SERVICE MANUAL MODEL PLUS 4 COMPUTER OCT. 1984 PN-314001-04

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PLUS 4 PRODUCT SPECIFICATION

MEMORY

64K RAM. 60K RAM User accessible for BASIC programs.

ROM

32K ROM Standard (includes operating system and BASIC interpreter) with 32K additional ROM containing the built-in productivity software.

MICROPROCESSOR

7501 Microprocessor — .89 or 1.76 MHz clock.

DISPLAY

40 Columns x 25 lines of text.

COLORS

128 Colors (16 colors; 8 luminance levels).

CHARACTERS

Upper & lower case letters, numerals and symbols. Reverse and flashing charachters. All PET graphic characters.

DISPLAY MODES

Text characters. High resolution graphics. Split screen text/high resolution graphics. Multicolor graphics.

RESOLUTION

320 x 200 Pixels

SOUND

2 Tone generators or 1 Tone and 1 white noise generator.

VOLUME

8 Volume levels

KEYBOARD

Full size typewriter style design

KEYS

67 Keys total. 4 Cursor control keys. 4 Programmed (reprogrammable) function keys (up to 8 user defined functions possible). Color control keys. HELP key. Upper and lower case character set. Graphics character set.

INPUTS/OUTPUTS

PLUS/4 MODEM (User) port. Serial port. ROM cartridge and parallel disk drive port. 2 Joystick ports. C1531 Cassette drive interface port. RF Output-channel 3 or 4. Video output-composite/chrominance/luminance. Audio input/output. Power supply input.

PLUS 4 PRODUCT SPECIFICATION (Continued)

FEATURES

Built-in extended BASIC 3.5 — over 75 commands. Built-in Machine Language monitor — over 12 commands. Built-in graphics and sound commands. Screen window capability. Reset button (Warm start). Built-in integrated productivity software.

PERIPHERALS

C1551 Fast Disk drive, C1531 Datasette, MPS 802 Dot matrix printer, MPS 803 Dot matrix printer, DPS 1101 Daisy wheel printer, C1802 color monitor.

OTHER PERIPHERALS

C1541 Disk drive, MPS 801 Dot matrix printer, C1702 color monitor.

PLUS 4 OVERVIEW

The Plus 4 system is based on the 7501 microprocessor, an HMOS version of the 6510. Video processing is achieved by the 7360 TED chip. 64K bytes of dynamic RAM are accomplished by 8 (64K \times 1) I.C.'s. (See page). The system program is contained in 2 (16K \times 8) ROMs. The system supports up to 128K \times 8 of ROM banked in 16K sections. By software control, through the 7360, ROM can be completely banked out and RAM banked in for a true 64K of RAM (minus 256 byte pages), allowing 60,671 bytes available for BASIC.

Keyboard and joystick scanning are accomplished by outputting the row data on the data bus while addressing a particular register in the TED chip. This will in turn cause the TED chip to latch the column information.

A standard serial port supports serial bus peripherals such as the 1541 disk drive and the various serial printers. A cassette port is provided and the expansion port supports ROM cartrdiges. TTL serial ASCII is intended to drive an RS-232 adapter.

PARTS LIST PLUS/4

TOP CASE ASSY

Top Case	C 251453-01
Keyboard, 67 Key, KKR-I	C 251501-01
Nameplate	C 251655-01
Shield Clip, R	C 251855-01
Shield Clip, F	C 251856-01

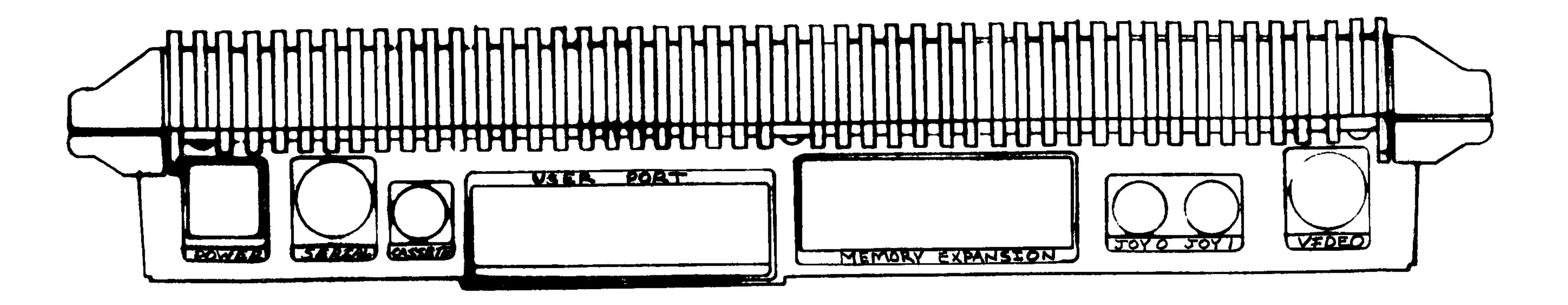
BOTTOM CASE ASSY

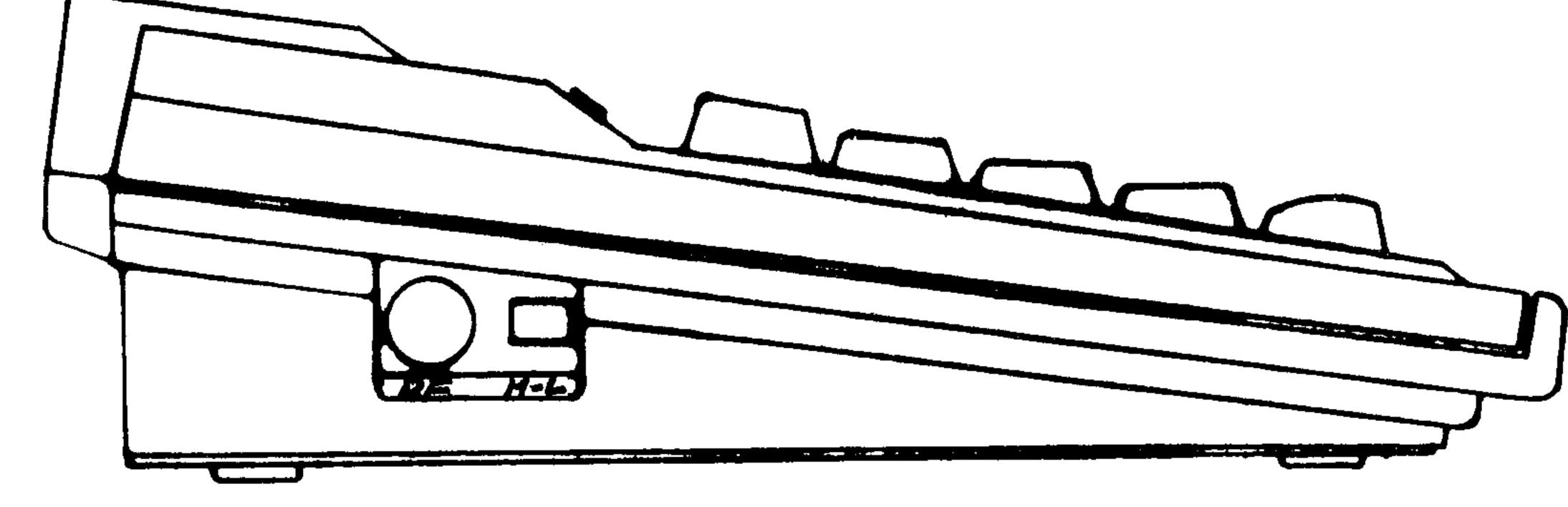
C 251454-01
C 950157-04
C 310156-01
C 310199-01
C 310197-01
C 310198-01

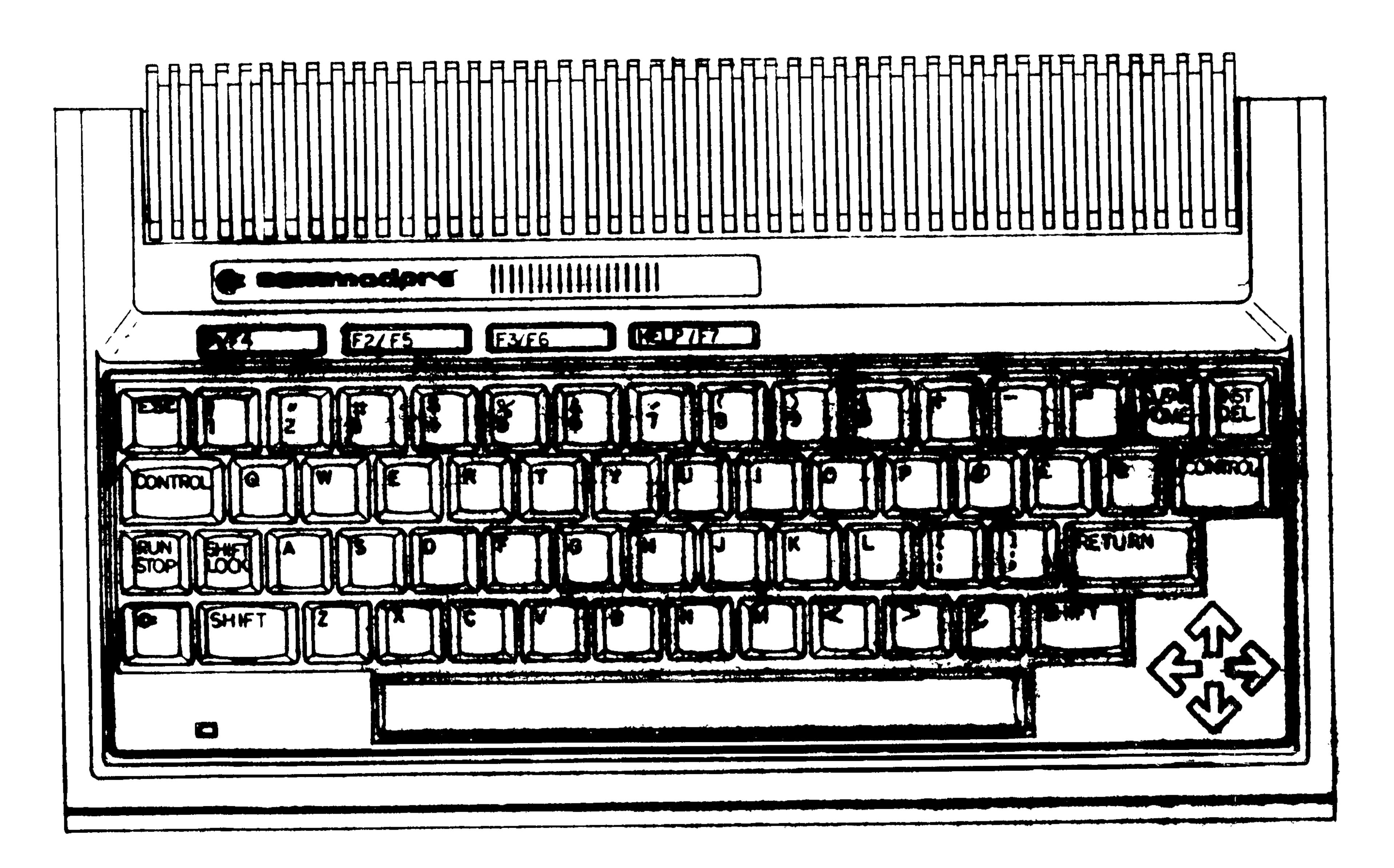
ACCESSORIES

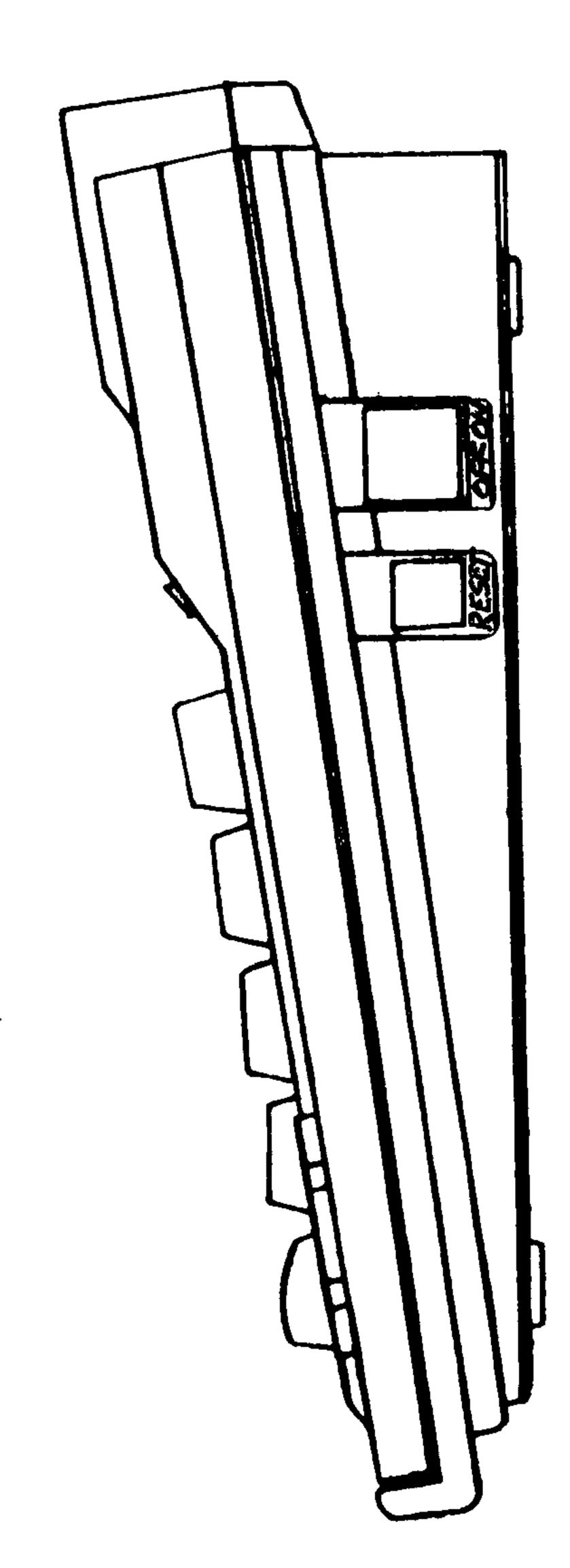
Users Manual	C 310196-01
Power Supply	C 310157
RF Cable	C 326189-02
Switch Box	C 904778-01

C — Commodore Stock Part

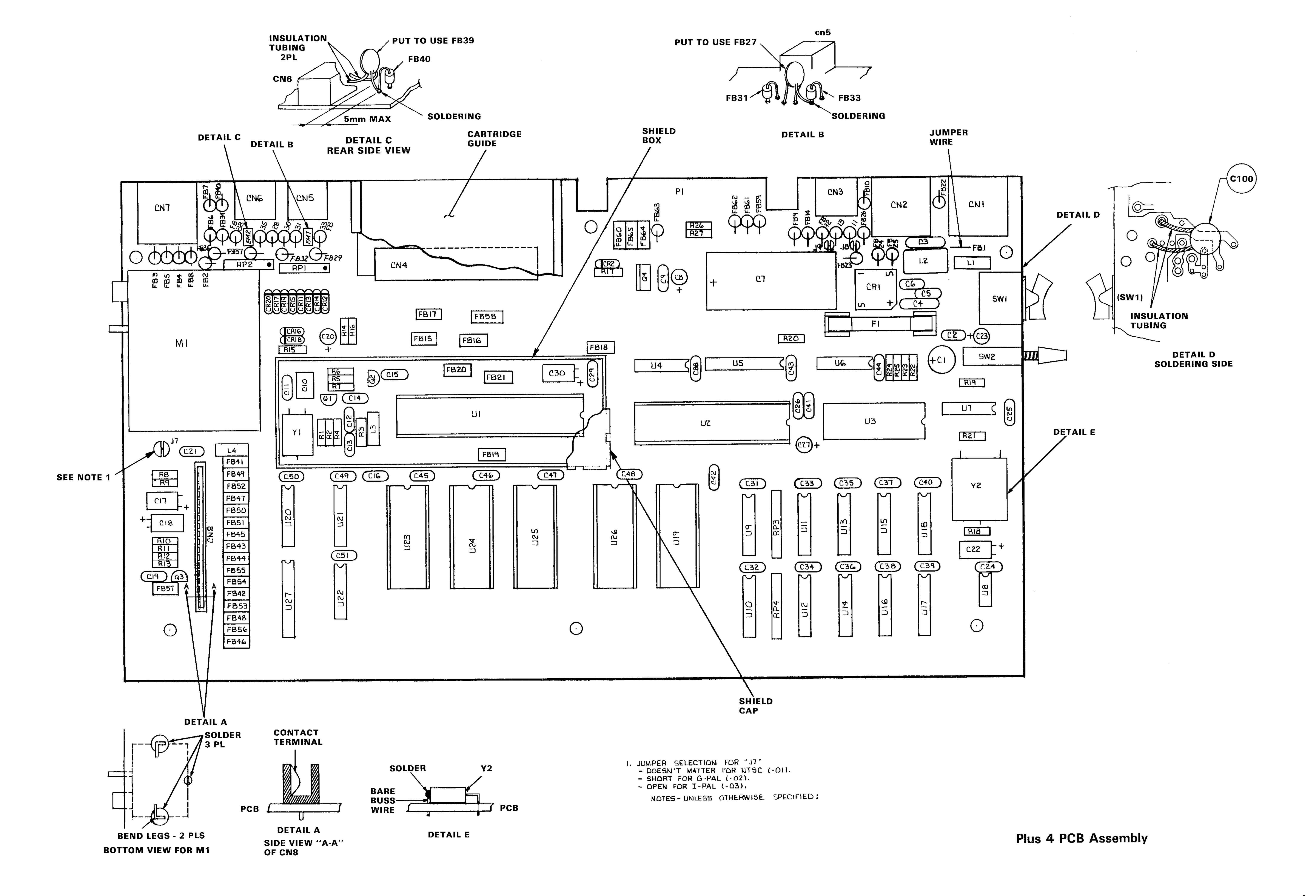








Plus 4 Casework Identification



PARTS LIST -- PLUS/4 PCB ASSEMBLY #310163-01

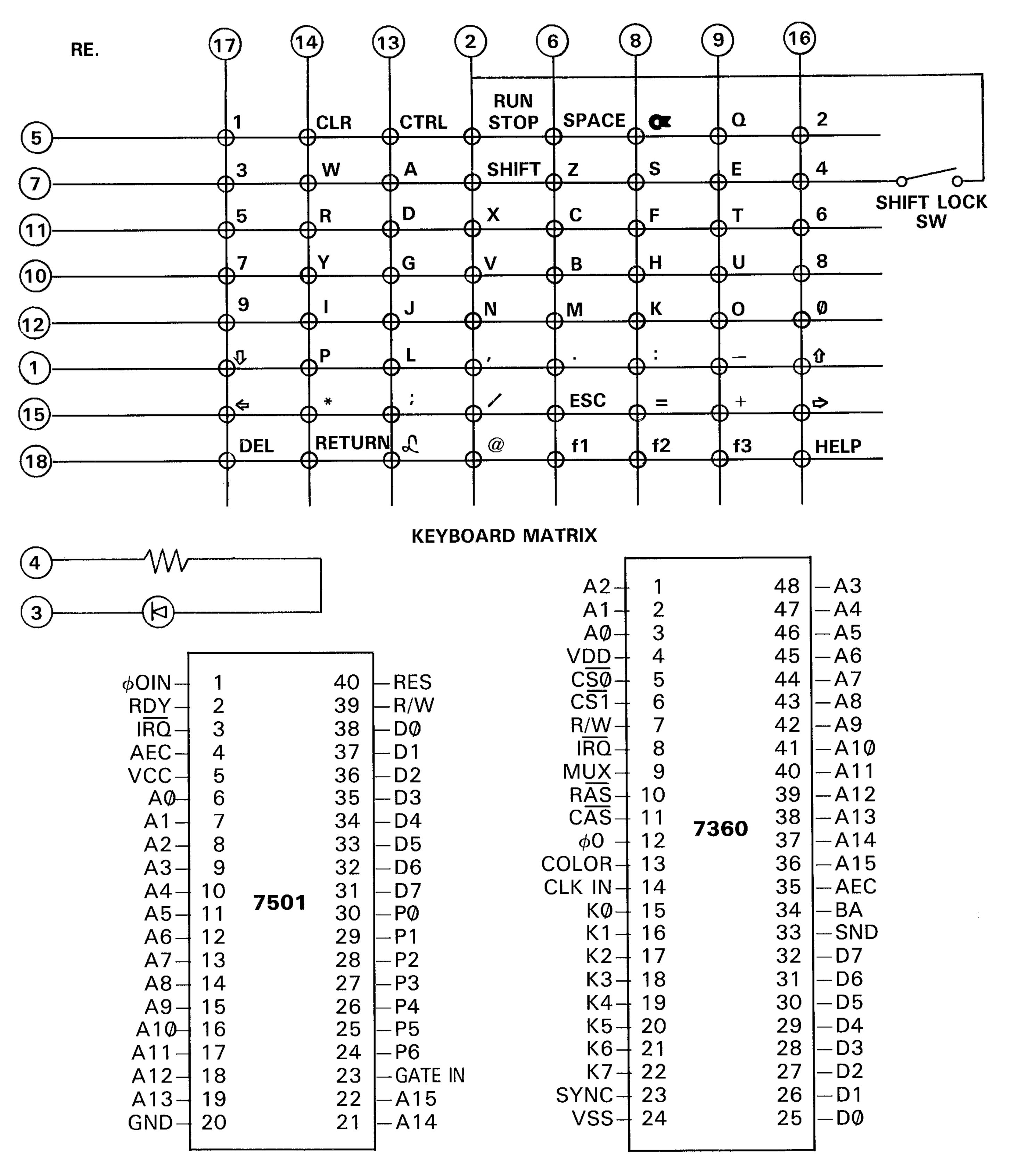
PLEASE NOTE: Commodore part numbers are provided for reference only and do not indicate the availability of parts from Commodore. Industry standard parts (Resistors, Capacitors, Connectors) should be secured locally. Approved cross-references for TTL chips, Transistors, etc. will be available in manual form through the Service Department in November of 1984. Unique or non-standard parts will be stocked by Commodore and are indicated on the parts list by a "C".

INTEGRA	TED CIRCUITS		DIODES (Continued)		
U1	7360 VLSI, Text Disla Sub:	C 251535-01	CR1 (cont.)	Bridge Rectifie Sanyo	•	251026-03
U2	7501 Custom Micropr	C 251535-02 ocessor C 251536-01	CR2 CR11-20	Diode, Zener F Diode, IN 914 Diode, IN 414	Sub:	900927-01 900850-16
U3 U4	6551A (Synertek) 74LS08	901895-02		Diode, IN 414	251	819-21 Sub: 900850-01
U5 U6	6529B Single Port Intellection 74LS04	erface C 251640-03 901521-02	RESISTO	RS — All values 5% unless	are in ohms- noted other	
U7 U8 U9-10 U11-18 U19 U20 U21 U23 U24 U25 U25	7406 555 74LS257 4164-2 D-RAM 7700-010 PLA 74LS139 74LS175 74LS27 2312B ROM TED Bas 23128 ROM TED Kern 23128 FUNCTION RO 6529B Single Port Int	C 318006-01 nal C 318005-04 M, 3+1 LOW C 317053-01 M, 3+HIGH C 317054-01	R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13	1	R14 R15 R16 R17 R18 R19 R20 R21 R22 R23 R24 R25	240 250 100K 1.5K 47K 100K 3K 1K 1K 1K 1K 1K
027	1 0323B Single Fort life	C 251640-03	RP1, 2 RP3, 4	3.3K, 6 PIN 68, 8 PIN 4 I		326149-06
TRANSI	STORS	<u>.</u>	CAPACIT	ORS		
Q1-Q3 Q4	··· -	902693-01 02694-01 Sub: 02653-01 Sub: 902694-04	C1 C2 C3 C4	Ceramic 0.1 Film 0.22 Film 0.22	μF 25V 2 μF 100V 2 μF 100V	900100-40 251075-06 900150-11 900150-11
DIODES			C5-C6 C7	Ceramic 0.22 Elect 220	F	900022-01 900101-33
CR1	Bridge Recitifers DBA	15026-01 Sub:	C8 C9 C10 C11	Ceramic 0.1	μF 25V	900100-25 251075-06 251029-02 251070-14

PARTS LIST — PLUS/4 PCB ASSEMBLY #310163-01 (Continued)

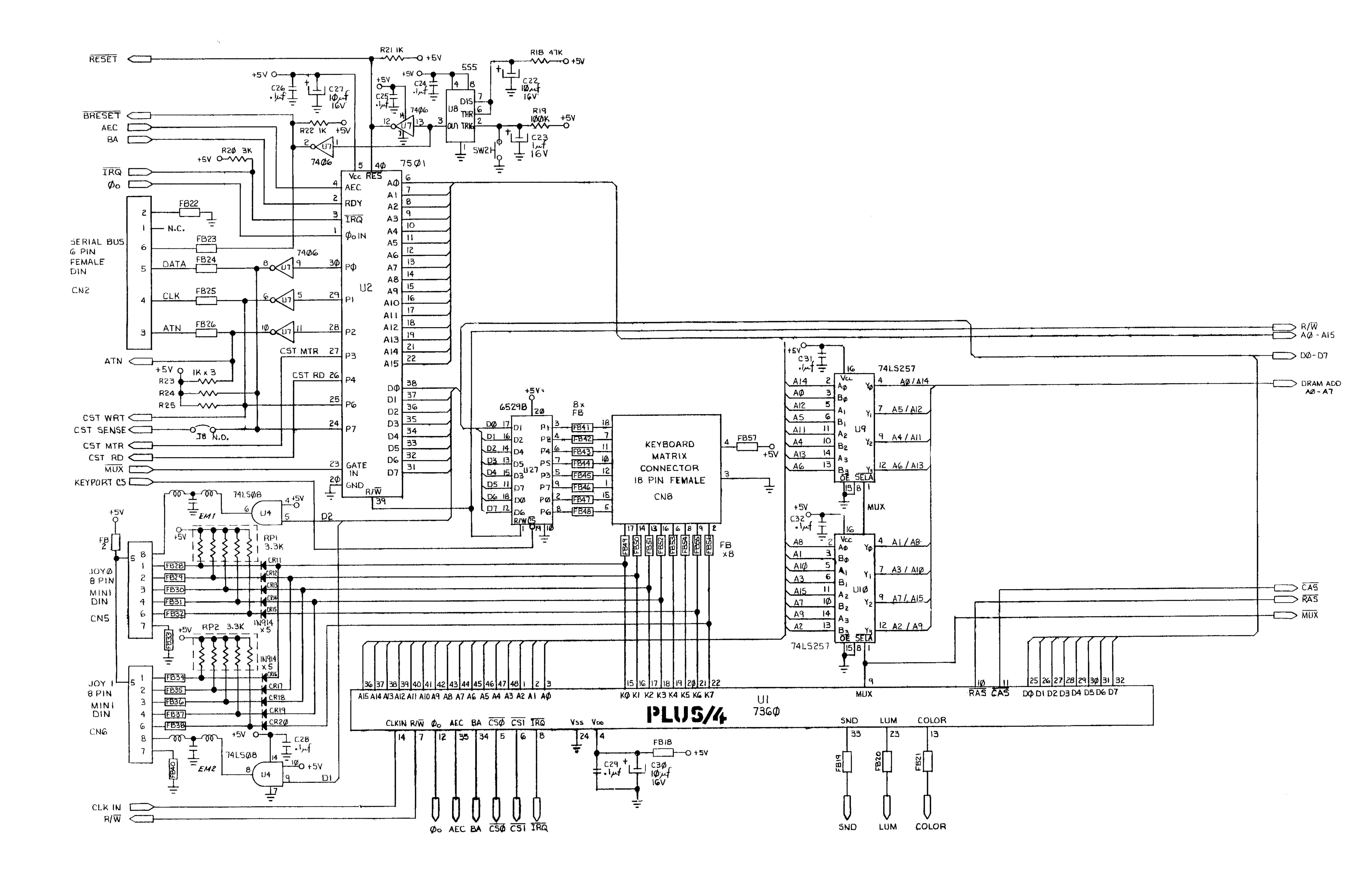
CAPACITO	ORS (Continued)		MISCELLA	ANEOUS (Continued)	
C12	Ceramic 220 pF 50V	Sub:	FB2-14	Ferrite bead	325563-
	251071-26 Sub:		FB15-21	Ferrite bead	903025
	Ceramic 220 pF 50V	900463-08	FB22-26,		
C13	Ceramic 150 pF 50V		FB28-38,	Ferrite bead	325563
010	Sub:		FB40		
		900462-41	FB41-58	Ferrite bead	903025
C14	Ceramic $0.1 \mu F 25V$		FB59	Ferrite bead	325563
C15-C16	·}	251075-06	FB60	Ferrite bead	903025
C17-C18	Ceramic $0.10 \mu F 16V$		FB61-63	Ferrite bead	325563
	Ceramic $0.01 \mu F 25V$		FB64-65	Ferrite bead	903025
C19	1	900100-25		, 01110 2000	
C20	1		EM1,2	EMI Filter	251842
C21		1		L_1411 i IICCI	201072
C22	Elect 10 μF 16V	900100-25	CNIA	Connector 4 PIN (power	eunnha
C23	Elect $1 \mu F 16V$	900100-16	CN1	Confector 4 File (power	C 2516
C24-C26	·	251075-06		O DINI DINI /oo	
C27	Elect 10 μF 16V		CN2	Connector 6 PIN DIN (se	
C28-C29	Ceramic 0.1 μ F 25V				C 9033
C30	Elect 10 μF 16V		CN3	Connector 7 PIN MINI D	
C31-C32	Ceramic 0.1 μ F 25V				C 2516
C33-C40	Ceramic 0.22 μF 25V	251075-07	CN4	Connector 50 PIN Femal	
	Sub:			(exoab)	C 2516
	Ceramic 0.22 μF 50V	900022-01	CN5-6	Connector 8 PIN MINI D	
C41-C51	Ceramic 0.1 μ F 50V			(joy 1 & 2)	
	Sub:	j	CN7	Connector 8 PIN DIN (au	ıdio/videc
	1	9000010-01			32557
C100	Ceramic 0.1 μ F 50V	· · · · · · · · · · · · · · · · · · ·	CN8	Connector 18 PIN (keybo	oard)
	<u> </u>				C 2518
MISCELL			L1	Noise Filter	25126
Y1	Crystal 14.31818 MHZ	251081-01	L2	Line Filter	90612
	Sub:			Sub:	25170
	Crystal 14.31818 MHZ	251081-02		Sub:	
Y2	Crystal 1.8432 MHZ		L3,L3	Coil Inductor 1.2 uHpt	90115
				Sub:	32557
SW1	Switch, Rocker	C 251587-01		Jub.	J2007
	(PC Mount)	<u>-</u>		Fuse 250V 1.5A	90355
SW2	Switch, Push Button	C 251260-01	F1		90333
3002	Ovvicori, i don Datton	<u> </u>		Fuse Clip	31017
 M1	RF Modulator	C 251844-01]	Cartridge Guide	
IVII		U 2010 11 -01		Shield Box	C 310
	Sub:	2 ⊑1211 ∆ 1		Shield Cap	C 310
	RF Modulator	251311-01	<u> </u>	<u> </u>	·

C — Commodore Stock Part



PIN ASSIGNMENT U2-251536-01 CUSTOM MICROPROCESSOR

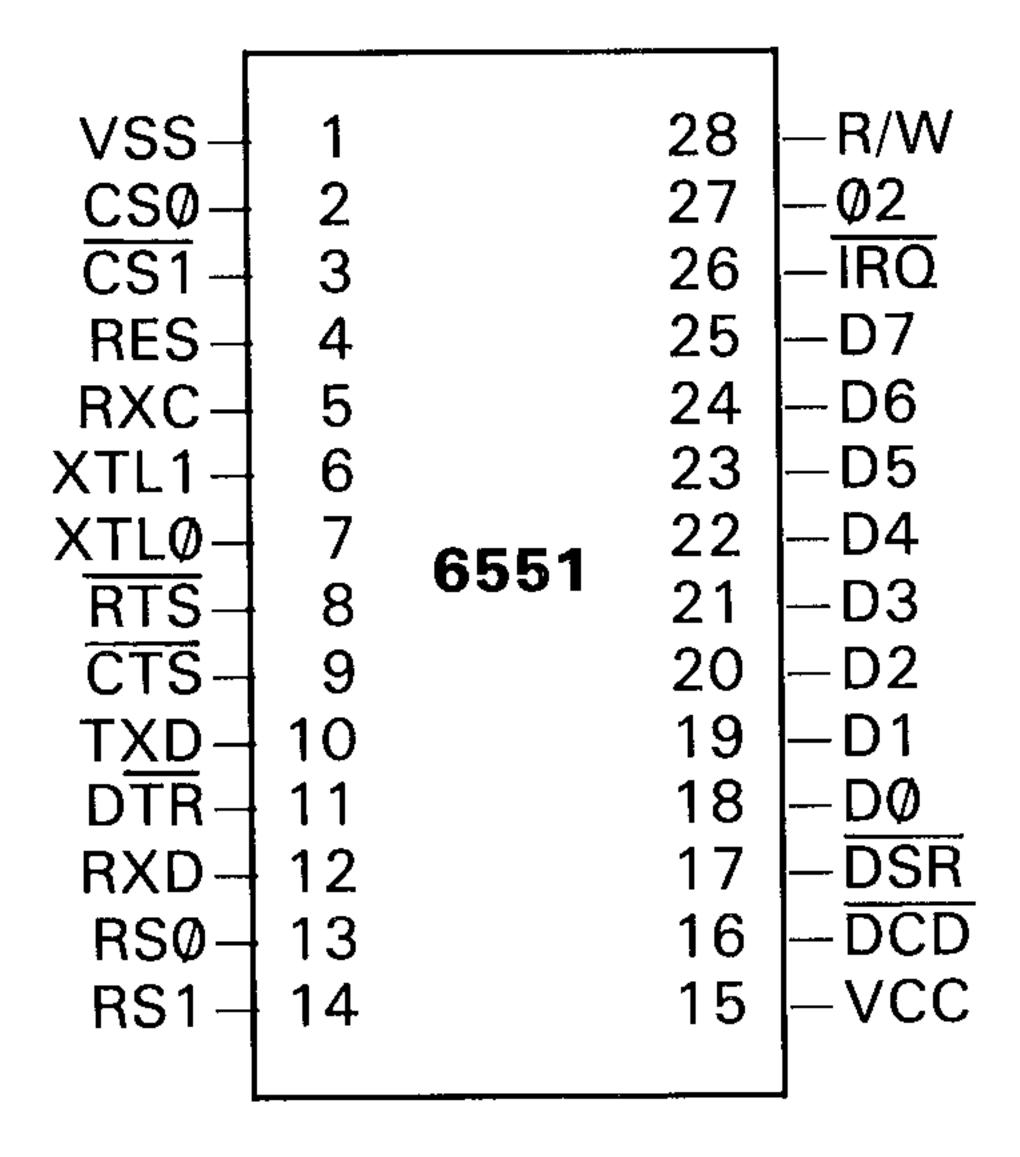
PIN ASSIGNMENT U1-251535-01 VLSI, TEXT DISPLAY (TED)



Plus 4 Schematic #310164 (1 of 4)

M₁ SCHEMATIC ON PAGE 11

PIN CONFIGURATION



U3-901895-02 ACIA

SYNERTEK	SYP6551A	2 MHZ
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TRANSMIT/RECIEVE CHARACTERISTICS

CHARACTERTISTICS	SYM		02 /IHZ	UNIT
		MIN	MAX	
TRANSMIT/RECEIVE CLOCK RATE	tCCY	* 400		ns
TRANSMIT/RECEIVE CLOCK HIGH TIME	^t CH	175	<u> </u>	ns
TRANSMIT/RECEIVE CLOCK LOW TIME	tCL	175		ns
XTL1 TO TXD PROPAGATION DELAY	t _{DD}		500	ns
RTS PROPAGATION DELAY	tDLY		500	ns
IRQ PROPAGATION DELAY (CLEAR)	^t IRQ		500	ns

(tr, tf = 10 to 30 ns)

*The Baud Rate with External Clocking is:

BAUD RATE 1 16 x T_{CCY}

PIN CONFIGURATION

FE 1 28 - VCC 17 2 27 - 18 16 3 26 - 19				ì
15 7 4 25 1 11 4	17 –	_	27	18
	14	5		<u> </u>
	10			140
14 5 24 - 111	13-	р	23	一 Z
14 5 24 - 111	12-	7	22	—I13
14 5 24 — Ī11 13 — 6 23 — I12	11 –	8	21	<u> </u>
I4 5 24 —I11 I3 6 23 —I12 I2 7 22 —I13	10-	9	20	— 1115
$ \begin{array}{ccccccccccccccccccccccccccccccccc$	F7	10	19	— CE
$ \begin{array}{ccccccccccccccccccccccccccccccccc$		11	18	—FØ
I4- 5 24 - 11 I3- 6 23 - 112 I2- 7 22 - 113 I1- 8 21 - 114 IØ- 9 20 - 115 F7- 10 19 - CE		12	17	F1
I4- 5 24 -Ī11 I3- 6 23 -I12 I2- 7 22 -I13 I1- 8 21 -I14 IØ- 9 20 -I115 F7- 10 19 -CE F6- 11 18 -FØ	F4-	13	16	—F2
I4- 5 24 -I11 I3- 6 23 -I12 I2- 7 22 -I13 I1- 8 21 -I14 IØ- 9 20 -I115 F7- 10 19 -CE F6- 11 18 -FØ F5- 12 17 -F1	GND-	14	15	_F3
I4- 5 24 -Ī11 I3- 6 23 -I12 I2- 7 22 -I13 I1- 8 21 -I14 IØ- 9 20 -I115 F7- 10 19 -CE F6- 11 18 -FØ F5- 12 17 -F1 F4- 13 16 -F2				

U19-251641-02 PLA

CS R/W D0-D7

L	L	DATA BUS TO PORT
L	Н	PORT TO DATA BUS
H	Х	ISOLATION

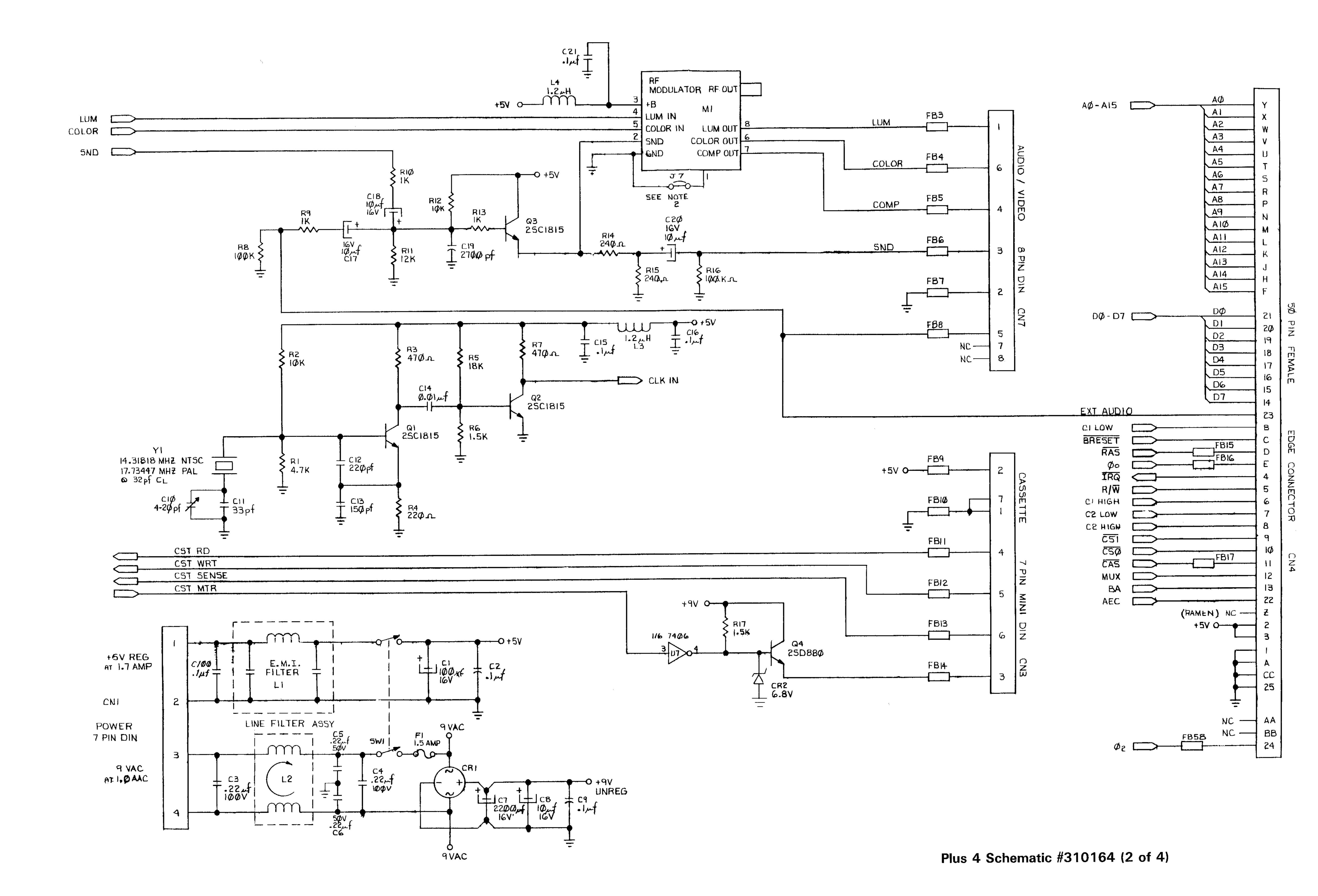
L = LOW LEVEL H = HIGH LEVEL X = IRREVELANT

PIN CONFIGURATION

R/W 1 PØ 2 P1 3 P2 4 P3 5 P4 6 P5 7 P6 8 P7 9 VSS 10	20 19 17 16 15 14 11	-VDD - DB0 - DB1 - DB3 - DB4 - DB6 - DB7
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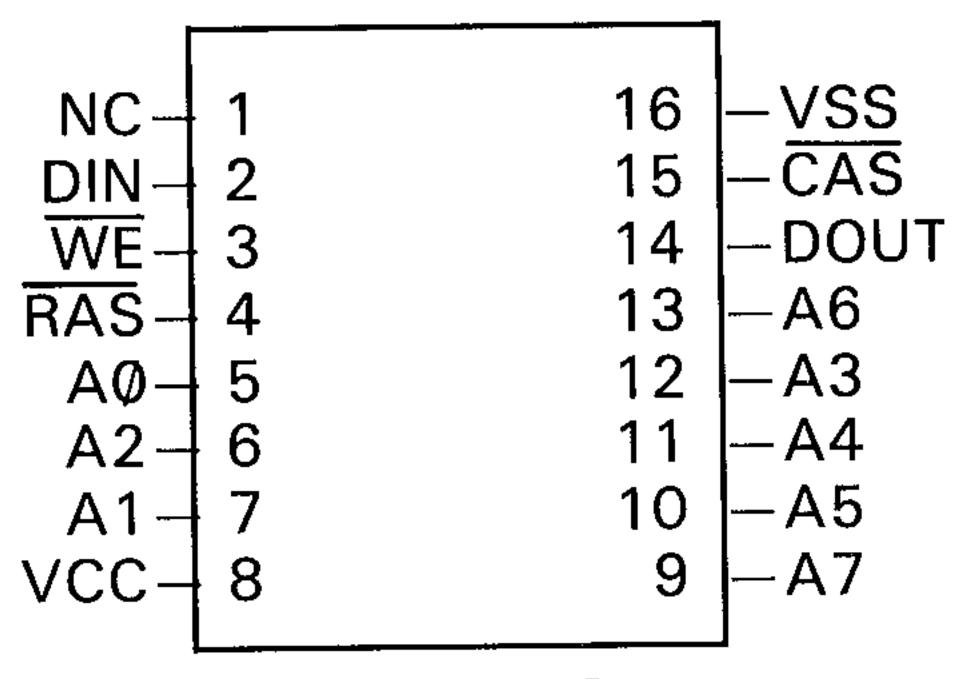
MOS 6529B 3 MHz

U5/U27-251640-03 SINGLE PORT INTERFACE



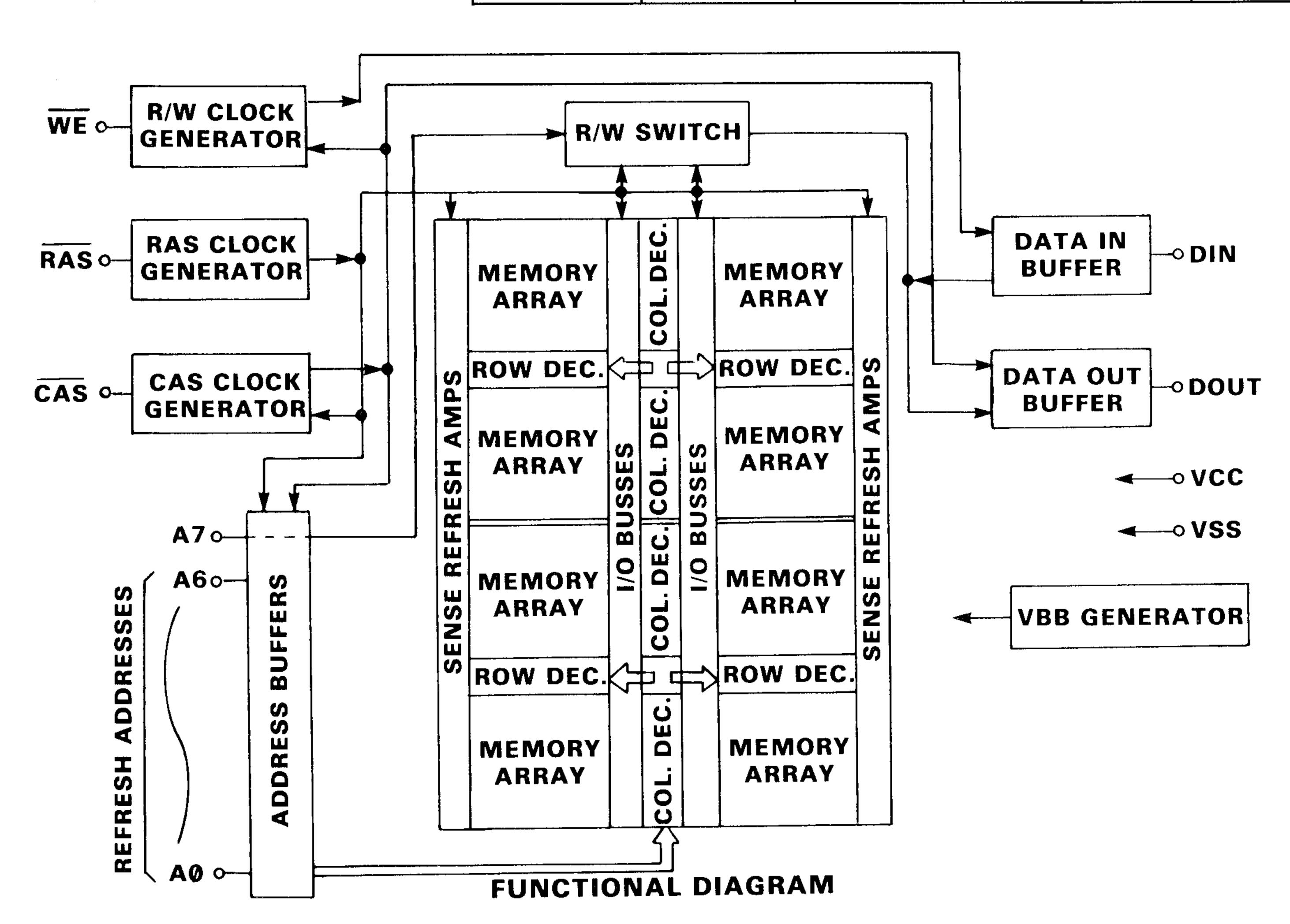
U3, U5, U19 PINOUTS ON PAGE 8

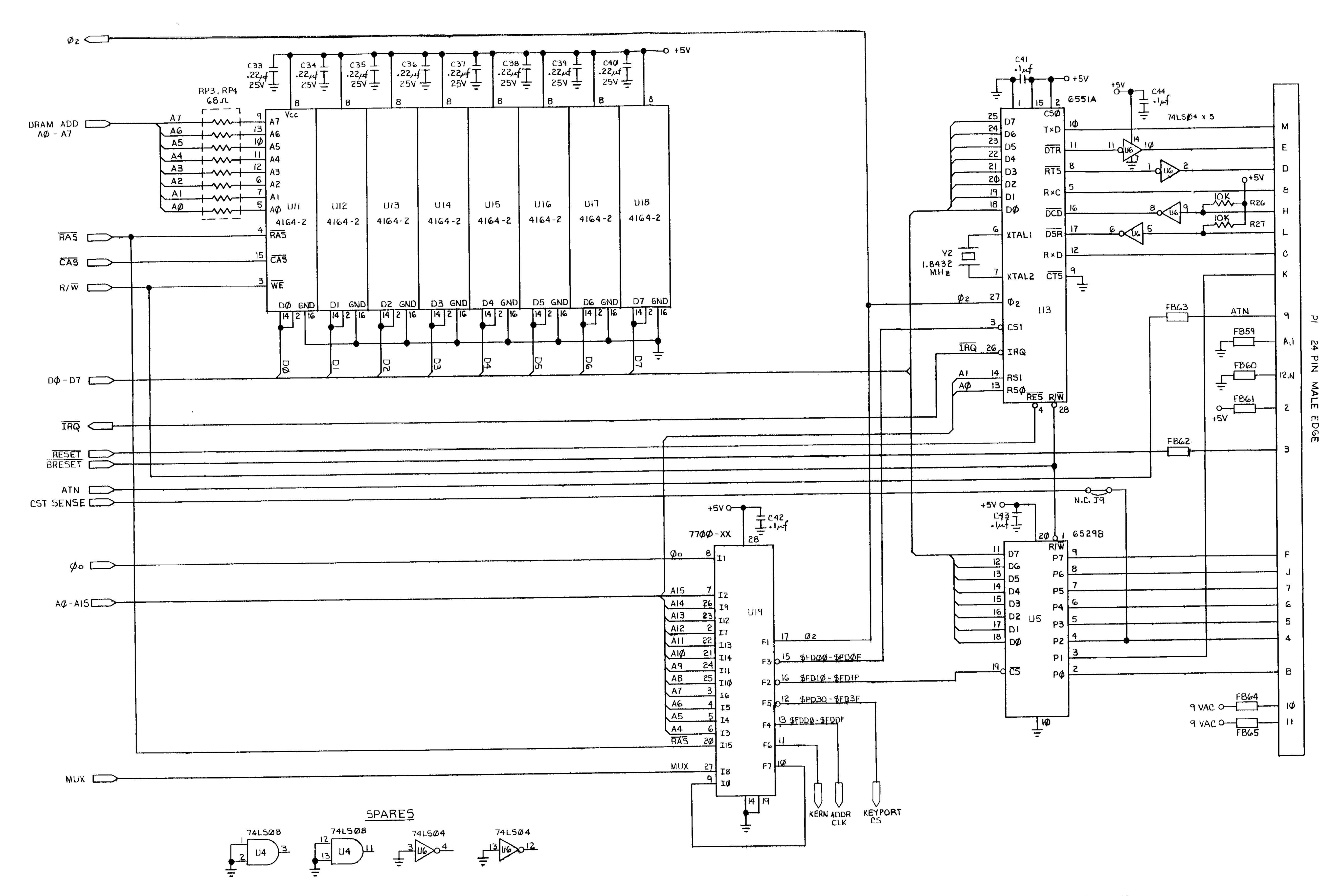
PIN CONFIGURATION



U11 ~ 18 64K DYNAMIC RAM 901505-01

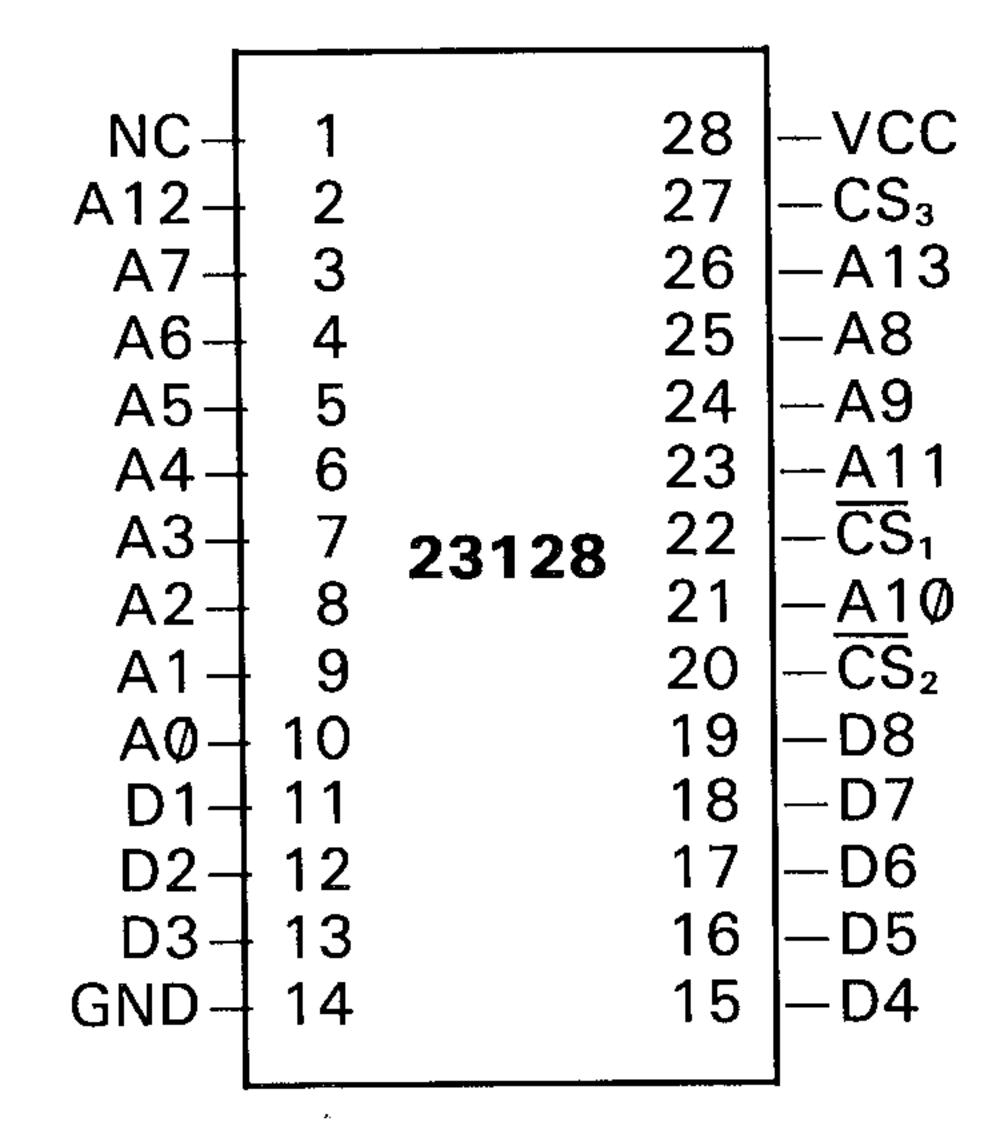
COMMODORE	APPROVED	VENDOR	ACCESS		PO	WER
PART NUMBER	SOURCE 1 OF SUPPLY	PART NUMBER	TIME (ns)	CYCLES (ns)	ACTIVE (MW)	STANDBY (MAX)(MW)
901505-01	HITACHI	HM4864-3	200	335	330	20
901505-01	NEC	μPD4164-2	200	375	250	28
901505-01	MITSUBISHI	M5K416NS-20	200	330	275	28
901505-01	MOSTEK	MK4564N-20	200	345	300	22
901505-01	OKI	MSM3764-20	200	330	248	23
901505-01	HITACHI	HM4864P-3	200	335	330	20
901505-01	MATSUSHITA (PANASONIC)	MN4164P-20	200	330	275	27.5
901505-01	SIEMENS	HYB4164-3	200	330	150	20
901505-01	SHARP	LH2164-Z1	200	330	248	28
901505-01	HITACHI	HM4864AP-3	200	330	242	20
901505-01	TOSHIBA	TMM4164AP-20	200	330	275	22





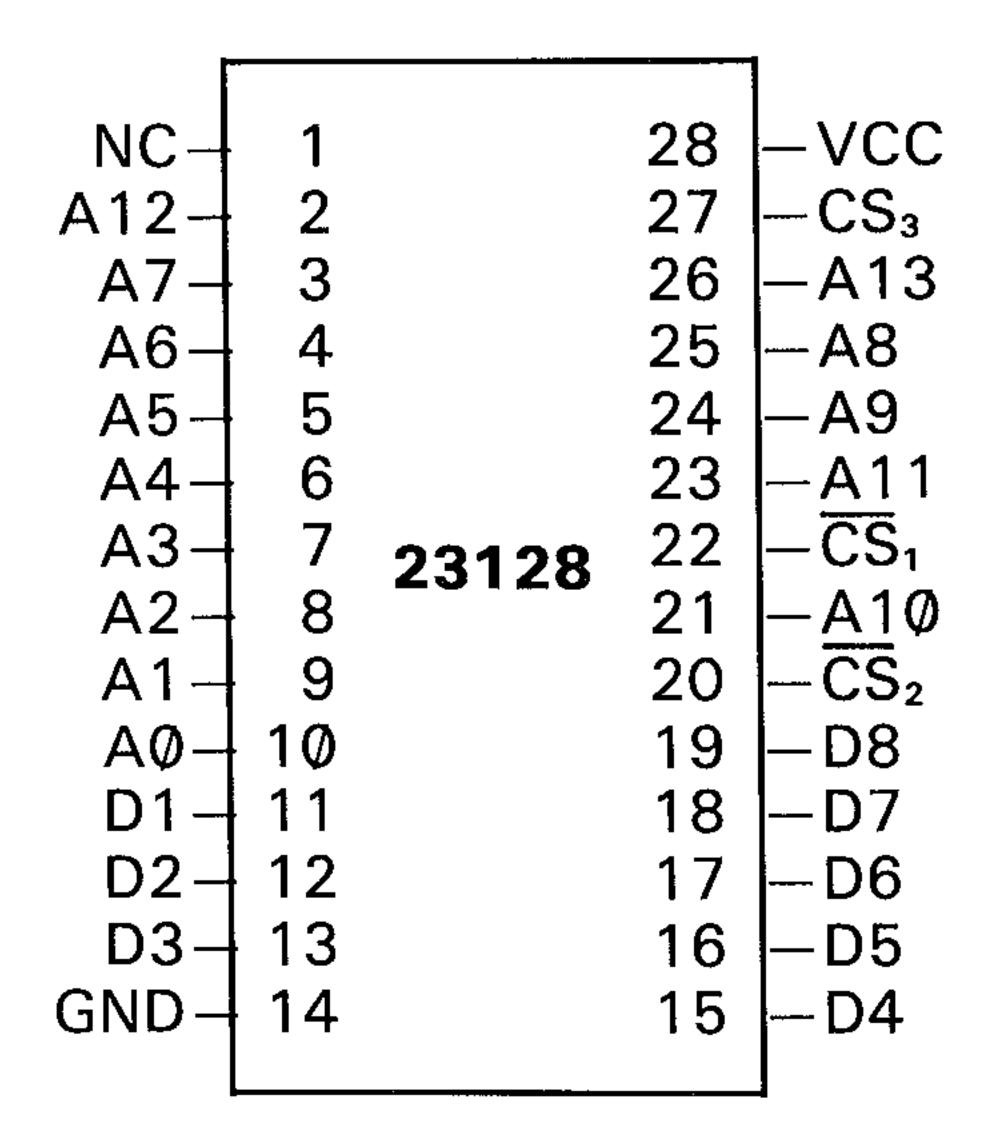
Plus 4 Schematic #310164 (3 of 4)

PIN CONFIGURATION

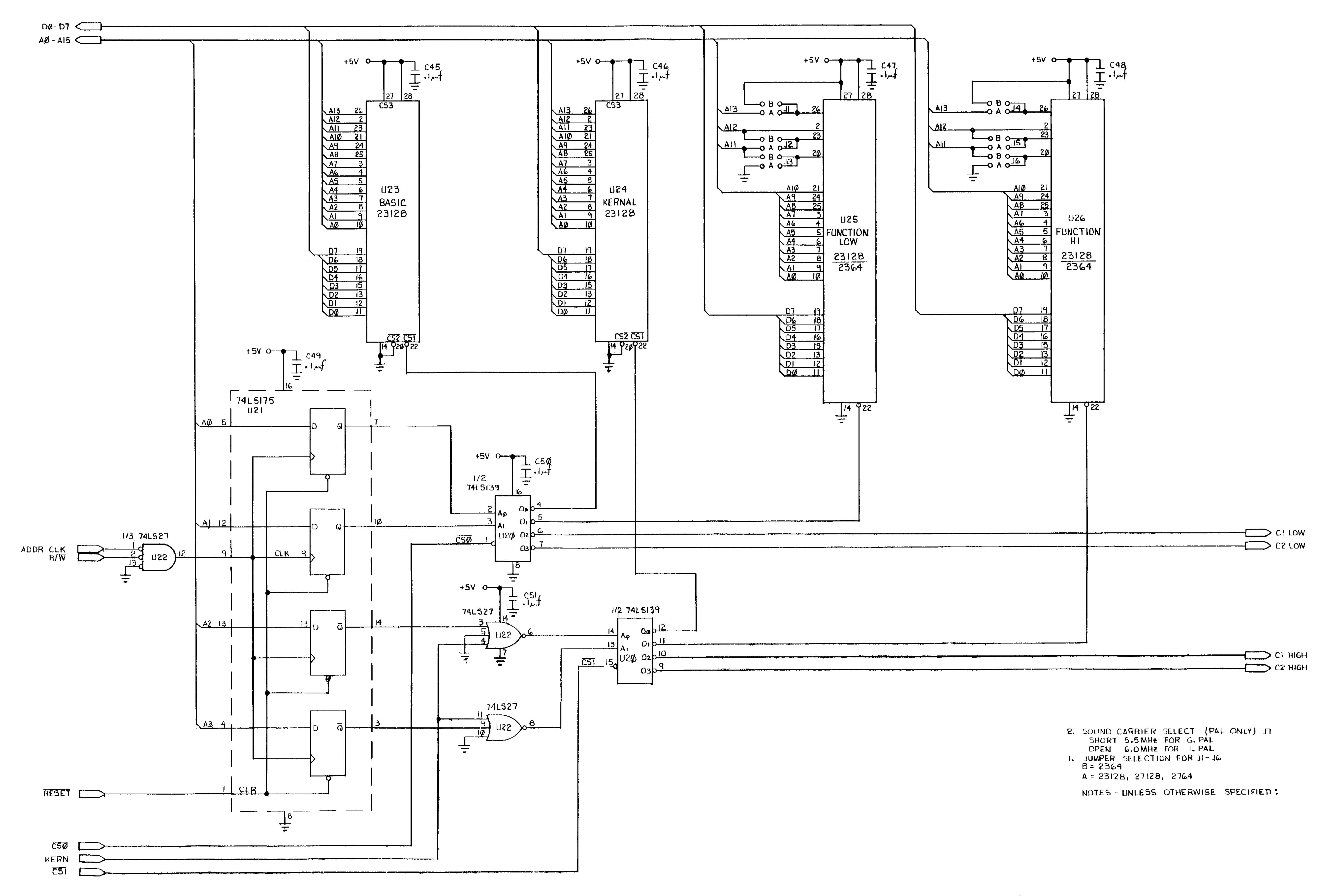


U23-318006-01 ROM — BASIC

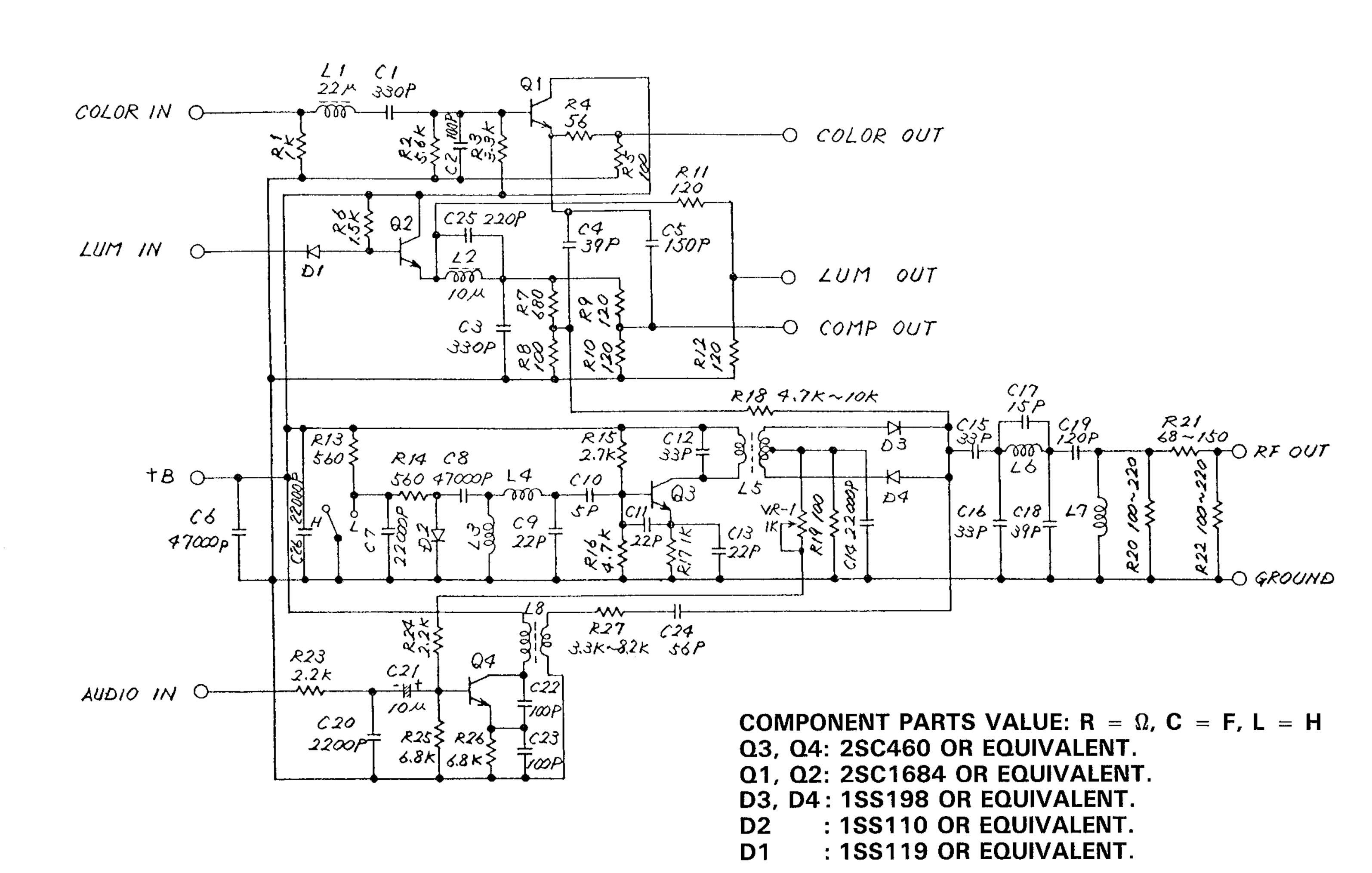
PIN CONFIGURATION

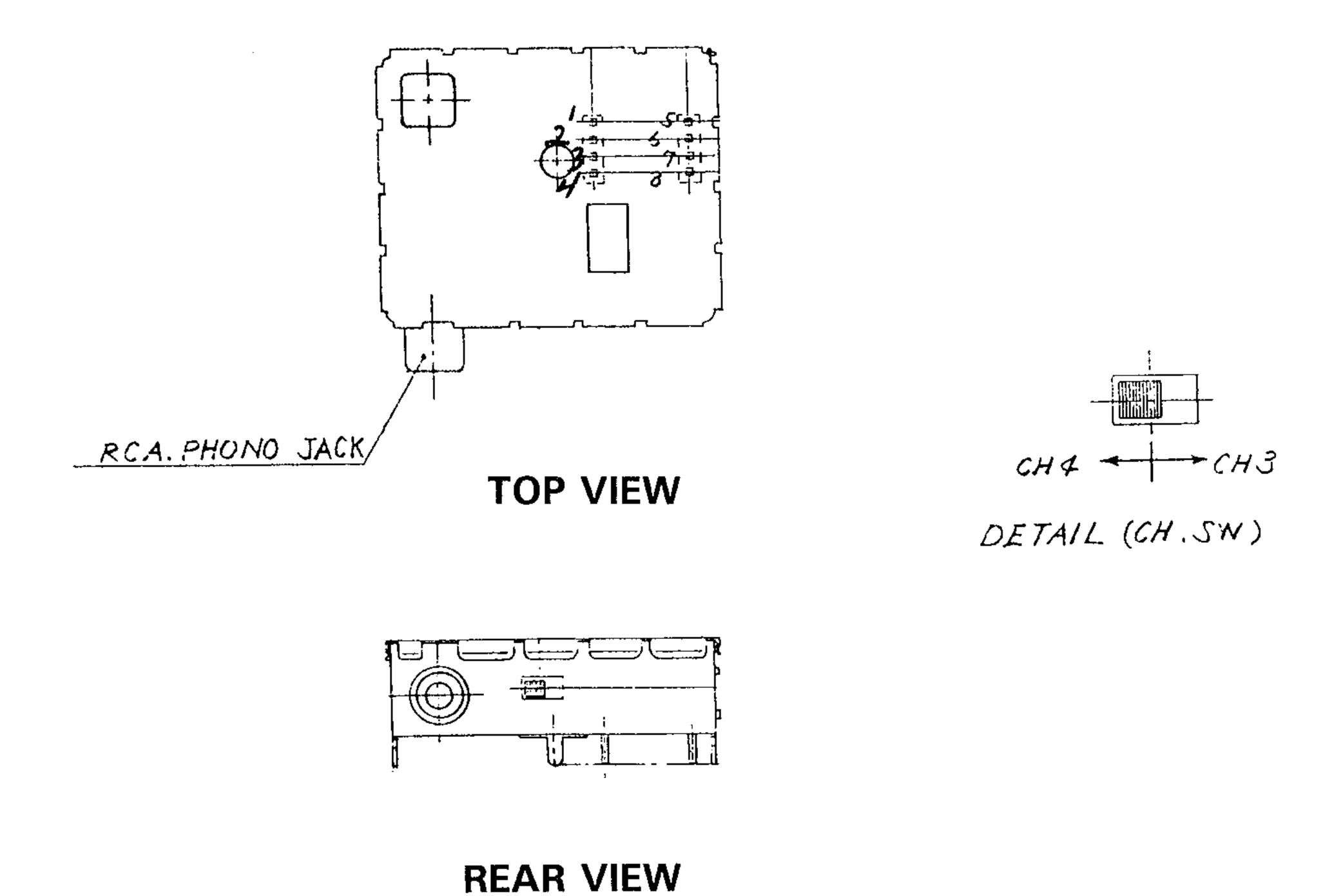


U24-318005-04 ROM — KERNAL

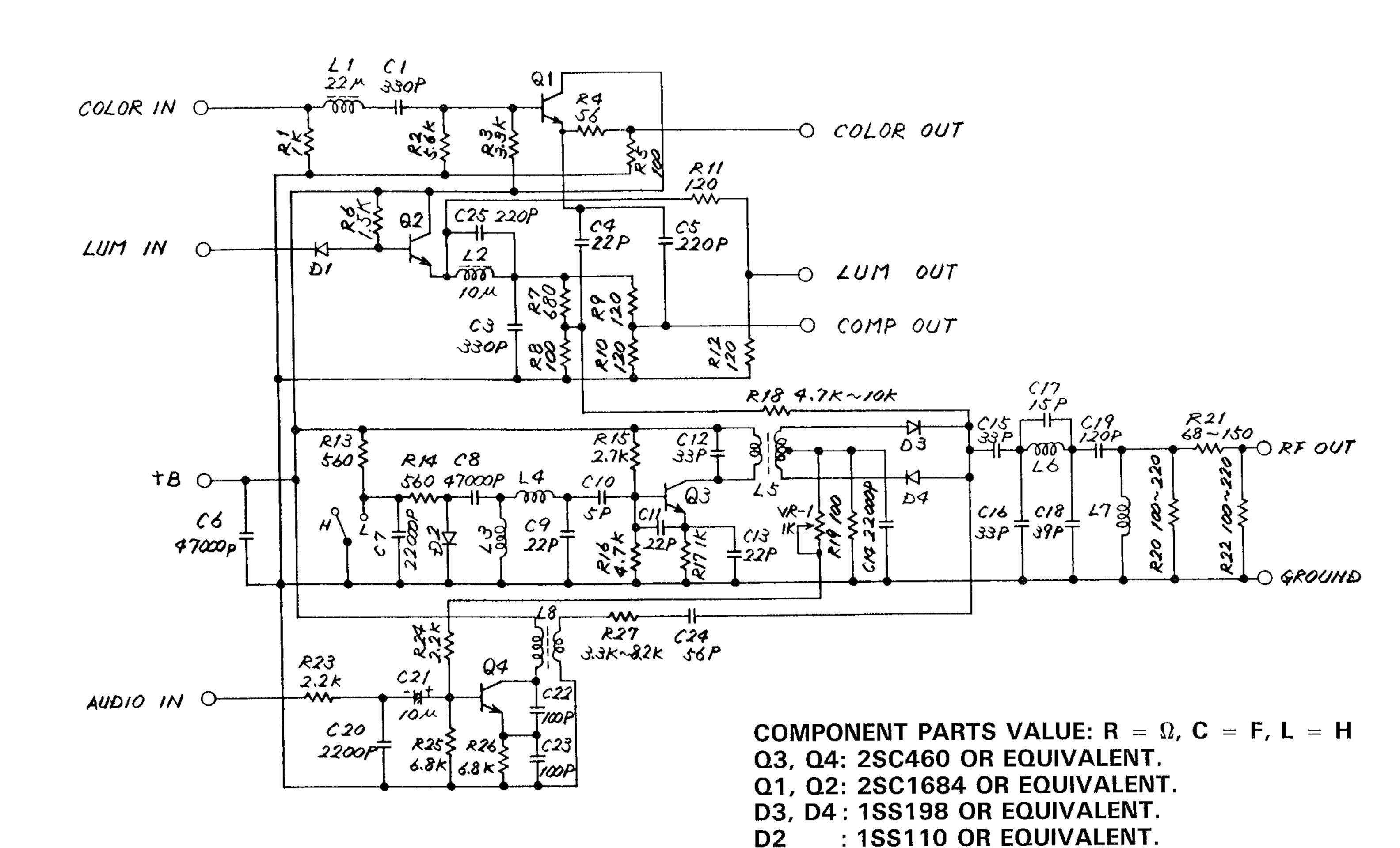


Plus 4 Schematic #310164 (4 of 4)

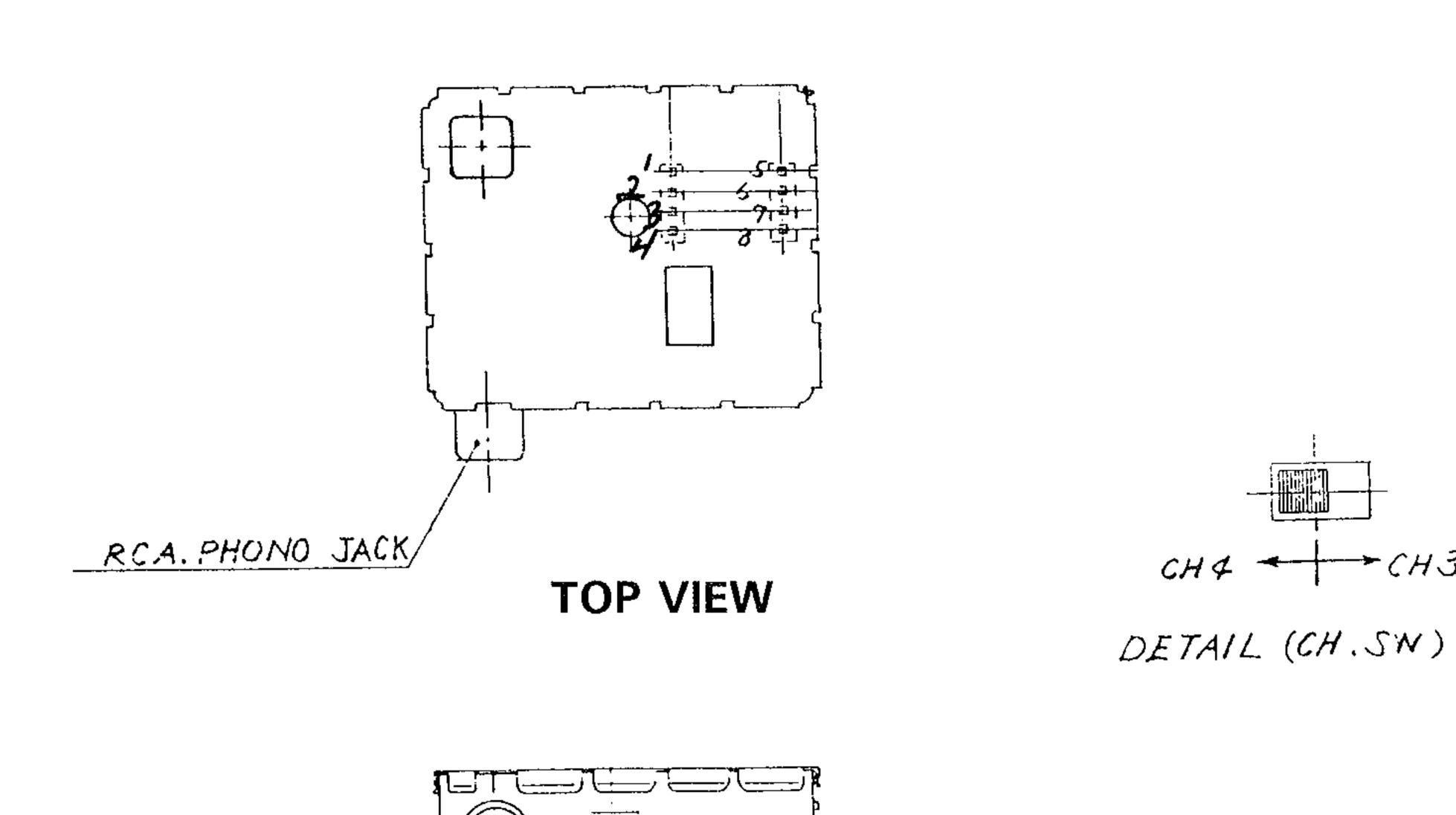




NO.	TERMINALS					
1	N.C.					
2	AUDIO SIG. INPUT					
3	+B (+5V)					
4	SYNC + LUM. SIG. INPUT					
5	COLOR SIG. INPUT					
6	COLOR SIG. OUTPUT					
7	COMPO. SIG. OUTPUT					
8	SYNC + LUM. SIG. OUTPUT					
9	RF OUTPUT					
10	CHANNEL SELECT SW.					



D1



NO.	TERMINALS						
1	N.C.						
2	AUDIO SIG. INPUT						
3	+B(+5V)						
4	SYNC + LUM. SIG. INPUT						
5	COLOR SIG. INPUT						
6	COLOR SIG. OUTPUT						
7	COMPO. SIG. OUTPUT						
8	SYNC + LUM. SIG. OUTPUT						
9	RF OUTPUT						
10	CHANNEL SELECT SW.						

: 1SS119 OR EQUIVALENT.

REAR VIEW

Issue 6, 1984 : Computer 3



Model: PLUS 4

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Troubleshooting Aides

NOTE: Visual inspection is critical in this unit! The upright position of many of the components used on the board can create problems. It is possible for them to be shorted to the shield or to each other. Make sure they are evenly spaced and do not contact the shield.

Areas of the PCB particularly vulnerable to this problem are:

Bottom right corner - caps
Bottom center - J1-J6
Bottom left - Q3 shorted to FB57
Top left - ferrite beads
Center - Twisted caps (just outside of RF can)

- 1) NO VIDEO Absolutely no video on screen
 - A) Check for 5 volts

O.K. If not: 1) Check fuse

- 2) Check for twisted or bent caps
 - (5 V. short to ground)
- 3) Check Ll
- B) Check for oscillation at pin 14 of Ul
 - O.K. If not: 1) Check for good connection at pin 14 of Ul
 - 2) Check for good connection at Rl thru R7
- C) Check for LUM signal at pin 23 of Ul, at pin 4 of the modulator, at pin 8 of the modulator, at FB3 and at pinl of CN7
 - O.K. If not: 1) Check for LUM signal shorted to ground
 - 2) Check for open traces
 - 3) Check modulator
- D) Check for reset O.K.
- E) Check for control signals:

Signal	I.C.	Pin	Signal	I.C.	Pin	
AEC	U1	35	R/W	U1	7	
AEC	U2	4	0	Ul	12	
CAS	U1	11	MUX	Ul	9	
CSI	U1	6	IRQ	Ul	8	
CSI	U20	15	RDY	U2	2	
CS0	U1	5	BA	U1	34	
CS0	U20	1	RAS	Ul	10	

- 2) BAD VIDEO Scrolling lines on screen Random blocks on screen Blurred display
 - A) Check J1-J6 for shorts to ground or each other O.K.
 - B) Check reset for correct operation O.K.
 - C) Check Ul for proper operation
 O.K. If not: 1) Check socket for good solder
 ★ 2) Check for bad Ul
 - D) Check U2 for proper operation O.K. If not: 1) Check socket → 2) Check for bad U2
 - E) Check RAM data lines for correct amplitude O.K. If not: 1) Check for hot surface of RAM

 2) Jump out RAM to verify
 - F) Check multiplexers U9, U10 signals at RP3 and RP4 should be similar in frequency and amplitude
 O.K. If not: 1) Suspect U9 or U10
 - G) Check ROM for chip select signal at pin 22 of U23 and U24
 O.K. If not: 1) Check for signal generation at U20
 - H) Check that all ROM addresses are present and correct amplitude O.K. If not: 1) Trace problem address A0-A15
 - I) Check U19, U23, U24 by replacement with known good
- 3) NO POWER
 - A) Verify voltage +5 and +9 volts
 - 1) Check for shorts to ground
 - 2) Check switch
 - 3) Check power supply
- 4) BAD BASIC Random characters on screen Random colors Power-up message is missing
 - A) Check Basic ROM U23
 - B) Check B thru I above (Bad Video)

5) NO COLOR or BAD COLOR

- A) Check Ul pin 14 for 14.31818 MHz with frequency counter
 - O.K. If not: 1) Check solder joints of CTl

 and adjust for correct frequency
 - 2) Check crystal, Ql and Q2
 - 3) Check clock circuit for opens or shorts
- B) Check Ul pin 13 for Color Out signal.
 O.K. If not: 1) Swap Ul w/known good
- C) Check modulator Ml pin 5 for Color In signal and pin 6 for Color Out signal O.K. If not: 1) Check Ml operation
- D) Check FB4 and CN7 pin 6 to see if color signal is present.
 - 1) Check for shorts

6) NO SOUND or BAD SOUND

- A) Check Ul pin 33 for SND signal O.K. If not: 1) Check socket for open circuit
 - 2) Swap Ul w/known good
- B) Check audio circuit for short to ground or loss of signal.
 - O.K. If not: 1) Check Q3 Be sure emitter and base \blacklozenge are not shorted to 5 V.
- C) Check modulator Ml pin 2 for SND signal
 - 1) Adjust I.F. can (top right of modulator) for clean, loud volume
 - 2) Ml pin 2 to ground should read approximately 480 ohms
 - 3) Check Ml for component failure

7) SERIAL FAILURES

- A) Check FB23-26 for shorts to shield or each other
- B) Check U7, U2 and CN2

8) KEYBOARD FAILURES

- A) Check pins on ribbon cable for good connection O.K.
- B) Check for shorts CN5, CN6, FB's, Diodes O.K.
- C) Check chip select to U27 and the I.C. U27 O.K.
- D) Check Ul for proper operation
 O.K. If not: 1) Check socket
 2) Check for bad Ul
- 9) FAILURES IN SOFTWARE MODE All units should be checked for proper operation, when any repairs are necessary.
 - To Check: 1) Press 'Fl' on keyboard
 - 2) Press 'Return' to enter Word Processing mode
 - 3) Press 'Commodore' key and 'C' key at the same time
 - 4) Type 'tc' and press 'Return' to enter Spreadsheet
 - 5) Press 'Commodore' key and 'C' key again
 - 6) Type 'tw' to return to Word Processing mode

Watch for video or loading problems, then:

- A) Check jumpers at Jl-J6 for correct connection O.K.
- B) Check U1, U2, U25, U26

Issue 7, 1984 : Computer 4



Model: C16, PLUS 4

LINE DEFINITIONS

TxD

Address Bit 0 to 15 A0 to A15 Address Enable Control AEC Attention ATN Bus Available BA Buffered System Reset BRESET External Cartridge Chip Select Cl HIGH, Cl LOW C2 HIGH, C2 LOW Dynamic RAM Column Address Strobe CAS Master Clock (Single Phase, 14.31818 MHz) CLK IN Chroma Output COLOR Composite Chroma and Luma COMP Chip Enable CE Chip Select CS Low ROM Chip Select CS0 High ROM Chip Select CS1 Cassette Motor Control CST MTR Cassette Read CST RD Cassette Sensor CST SENSE Cassette Write CST WRT Clear To Send CTS Data Bit 0 to 7 DBO to DB7 Data Carrier Detect DCD Dynamic RAM DRAM Dynamic RAM Address DRAM ADD Data Set Ready DSR Data Terminal Ready DTR External Audio Input EXT AUDIO R/W GATE GATE IN Interupt Request IRQ Keyboard Latch 0 to 7 KO to K7 Kernal ROM Control Line KERN Composite Sync and Luminence LUM Address Multiplex Control MUX Port Bit 0 to 7 PO to P7 Dynamic RAM Row Address Strobe RAS System Reset RESET Receive Clock RxCReceive Data RxDRead/Write Line R/W Request To Send RTS Sound Line SND Text Display TED Transmit Data

System Clock (Varies between 1 and 2 MHz)

Artificial / 2, Address Valid Rising Edge,

Data Valid Falling Edge

Issue 6, 1985 : Computer 1
Model: C-64, C-16, Plus 4

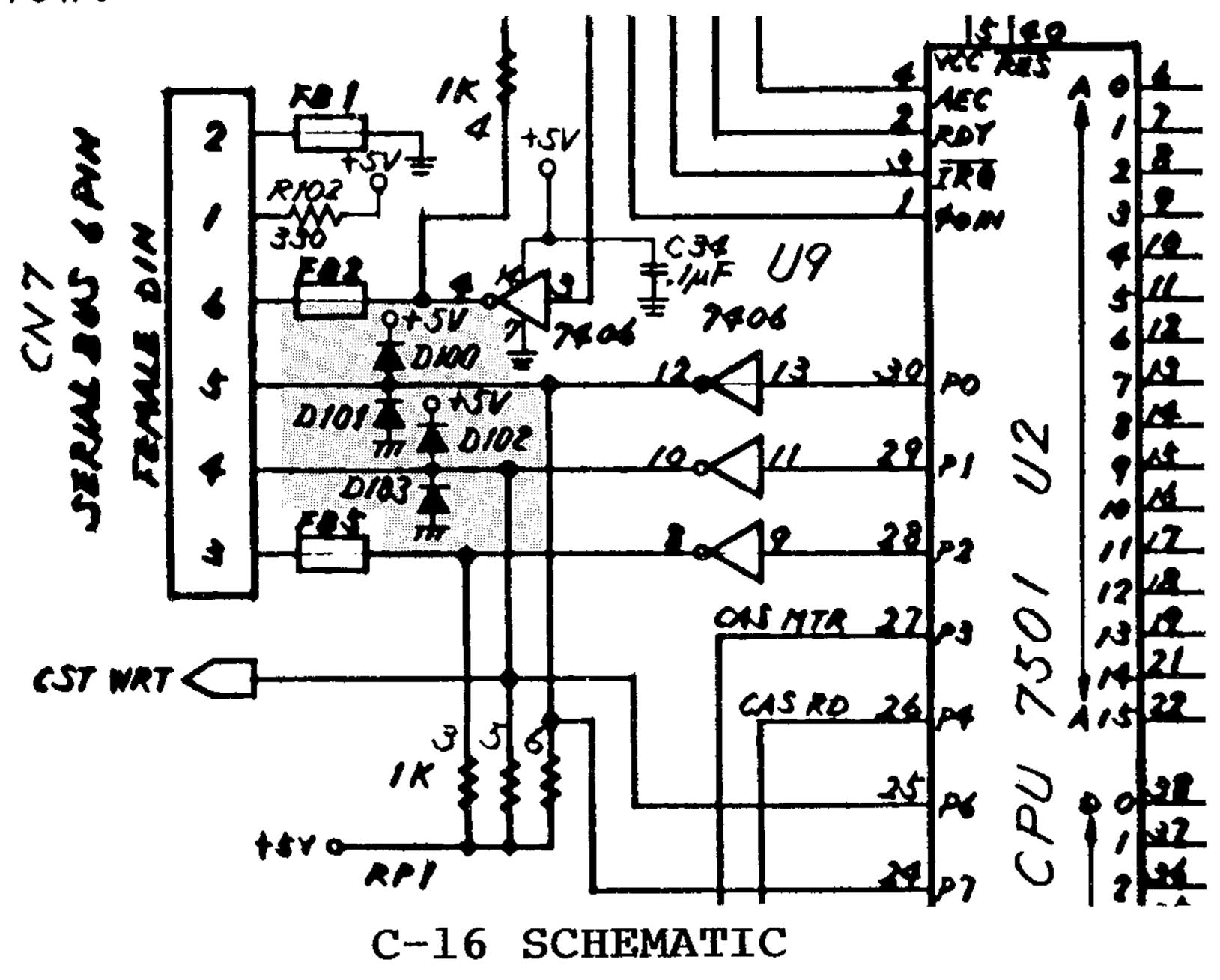
TECHTOPICS

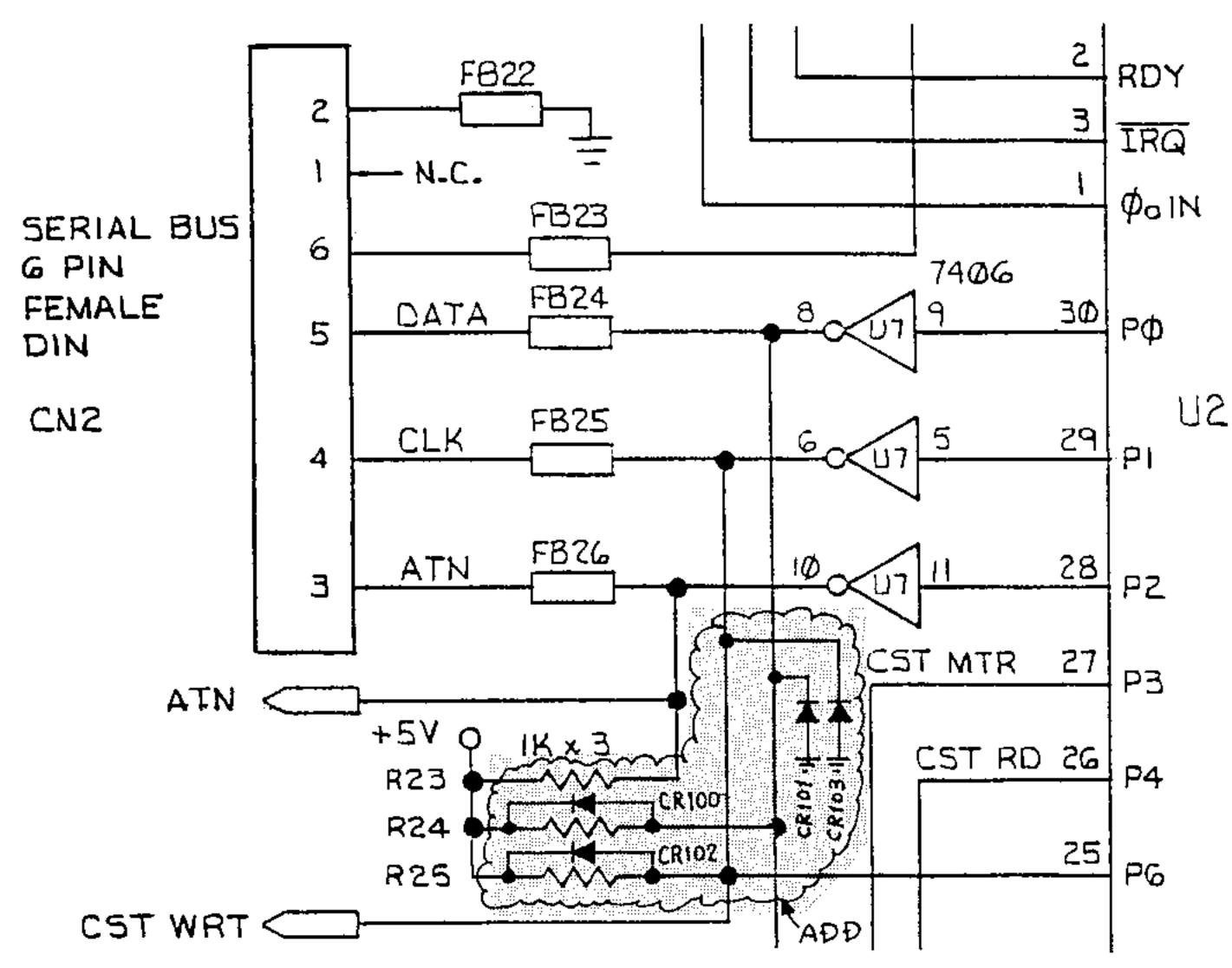
SCHEMATICS FOR C-64, C-16, PLUS 4

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These computers have been affected by an Engineering Change Order that adds 4 diodes to the serial port. These protection diodes are not required as field upgrades. They are 1N914s and were added as a circuit improvement.

The Schematic and PCB Layout for the C-64 in the Service Manual (Pages 28 and 32) include these diodes. However, the C-16 and Plus 4 Service Manuals were completed before the changes were made. The Schematic corrections are shown below:





PLUS 4 SCHEMATIC