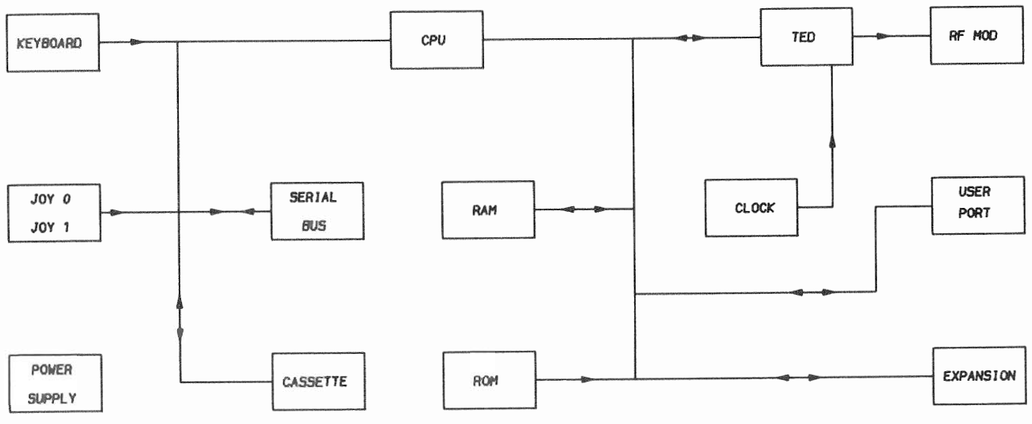
SAFETY PRECAUTIONS

1. Use an isolation transformer for servicing.
2. Maintain AC line voltage at rated input.
3. Remove 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 boards, 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 power line.



BLOCK DIAGRAM

CC9 COMMODORE MODEL PLUS/4

CC9 COMMODORE MODEL PLUS/4

MODEL PLUS/4

SAFETY PRECAUTIONS

See page 21.

PRELIMINARY SERVICE CHECKS

ENCLOSED

INDEX

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. 84CC14931 DATE 1-85

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.

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

GENERAL OPERATING INSTRUCTIONS

POWER UP

The Computer will come on 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 to enable the user to program with machine language. To go from Basic to Monitor, 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, type X and press the RETURN key.

CASSETTE OPERATION

Plug a Datassette Recorder into Connector CN3 at the rear of the Computer. Note: A standard tape recorder will not work on the Commodore Plus/4. 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 Connector (CN2) 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 diskette has been inserted, close the protective gate by pushing down on the gate lever. To load a program from the diskette, type LOAD "PROGRAM NAME", 8 and press the RETURN key. To save a program, type SAVE "PROGRAM NAME", 8 and press the RETURN key.

NOTE: Number 8 is the Device number the Disk Drive is normally set up for. 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 five screws from cabinet bottom holding keyboard assembly and cabinet top. Carefully lift cabinet top from unit and disconnect keyboard ribbon wire from main board.

KEYBOARD REMOVAL

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

CPU BOARD REMOVAL

Remove five screws holding CPU board to cabinet bottom. Lift CPU board from cabinet.

Datasette is a trademark of Commodore Business Machines, Inc.

1. Use an isolation transformer for
2. Maintain AC line voltage at rated
3. Remove power from the Compute ES devices are integrated circuits
4. Use extreme caution when handli static electricity. Drain off any ele ly available discharging wrist stra
5. Use a grounded-tip, low voltage s
6. Use an isolation (times 10) probe
7. Do not remove or install boards, f
8. Do not use freon-propelled sprays
9. The Computer cabinet is equippe
10. Instructions should be given, espe cabinet. This could cause shock
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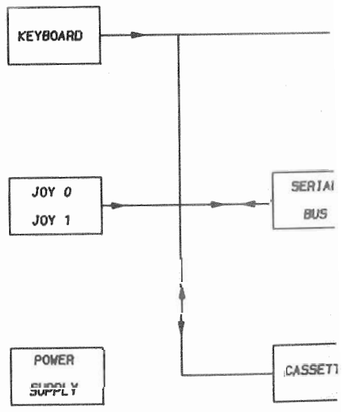
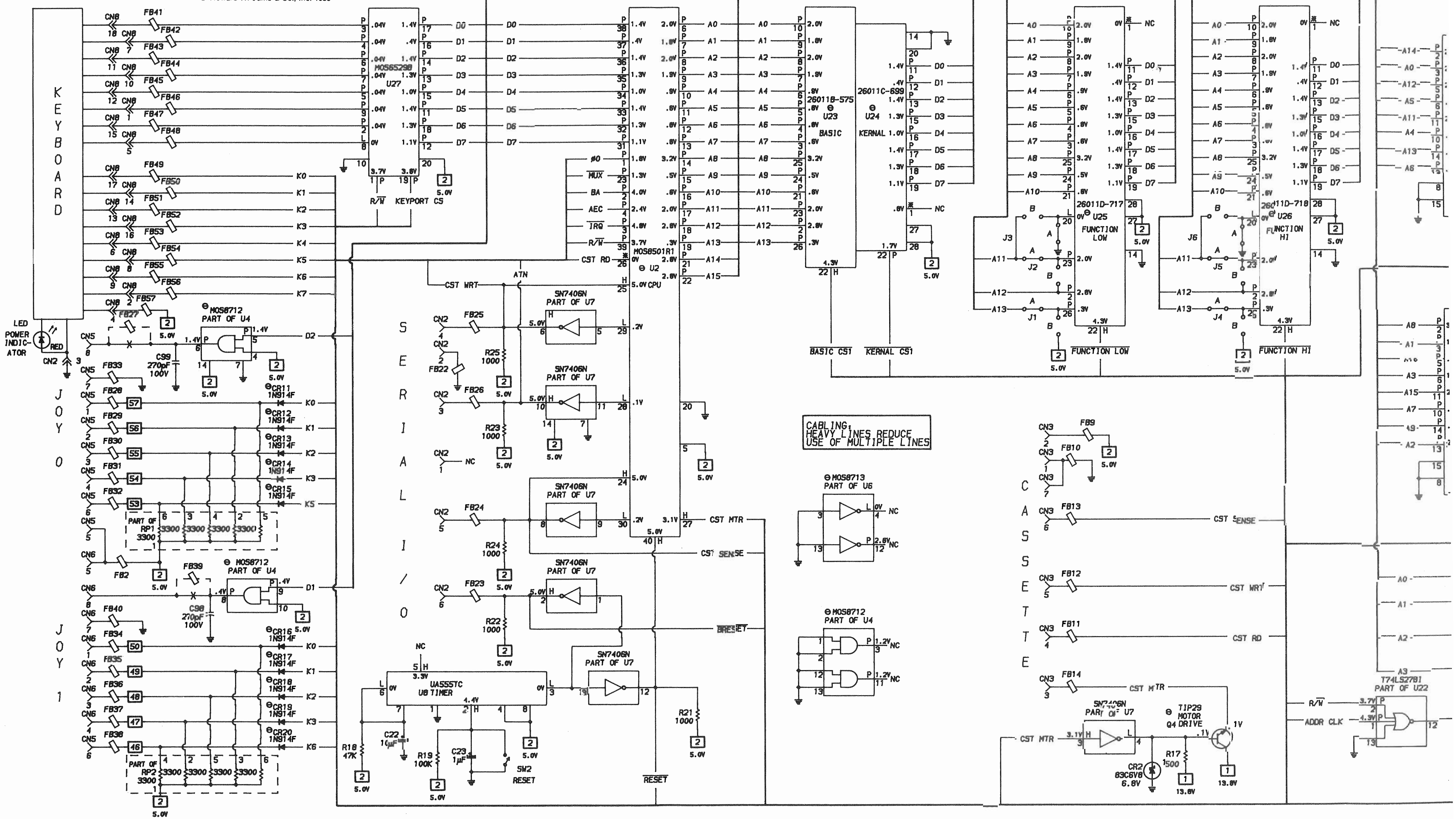


BLOCK DIAGRAM

A PHOTOFACT STANDARD NOTATION SCHEMATIC
WITH CIRCUITRACE



KEYBOARD
LED POWER INDICATOR
RED
JOY 0
JOY 1
SERIAL I/O
CASSETTE
MOS6529B U27
R/W
KEYPORT CS
MOS8501R1 U2 CPU
260118-575 U23 BASIC
26011C-699 U24 KERNAL
BASIC CS1
KERNAL CS1
26011D-717 U25 FUNCTION LOW
26011D-718 U26 FUNCTION HI
FUNCTION LOW
FUNCTION HI
MOS8712 PART OF U4
MOS8713 PART OF U6
SN7406N PART OF U7
UA555TC U8 TIMER
SW2 RESET
RESET
BRESET
CST WRT
CST RD
CST MTR
CST SENSE
ATN
CABLING: HEAVY LINES REDUCE USE OF MULTIPLE LINES
TIP29 MOTOR Q4 DRIVE
CR2 83C6V8 6.8V
R17 1500
T74LS27BI PART OF U22
R/W
ADDR CLK
PART OF RP1 3300
PART OF RP2 3300
C99 270pF 100V
C98 270pF 100V

SEE PINOUTS, TERMINAL GUIDES AND SCHEMATIC NOTES PAGES 8,19

PHOTO CIRCUITRACE = 11

SCHEMATIC CIRCUITRACE = 11

LINE IDENTIFICATIONS ASSIGNED FOR REFERENCE

FUNCTION LOW

FUNCTION HI

CST SENSE

CST WRT

CST RD

CST MTR

ADDR CLK

KERN

RESET

ATN

BASIC CST

C1 LOW

C2 LOW

KERNAL CST

C1 HIGH

C2 HIGH

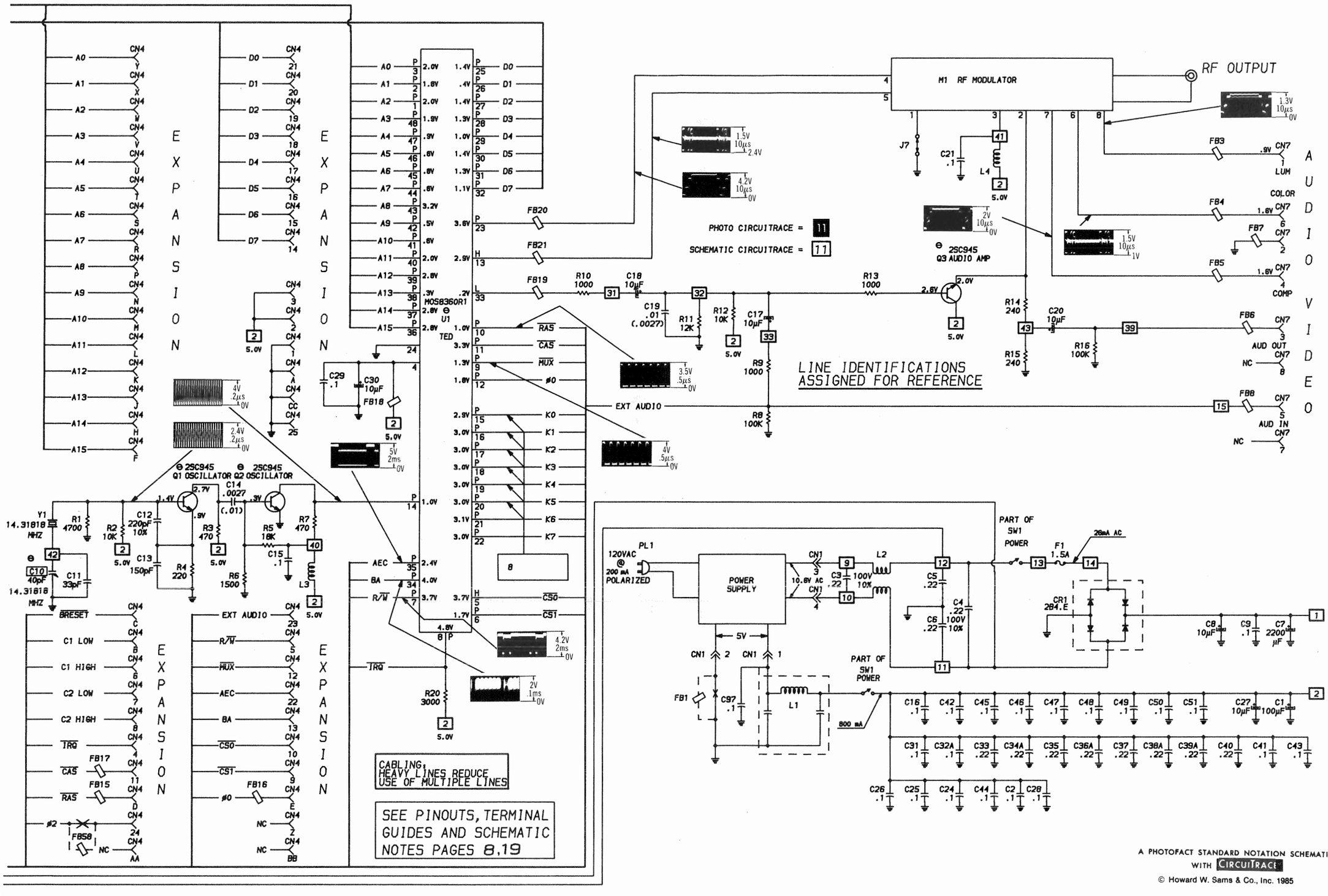
CS0

CST

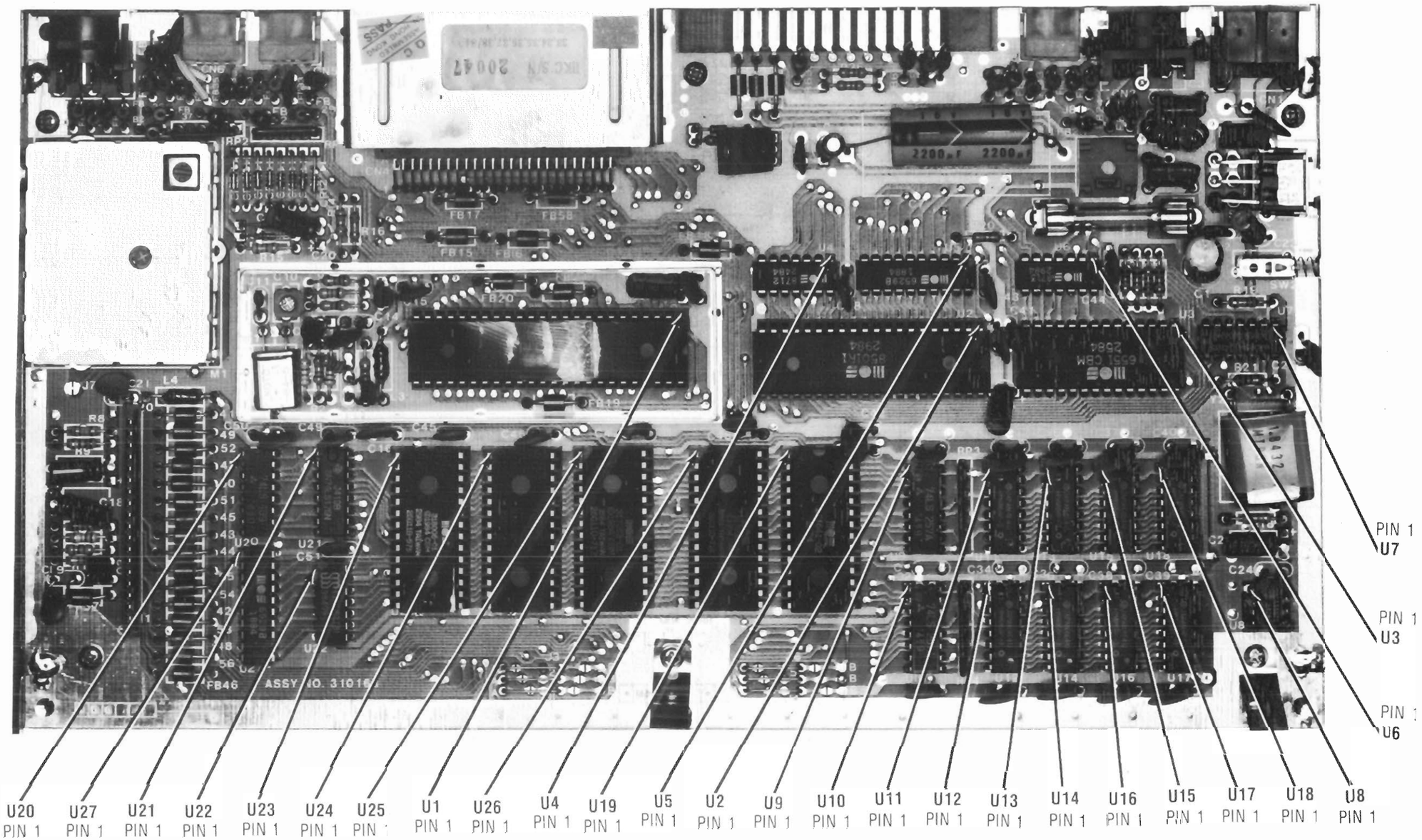
KEYPORT CS

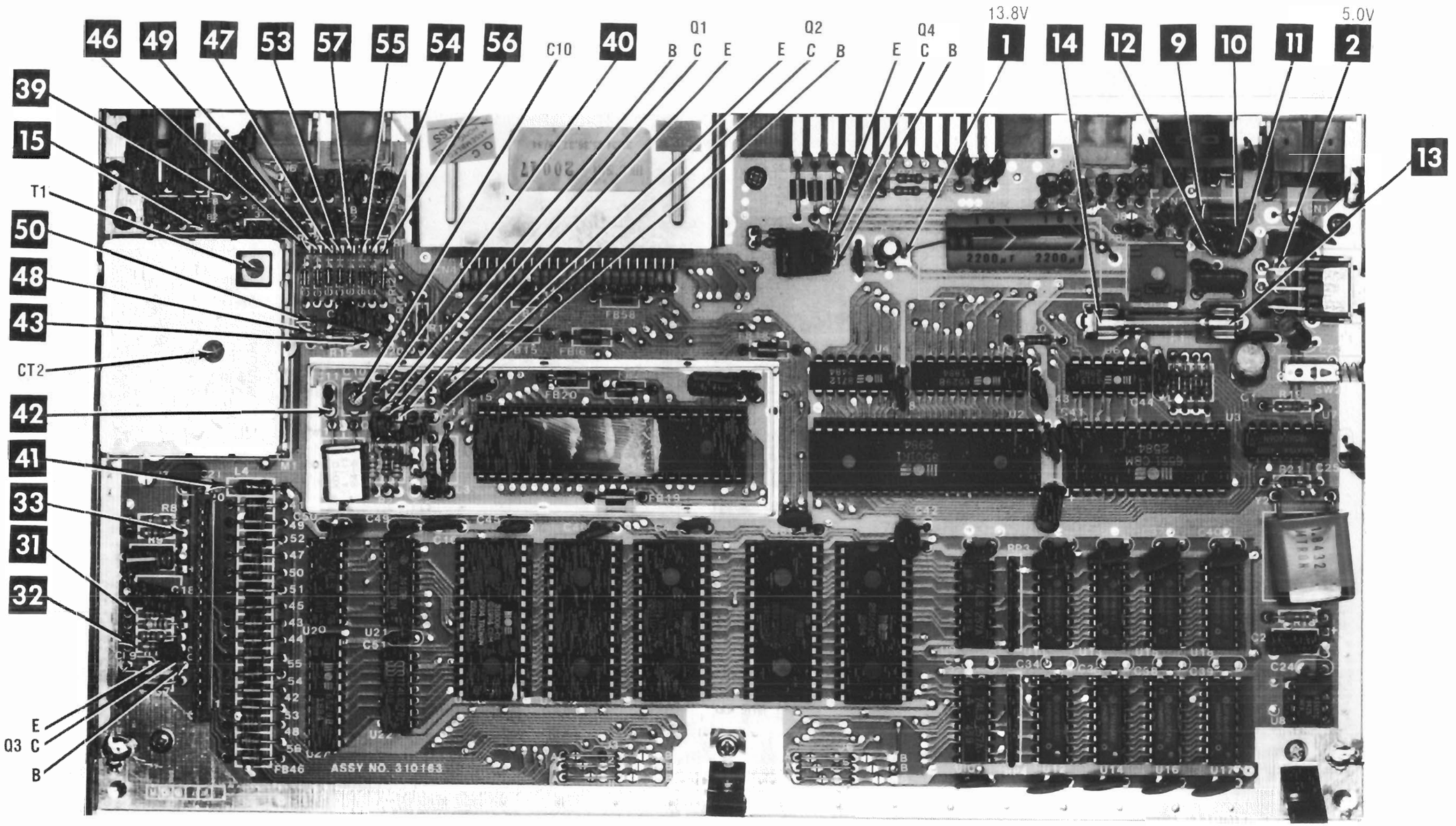
USER PORT

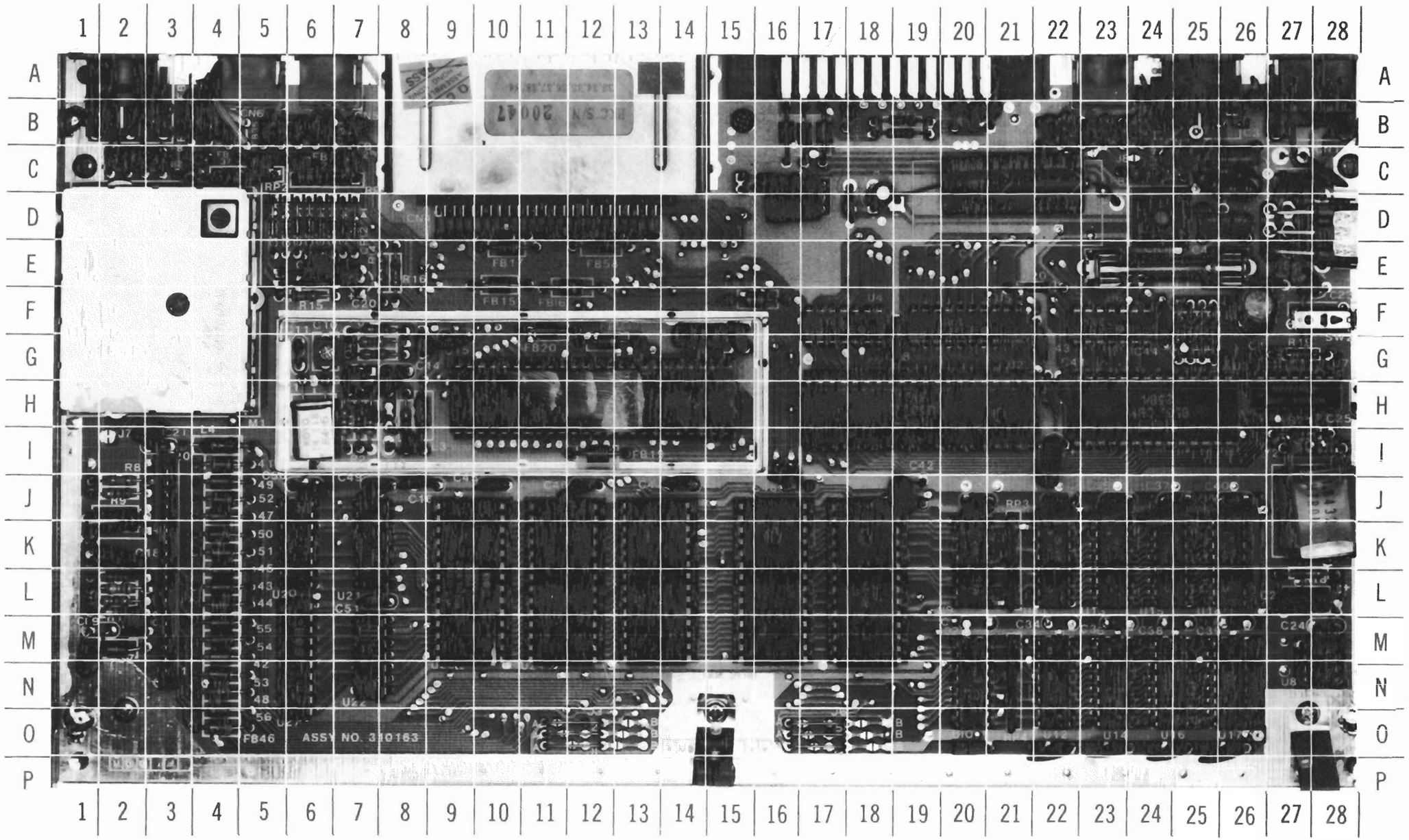
COMMODORE MODEL PLUS/4



A PHOTOFACT STANDARD NOTATION SCHEMATIC WITH CIRCUITRACE


U20 PIN 1
U27 PIN 1
U21 PIN 1
U22 PIN 1
U23 PIN 1
U24 PIN 1
U25 PIN 1
U1 PIN 1
U26 PIN 1
U4 PIN 1
U19 PIN 1
U5 PIN 1
U2 PIN 1
U9 PIN 1
U10 PIN 1
U11 PIN 1
U12 PIN 1
U13 PIN 1
U14 PIN 1
U16 PIN 1
U15 PIN 1
U17 PIN 1
U18 PIN 1
U8 PIN 1
PIN 1 U7
PIN 1 U3
PIN 1 U6





MAIN BOARD

A Howard W. Sams GRIDTRACE™ Photo

MAIN BOARD

MAIN BOARD LOGIC (Continued)

PIN NO.	IC U19	PIN NO.	IC U19	PIN NO.	IC U20	IC U21	IC U22	PIN NO.	IC U23	PIN NO.	IC U23	PIN NO.	IC U24	PIN NO.	IC U24
1	*	15	P	1	H	H	P	1	*	15	P	1	*	15	P
2	P	16	P	2	L	L	P	2	P	16	P	2	P	16	P
3	P	17	P	3	L	H	H	3	P	17	P	3	P	17	P
4	P	18	P	4	H	P	P	4	P	18	P	4	P	18	P
5	P	19	L	5	H	P	L	5	P	19	P	5	P	19	P
6	P	20	P	6	H	H	L	6	P	20	L	6	P	20	L
7	P	21	P	7	H	L	L	7	P	21	P	7	P	21	P
8	P	22	P	8	L	L	L	8	P	22	H	8	P	22	P
9	P	23	P	9	H	P	H	9	P	23	P	9	P	23	P
10	P	24	P	10	H	L	L	10	P	24	P	10	P	24	P
11	P	25	P	11	H	H	P	11	P	25	P	11	P	25	P
12	P	26	P	12	P	P	P	12	P	26	P	12	P	26	P
13	P	27	P	13	L	P	L	13	P	27	H	13	P	27	H
14	L	28	H	14	L	H	H	14	L	28	H	14	L	28	H
				15	P	L									
				16	H	H									

PIN NO.	IC U25	PIN NO.	IC U25	PIN NO.	IC U26	PIN NO.	IC U26	PIN NO.	IC U27	PIN NO.	IC U27
1	*	15	P	1	*	15	P	1	P	11	P
2	P	16	P	2	P	16	P	2	P	12	P
3	P	17	P	3	P	17	P	3	P	13	P
4	P	18	P	4	P	18	P	4	P	14	P
5	P	19	P	5	P	19	P	5	P	15	P
6	P	20	L	6	P	20	L	6	P	16	P
7	P	21	P	7	P	21	P	7	P	17	P
8	P	22	P	8	H	22	H	8	L	18	P
9	P	23	P	9	P	23	P	9	P	19	P
10	P	24	P	10	P	24	P	10	L	20	H
11	P	25	P	11	P	25	P				
12	P	26	P	12	P	26	P				
13	P	27	H	13	P	27	H				
14	L	28	H	14	L	28	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)

MISCELLANEOUS ADJUSTMENTS

Alignment Tools **GC ELECTRONICS**

T1 .....5000, 5009, 8276

CRYSTAL OSCILLATOR ADJUSTMENT

Connect a frequency counter to the base of Oscillator Transistor (Q1). Adjust Trimmer Capacitor (C10) 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.

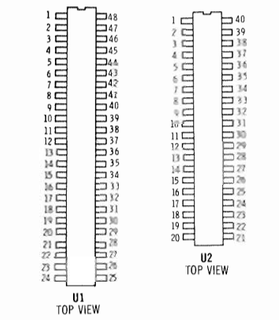
VIDEO LEVEL

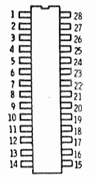
Connect the Computer to a TV and set the TV and Computer Channel Selector Switches to the same channel L (3) or H (4). Adjust the Video Level Trimmer Capacitor (CT2) for the best picture on the Monitor.

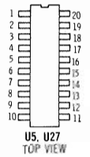
MAIN BOARD GridTrace LOCATION GUIDE

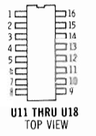
C1	F-26	CR20	D-5	J9	C-23
C2	E-27	F1	E-23	L1	C-27
C3	C-26	FB2	C-3	L2	C-26
C4	D-26	FB3	C-2	L3	H-8
C5	D-26	FB4	C-3	L4	I-4
C6	D-25	FB5	C-2	P1	A-21
C7	C-21	FB6	B-3	Q1	G-7
C8	C-18	FB7	A-3	Q2	G-8
C9	C-18	FB8	C-3	Q3	M-2
C10	G-6	FB9	B-22	Q4	C-17
C11	G-6	FB10	A-24	R1	H-7
C12	H-8	FB11	B-24	R2	H-7
C13	I-8	FB12	B-23	R3	H-8
C14	G-8	FB13	B-23	R4	H-7
C15	G-9	FB14	B-22	R5	G-7
C16	J-8	FB15	E-10	R6	F-7
C17	J-2	FB16	E-12	R7	G-7
C18	K-2	FB17	E-10	R8	J-2
C19	M-2	FB18	F-16	R9	J-2
C20	E-7	FB19	I-12	R10	L-2
C21	I-3	FB20	F-11	R11	L-2
C22	L-27	FB21	G-12	R12	L-2
C23	E-28	FB22	A-26	R13	L-2
C24	M-28	FB23	C-24	R14	E-8
C25	H-28	FB24	C-24	R15	F-6
C26	H-22	FB25	C-25	R16	E-8
C27	I-22	FB26	B-24	R17	C-16
C28	G-19	FB28	B-5	R18	L-27
C29	G-15	FB29	C-7	R19	G-27
C30	G-15	FB30	B-6	R20	F-22
C31	J-20	FB31	B-6	R21	I-27
C32A	O-20	FB32	C-6	R22	F-25
C33	J-22	FB33	B-7	R23	F-25
C34A	O-22	FB34	B-4	R24	F-25
C35	J-23	FB35	B-5	R25	F-25
C36A	O-23	FB36	C-4	R26	B-19
C37	J-24	FB37	C-5	R27	B-19
C38A	O-24	FB38	B-4	RP1	C-4
C39A	O-26	FB39	B-4	RP2	C-7
C40	J-26	FB40	B-4	RP3	K-21
C41	H-22	FB41	I-4	RP4	M-21
C42	J-19	FB42	M-4	SW1	D-28
C43	G-22	FB43	L-4	SW2	F-28
C44	F-24	FB44	L-4	U1	G-15
C45	J-10	FB45	K-4	U2	G-21
C46	J-12	FB46	O-4	U3	G-26
C47	J-14	FB47	J-4	U4	F-18
C48	J-16	FB48	N-4	U5	F-21
C49	J-7	FB49	J-4	U6	F-24
C50	J-6	FB50	K-4	U7	G-28
C51	L-7	FB51	K-4	U8	M-27
C97	C-28	FB52	J-4	U9	K-20
C98	B-5	FB53	N-4	U10	M-20
C99	B-6	FB54	M-4	U11	K-22
CN1	A-27	FB55	M-4	U12	M-22
CN2	A-25	FB56	N-4	U13	K-23
CN3	A-23	FB57	M-2	U14	M-23
CN4	D-9	FB58	E-12	U15	K-24
CN5	A-6	FB59	B-21	U16	M-24
CN6	A-5	FB60	B-16	U17	M-26
CN7	A-2	FB61	B-20	U18	K-26
CN8	N-3	FB62	B-20	U19	J-17
CR1	D-24	FB63	B-18	U20	J-6
CR2	C-16	FB64	B-17	U21	J-7
CR11	D-6	FB65	B-17	U22	M-7
CR12	D-7	J1	O-12	U23	J-9
CR13	D-6	J2	O-12	U24	J-11
CR14	D-7	J3	O-12	U25	J-13
CR15	D-6	J4	O-17	U26	J-15
CR16	E-6	J5	O-17	U27	L-5
CR17	D-5	J6	O-17	Y1	H-6
CR18	E-6	J7	I-2	Y2	I-27
CR19	D-6	J8	C-24		

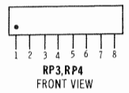
IC PINOUTS & TERMINAL GUIDES

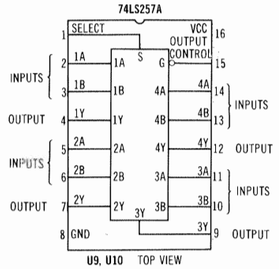


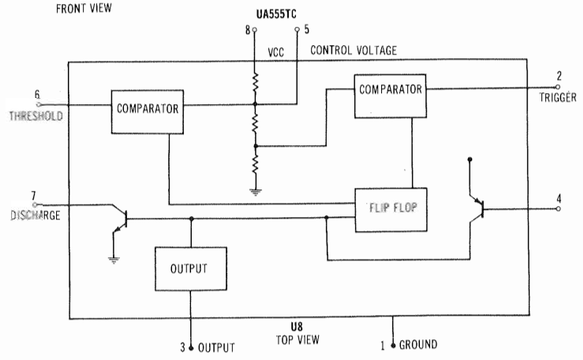


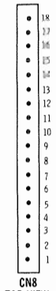


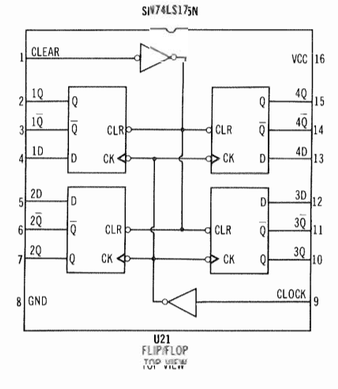












LINE DEFINITIONS

A0 Thru A15 ..... Address Lines
ADDR CLK ..... Address Clock
AEC ..... Address Enable Control
ATN ..... Attention
BA ..... Bus Available
BASIC CS1 ..... Basic Chip Select
BRESET
C1 HIGH
C1 LOW
C2 HIGH
C2 LOW
CAS ..... Column Address Strobe
CST RD ..... Cassette Read
CST MTR ..... Cassette Motor
CST SENSE ..... Cassette Sensor
CST WRT ..... Cassette Write
CS0, CS1 ..... Chip Select Lines
D0 Thru D7 ..... Data Lines
EXT AUDIO ..... External Audio
FUNCTION HI ..... Function High Line
FUNCTION LOW ..... Function Low Line
IRQ ..... Interrupt Request
K0 Thru K7 ..... Keyboard Matrix Line
KERN
KERNAL CS1 ..... Kernal Chip Select
KEYPORT 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.

MAIN BOARD LOGIC

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

PIN NO.	IC U5	IC U6	IC U7	IC U8	IC U9	IC U10	IC U11	IC U12	IC U13	IC U14	IC U15	IC U16	IC U17	IC U18	
1	P	H	L	L	P	P	*	*	*	*	*	*	*	*	
2	H	L	H	H	P	P	P	P	P	P	P	P	P	P	
3	H	L	H	L	P	P	P	P	P	P	P	P	P	P	
4	H	L	L	H	P	P	P	P	P	P	P	P	P	P	
5	H	H	L	H	P	P	P	P	P	P	P	P	P	P	
6	H	L	H	L	P	P	P	P	P	P	P	P	P	P	
7	H	L	L	L	P	P	P	P	P	P	P	P	P	P	
8	H	L	H	H	L	L	H	H	H	H	H	H	H	H	
9	H	H	L		P	P	P	P	P	P	P	P	P	P	
10	L	L	H		P	P	P	P	P	P	P	P	P	P	
11	P	H	L		P	P	P	P	P	P	P	P	P	P	
12	P	P	H		P	P	P	P	P	P	P	P	P	P	
13	P	L	L		P	P	P	P	P	P	P	P	P	P	
14	P	H	H		P	P	P	P	P	P	P	P	P	P	
15	P				L	L	P	P	P	P	P	P	P	P	
16	P				H	H	L	L	L	L	L	L	L	L	
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)

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.
C10	Trimmer 40pF	251029-01

ITEM No.	RATING	MFGR. PART No.

RESISTORS (Power and Special)

ITEM No.	RATING	REPLACEMENT DATA		
		MFGR. PART No.	NEW-TONE PART No.	WORKMAN PART No.
RP1	Resistor Network (1)	902441-29		
RP2	Resistor Network (1)	902441-29		
RP3	Resistor Network (2)	326149-06		
RP4	Resistor Network (2)	326149-06		

(1) Contains five 3300.
(2) Contains four 68 5%.

COILS (RF-IF)

ITEM No.	FUNCTION	MFGR. PART No.
L1	Filter, EMI	251264-01
L2	Line Choke	906127-01

ITEM No.	FUNCTION	MFGR. PART No.
L3	RF Choke 1.2uH	901152-01
L4	RF Choke 1.2uH	901152-01

FUSE DEVICES

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

MISCELLANEOUS

ITEM No.	PART NAME	MFGR. PART No.	NOTES
FB1 thru FB65	Ferrite Bead	903025-01	
M1	Modulator	251311-01	NTSC
	Modulator	251312-01	PAL
SW1	Switch	251587-01	Power, On/Off
SW2	Switch	251260-01	Reset
Y1	Crystal	251081-01	14.31818MHz (NTSC)
	Crystal	251082-01	17.73447MHz (PAL)
Y2	Crystal	900555-02	1.8432MHz
	Power Supply		Includes AC Plug and Cord

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

TROUBLESHOOTING

POWER SUPPLY

Connect the Power Supply to 120V AC. Check for 5V between pins 1 and 2 and for 10.6V AC between pins 3 and 4 of (male) Connector CN1. If voltages are missing, replace the Power Supply. If voltages are normal, connect the Power Supply to (female) Connector CN1. Press the Power Switch (SW1) On and check for 5V at the positive (+) end of Electrolytic C1. Also, check for 13.8V at the positive (+) end of Electrolytic C7. If the 5V is missing, check Line Filter (L1) and Switch SW1. If the 13.8V is missing at CR1 Output, check DC Fuse (F1). If Fuse F1 is open, check for a shorted Diode CR1 and also check Electrolytics C7 and C8.

MICROPROCESSOR (CPU) OPERATION

Check for 5V at pin 5 of the CPU IC (U2). See if the Microprocessor is functioning by checking with a logic probe for pulses on Address Lines, (pins 4 and 6 thru 22) and Data Lines, (pins 31 thru 38) of IC U2. If the Microprocessor is not functioning, turn the Computer Off and connect a logic probe to pin 40 of IC U2. Turn the Computer On and check for a logic Low reading lasting about two seconds. After two seconds the reading will then change to logic Hi, resetting IC U2. If the logic readings are incorrect, troublesnoot components associated with IC U7 and Timer IC U8.

Check for clock pulses on pin 14 of the TED IC (U1). If the pulses are missing, troubleshoot the Master Clock circuit and check the frequency at the base of Oscillator Transistor (Q1). Adjust Trimmer (C10) for a frequency of 14.31818MHz for (NTSC) or 17.7344MHz for (PAL). If the frequency will not adjust, check Crystal (Y1) by substitution and also check voltages, waveforms and components associated with Oscillator Transistors (Q1 and Q2). If clock pulses are present at pin 14 of IC U1, check for clock pulses at pin 12 of IC U1. If the clock pulses are missing at pin 12, check IC U1 by substitution. If the clock pulses are present at pin 12 of IC U1, check for the clock pulses at pin 1 of IC U2. If the clock pulses are present at pin 1 of IC U2 and the CPU still does not work, check the IC U2 by substitution.

SOUND

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

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

Check for a square shape waveform at pin 33 of TED IC (U1). See Figure 1. If the waveform is missing, check TED IC (U1) by substitution. If the waveform is present, check the voltages and components associated with Audio Amp Transistor (Q3), Electrolytic C20 and the RF Modulator (M1). If the sound is only missing when using a game cartridge, check Electrolytics C17 and C18 and associated components.

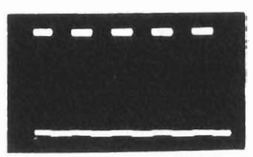


Figure 1

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 present, check for video waveforms on pins 6, 7 and 8 of the RF Modulator (M1). If waveforms are missing, check Modulator M1 by substitution. If the waveforms are present at Modulator M1, check the Video Output Connector CN7 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 colors are incorrect, check adjustment of 14.31818MHz Oscillator. See "Crystal Oscillator Adjustment" section of Miscellaneous Adjustments.

KEYBOARD

Keyboard does not work. Check the waveforms at pins 2 thru 9 of Kernal IC (U27). If any waveform is missing, check IC U27 by substitution. If the waveforms are normal, check the Keyboard Connector CN8 for good connections. If the connections are normal, check TED IC (U1) by substitution. If none of the function keys are operating, check PLA IC (U19) by substitution. If Function Keys F1/F4 or F1/F5 are not operating, check Function Low IC (U25) by substitution. If Function Keys F3/F6 or HELP/F7 are not operating, check Function Hi IC (U26) by substitution. If any other key is erratic or does not operate, clean the switch contacts associated with the erratic key with a contact cleaner.

CASSETTE OPERATION

Note: See "Cassette Operation" section of the General Operating Instructions for correct procedures on loading and saving programs with a Datassette tape recorder.

Check Connector CN3 for good connections. If a program does not SAVE onto tape, check for pulses at pin 29 of CPU IC (U2) while attempting to save a program. 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 6 of IC U7. If the pulses are missing at pin 6, check IC U7 by substitution. If a program does not load from tape, check for pulses at pin 26 of IC U2 while attempting to load a program. If pulses are present at pin 26, check pin 4 of Connector CN3.

If the cassette motor does not run, check for a logic Low reading at pin 3 and a logic Hi reading at pin 4 of IC U7 while attempting to save a program onto tape. If the logic reading at pin 3 of IC U7 is Hi, check IC U7 by substitution. If the logic reading is Low at pins 3 and 4 of IC U7, check IC U7, Zener Diode (CR2), Motor Drive Transistor (Q4) and Resistor R17 by substitution. If the readings at pins 3 and 4 of IC U7 are normal, check for a logic Low reading at pin 27 of IC U2 while attempting to save a program. If the logic reading at pin 27 is Hi, check IC U2 by substitution.

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PARTS LIST AND DESCRIPTION

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

SEMICONDUCTORS (Select replacement transistor 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.
CR1	2B4.E	251026-01 251026-02 251026-03		MDA802	NTE5313	ECG5313	SK3986/53B		
CR2	83C6V8	900927-01	GEZD-6.8	1N4736A	NTE5071A	ECG5071A	SK6V8/5071A	WEP1106/5071	103-Z9020
CR11 Thru CR20	1N914F 1N4148	900850-16 900850-01	GE-300 GE-514	1N4935 1N4935	NTE177 NTE519	ECG177 ECG519	SK9091/177 SK3100/519	WEP1062/177 WEP925/519	103-131 103-131
Q1 Thru Q3	2SC945 2SC1815	902693-01	GE-212 GE-62	MPSA18* MPSA05*	NTE85 NTE85	ECG85 ECG85	SK3124A/289A SK3124A/289A	WEP736/123A* WEP66/199	121-972* 121-Z9065
Q4	TIP29 2SD880	902653-01 902694-01	GE-66A GE-66A	TIP29B TIP41A	NTE152 NTE152	ECG152 ECG152	SK3893/152 SK3440/291	WEP745/152 WEP745/152	121-987-03 121-987-03
U1	MOS8360R1 7360R7	251535-01							
U2	MOS8501R1 7501R1	251536-01							
U3	MOS6551CBM 6551A	901895-02							
U4	MOS8712 74LS08	901521-03	74LS08	SN74LS08N	NTE74LS08	ECG74LS08	SK74LS08		HE-443-780
U5	MOS6529B	251640-03							
U6	MOS8713 74LS04	901521-02	74LS04	SN74LS04N	NTE74LS04	ECG74LS04	SK74LS04		HE-443-755
U7	SN7406N	901522-06	GE-7406		NTE7406	ECG7406	SK7406		HE-443-698
U8	UA555TC	901523-01	GEIC-269	MC1455P1	NTE955M	ECG955M	SK3564/955M	WEP2119/955M	221-Z9042
U9,10	74LS257A	901521-57	74LS257	SN74LS257AN	NTE74LS257	ECG74LS257	SK74LS257		HE-443-802
U11 Thru U18	HM4864P-3 4164-2	901505-01			NTE4164				

PARTS LIST AND DESCRIPTION (Continued)

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

SEMICONDUCTORS (Select replacement transistor 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.
U19	7700-01D	251641-02							
U20	74LS139	901521-18	74LS139	SN74LS139N	NTE74LS139	ECG74LS139	SK74LS139		
U21	SN74LS175N	901521-34	74LS175	SN74LS175N	NTE74LS175	ECG74LS175	SK74LS175		HE-443-752
U22	T74LS27B1	901521-22	74LS27	SN74LS27N	NTE74LS27	ECG74LS27	SK74LS27		HE-443-800
U23	26011B-575	318006-01 (1)							
	23128B	318006-01							
U24	26011C-699	318005-04 (1)							
	23128B	318005-01 318004-01 (2)							
U25	26011D-717	317053-01 (1)							
	23128 2364								
U26	26011D-718	317054-01 (1)							
	23128 2364								
U27	MOS6529B	251640-03							

\# For SAFETY use only equivalent replacement part.
* Lead configuration may vary from original.

(1) Number on unit.
(2) Used in United Kingdom and Germany.

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
300-Ohm Input Lead	Use BELDEN No.	8225
75-Ohm Input Lead	Use BELDEN No.	8241

PRELIMINARY SERVICE CHECKS (Continued)

SAFETY PRECAUTIONS

1. Use an isolation transformer for servicing.
2. Maintain AC line voltage at rated input.
3. Remove 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 boards, 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 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 correct hookup before making service checks.

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

GENERAL OPERATING INSTRUCTIONS

POWER UP

The Computer will come on 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 to enable the user to program with machine language. To go from Basic to Monitor, 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, type X and press the RETURN key.

CASSETTE OPERATION

Plug a Datassette Recorder into Connector CN3 at the rear of the Computer. Note: A standard tape recorder will not work on the Commodore Plus/4. 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 Connector (CN2) 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 diskette has been inserted, close the protective gate by pushing down on the gate lever. To load a program from the diskette, type LOAD "PROGRAM NAME", 8 and press the RETURN key. To save a program, type SAVE "PROGRAM NAME", 8 and press the RETURN key.

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

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DISASSEMBLY INSTRUCTIONS

CABINET TOP REMOVAL

Remove five screws from cabinet bottom holding keyboard assembly and cabinet top. Carefully lift cabinet top from unit and disconnect keyboard ribbon wire from main board.

KEYBOARD REMOVAL

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

CPU BOARD REMOVAL

Remove five screws holding CPU board to cabinet bottom. Lift CPU board from cabinet.

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PRELIMINARY SERVICE CHECKS (Continued)

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 (SNOWY SCREEN)

(A) Turn Computer On and check if the Power Indicator LED is lit. If Indicator LED is not lit, see "Power Supply" section of the Preliminary Service Checks.

(B) Make certain the TV and Computer Channel Selector Switches are on the same channel L (3) or H (4).

(C) Make certain the Antenna Switch is in Computer position.

(D) Check for open or intermittent connections or an improper hookup at both the Monitor and Computer.

(E) Check for 5V at end of Coil L4, for .9V at pin 1 of Connector CN7 and for 1.6V at pins 4 and 6 of Connector CN7.

(F) To help isolate problem, connect the Video Input of the Monitor to the Video Output Connector CN7. If video appears, replace RF Modulator (M1). If the video does not appear when Video Input of Monitor is used, the problem is probably not the RF Modulator. See "Main Board (Processing)" section of the Preliminary Service Checks.

(2) POWER SUPPLY

(A) Connect the Power Supply to 120V AC. Disconnect Power Connector (CN1). Check for 5V DC between pins 1 and 2 of Connector CN1. Check for 10.6V AC between pins 3 and 4 of Connector CN1.

(B) Check AC Fuse (F1).

(C) If the AC Fuse (F1) is open, check for a shorted Diode (CR1).

(D) Connect the Power Supply to the Computer, press Power Switch (SW1) On and check for 13.8V at the positive (+) end of Electrolytic C7.

(3) MAIN BOARD (PROCESSING)

(A) If the power supply is normal but the Computer does not come up when powered, check for a clock waveform at pin 1 of CPU IC (U2) and also check IC U2 by substitution.

(B) If the Microprocessor is working and the Computer does not come up, check Kernal IC (U24) and PLA IC (U19) by substitution.

(C) If Computer comes up but not in Basic Ready mode, check Basic ROM IC (U23) by substitution.

(D) If the Computer does not come up and the Monitor screen remains black, check for clock waveforms at pins 12 and 14 of TED IC (U1).

(E) If special programs activated by pressing the function switches do not operate, check Function Low IC (U25) and Function Hi IC (U26) by substitution.

(F) Disk Drive or Printer does not function properly. Check for open or intermittent connections at Connector CN2.

(G) Video Output Connector (CN7) does not function, check TED IC (U1) by substitution. If IC U1 is good, check the RF modulator (M1).

(H) Joystick Connectors (CN5 and CN6), Keyboard Connector (CN8) or Expansion Connector (CN4) do not function, check the CPU IC (U2) by substitution.

(K) No sound, check Audio Amp Transistor (Q3) by substitution.

(L) Sound only missing when game cartridge is used, check Electrolytics C17 and C18.

(4) KEYBOARD

(A) If any or all of the keys function abnormally, check Connector CN8 and check the keyboard by substitution.

(B) If the function keys do not function properly, check Function Hi IC (U26) by substitution.

(5) CASSETTE OPERATION

(A) If cassette motor does not run, check voltages at Motor Drive Transistor (Q4) and also check Zener Diode (CR2) by substitution.

(B) If the cassette motor still does not run, check IC (U7) by substitution.

PRELIMINARY SERVICE CHECKS (Continued)

MISCELLANEOUS ADJUSTMENTS

Alignment Tools	GC ELECTRONICS
T1	5000,5009,8276

CRYSTAL OSCILLATOR ADJUSTMENT

Connect a frequency counter to the base of Oscillator Transistor (Q1). Adjust Trimmer Capacitor (C10) 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 Monitor.

TEST EQUIPMENT AND TOOLS

TEST EQUIPMENT

Digital Volt/Ohm Meter
Logic Probe
Monitor with Audio
Frequency Counter

TOOLS

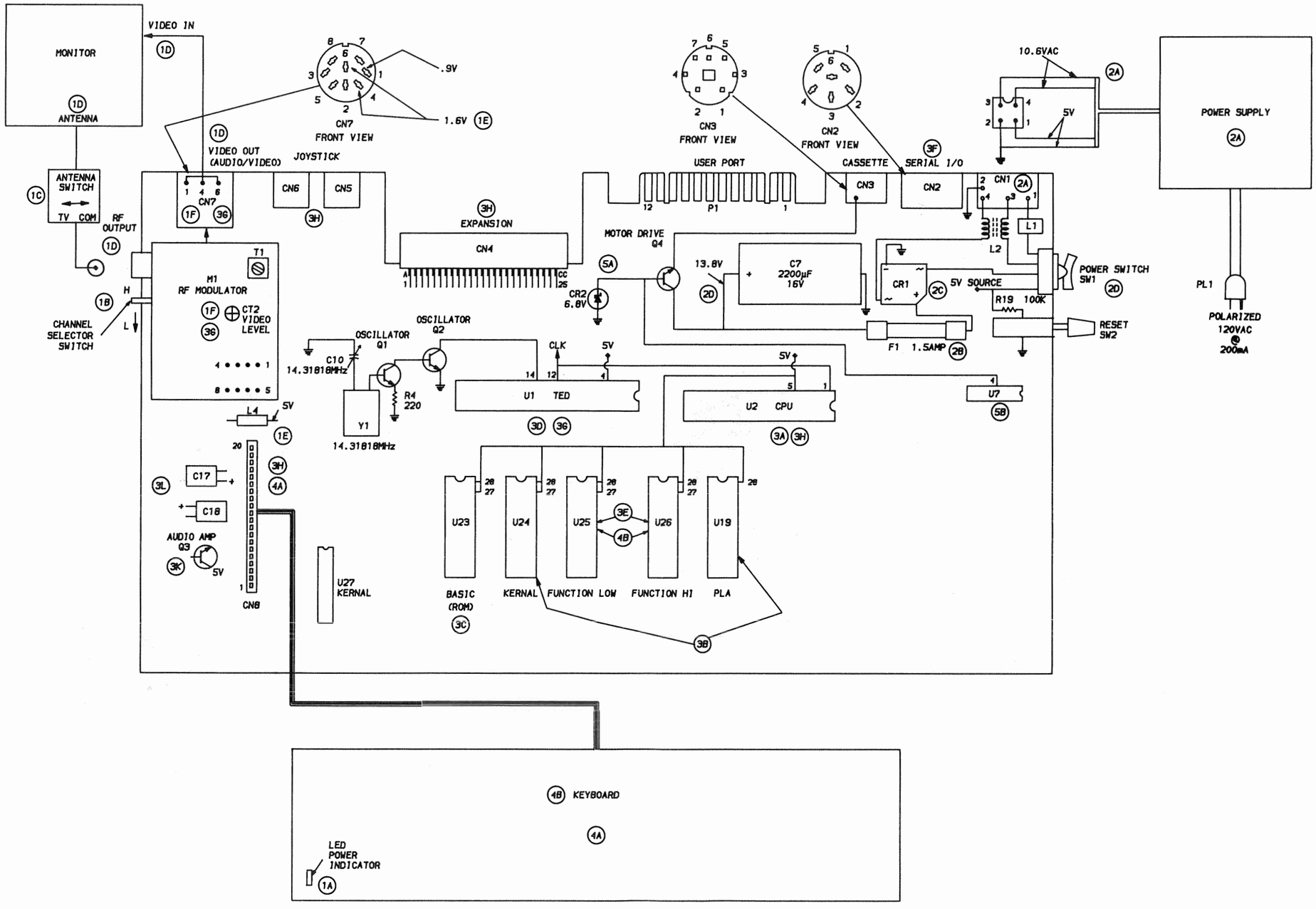
Phillips Screwdriver
Low Voltage Soldering Iron
Desoldering Tool
Alignment Tool (GC ELECTRONICS 5000, 5009, 8276)
Small Screwdriver

REPLACEMENT PARTS

ITEM	PART NO.	DESCRIPTION
C7	900101-33	Electrolytic, 2200μF 16V
C10	251029-01	Trimmer, Oscillator, 40pF
C17	900100-25	Electrolytic 10μF 16V
C18	900100-25	Electrolytic 10μF 16V
CR1	251026-01	Diode, Bridge Rectifier, 2B4•E
CR2	900927-01	Diode, Zener, 83C6V8 (6•8V)
F1	903556-18	Fuse, AC 1.5A @ 250V Fast Acting
L4	901152-01	Coil
LED		LED, Power Indicator
M1	251311-01	RF Modulator, with Channel Selector Switch (H/L) and Video Level Trimmer (CT2)
Q1		Transistor, Oscillator 2SC945
Q3		Transistor, Audio Amp 2SC945
Q4	902653-01	Transistor, Motor Drive TIP29
SW1	251587-01	Switch, Power
U1		IC, TED, MOS8360R1
U2		IC, CPU, MOS8501R1
U7	901522-06	IC, SN7406N
U19	251641-02	IC, PLA, 7700-01D
U23	318006-01(1)	IC, BASIC ROM, 26011B-575
U24	318005-04(1)	IC, Kernal, 26011C-699
U25	317053-01(1)	IC, Function Low, 26011D-717
U26	317054-01(1)	IC, Function Hi, 26011D-718
		Power Supply Unit

(1) Number on Unit

PRELIMINARY SERVICE CHECKS (Continued)



INTERCONNECTING DIAGRAM

PRELIMINARY SERVICE CHECKS (Continued)