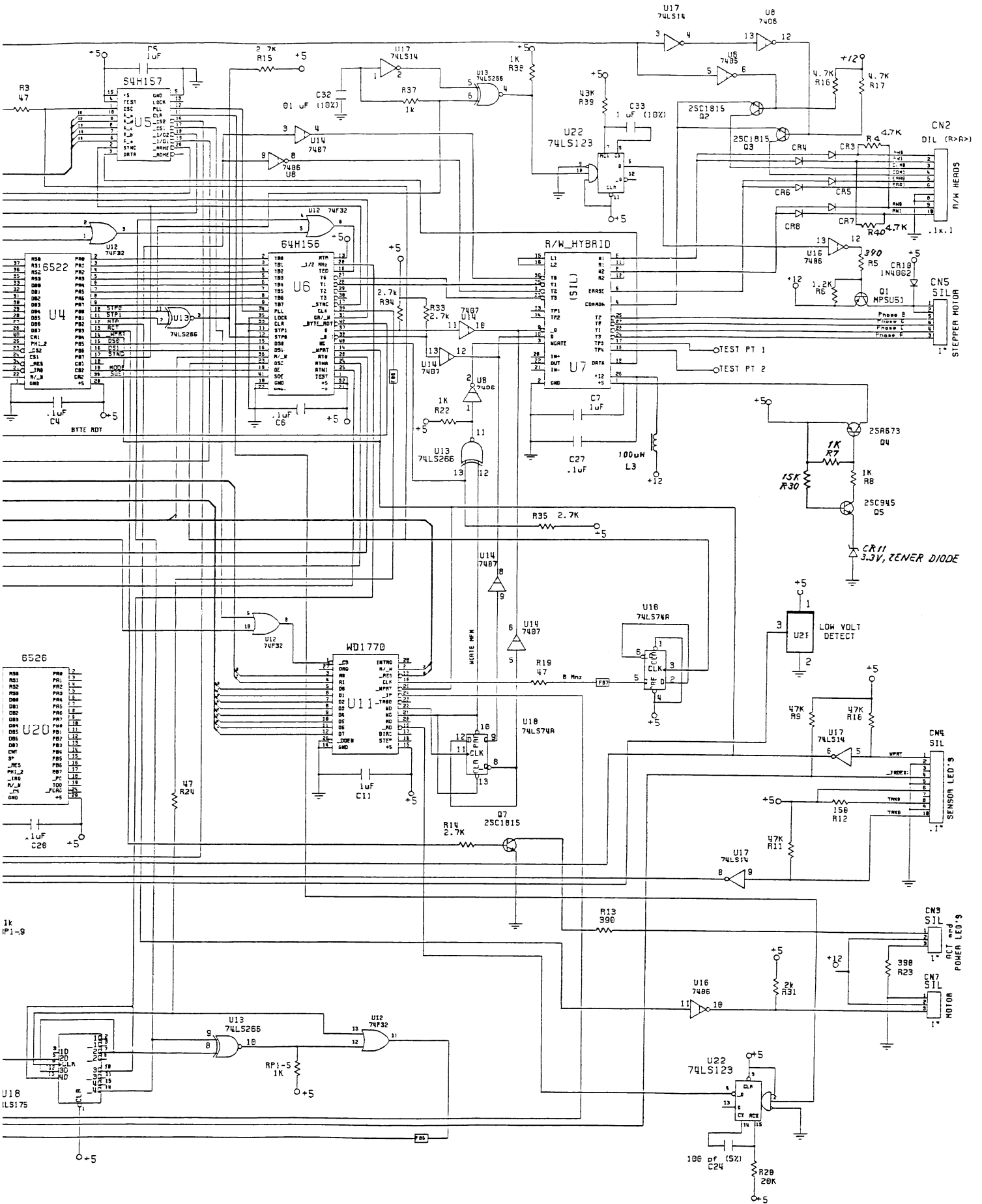
CN1 Header Assy, 4Pin (Molex 3022-04A,
 AMP 640098-4)
 CN2 Header Assy, Dual RT Angle 10Pin
 CN3 Header Assy, 3Pin (Molex 3022-03A,
 AMP 640098-3)
 CN4 Header Assy, 10Pin (Molex 3022-10A,
 AMP 1-640098-0)
 CN5 Header Assy, 6Pin (Molex 3022-06A,
 AMP 640098-6)
 CN6,8 Connector, 6Pin Din, Shielded C252166-01
 CN7 Header Assy, 3Pin (Molex 3022-03A,
 AMP 640098-3)

PCB ASSEMBLY #310420

BOARD LAYOUT







PCB ASSEMBLY #310420 SCHEMATIC