

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

 **commodore**  
COMPUTERS

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**MODEL PLUS 4 COMPUTER**  
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**OCT. 1984      PN-314001-04**

**Commodore Business Machines, Inc.**

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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 characters. 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 x 1) I.C.'s. (See page ). The system program is contained in 2 (16K x 8) ROMs. The system supports up to 128K x 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 cartridges. 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

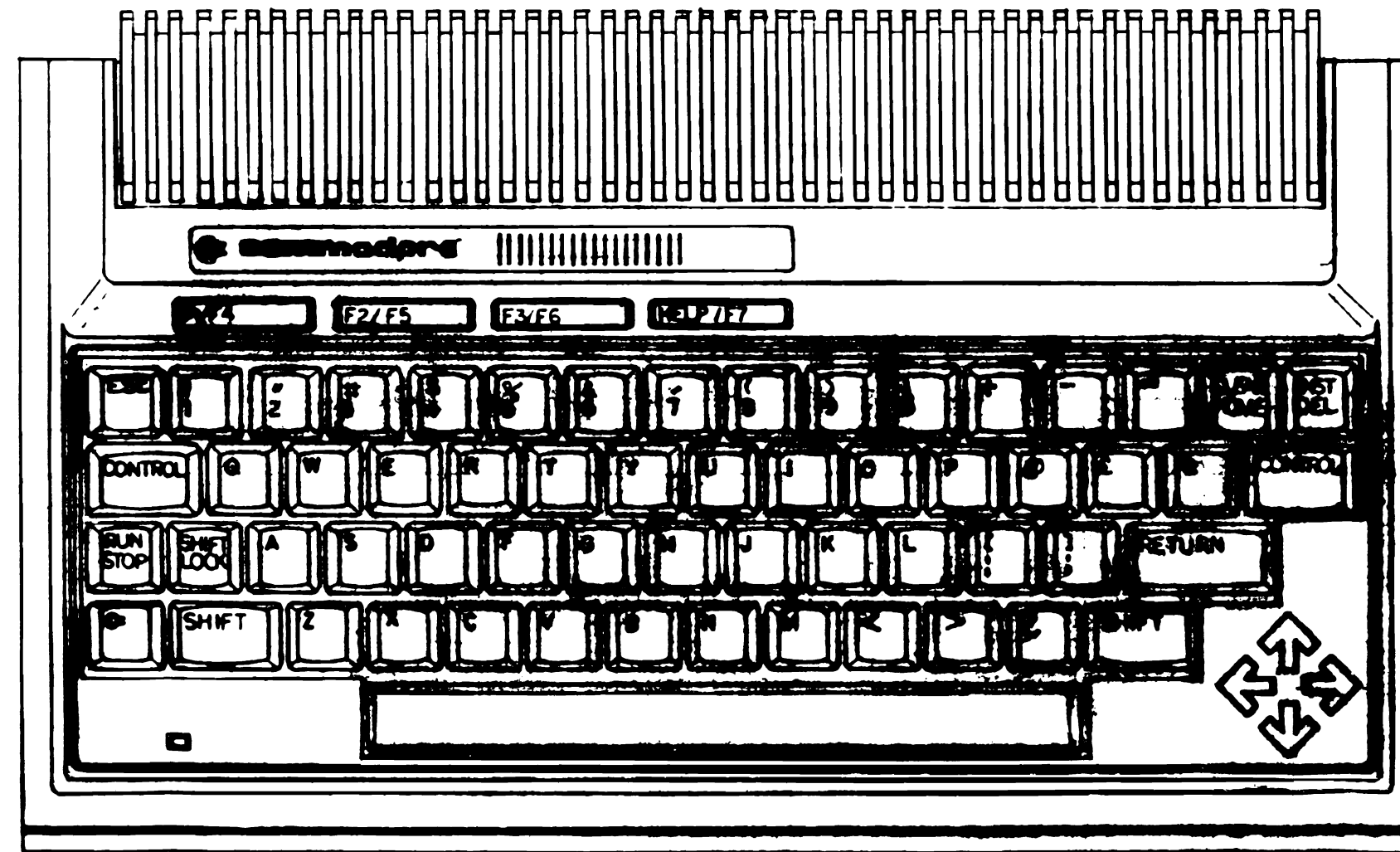
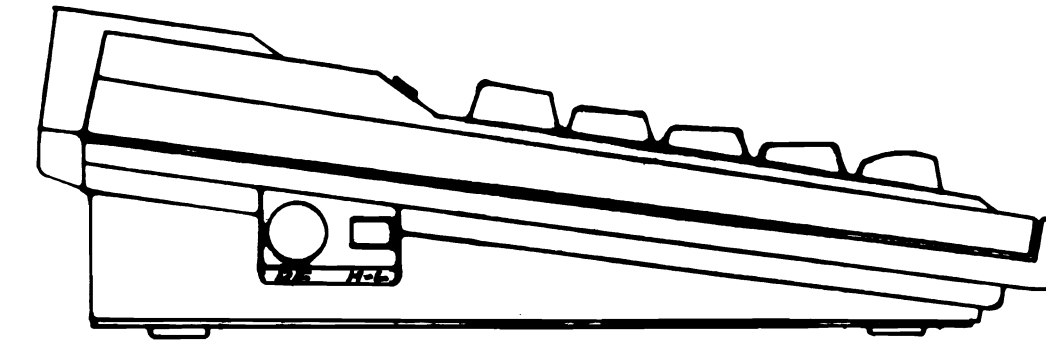
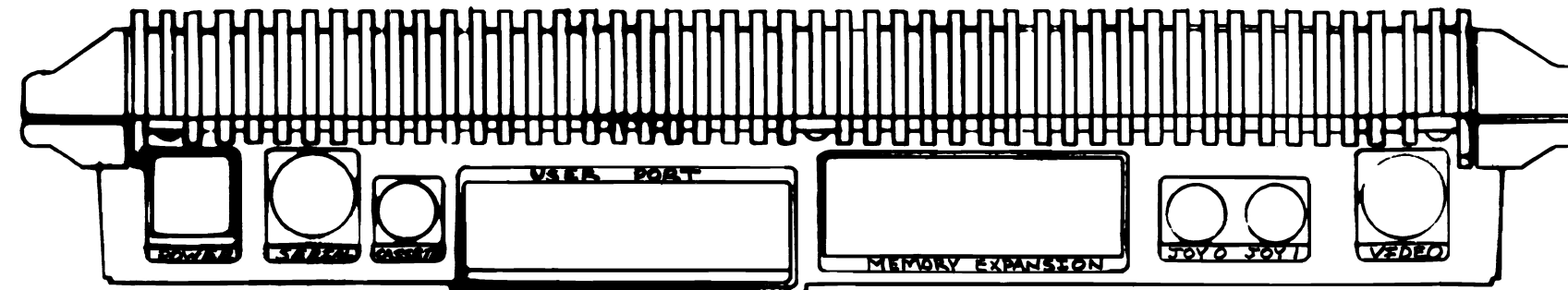
**BOTTOM CASE ASSY**

Bottom Case	C 251454-01
Foot, Self-Adhesive	C 950157-04
Paper Shield	C 310156-01
Shield Chip	C 310199-01
Shield Plate	C 310197-01
Insulation Sheet	C 310198-01

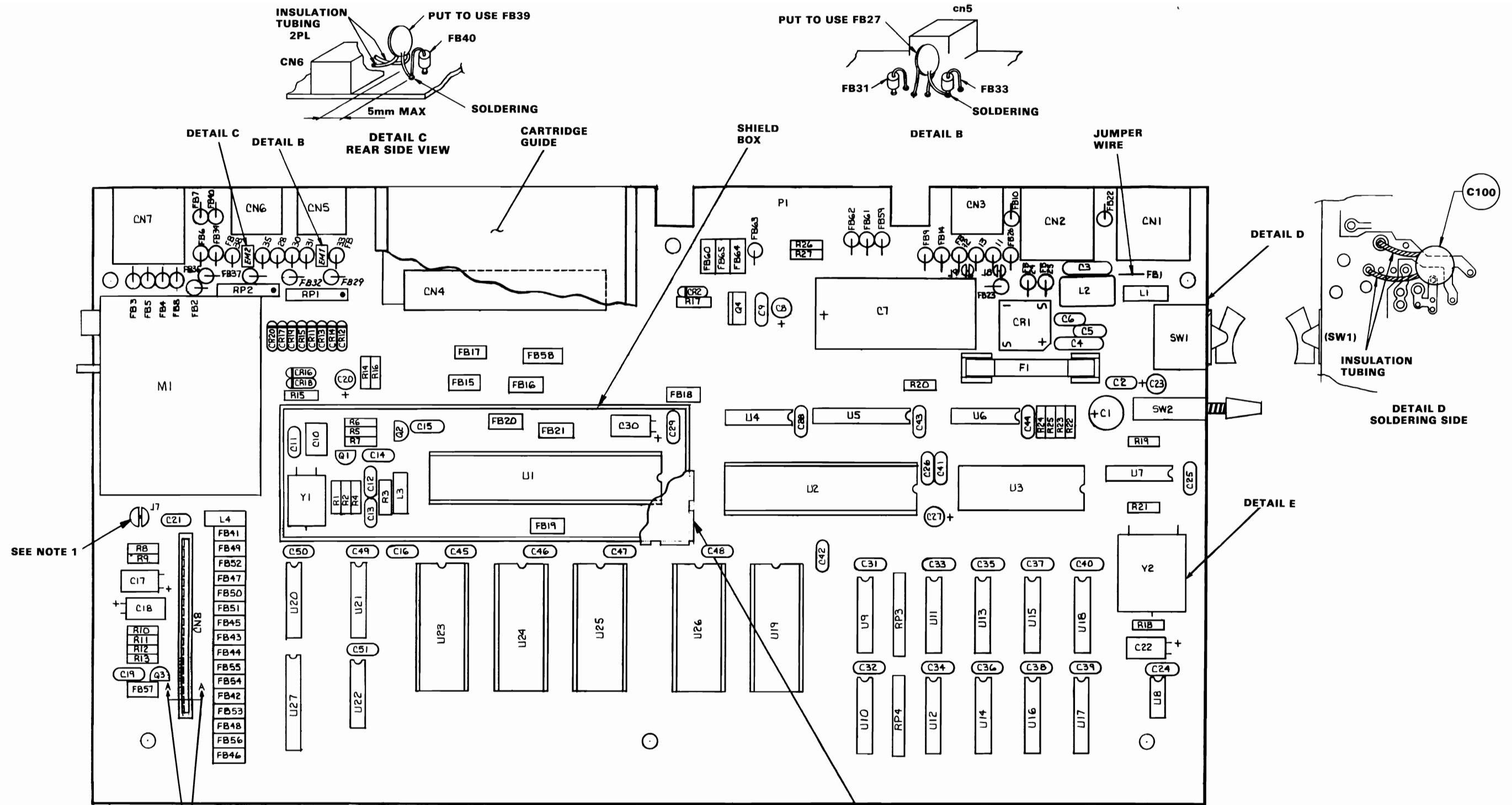
**ACCESSORIES**

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

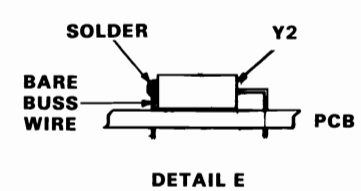
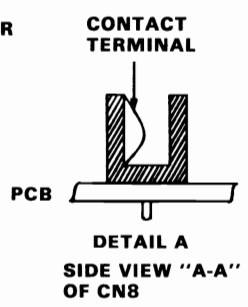
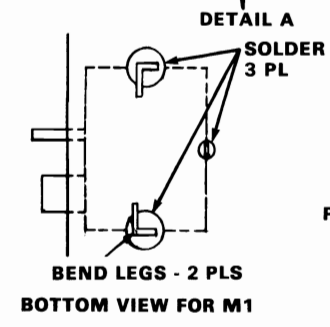
C — Commodore Stock Part



Plus 4 Casework Identification



SEE NOTE 1



1. JUMPER SELECTION FOR "J7"
- DOESN'T MATTER FOR NTSC (-01).
  - SHORT FOR G-PAL (-02).
  - OPEN FOR I-PAL (-03).
- NOTES - UNLESS OTHERWISE SPECIFIED:

Plus 4 PCB Assembly



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

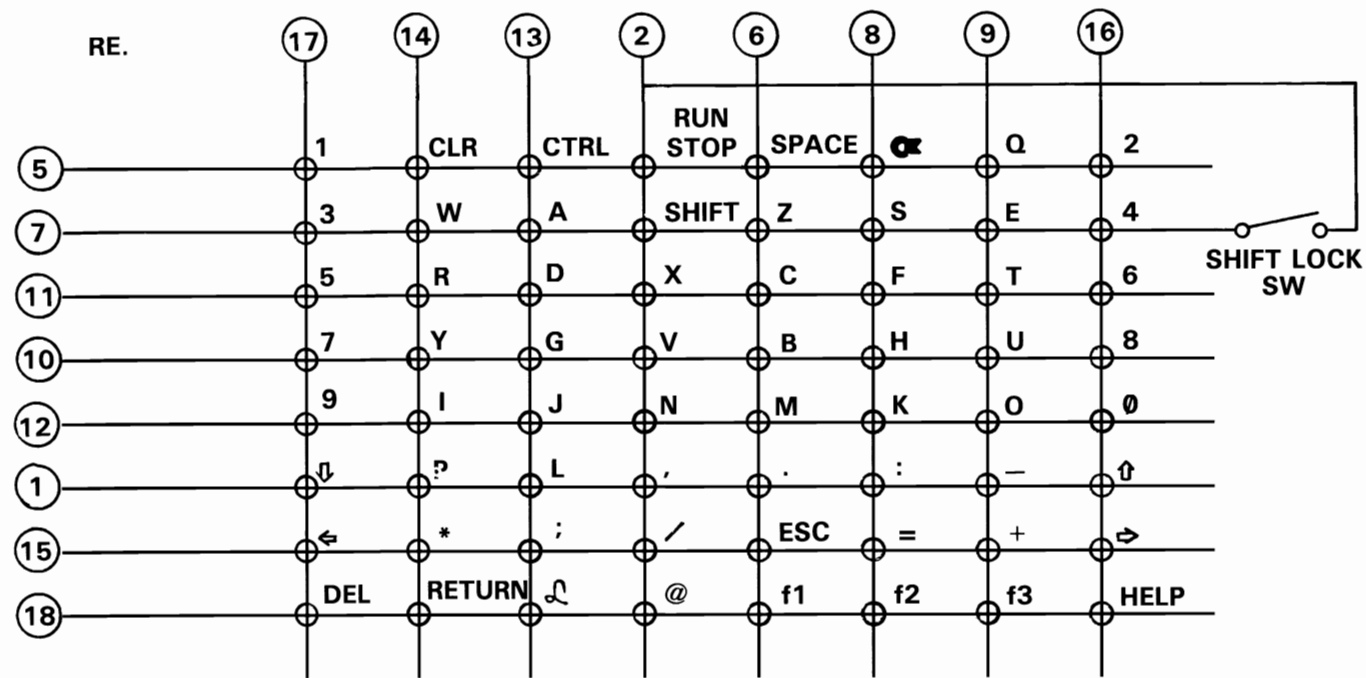
**PLEASE NOTE:** Commodore part numbers are provided for reference only and do not indicate the availability of parts from Commodore. Industry standard parts (Resistors, Capacitors, Connectors) should be secured locally. Approved cross-references for TTL chips, Transistors, etc. will be available in 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".

INTEGRATED CIRCUITS		DIODES (Continued)	
U1	7360 VLSI, Text Display (TED) Sub: C 251535-01 8360 C 251535-02	CR1 (cont.)	Bridge Rectifiers DBA20C Sanyo 251026-03
U2	7501 Custom Microprocessor C 251536-01	CR2	Diode, Zener RD 6.8 EB 900927-01
U3	6551A (Synertek) 901895-02	CR11-20	Diode, IN 914 Sub: 900850-16 Diode, IN 4148 Taping 251819-21 Sub:
U4	74LS08 901521-03		Diode, IN 4148 900850-01
U5	6529B Single Port Interface C 251640-03	<b>RESISTORS</b> — All values are in ohms-1/4 W 5% unless noted otherwise.	
U6	74LS04 901521-02	R1	4.7K
U7	7406 901522-06	R2	10K
U8	555 901523-01	R3	470K
U9-10	74LS257 901521-57	R4	220K
U11-18	4164-2 D-RAM 901505-01	R5	18K
U19	7700-010 PLA C 251641-02	R6	1.5K
U20	74LS139 901521-18	R7	470K
U21	74LS175 901521-34	R8	100K
U22	74LS27 901521-22	R9	1K
U23	2312B ROM TED Basic C 318006-01	R10	1K
U24	23128 ROM TED Kernal C 318005-04	R11	12K
U25	23128 FUNCTION ROM, 3+1 LOW C 317053-01	R12	10K
U26	23128 FUNCTION ROM, 3+HIGH C 317054-01	R13	1K
U27	6529B Single Port Interface C 251640-03	R14	240
<b>TRANSISTORS</b>		R15	250
Q1-Q3	2SC 1815 902693-01	R16	100K
Q4	2SD 880 902694-01 Sub: Tip 29A 902653-01 Sub: 2SD 1266 902694-04	R17	1.5K
<b>DIODES</b>		R18	47K
CR1	Bridge Rectifiers S2VB10 Sindengen 215026-01 Sub: Bridge Rectifiers DBA20B Sanyo 251026-02 Sub:	R19	100K
		R20	3K
		R21	1K
		R22	1K
		R23	1K
		R24	1K
		R25	1K
<b>RESISTOR PACK</b>			
RP1, 2	3.3K, 6 PIN	902441-29	
RP3, 4	68, 8 PIN 4 ISOLATED	326149-06	
<b>CAPACITORS</b>			
C1	Elect 0.1 μF 25V	900100-40	
C2	Ceramic 0.1 μF 25V	251075-06	
C3	Film 0.22 μF 100V	900150-11	
C4	Film 0.22 μF 100V	900150-11	
C5-C6	Ceramic 0.22 μF 50V	900022-01	
C7	Elect 2200 μF 16V	900101-33	
C8	Elect 10 μF 16V	900100-25	
C9	Ceramic 0.1 μF 25V	251075-06	
C10	Trimmer 40 pF	251029-02	
C11	Ceramic 22 pF 50V	251070-14	

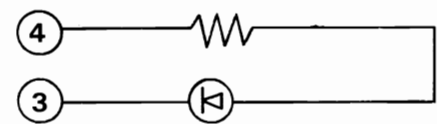
**PARTS LIST — PLUS/4**  
**PCB ASSEMBLY # 310163-01 (Continued)**

<b>CAPACITORS (Continued)</b>				<b>MISCELLANEOUS (Continued)</b>		
C12	Ceramic	220 pF 50V	Sub: 251071-26 Sub:	FB2-14	Ferrite bead	325563-01
				FB15-21	Ferrite bead	903025-01
	Ceramic	220 pF 50V	900463-08	FB22-26,		
C13	Ceramic	150 pF 50V	251071-24	FB28-38,	Ferrite bead	325563-01
			Sub:	FB40		
	Ceramic	150 pF 50V	900462-41	FB41-58	Ferrite bead	903025-01
C14	Ceramic	0.1 $\mu$ F 25V	251075-01	FB59	Ferrite bead	325563-01
C15-C16	Ceramic	0.1 $\mu$ F 25V	251075-06	FB60	Ferrite bead	903025-01
C17-C18	Ceramic	10 $\mu$ F 16V	900100-25	FB61-63	Ferrite bead	325563-01
C19	Ceramic	0.01 $\mu$ F 25V	251075-01	FB64-65	Ferrite bead	903025-01
C20	Elect	10 $\mu$ F 16V	900100-25			
C21	Ceramic	0.1 $\mu$ F 25V	251075-06	EM1,2	EMI Filter	251842-01
C22	Elect	10 $\mu$ F 16V	900100-25			
C23	Elect	1 $\mu$ F 16V	900100-16	CN1	Connector 4 PIN (power supply)	
C24-C26	Ceramic	0.1 $\mu$ F 25V	251075-06			C 251614-01
C27	Elect	10 $\mu$ F 16V	900100-25	CN2	Connector 6 PIN DIN (serial bus)	
C28-C29	Ceramic	0.1 $\mu$ F 25V	251075-06			C 903361-01
C30	Elect	10 $\mu$ F 16V	900100-25	CN3	Connector 7 PIN MINI DIN (cassette)	
C31-C32	Ceramic	0.1 $\mu$ F 25V	251075-06			C 251616-01
C33-C40	Ceramic	0.22 $\mu$ F 25V	251075-07	CN4	Connector 50 PIN Female Edge (exoab)	C 251630-01
			Sub:	CN5-6	Connector 8 PIN MINI DIN (joy 1 & 2)	C 251259-01
C41-C51	Ceramic	0.1 $\mu$ F 50V	900022-01			
	Ceramic	0.1 $\mu$ F 50V	900020-06	CN7	Connector 8 PIN DIN (audio/video)	325573-01
			Sub:			
C100	Ceramic	0.1 $\mu$ F 50V	900010-01	CN8	Connector 18 PIN (keyboard)	C 251841-01
	Ceramic	0.1 $\mu$ F 50V	900010-20			
<b>MISCELLANEOUS</b>						
Y1	Crystal	14.31818 MHZ	251081-01	L1	Noise Filter	251264-01
			Sub:	L2	Line Filter	906127-01
	Crystal	14.31818 MHZ	251081-02		Sub:	251701-01
Y2	Crystal	1.8432 MHZ	900555-02		Sub:	
				L3,L3	Coil Inductor 1.2 uHpt	901152-01
SW1	Switch, Rocker (PC Mount)		C 251587-01		Sub:	325570-01
SW2	Switch, Push Button		C 251260-01	F1	Fuse 250V 1.5A	903556-18
M1	RF Modulator		C 251844-01		Fuse Clip	906102-01
	Sub:				Cartridge Guide	310171-01
	RF Modulator		251311-01		Shield Box	C 310172-01
					Shield Cap	C 310173-01

C — Commodore Stock Part



KEYBOARD MATRIX

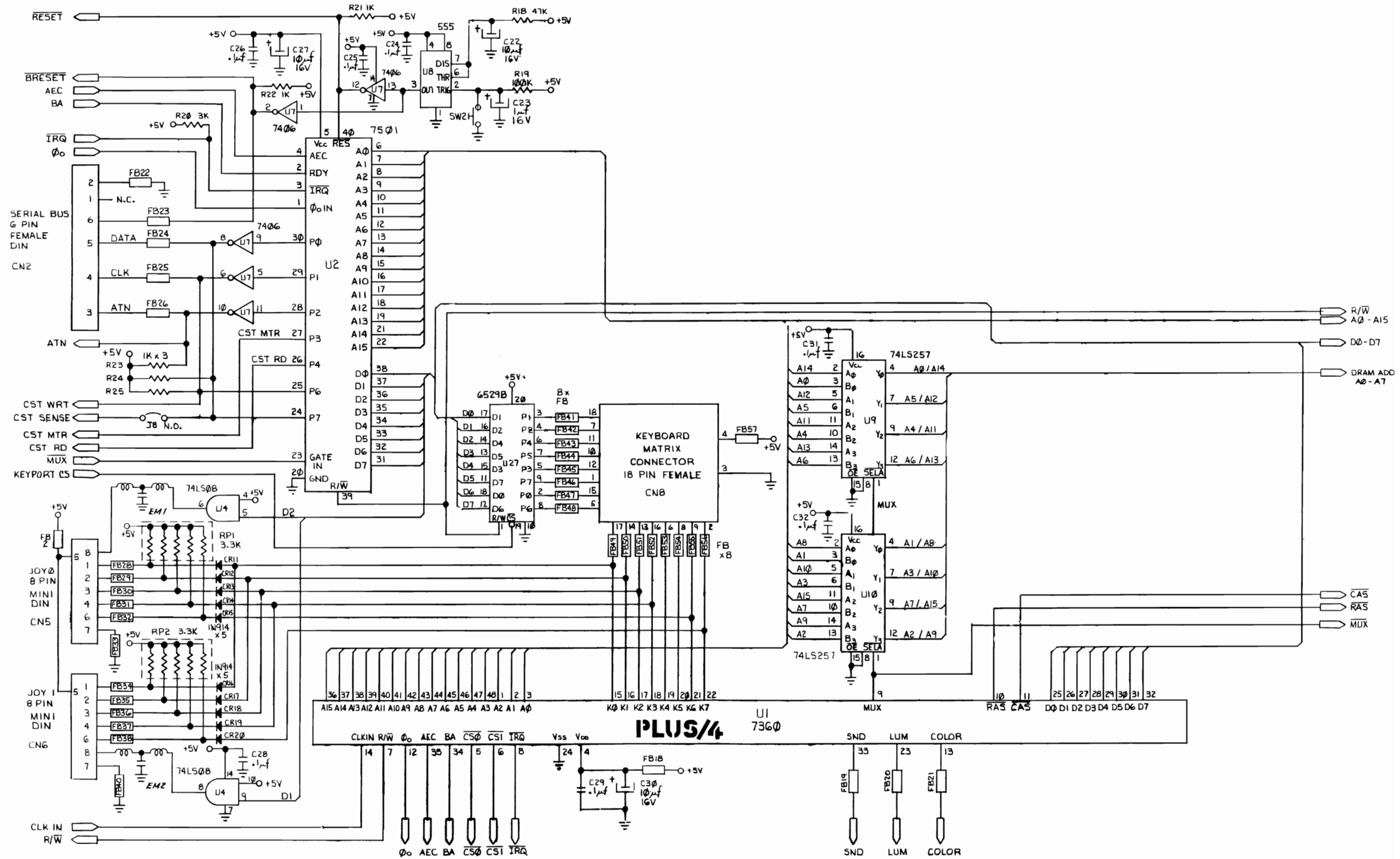


φOIN	1	40	RES
RDY	2	39	R/W
IRQ	3	38	D0
AEC	4	37	D1
VCC	5	36	D2
A0	6	35	D3
A1	7	34	D4
A2	8	33	D5
A3	9	32	D6
A4	10	31	D7
A5	11	30	P0
A6	12	29	P1
A7	13	28	P2
A8	14	27	P3
A9	15	26	P4
A10	16	25	P5
A11	17	24	P6
A12	18	23	GATE IN
A13	19	22	A15
A14	20	21	A14

PIN ASSIGNMENT  
U2-251536-01  
CUSTOM MICROPROCESSOR

A2	1	48	A3
A1	2	47	A4
A0	3	46	A5
VDD	4	45	A6
CS0	5	44	A7
CS1	6	43	A8
R/W	7	42	A9
IRQ	8	41	A10
MUX	9	40	A11
RAS	10	39	A12
CAS	11	38	A13
φ0	12	37	A14
COLOR	13	36	A15
CLK IN	14	35	AEC
K0	15	34	BA
K1	16	33	SND
K2	17	32	D7
K3	18	31	D6
K4	19	30	D5
K5	20	29	D4
K6	21	28	D3
K7	22	27	D2
SYNC	23	26	D1
VSS	24	25	D0

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



Plus 4 Schematic #310164 (1 of 4)

**M<sub>1</sub> SCHEMATIC ON PAGE 11**

**PIN CONFIGURATION**

VSS	1	28	R/W
CS0	2	27	02
CS1	3	26	IRQ
RES	4	25	D7
RXC	5	24	D6
XTL1	6	23	D5
XTL0	7	22	D4
RTS	8	21	D3
CTS	9	20	D2
TXD	10	19	D1
DTR	11	18	D0
RXD	12	17	DSR
RS0	13	16	DCD
RS1	14	15	VCC

**U3-901895-02  
ACIA**

**SYNERTEK SYP6551A 2 MHz**

**PIN CONFIGURATION**

FE	1	28	VCC
17	2	27	18
16	3	26	19
15	4	25	10
14	5	24	11
13	6	23	12
12	7	22	13
11	8	21	14
10	9	20	115
F7	10	19	CE
F6	11	18	F0
F5	12	17	F1
F4	13	16	F2
GND	14	15	F3

**U19-251641-02  
PLA**

**TRANSMIT/RECEIVE CHARACTERISTICS**

CHARACTERISTICS	SYM	-02 2 MHz		UNIT
		MIN	MAX	
TRANSMIT/RECEIVE CLOCK RATE	t <sub>CCY</sub>	400	—	ns
TRANSMIT/RECEIVE CLOCK HIGH TIME	t <sub>CH</sub>	175	—	ns
TRANSMIT/RECEIVE CLOCK LOW TIME	t <sub>CL</sub>	175	—	ns
XTL1 TO TXD PROPAGATION DELAY	t <sub>DD</sub>	—	500	ns
RTS PROPAGATION DELAY	t <sub>DLY</sub>	—	500	ns
IRQ PROPAGATION DELAY (CLEAR)	t <sub>IRQ</sub>	—	500	ns

(tr, tf = 10 to 30 ns)

\*The Baud Rate with External Clocking is:  
BAUD RATE =  $\frac{1}{16 \times T_{CCY}}$

CS	R/W	D0-D7
L	L	DATA BUS TO PORT
L	H	PORT TO DATA BUS
H	X	ISOLATION

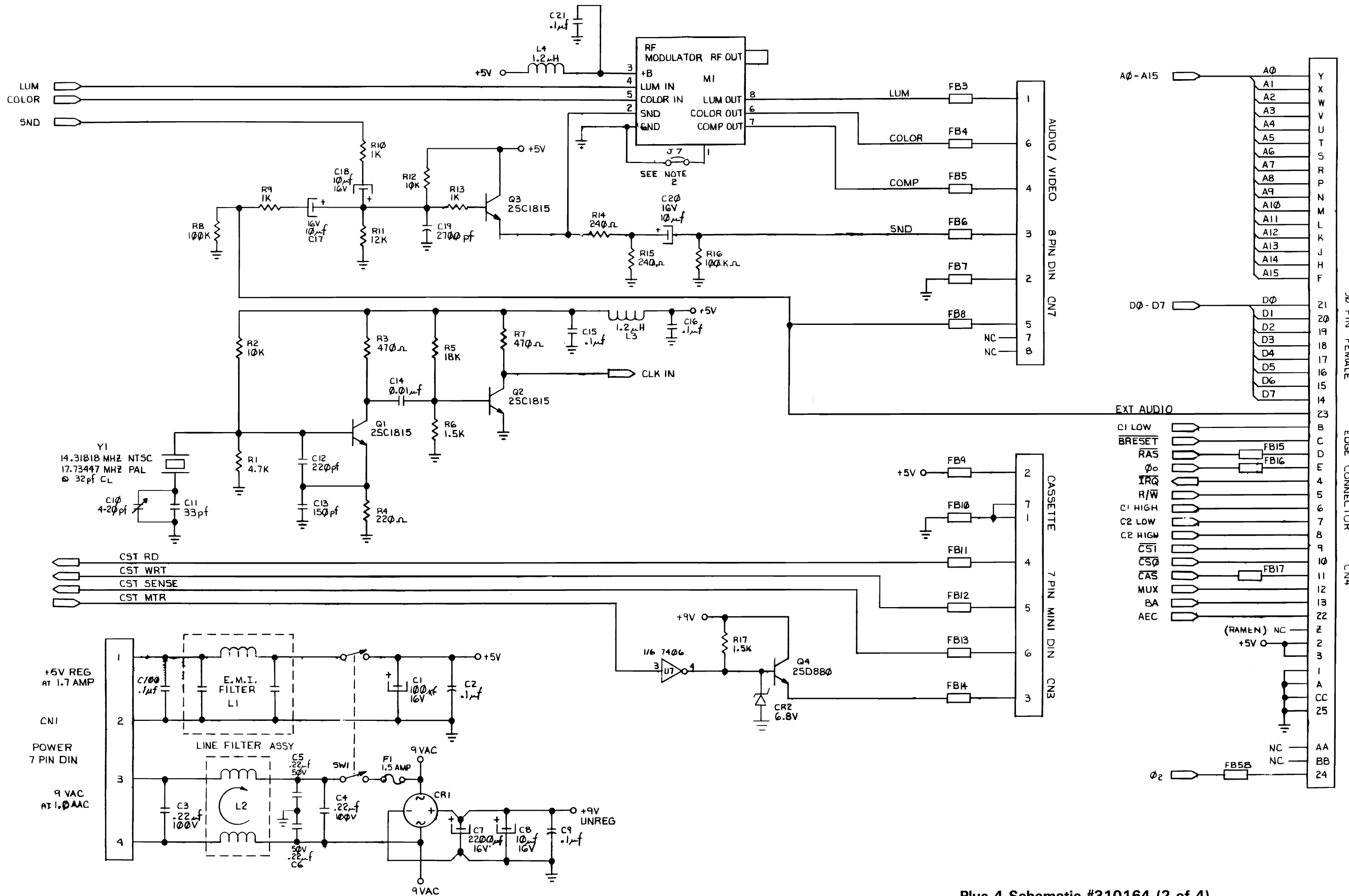
L = LOW LEVEL  
H = HIGH LEVEL  
X = IRRELEVANT

**PIN CONFIGURATION**

R/W	1	20	VDD
P0	2	19	CS
P1	3	18	DB0
P2	4	17	DB1
P3	5	16	DB2
P4	6	15	DB3
P5	7	14	DB4
P6	8	13	DB5
P7	9	12	DB6
VSS	10	11	DB7

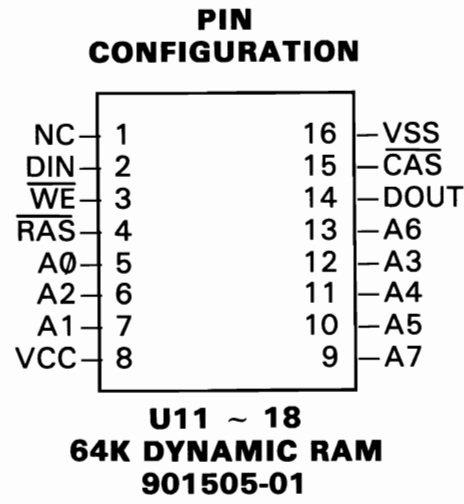
**MOS 6529B 3 MHz**

**U5/U27-251640-03  
SINGLE PORT  
INTERFACE**

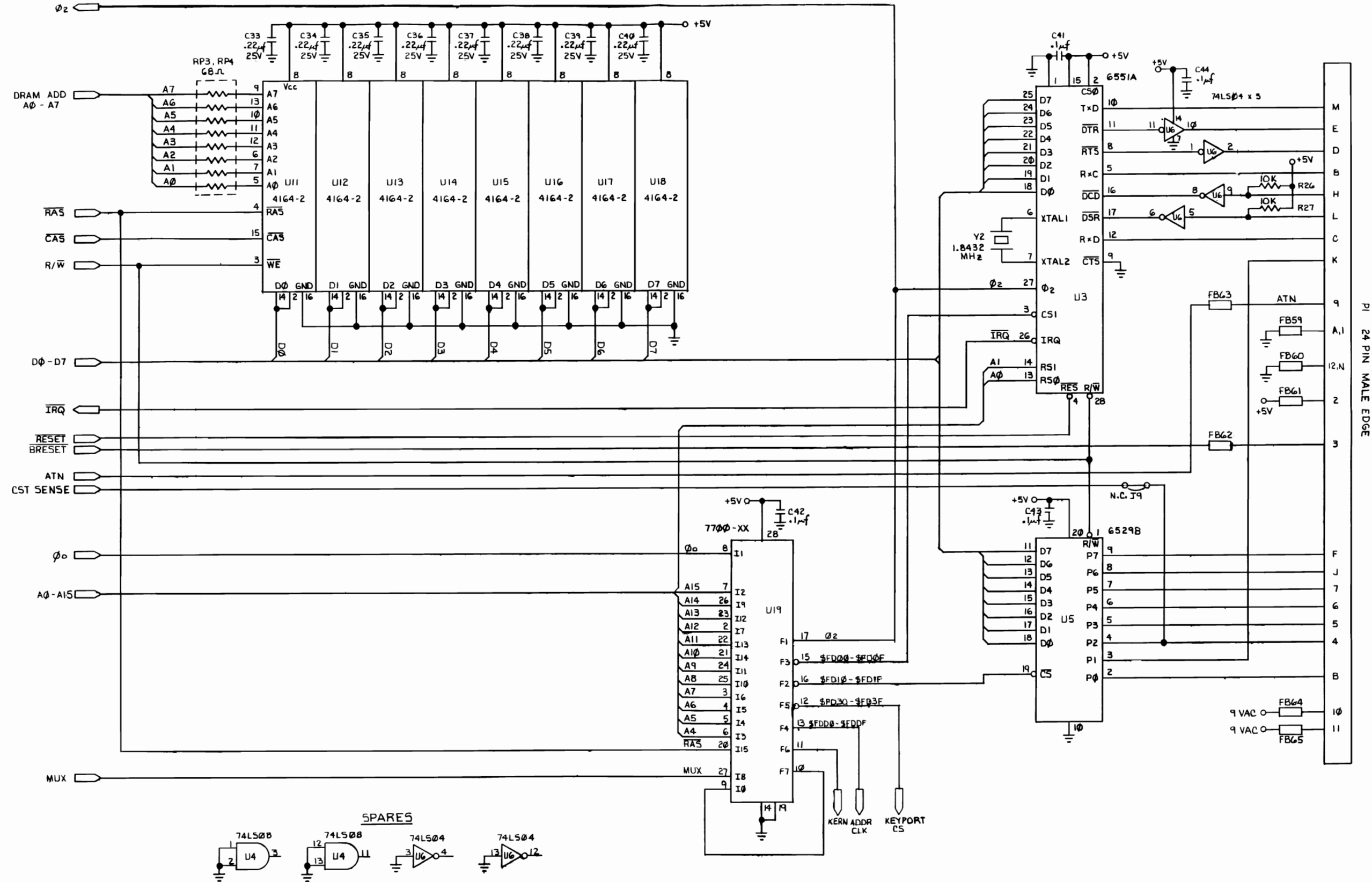
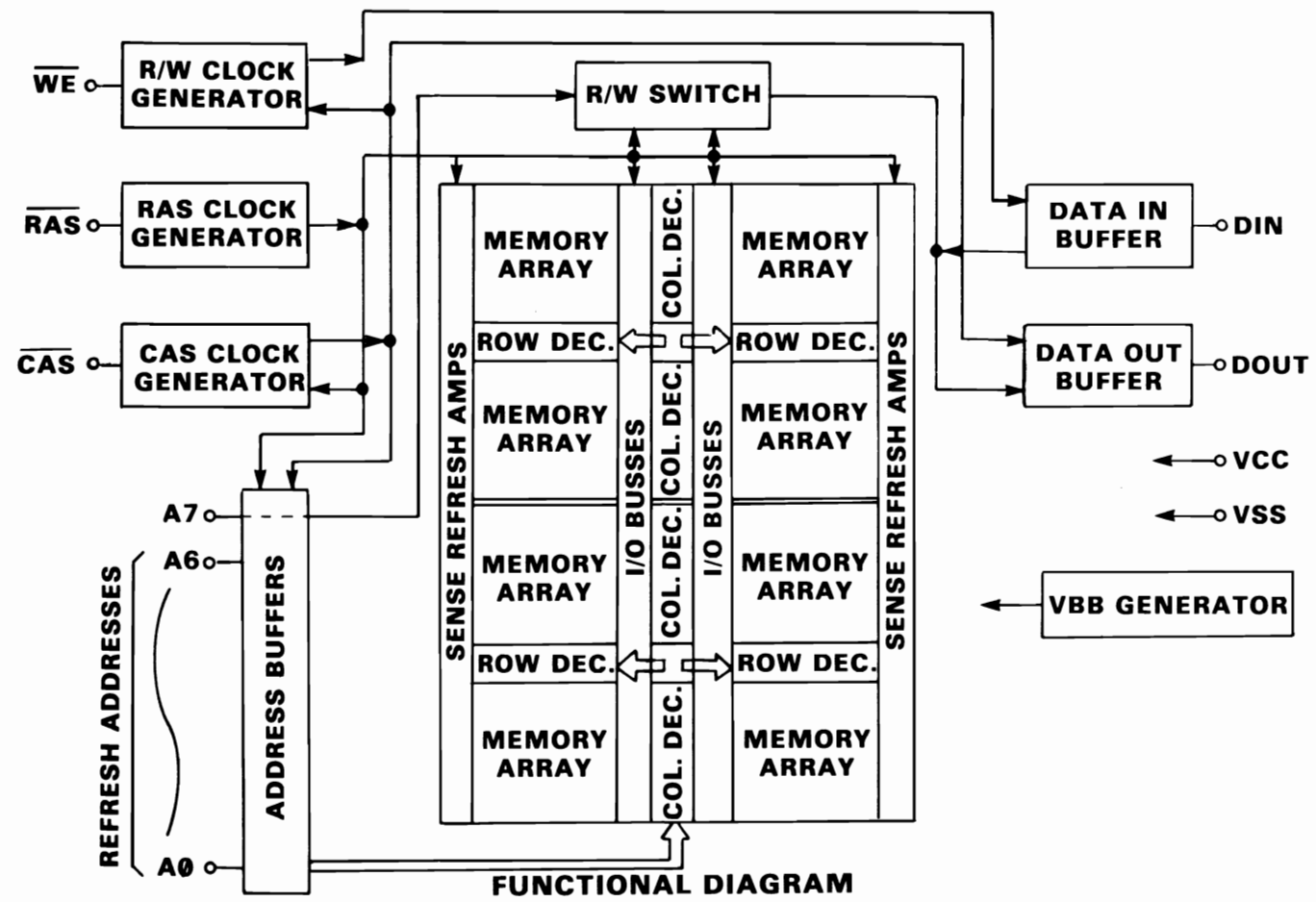


Plus 4 Schematic #310164 (2 of 4)

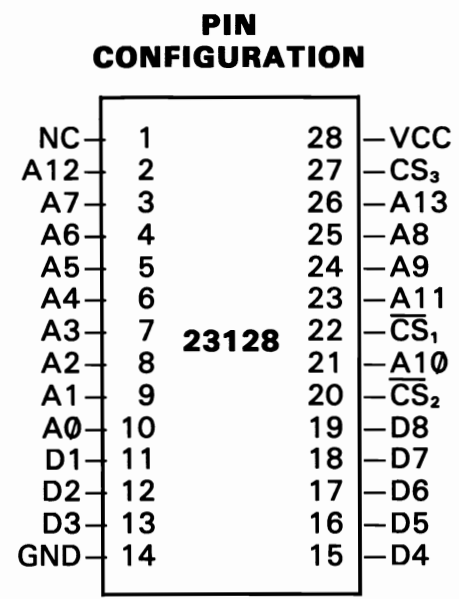
U3, U5, U19 PINOUTS ON PAGE 8



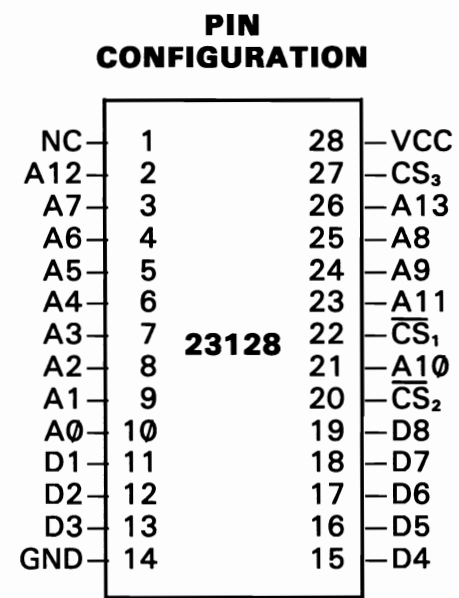
COMMODORE PART NUMBER	APPROVED SOURCE 1 OF SUPPLY	VENDOR PART NUMBER	ACCESS TIME (ns)	CYCLES (ns)	POWER	
					ACTIVE (MW)	STANDBY (MAX)(MW)
901505-01	HITACHI	HM4864-3	200	335	330	20
901505-01	NEC	μPD4164-2	200	375	250	28
901505-01	MITSUBISHI	M5K416NS-20	200	330	275	28
901505-01	MOSTEK	MK4564N-20	200	345	300	22
901505-01	OKI	MSM3764-20	200	330	248	23
901505-01	MICRON TECHNOLOGY	MT4264-3	200	385	300	30
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



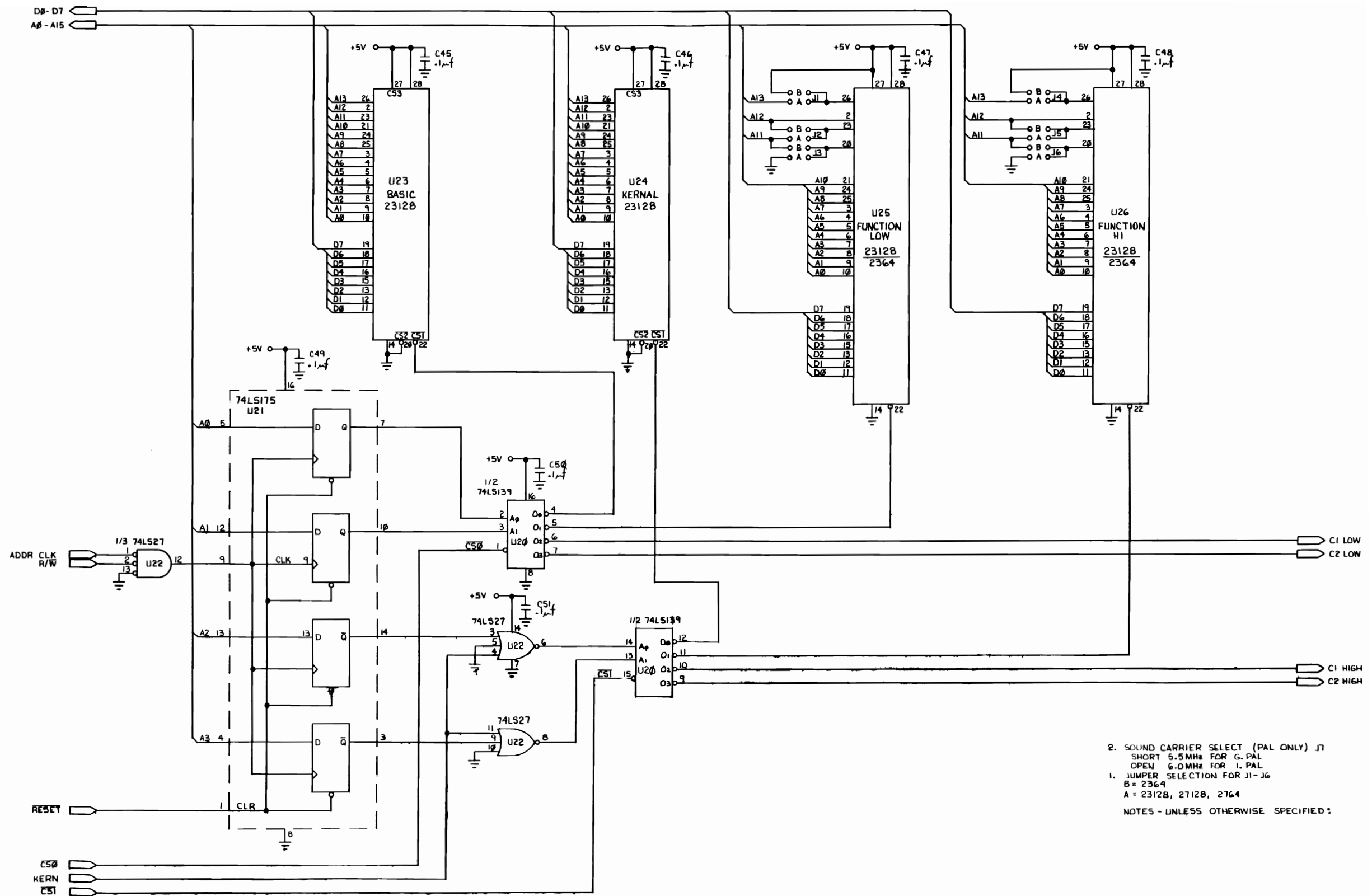
Plus 4 Schematic #310164 (3 of 4)



**U23-318006-01  
ROM - BASIC**

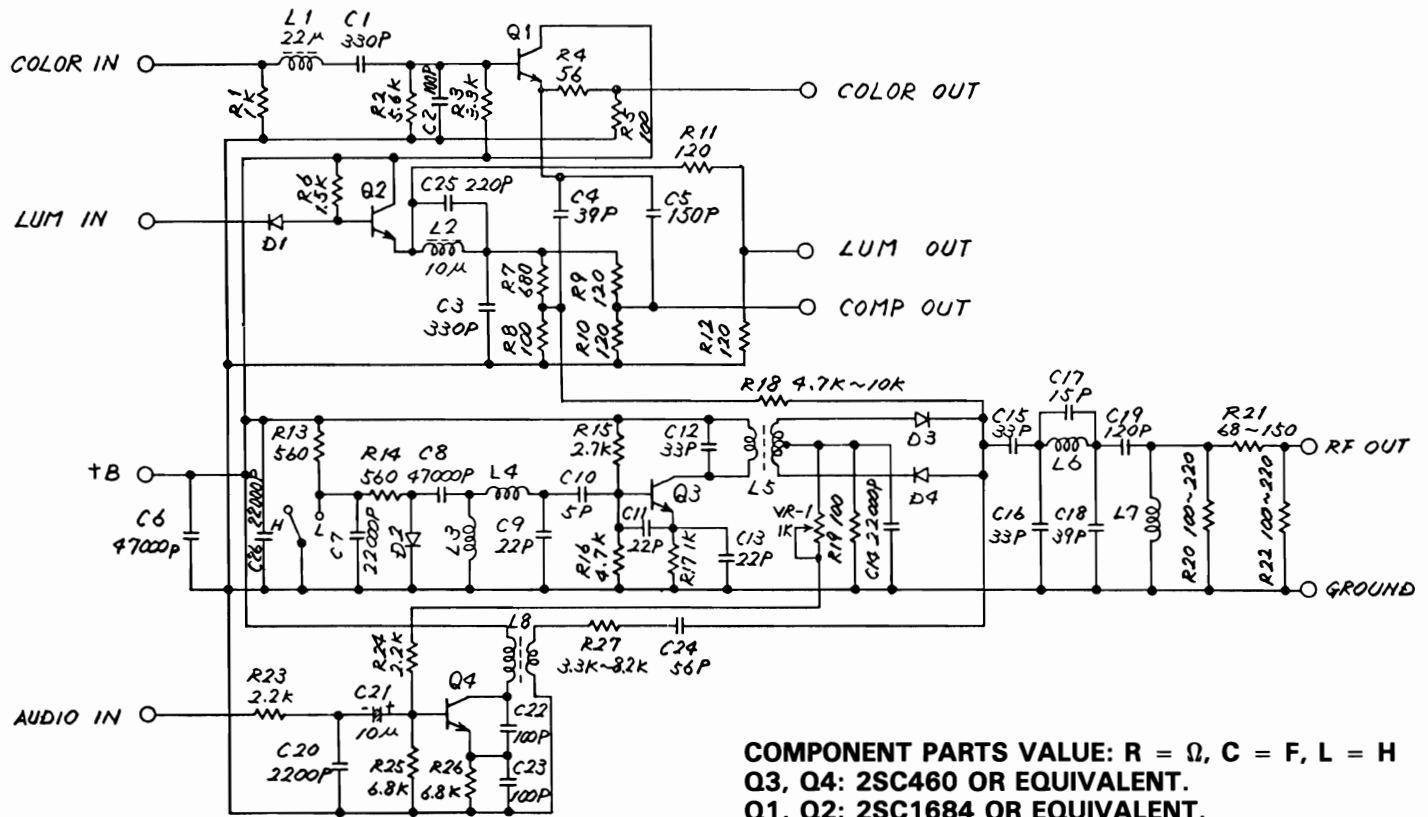


**U24-318005-04  
ROM - KERNAL**

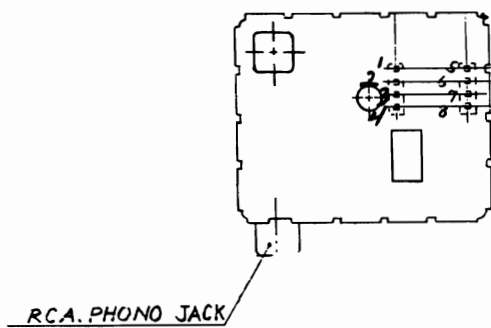


2. SOUND CARRIER SELECT (PAL ONLY) J1  
SHORT 5.5MHZ FOR G. PAL  
OPEN 6.0MHZ FOR I. PAL  
1. JUMPER SELECTION FOR J1-J6  
B = 2364  
A = 2312B, 2712B, 2764  
NOTES - UNLESS OTHERWISE SPECIFIED:

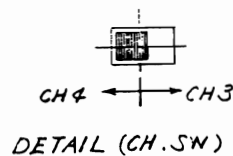
**Plus 4 Schematic #310164 (4 of 4)**



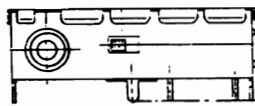
**COMPONENT PARTS VALUE: R =  $\Omega$ , C = F, L = H**  
**Q3, Q4: 2SC460 OR EQUIVALENT.**  
**Q1, Q2: 2SC1684 OR EQUIVALENT.**  
**D3, D4: 1SS198 OR EQUIVALENT.**  
**D2 : 1SS110 OR EQUIVALENT.**  
**D1 : 1SS119 OR EQUIVALENT.**



**TOP VIEW**



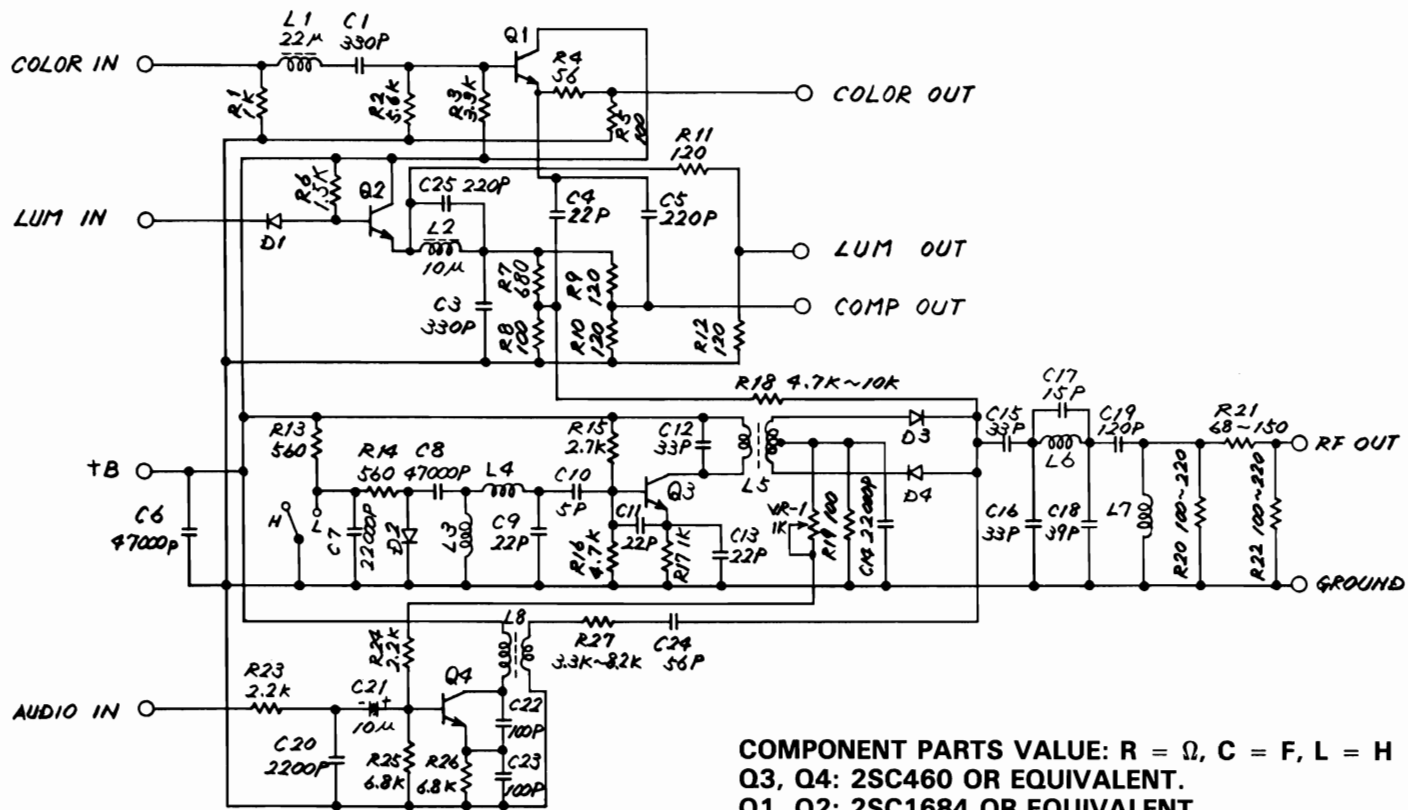
**DETAIL (CH. SW)**



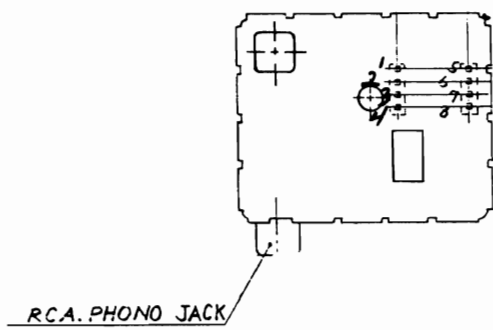
**REAR VIEW**

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.

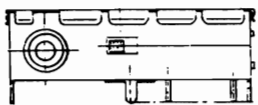
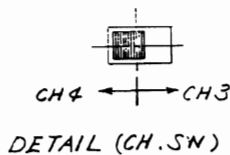
**RF Modulator Layout and Schematic #251844**



COMPONENT PARTS VALUE: R =  $\Omega$ , C = F, L = H  
 Q3, Q4: 2SC460 OR EQUIVALENT.  
 Q1, Q2: 2SC1684 OR EQUIVALENT.  
 D3, D4: 1SS198 OR EQUIVALENT.  
 D2 : 1SS110 OR EQUIVALENT.  
 D1 : 1SS119 OR EQUIVALENT.



TOP VIEW



REAR VIEW

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.



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