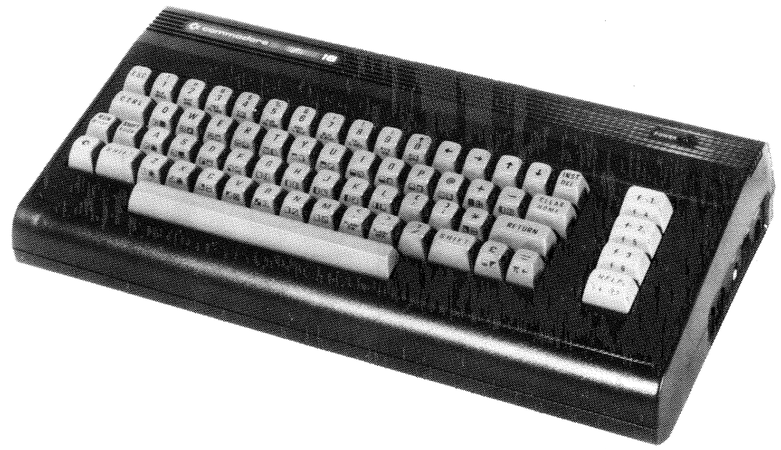
LINE DEFINITIONS

A0 Thru A15 ..... Address Lines
AEC ..... Address Enable Code
ADDR CLK ..... Address Clock
BA ..... Bus Available
BASIC CS1 ..... Basic Chip Select
CASSETTE ..... Cassette
CAS ..... Column Address Strobe
CS0, CS1 ..... Chip Select Lines
CST MTR ..... Cassette Motor
CST RD ..... Cassette Read
CST WRT ..... Cassette Write
C1 LOW
C1 HIGH
C2 LOW
C2 HIGH
D0 Thru D7 ..... Data Lines
EXT AUDIO ..... External Audio
IRQ ..... Interrupt Request
K0 Thru K7
KERNAL
KERNAL CS1 ..... Kernal Chip Select
KEY PORT CS ..... Key Port Chip Select
MUX ..... Multiplex
R/W ..... Read/Write
RAS ..... Row Address Strobe
RESET ..... Reset
O0 ..... Phase 0
O2 ..... Phase Two

Any Bar above any alphabetical or numerical combination indicates line active in a low (0) state.

SAFETY PRECAUTIONS

1. Use an isolation transformer for servicing.
2. Maintain AC line voltage at rated input.
3. Remove AC power from the Computer before servicing or installing electrostatically sensitive devices. Examples of typical ES devices are integrated circuits and semiconductor "chip" components.
4. Use extreme caution when handling the printed circuit boards. Some semiconductor devices can be damaged easily by static electricity. Drain off any electrostatic charge on your body by touching a known earth ground. Wear a commercially available discharging wrist strap device. This should be removed prior to applying power to the unit under test.
5. Use a grounded-tip, low voltage soldering iron.
6. Use an isolation (times 10) probe on scope.
7. Do not remove or install board, floppy disk drives, printers, or other peripherals with power On.
8. Do not use freon-propelled sprays. These can generate electrical charges sufficient to damage semiconductor devices.
9. The Computer cabinet is equipped with vents to prevent heat build-up. Never block, cover, or obstruct these vents.
10. Instructions should be given, especially to children, that objects should not be dropped or pushed into the vents of the cabinet. This could cause shock or equipment damage.
11. Never expose the Computer to water. If exposed to water, turn the unit off. Do not place the Computer near possible water sources.
12. Never leave the Computer unattended or plugged into the AC outlet for long periods of time. Remove AC plug from AC outlet during lightning storms.
13. Never use liquids or aerosols directly on the Computer. Spray on cloth and then apply to the Computer cabinet. Make sure the Computer is disconnected from the AC power line.



MODEL 16

CC8 COMMODORE MODEL 16

SAFETY PRECAUTIONS

See Page 17.

PRELIMINARY SERVICE CHECKS

ENCLOSED

INDEX

	Page
Block Diagram	16
Disassembly Instructions	4
General Operating Instructions	4
GridTrace Location Guide	
Main Board	6,11
Line Definitions	17
Logic Chart	14
Miscellaneous Adjustments	4
Parts List	7 thru 10
Photos	
Main Board	5,6,11,12
Safety Precautions	17
Schematics	
IC Pinouts & Terminal Guides	3
Main Board	2
Notes	15
Troubleshooting	13

SAMS™ Howard W. Sams & Co., Inc.
4300 West 62nd Street, P.O. Box 7092, Indianapolis, Indiana 46206 U.S.A.

4300 West 62nd Street, P.O. Box 7092, Indianapolis, Indiana 46206 U.S.A.
Printed in U.S. of America. 84CC14937 DATE 12-84

SCHEMATIC NOTES

—✕— Circuitry not used in some versions
- - - Circuitry used in some versions
⊖ See parts list
⏚ Ground
Chassis
▽ Common tie point

Waveforms and voltages taken from ground, unless noted otherwise.

Voltages, Waveforms and Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.

Waveforms taken with triggered scope and Sweep/Time switch in Calibrate position, scope input set for DC coupling on 0 reference voltage waveforms. Switch to AC input to view waveforms after DC reference is measured when necessary. Each waveform is 7 cm. width with DC reference voltage given at the bottom line of each waveform.

Time in μsec. per cm, given with p-p reading at the end of each waveform.

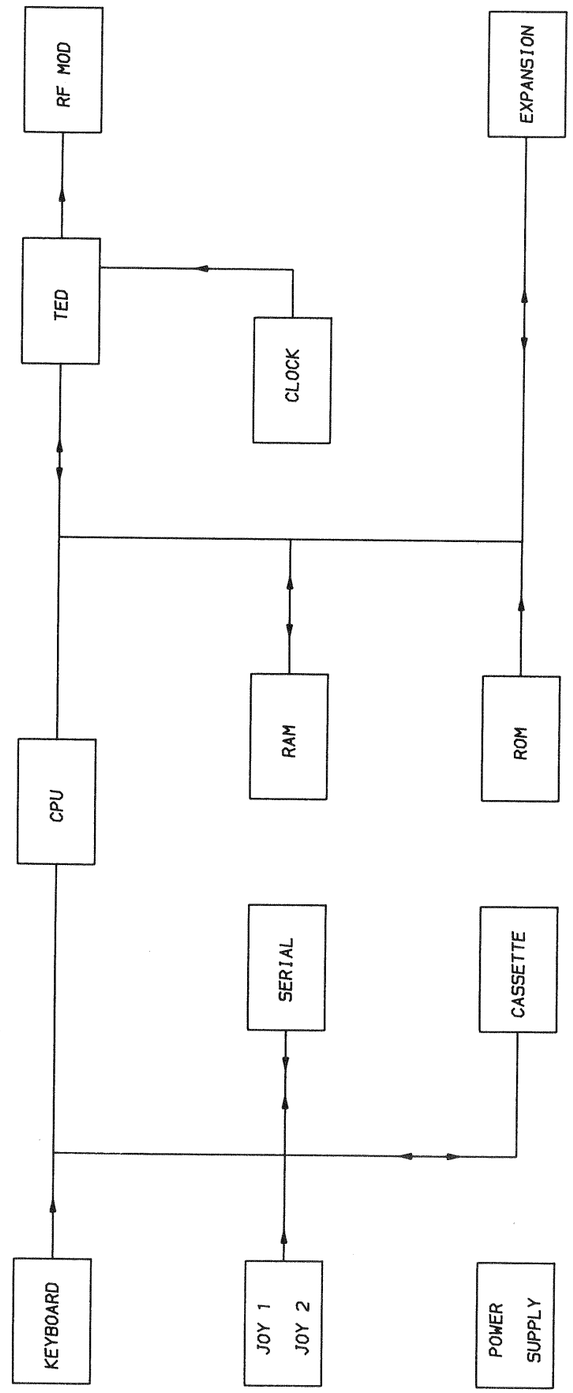
Item numbers in rectangles appear in the alignment/adjustment instructions.

Supply voltages maintained as shown at input.
Voltages measured with digital meter, no signal.
Controls adjusted for normal operation.
Terminal identification may not be found on unit.
Capacitors are 50 volts or less, 5% unless noted.
Electrolytic capacitors are 50 volts or less, 20% unless noted.
Resistors are ½W or less, 5% unless noted.
Value in ( ) used in some versions.
Measurements with switching as shown, unless noted.

NOTE: Logic probe readings taken with Computer turned On, no keys pressed, unless otherwise noted.

Logic Probe Display
L = Low
H = High
P = Pulse
* = Open (No Light On)

(1) Probe indicates P when a key is pressed.
(2) Probe indicates P while saving a program to tape.
(3) Probe indicates P while loading a program from tape.
(4) Probe indicates L while saving or loading a program from cassette.
(5) Probe indicates H while saving or loading a program from cassette.



BLOCK DIAGRAM

A0 Thru A15 . . .
AEC . . . . . .
ADDR CLK . . . .
BA . . . . . .
BASIC CS1 . . . .
CASSETTE . . . .
CAS . . . . . .
CS0, CS1 . . . . . .
CST MTR . . . . .
CST RD . . . . . .
CST WRT . . . . . .
C1 LOW
C1 HIGH
C2 LOW

Any

1. Use an isol
2. Maintain A
3. Remove AC typical ES
4. Use extrem static elect ly available
5. Use a grou
6. Use an isol
7. Do not rem
8. Do not use
9. The Compu
10. Instructions cabinet. Th
11. Never expo water sourc
12. Never leave outlet durin
13. Never use li sure the Co

KEYBOARD

JOY 1

JOY 2

SERIAL

CASSETTE

MOS65298 U13 PIA

MOS7501 U2 CPU

8006-01 U3 BASIC

MBM27128-25TED-K U4 KERNAL

HD74LS257P U7 MULTI-PLEXER

HD74LS257P U8 MULTI-PLEXER

TMS4416-15NL U5 RAM

SN74LS175N U15 FLIP/FLOP

UA555TC U10 TIMER

SN74LS125AN PART OF U11

74LS02PC PART OF U12

74LS02PC NC PART OF U12

7406PC PART OF U9

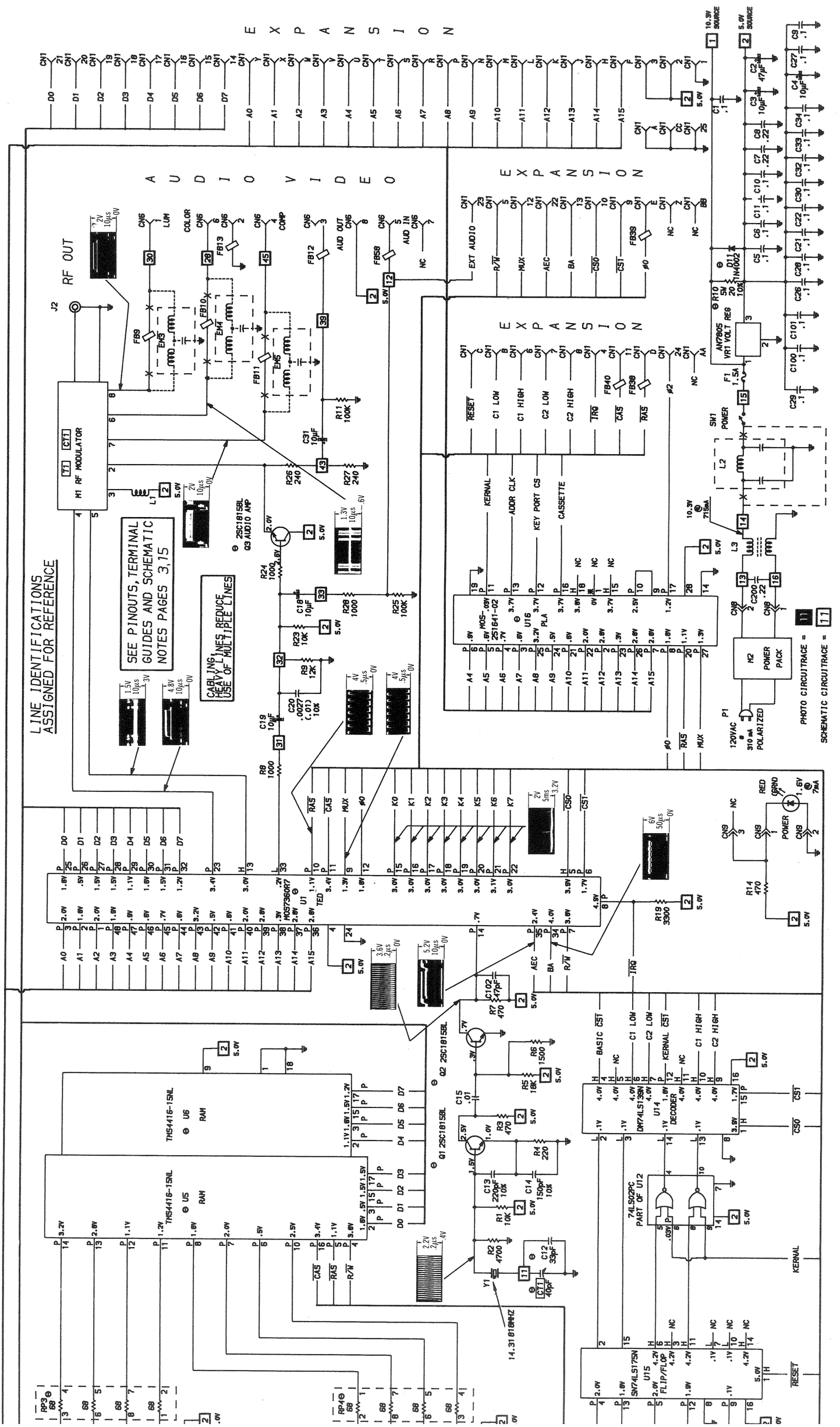
2SD880GR Q5 SWITCH

D1N4148

TAKEN WHILE SAVING A PROGRAM TO TAPE (HEADER SIGNAL)

14.31818MHZ

SW2 RESET


EXPANSION
AUDIO VIDEO
RF OUT
M1 RF MODULATOR
Q3 AUDIO AMP
LINE IDENTIFICATIONS ASSIGNED FOR REFERENCE
SEE PINOUTS, TERMINAL GUIDES AND SCHEMATIC NOTES PAGES 3,15
CABLING, HEAVY LINES REDUCE USE OF MULTIPLE LINES
KERNAL
ADDR CLK
KEY PORT CS
CASSETTE
H2 POWER PACK
P1 120VAC @ 310 mA POLARIZED
PHOTO CIRCUITRACE = 11
SCHEMATIC CIRCUITRACE = 11
U1 MOS7360R7 TED
U5 TMS4416-15NL RAM
U6 TMS4416-15NL RAM
U14 DM74LS138N DECODER
U15 SN74LS175N FLIP/FLOP
74LS02PC PART OF U12
Q1 2SC1815BL
Q2 2SC1815BL
Y1 14.31818MHZ
U16 251641-02 PLA
U7 AN7805 VR1 VOLT REG
D11 1N4002
SW1 POWER
F1 1.5A

MAIN BOARD LOGIC

PIN NO.	IC U1	PIN NO.	IC U1	PIN NO.	IC U2	PIN NO.	IC U2	PIN NO.	IC U3	IC U4	IC U5	IC U6	IC U7
1	P	25	P	1	P	21	P	1	H	H	L	L	P
2	P	26	P	2	P	22	P	2	P	P	P	P	H
3	P	27	P	3	P	23	P	3	P	P	P	P	P
4	H	28	P	4	P	24	H	4	P	P	P	P	P
5	H	29	P	5	H	25	H(2)	5	P	P	P	P	P
6	P	30	P	6	P	26	*(3)	6	P	P	P	P	P
7	P	31	P	7	P	27	H(4)	7	P	P	P	P	P
8	P	32	P	8	P	28	L	8	P	P	P	P	L
9	P	33	L	9	P	29	L(2)	9	P	P	H	H	P
10	P	34	P	10	P	30	L	10	P	P	P	P	P
11	P	35	P	11	P	31	P	11	P	P	P	P	P
12	P	36	P	12	P	32	P	12	P	P	P	P	P
13	H	37	P	13	P	33	P	13	P	P	P	P	P
14	P	38	P	14	P	34	P	14	L	L	P	P	P
15	P	39	P	15	P	35	P	15	P	P	P	P	L
16	P	40	P	16	P	36	P	16	P	P	P	P	H
17	P	41	P	17	P	37	P	17	P	P	P	P	
18	P	42	P	18	P	38	P	18	P	P	L	L	
19	P	43	P	19	P	39	P	19	P	P			
20	P	44	P	20	L	40	H	20	L	L			
21	P	45	P					21	P	P			
22	P	46	P					22	H	P			
23	P	47	P					23	P	P			
24	L	48	P					24	P	P			
								25	P	P			
								26	P	P			
								27	H	H			
								28	H	H			

PIN NO.	IC U8	IC U9	IC U10	IC U11	IC U12	IC U13	IC U14	IC U15	PIN NO.	IC U16	PIN NO.	IC U16
1	P	L	L	L	P	P	H	H	1	*	15	H
2	P	H	H	P	P	P	L	L	2	P	16	P
3	P	L	L	P	P	P	L	H	3	P	17	P
4	P	H	H	L	L	P	H	P	4	P	18	H
5	P	H(4)	H	P	H	P	H	P	5	P	19	L
6	P	L(5)	L	P	P	P	H	H	6	P	20	P
7	P	L	L	L	L	P	H	L	7	P	21	P
8	L	H	H	P	H	P	L	L	8	P	22	P
9	P	L		H	P	L(1)	H	P	9	P	23	P
10	P	H(2)		P	L	L	H	L	10	P	24	P
11	P	L(2)		*	*	P	H	H	11	P	25	P
12	P	H		*	*	P	P	P	12	P	26	P
13	P	L		*	L	P	L	P	13	P	27	P
14	H	H		H	H	P	L	H	14	L	28	H
15	L					P	P	L				
16	H					P	H	H				
17						P						
18						P						
19						P						
20						H						

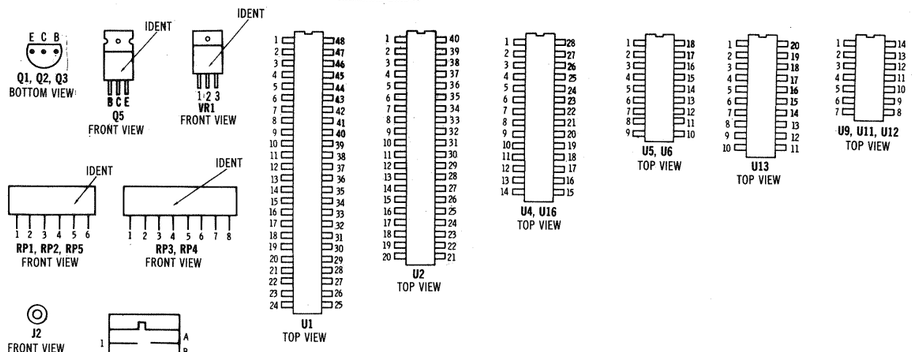
NOTE: Logic probe readings taken with Computer turned On, no keys pressed, unless otherwise noted.

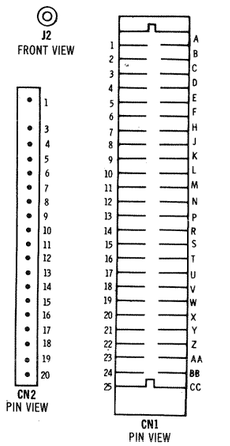
Logic Probe Display
L = Low
H = High
P = Pulse
* = Open (No Light On)

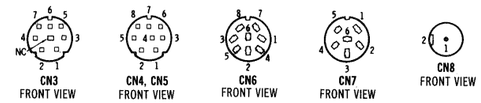
(1) Probe indicates P when a key is pressed.
(2) Probe indicates P while saving a program to tape.
(3) Probe indicates P while loading a program from tape.
(4) Probe indicates L while saving or loading a program from cassette.
(5) Probe indicates H while saving or loading a program from cassette.

IC PINOUTS & TERMINAL GUIDES

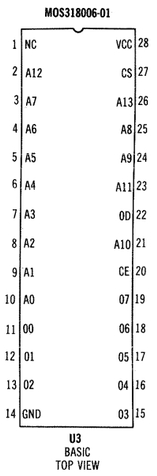
TERMINAL GUIDES

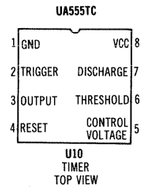


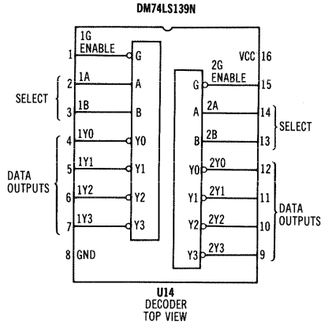


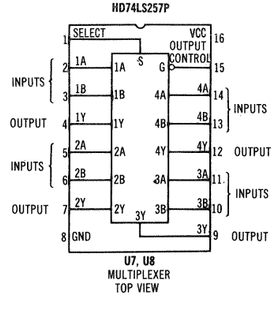


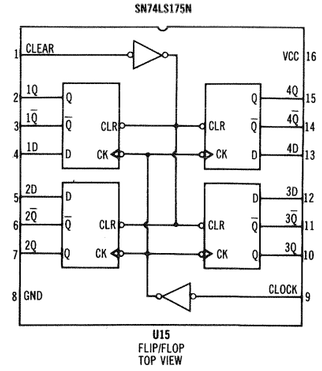
PIN OUTS











GENERAL OPERATING INSTRUCTIONS

POWER UP

The Computer will come up ready to program in Commodore Basic when turned On. For instructions on loading and saving programs see "Cassette or Disk Operation" section of the General Operating Instructions. To run a program when loaded, type RUN and press the RETURN key. To stop a program in progress, press the RUN/STOP key. A program can also be stopped by pressing RESET button on the right side of the Computer but the program will also be lost.

MONITOR PROGRAM

The Computer has a built-in Monitor Program which enables the user to program in machine language. To go from Basic to Monitor mode, hold down the RUN/STOP key and press the RESET key. The word Monitor will appear at the top left of the display screen. To go back to Basic from Monitor mode, type X and press the RETURN key.

CASSETTE OPERATION

Plug a Datassette cassette recorder onto the six pin edge Connector CN3 at the rear of the Computer. Note: A standard tape recorder will not work on the Commodore Model 16. To load a program type LOAD, press the RETURN key and follow the instructions displayed on the Monitor screen. To save a program, type SAVE, press the RETURN key and follow the instructions displayed on the screen.

DISK OPERATION

Connect Disk Drive unit to the Serial I/O Port (Connector CN7) located at the rear of the Computer. Carefully insert the diskette so that the label on the diskette is facing up and the notch on the diskette is on the left side. Once the disk has been inserted, close the protective gate by pushing down on the gate lever. To load a program from the diskette, type LOAD "PROGAM NAME", 8 and press the RETURN key. To save a program, type SAVE "PROGRAM NAME", 8 and press the RETURN key.

NOTE: The number 8 is the Device number for which the Disk Drive is normally set up. The device number can be any number from 8 to 11 depending on how the device number jumpers are connected in the Disk Drive.

DISASSEMBLY INSTRUCTIONS

CABINET TOP REMOVAL

Remove three screws from cabinet bottom. Carefully lift cabinet top and Keyboard from cabinet bottom. Disconnect the Keyboard connector and the Power Indicator connector from the Main Board.

MAIN BOARD REMOVAL

Remove eight screws holding Shield and Main Board to cabinet bottom. The Shield and Main Board may now be removed from cabinet bottom.

KEYBOARD REMOVAL

Remove eight screws holding Keyboard to cabinet top. Lift Keyboard assembly from cabinet top.

MISCELLANEOUS ADJUSTMENTS

Alignment Tools	GC Electronics
T1	5000, 5009, 8276

CRYSTAL OSCILLATOR

Connect a frequency counter to the base of Transistor Q1. Adjust Trimmer Capacitor (CT1) for a frequency of 14.31818MHz.

RF FREQUENCY

Connect the Computer to a TV and set the TV and Computer channel selector switches to the same channel [L(3) or H(4)]. Adjust T1 for the best picture with MINIMUM noise from the TV speaker.

VIDEO LEVEL

Connect the Computer to a TV and set the TV and Computer channel selector switches to the same channel [L(3) or H(4)]. Adjust the Video Level Trimmer Capacitor (CT2) for the best picture on the TV Monitor.

Datassette is a trademark of Commodore Business Machines, Inc.

TROUBLESHOOTING

POWER SUPPLY

If DC Fuse (F1) is open, check Voltage Regulator IC (VR1) for a short to ground. If IC VR1 is good, check Capacitor C1 and Electrolytic C2 for shorts. If Fuse F1 is good, check for 10.3V at the fuse. If the voltage is missing, check the Power Switch (SW1) and the Power Pack (M2). If the 10.3V is normal, check for 5V on pin 3 of IC VR1. If the voltage is incorrect, check Resistor R10 and Diode D11.

MICROPROCESSOR CHIP (CPU) OPERATION

Check for 5V on pin 5 of the CPU IC (U2). To verify IC U2 is functioning, use a logic probe and check for pulses on address lines (pins 6 thru 22) and data lines (pins 31 thru 38) of IC U2. If the Microprocessor is not functioning, check pin 40 of IC U2 with the logic probe while the computer is turned Off and then On again. The logic probe should read Low for about two seconds after set is turned On and then read High as IC U2 is reset. If the logic readings are wrong, troubleshoot components associated with Timer IC (U10).

Check for clock pulses on pin 14 of the TED IC (U1). If the pulses are missing, check the Master Clock circuit, Transistors Q1 and Q2. If clock pulses are present on pin 14 of IC U1, check for clock pulses on pin 12 of IC U1 and if missing, check IC U1 by substitution. If CPU still does not function, check for clock pulses at pin 1 of CPU IC (U2). If clock pulses are present, check IC U2 by substitution.

VIDEO

Check for video waveforms on pins 13 and 23 of the TED IC (U1). If waveforms are missing, check IC U1 by substitution. If the waveforms are normal, check for video waveforms on pins 6, 7 and 8 of the RF Module (M1). If waveforms are missing, check Module M1 by substitution. If the waveforms are present at Module M1, check the Video Output Connector (CN6) for bad connections.

COLOR

No color. Check for a color waveform on pin 13 of TED IC (U1). If the waveform is missing, check IC U1 by substitution. If the colors are incorrect, check the adjustment of the 14.31818MHz Oscillator. (See "Miscellaneous Adjustments").

SOUND

If there is no sound, type and run the following program:

10 VOL 8: SOUND 2, 222, 22: GOTO 10

Check for the waveform shown in Figure 1 at pin 33 of TED IC (U1). If the waveform is missing, check IC U1 by substitution. If the waveform is present, check the voltages and components associated with Audio Amp Transistor (Q3) and check RF Modulator (M1). If the sound is only missing when using a game cartridge, check Capacitor C18 and Resistor R28. Also, check for a bad connection on pin 28 of the Expansion Connector CN1.

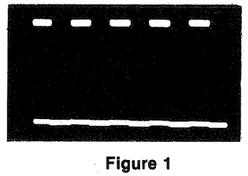


Figure 1

KEYBOARD

Keyboard does not function. Check the waveforms at pins 2 thru 8 of PIA IC (U13). If any waveform is missing, check IC U13 by substitution. If the waveforms are good, check the Keyboard Connector CN2 for good connections. If the connections are good, check the TED IC (U1) by substitution.

If any one key is not working, check the key contacts for good connection. The contacts should measure about 100 Ohms each when depressed.

If any one key is erratic in operation, carefully clean the switch contacts with a contact cleaner.

JOYSTICK

Joysticks do not function. Check TED IC (U1) by substitution. If the joysticks function incorrectly, check Connectors CN4 and CN5 for bad connections. Also, check Diodes D1 thru D10 and Resistor Pack RP2.

CASSETTE

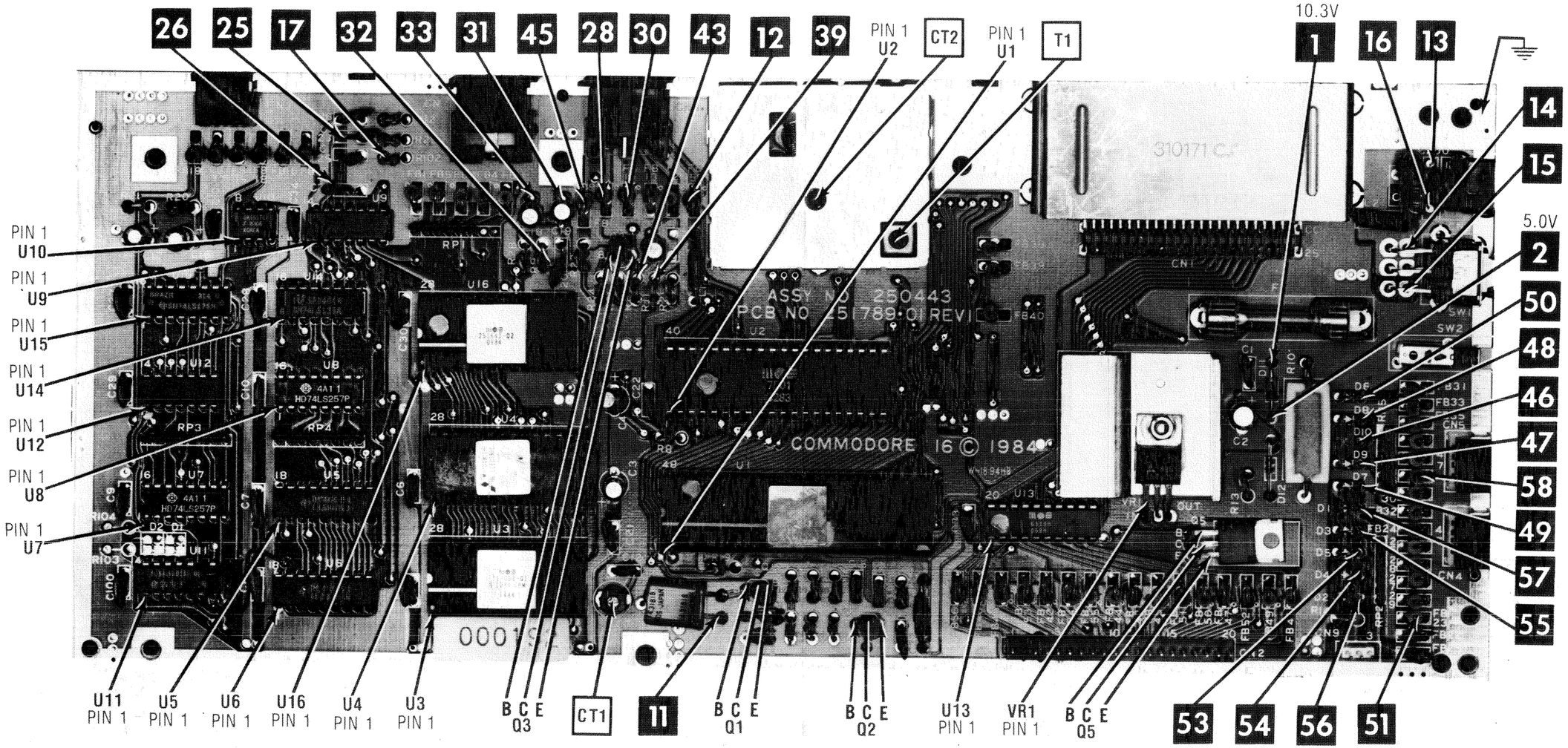
Check Connector CN3 for good connections. If a program will not save on tape, check for pulses at pin 29 of CPU IC (U2) while attempting to save a program. (See "General Operating Instructions"). If the pulses are missing, check IC U2 by substitution. If pulses are present at pin 29 of IC U2, check for pulses at pin 10 of IC U9 while attempting to save a program on tape. If pulses are missing at pin 10, check IC U9 by substitution. If pulses are present at pin 10, check Resistor R29 and Capacitor C24.

Program will not load from tape. Check for pulses at pin 26 of IC U2 while attempting to load a program (See "General Operating Instructions"). If pulses are present at pin 26, check IC U2 by substitution. If pulses are missing at pin 26, check Capacitor C23 and also check pin 4 of Connector CN3 for good connection.

Cassette motor does not run. Check for a Low logic reading at pin 9 and a High logic reading at pin 10 of IC U11 while attempting to save a program on tape. If the logic reading at pin 9 is incorrect, check pin 6 of Connector CN3 for a good connection. Also, check ICs U2, U11 and PLA IC (U16) by substitution. If logic reading is correct at IC U11, check for a Low logic reading at pin 27 of IC U2 while attempting to save a program on tape. If the logic reading is incorrect, check IC U2 by substitution. If the logic reading at pin 27 is correct, check for a High logic reading at pin 6 of IC U9. If logic reading at pin 6 is not correct, check IC U9 by substitution. If logic reading at pin 6 incorrect, check the voltages and components associated with Switch Transistor (Q5). Also, check pin 3 of Connector CN3 for good connection.

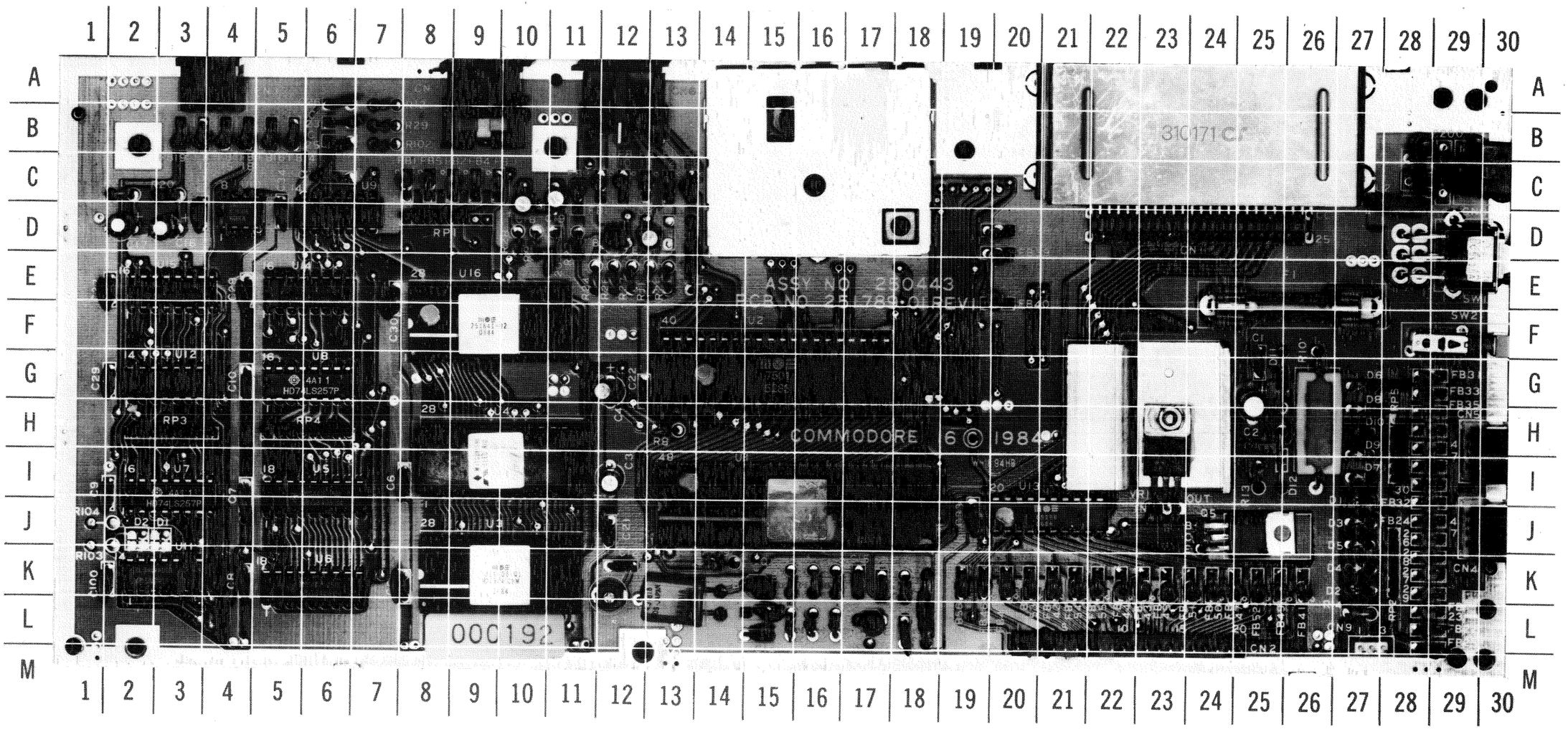
DISK DRIVE

If Disk Drive does not operate with the computer, check the connections at Connector CN7. If the connections are good, check CPU IC (U2) and IC U9 by substitution.



MAIN BOARD GridTrace LOCATION GUIDE

C1	G-25	C19	C-11	C101	D-3	D5	J-27	FB11	C-12	FB30	I-29	FB47	K-25	Q2	L-17	R20	C-3	U1	J-13
C2	H-25	C20	D-11	C102	K-17	D6	G-27	FB12	C-13	FB31	G-28	FB48	K-20	Q3	D-12	R21	C-2	U2	G-13
C3	I-12	C21	J-12	C200	B-29	D7	I-27	FB13	C-12	FB32	I-29	FB49	K-26	Q5	J-24	R23	D-11	U3	K-8
C4	G-12	C22	G-12	CN1	D-22	D8	G-27	FB14	B-5	FB33	G-28	FB50	K-24	R1	K-15	R24	E-11	U4	I-8
C5	K-8	C23	B-6	CN2	L-20	D9	H-27	FB15	B-4	FB34	H-29	FB51	K-24	R2	L-16	R25	E-13	U5	J-5
C6	I-8	C24	C-6	CN3	A-4	D10	H-27	FB16	B-5	FB35	H-29	FB52	K-25	R3	K-16	R26	E-12	U6	K-5
C7	J-4	C25	B-6	CN4	J-29	D11	G-26	FB17	B-3	FB36	I-29	FB53	K-20	R4	L-16	R27	E-12	U7	J-2
C8	K-4	C26	B-6	CN5	H-30	D12	H-25	FB18	B-4	FB37	H-29	FB54	K-21	R5	K-16	R28	D-10	U8	G-5
C9	J-2	C27	E-1	CN6	A-12	F1	E-24	FB19	B-3	FB38	D-20	FB55	K-22	R6	L-16	R29	B-7	U9	D-6
C10	G-4	C28	E-4	CN7	A-9	FB1	C-8	FB22	L-29	FB39	D-20	FB56	K-19	R7	K-18	R102	B-7	U10	D-4
C12	K-12	C29	G-2	CN8	B-30	FB2	C-9	FB23	L-29	FB40	E-20	FB58	C-13	R8	H-13	RP1	D-8	U11	K-2
C13	L-15	C30	E-7	CN9	L-27	FB3	C-9	FB24	J-29	FB41	K-26	J2	A-16	R9	D-10	RP2	J-28	U12	G-2
C14	L-15	C31	D-13	CT1	K-12	FB4	C-9	FB25	L-29	FB42	K-21	L1	D-13	R10	G-26	RP3	H-2	U13	J-20
C15	K-17	C32	L-18	D1	I-27	FB5	C-8	FB26	J-29	FB43	K-23	L2	C-28	R11	E-13	RP4	H-4	U14	E-5
C16	D-3	C33	J-19	D2	K-27	FB8	K-4	FB27	K-29	FB44	K-22	L3	C-28	R12	B-7	RP5	H-28	U15	E-2
C17	D-2	C34	D-5	D3	J-27	FB9	C-11	FB28	K-29	FB45	K-23	L4	K-18	R13	I-25	SW1	D-29	U16	E-8
C18	C-10	C100	K-2	D4	K-27	FB10	C-12	FB29	K-29	FB46	K-19	Q1	K-15	R14	L-27	SW2	F-29	Y1	I-23
																			K-13



MAIN BOARD A Howard W. Sams GRIDTRACE™ Photo

MAIN BOARD

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

MISCELLANEOUS

ITEM No.	PART NAME	MFGR. PART No.	NOTES
EM1 thru EM5	Filter	251842-01	Electromagnetic Interference
FB1 thru FB5	Ferrite Bead	325563-01	
FB12 thru FB19	Ferrite Bead	325563-01	
FB22	Ferrite Bead	325563-01	
FB24 thru FB35	Ferrite Bead	325563-01	
FB37 thru FB56	Ferrite Bead	325563-01	
FB58	Ferrite Bead	325563-01	
M1	RF Modulator	251844-01	
	RF Modulator	251847-01	German and United Kingdom versions
	RF Modulator	251312-01	Alternately used German and United Kingdom versions
M2	Power Pack	251539-01	
	Power Pack	251539-02	Canada version
	Power Pack	251539-03	German version
	Power Pack	251539-04	United Kingdom version
SW1	Switch	251587-01	Power, On-Off
SW2	Switch	251260-01	Reset
Y1	Crystal	251081-03	14.31818MHz
	Crystal	251081-01	14.31818MHz Alternate
	Crystal	251082-03	17.734475MHz, German and United Kingdom versions
	Crystal	251082-01	17.734475MHz Alternate
	LED	900707-03	Power Indicator (Red), 1.6V @ 7mA
	LED	903811-03	Power Indicator (Green), German version
	P.C. Board	250443-01	Main Board
	P.C. Board	250443-02	Main Board, German version
	P.C. Board	250443-03	Main Board, United Kingdom version

CABINET & CABINET PARTS (When ordering specify model, chassis & color)

ITEM	PART No.
Cabinet, Top Assembly	250722-01
Cabinet, Top	251813-01
Cabinet, Bottom Assembly	250721-01
Cabinet, Bottom Assembly (German version)	250721-02

ITEM	PART No.
Cabinet, Bottom Assembly (United Kingdom version)	250721-03
Cabinet, Bottom	251790-01
Keyboard (66 Key)	251798-01

PARTS LIST AND DESCRIPTION

When ordering parts, state Model, Part Number, and Description

SEMICONDUCTORS (Select replacement for best results)

ITEM No.	TYPE No.	MFGR. PART No.	REPLACEMENT DATA: GENERAL ELECTRIC PART No.	MOTOROLA PART No.	NEW-TONE NTE PART No.	PHILIPS ECG PART No.	RCA PART No.	WORKMAN PART No.	ZENITH PART No.
D1 thru D10	1N4148		GE-514	1N4935	NTE519	ECG519	SK3100/519	WEP925/519	103-131
	1N914B	251819-16	GE-300	1N4935	NTE177	ECG177	SK9091/177	WEP1062/177	103-131
	1S953	251819-07	GE-514	1N4935	NTE519	ECG519	SK3100/519	WEP925/519	103-131
D11	1N4002		GE-504A	1N4002	NTE116	ECG116	SK3311	WEP155	212-76-02
	1N4001	900750-01	GE-504A	1N4001	NTE116	ECG116	SK3311	WEP154	212-76-02
D12	RD6.8EB	900927-01	GEZD-6.8	1N5235B	NTE5014A	ECG5014A	SK6A8/5014A	WEP1415/5014	103-Z9009
	1N754A	900927-02	GEZD-6.8	1N5235B	NTE5014A	ECG5014A	SK6A8/5014A	WEP1415/5014	103-Z9009
Q1 thru	2SC1815BL		GE-62	MPSA05*	NTE85	ECG85	SK3124A/289A	WEP66/199	121-Z9065
Q3	2SC1815	902693-01	GE-62	MPSA05*	NTE85	ECG85	SK3124A/289A	WEP66/199	121-Z9065
Q5	2SD880GR		GE-66A	T1P41A	NTE152	ECG152	SK3440/291	WEP745/152	121-987-03
	2SD880	902694-01	GE-66A	T1P41A	NTE152	ECG152	SK3440/291	WEP745/152	121-987-03
U1	MOS7360R7	251535-01							
	8360R1	251535-02(1)							
U2	MOS7501	251536-01							
U3	MOS318006-01								
	23128	318006-01							
U4	MBM27128-25TED-K								
	23128	318005-03(2)							
	23128	318004-03(3)							
U5,6	TMS4416-15NL	251538-02							
	TMS4416-20								
U7,8	HD74LS257P	901521-57		SN74LS257AN	NTE74LS257	ECG74LS257	SK74LS257		HE-443-802
U9	7406PC	901522-06	GE-7406		NTE7406	ECG7406	SK7406		HE-443-698
U10	UA555TC	901523-01	GEIC-269	MC1455P1	NTE955M	ECG955M	SK3564/955M	WEP2119/955M	221-Z9042
U11	SN74LS125AN	901521-20		SN74LS125AN	NTE74LS125A	ECG74LS125A	SK74LS125A		HE-443-811
U12	74LS02PC	901521-21		SN74LS02N	NTE74LS02	ECG74LS02	SK74LS02		HE-443-779

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

SEMICONDUCTORS (Select replacement for best results) (cont)

ITEM No.	TYPE No.	MFGR. PART No.	REPLACEMENT DATA						
			GENERAL ELECTRIC PART No.	MOTOROLA PART No.	NEW-TONE NTE PART No.	PHILIPS ECG PART No.	RCA PART No.	WORKMAN PART No.	ZENITH PART No.
U13	MOS6529B	251640-03							
U14	DM74LS139N	901521-18		SN74LS139N	NTE74LS139	ECG74LS139	SK74LS139		
U15	SN74LS175N	901521-34		SN74LS175N	NTE74LS175	ECG74LS175	SK74LS175		
U16	MOS251641-02								HE-443-752
	7700-010	251641-02							
VR1	AN7805	901527-02	GEVR-102	MC7805CT	NTE960	ECG960	SK3591/960		221-Z9043

(1) Used in United Kingdom and German versions, may be used in some USA versions.
(2) Used in USA versions.
(3) Used in United Kingdom and German versions.

WIRING DATA

Shielded Hook-up Wire	Use BELDEN No.	8401 or 8421 (Single-Conductor) 8208 (Two-Conductor)
General-use Unshielded Hook-up Wire	Use BELDEN No.	8529 (Solid) Available in 13 Colors 8522 (Stranded) Available in 13 Colors
75-Ohm Input Lead	Use BELDEN No.	8241

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

CAPACITORS Items not listed are normally available at local distributors.

ITEM No.	RATING	MFGR. PART No.
C12	33 NP0 50V 22 50V	251070-14

ITEM No.	RATING	MFGR. PART No.
CT1	Trimmer 40pF	251029-02

RESISTORS (Power and Special)

ITEM No.	RATING	REPLACEMENT DATA		
		MFGR. PART No.	NEW-TONE PART No.	WORKMAN PART No.
R10	20 10% 5W WW	251756-01	5W022	24-3035
RP1	Resistor Network	(1)		
	Resistor Network	902441-22 (2)		
RP2	Resistor Network	(3)		
	Resistor Network	902441-29 (4)		
RP3	Resistor Network	326149-06 (5)		
RP4	Resistor Network	326149-06 (5)		
RP5	Resistor Network	(3)		
	Resistor Network	902441-29 (4)		

(1) Contains five (5) 1000 5%. .19W.
(2) Contains five (5) 1000 2% .19W.
(3) Contains five (5) 3300 5%. .19W.
(4) Contains five (5) 3300 2% .19W.
(5) Contains four (4) 68 5%.

COILS (RF-IF)

ITEM No.	FUNCTION	MFGR. PART No.
L1 L2	Choke (1.2uH) Choke	325570-01 ZJK5103-05 (TDK)

ITEM No.	FUNCTION	MFGR. PART No.
L3	Choke	251701-01

FUSE DEVICES

ITEM NO.	DESCRIPTION	MFGR. PART NO.		NOTES
		DEVICE	HOLDER	
F1	1.5A @ 250V Fast-Acting	903556-18	906102-01	

SAFETY PRECAUTIONS

1. Use an isolation transformer for servicing.
2. Maintain AC line voltage at rated input.
3. Remove AC power from the Computer before servicing or installing electrostatically sensitive devices. Examples of typical ES devices are integrated circuits and semiconductor "chip" components.
4. Use extreme caution when handling the printed circuit boards. Some semiconductor devices can be damaged easily by static electricity. Drain off any electrostatic charge on your body by touching a known earth ground. Wear a commercially available discharging wrist strap device. This should be removed prior to applying power to the unit under test.
5. Use a grounded-tip, low voltage soldering iron.
6. Use an isolation (times 10) probe on scope.
7. Do not remove or install board, floppy disk drives, printers, or other peripherals with power On.
8. Do not use freon-propelled sprays. These can generate electrical charges sufficient to damage semiconductor devices.
9. The Computer cabinet is equipped with vents to prevent heat build-up. Never block, cover, or obstruct these vents.
10. Instructions should be given, especially to children, that objects should not be dropped or pushed into the vents of the cabinet. This could cause shock or equipment damage.
11. Never expose the Computer to water. If exposed to water, turn the unit off. Do not place the Computer near possible water sources.
12. Never leave the Computer unattended or plugged into the AC outlet for long periods of time. Remove AC plug from AC outlet during lightning storms.
13. Never use liquids or aerosols directly on the Computer. Spray on cloth and then apply to the Computer cabinet. Make sure the Computer is disconnected from the AC power line.

PRELIMINARY SERVICE CHECKS

This data provides the user with a time saving service tool which is designed for quick isolation and repair of Computer malfunctions.

Check all interconnecting cables for good connection and hookup before making service checks.

Disconnect all external peripherals from the Computer to eliminate possible malfunctions.

Replacement or repair of the Main Board, Keyboard or connectors may be necessary after the malfunction has been isolated.

GENERAL OPERATING INSTRUCTIONS

POWER UP
The Computer will come up ready to program in Commodore Basic when turned On. For instructions on loading and saving programs see "Cassette or Disk Operation" section of the General Operating Instructions. To run a program when loaded, type RUN and press the RETURN key. To stop a program in progress, press the RUN/STOP key. A program can also be stopped by pressing RESET button on the right side of the Computer but the program will also be lost.

MONITOR PROGRAM
The Computer has a built-in Monitor Program which enables the user to program in machine language. To go from Basic to Monitor mode, hold down the RUN/STOP key and press the RESET key. The word Monitor will appear at the top left of the display screen. To go back to Basic from Monitor mode, type X and press the RETURN key.

CASSETTE OPERATION
Plug a Datassette cassette recorder onto the six pin edge Connector CN3 at the rear of the Computer. Note: A standard tape recorder will not work on the Commodore Model 16. To load a program type LOAD, press the RETURN key and follow the instructions displayed on the Monitor screen. To save a program, type SAVE, press the RETURN key and follow the instructions displayed on the screen.

DISK OPERATION
Connect Disk Drive unit to the Serial I/O Port (Connector CN7) located at the rear of the Computer. Carefully insert the diskette so that the label on the diskette is facing up and the notch on the diskette is on the left side. Once the disk has been inserted, close the protective gate by pushing down on the gate lever. To load a program from the diskette, type LOAD "PROGAM NAME", 8 and press the RETURN key. To save a program, type SAVE "PROGRAM NAME", 8 and press the RETURN key.

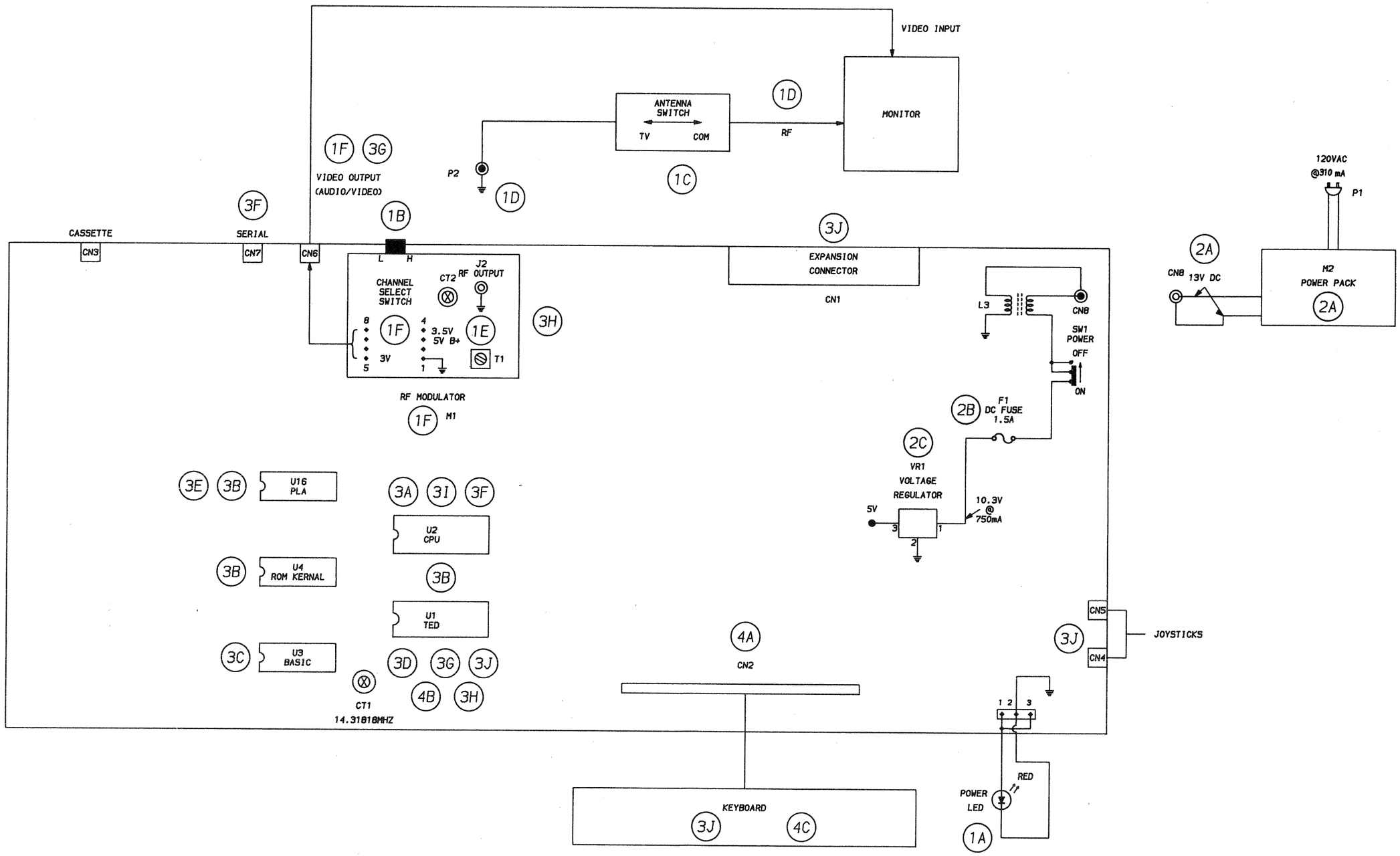
NOTE: The number 8 is the Device number for which the Disk Drive is normally set up. The device number can be any number from 8 to 11 depending on how the device number jumpers are connected in the Disk Drive.

Datassette is a trademark of Commodore Business Machines, Inc.

SAMS™ Howard W. Sams & Co., Inc.
4300 West 62nd Street, P.O. Box 7092, Indianapolis, Indiana 46206 U.S.A.

4300 West 62nd Street, P.O. Box 7092, Indianapolis, Indiana 46206 U.S.A.
Printed in U.S. of America. 84CC14937 DATE 12-84

PRELIMINARY SERVICE CHECKS (Continued)



TEST EQUIPMENT AND TOOLS

TEST EQUIPMENT

Digital Volt/Ohm Meter
Monitor
Frequency Counter

TOOLS

Phillips Screwdriver
Small Screwdriver
Low Voltage Soldering Iron
Desoldering Equipment
Tuner or Contact Cleaner

REPLACEMENT PARTS

ITEM NO.	PART NO.	DESCRIPTION
CT1	251029-02	Trimmer, Oscillator
F1	903556-18	DC Fuse 1.5A/250V Slow-Blo
LED	900707-03	LED, Power (Red)
L3	251701-01	Line Filter
M1	251844-01	RF Modulator Module (Contains Channel Selector Switch Hi-Low)
M2	251539-01	Power Pack, AC
Q1	902693-01	Transistor, Oscillator, 2SC1815
SW1	251587-01	Switch, Power
T1		Transformer, RF Frequency
VR1	901527-02	IC, Regulator, 7805
U1	251535-01	IC, TED, MOS7360R7
U1	251535-02	IC, TED, 8360R1
U2	251536-01	IC, CPU, MOS7501
U3	318006-01	IC, BASIC ROM, 23128
U4		IC, ROM, MBM27128-25TED-K
	318005-03	IC, ROM, 23128
U16		IC, PLA, MOS251641-02
	251641-02	IC, PLA, 7700-010

DISASSEMBLY INSTRUCTIONS

CABINET TOP REMOVAL

Remove three screws from cabinet bottom. Carefully lift cabinet top and Keyboard from cabinet bottom. Disconnect the Keyboard connector and the Power Indicator connector from the Main Board.

MAIN BOARD REMOVAL

Remove eight screws holding Shield and Main Board to cabinet bottom. The Shield and Main Board may now be removed from cabinet bottom.

KEYBOARD REMOVAL

Remove eight screws holding Keyboard to cabinet top. Lift Keyboard assembly from cabinet top.

SERVICE CHECKS

SEE INTERCONNECTING DIAGRAM, PLACEMENT CHART, AND PHOTOS TO MATCH THE NUMBER IN THE CIRCLES WITH THOSE IN THE FOLLOWING DATA FOR SERVICE CHECKS TO BE PERFORMED.

(1) RF MODULATOR CHECK (SNOWY SCREEN)

(A) Turn On Computer and verify the Power LED indicator is lit. If the power LED indicator is not lit, see "Power Supply Check" section of Preliminary Service Checks.

(B) Verify the Channel Select Switch of the RF Modulator is set on the same channel as the Monitor channel selector.

(C) Verify the Antenna Switch is in Computer position.

(D) Check for bad connections and improper hookup at the Monitor or at the Computer.

(E) Check the adjustment of the RF Frequency Transformer (T1) and the Video Level Trimmer (CT2) (See Miscellaneous Adjustments).

(F) To isolate the problem area, connect a Monitor to the Video Output Connector (CN6) instead of the RF Output Jack (J2). If the video returns and the voltages on pins 3, 4 and 5 of the RF Modulator (M1) are correct, substitute the Modulator M1. If the video does not return, see "Main Board" section of Preliminary Service Checks.

(2) POWER SUPPLY CHECK

(A) Connect the Power Pack (M2) to 120V AC. Disconnect Power Connector CN8 and check for 13VDC at Connector CN8. If the voltage is incorrect or missing, replace Power Pack.

(B) Check DC Fuse (F1).

(C) If DC Fuse (F1) is open, check Voltage Regulator IC (VR1) for a short to ground. If IC VR1 checks good, replace Fuse F1.

(3) MAIN BOARD

(A) If the power supply checks normal and the Computer does not function when powered, check the CPU IC (U2) by substitution.

(B) If CPU IC (U2) is good and the Computer does not function, check ROM IC (U4), PLA IC (U16) and TED IC (U1) by substitution.

(C) If Computer functions but not in the Basic Ready mode, check Basic IC (U3) by substitution.

(D) If Computer does not function and the Monitor screen remains black, check TED IC (U1) by substitution.

(E) If the function keys are inoperative, check PLA IC (U16) by substitution.

(F) Disk Drive or Printer do not function properly. Check for bad connections at Connector CN7 and check CPU IC (U2) by substitution.

(G) If Video Output (Audio/Video) Connector (CN6) is inoperative, check the TED IC (U1) by substitution.

(H) If TED IC (U1) is normal, check the RF Modulator (M1) by substitution.

(I) Datassette does not operate, check the CPU IC (U2) by substitution.

(J) The Joysticks, Keyboard, or Expansion Connector (CN1) do not function, check TED IC (U1) by substitution.

(4) KEYBOARD DEAD

(A) Check the Keyboard Connector (CN2) for good connections.

(B) Check the TED IC (U1) by substitution.

(C) If one key operates erratically, clean the switch contacts with a contact cleaner.

MISCELLANEOUS ADJUSTMENTS

Alignment Tools	GC Electronics
T1	5000, 5009, 8276

CRYSTAL OSCILLATOR

Connect a frequency counter to the base of Transistor Q1. Adjust Trimmer Capacitor (CT1) for a frequency of 14.31818MHz.

RF FREQUENCY

Connect the Computer to a TV and set the TV and Computer channel selector switches to the same channel [L(3) or H(4)]. Adjust T1 for the best picture with MINIMUM noise from the TV speaker.

VIDEO LEVEL

Connect the Computer to a TV and set the TV and Computer channel selector switches to the same channel [L(3) or H(4)]. Adjust the Video Level Trimmer Capacitor (CT2) for the best picture on the TV Monitor.

PRELIMINARY SERVICE CHECKS (Continued)