Commodore

C128 DIAGNOSTIC SPECIFICATION

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1. Introduction

How to use the diagnostic-program.

To run the diagnostic-program you need the diagnostic-box with a set of jumper plugs. The diagnostic box contains all software-routines and will start automatically.
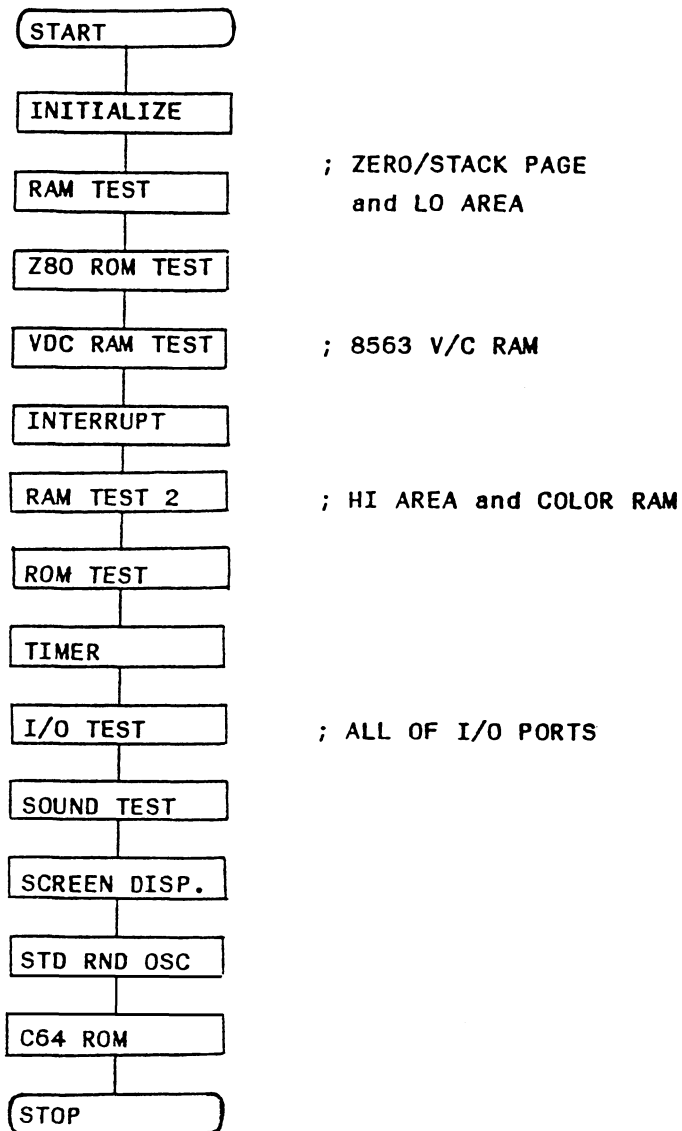
Plugs and box have to be installed on the switched-off machine. Then switch on.

If the diagnostic-program indicates parts as bad, first step should be to test the voltages at the part.

To find out which signal lines are tested in the test routines, one should look at the wiring of the jumpers, the schematics of the machine and schematics of the diagnostic box.

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2. General flow chart

```
  ┌─────────────┐
  ( START        )
  └──────┬──────┘
  ┌──────┴──────┐
  │ INITIALIZE  │
  └──────┬──────┘
  ┌──────┴──────┐
  │ RAM TEST    │        ; ZERO/STACK PAGE
  └──────┬──────┘          and LO AREA
  ┌──────┴──────┐
  │ Z80 ROM TEST│
  └──────┬──────┘
  ┌──────┴──────┐
  │ VDC RAM TEST│        ; 8563 V/C RAM
  └──────┬──────┘
  ┌──────┴──────┐
  │ INTERRUPT   │
  └──────┬──────┘
  ┌──────┴──────┐
  │ RAM TEST 2  │        ; HI AREA and COLOR RAM
  └──────┬──────┘
  ┌──────┴──────┐
  │ ROM TEST    │
  └──────┬──────┘
  ┌──────┴──────┐
  │ TIMER       │
  └──────┬──────┘
  ┌──────┴──────┐
  │ I/O TEST    │        ; ALL OF I/O PORTS
  └──────┬──────┘
  ┌──────┴──────┐
  │ SOUND TEST  │
  └──────┬──────┘
  ┌──────┴──────┐
  │ SCREEN DISP.│
  └──────┬──────┘
  ┌──────┴──────┐
  │ STD RND OSC │
  └──────┬──────┘
  ┌──────┴──────┐
  │ C64 ROM     │
  └──────┬──────┘
  ┌──────┴──────┐
  ( STOP         )
  └─────────────┘
```

* always tods are displayed

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3. Description

1) RAM TEST

Diag check both RAM bank 0 and 1.
When 1, also color RAM bank 1.
Color/RAM bank 0 is initialized blue, 1 is orange.
You can know collent bank by character color.

(1) Zero Page (addr 02_H - FF_H)
at first, write 80_H (MSB=1) to RAM,
and read verify for performed.
Then shift right 1 Bit, repeat.
Shift 8 Bit IS 1 cycle per 1 byte.

(2) Stack Page (addr 100_H - $1FF_H$)
Same as Zero Page test.

(3) RAM test 1 (addr 200_H - $2FFF_H$)
Fill by check data and read verify for performed.
There are 4 kind (type) of data-pattern.
Datas as following;
00_H, 55_H, AA_H, FF_H

2) Z80 ROM TEST

Switch for Z80 mode.

Calculate BIOS ROM (addr 0000 - $OFFF_H$) signature
and compare correct value in the table.
Return to 8502 mode.

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3) VDC RAM TEST

   (1) Block write
        Write data 00_H to first 128 bytes.

   (2) Block copy
        Copy from source of first 128 bytes to next 128 bytes,
        127 times.

        Same as fill all video RAM / COLOR RAM
        by 00_H data.
        Video RAM 8K / COLOR RAM 8K

   (3) V/C RAM TEST
        Fill all C/U RAM by check data
        and read verify for performed.
        Data-pattern as following;
        00_H, 55_H, AA_H, FF_H

4) RAM TEST 2

   (1) RAM TEST 2 (addr 4000_H - $FFFF_H$, skip MMU)
        same as RAM test 1

   (2) Color RAM test (addr $D800_H$ - $DBFF_H$, bank 0, 1)
        Same as RAM test 1
        and restore collent color code.

5) Interrupt
    Check if the interrupt of 6526 (U1, U4) is normal.

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6)   ROM TEST

ROM check sum; add carry and add last carry

1	addr	4000_H	–	$7FFF_H$	LO	(BASIC LO)	U33
2	addr	8000_H	–	$BFFF_H$	MID	(BASIC HI)	U34
3	addr	$C000_H$	–	$CFFF_H$	HI	(EDITOR)	U35
4	addr	$D000_H$	–	$DFFF_H$	CHARACTER(128)		U18
5	addr	$E000_H$	–	$FFFF_H$	HI	(KERNAL)	U35

7)   TIMER
Check 6526 Timers: U1 timer A/B and U4 timer A/B.

8)   I/O TEST
Check if I/O port is normal.
(1)   Cassette Test
(2)   Keyboard Test
(3)   Control Port Test
(4)   Serial Port Test
(5)   User Port Test

Add test as following;

(1)   I/O TEST
Cartridge port I/O 1, I/O 2, HI ROM line

(2)   KEYPORT TEST
Add VIC chip keyport test

(3)   FAST SERIAL
CIA SP (serial data), DNT (serial srqin) line
(cut user's port SP.CNT TEST)

Please refer C128 diag schematics

9) SOUND TEST

    To be confirmed by 'ear'.

10) SCREEN DISP (COLOR PATTERN)

    (1) Border/Background 16 Pattern Test
    (2) Vertical and horizontal stripes display
    (3) Display all colors (16 colors), one color per a byte
    (4) Display all colors every two lines

11) RANDOM OSC (SID)

    Routine will show Asterix on screen which will be found with random generator.

12) C64 ROM

    C64 ROM check sum (BASIC/CHARACTER/KERNAL)

13) TOD

    Display the clock of 6526 (U1, U4)

    (Display when the screen is renewed)

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4.   ERROR CODE LIST

- RAM ERROR

```
NG BX (FFFF) (FF) (FF)
    |   |      |    |
    |   |      |    READ DATA
    |   |      |
    |   |      WRITE DATA
    |   |
    |   ERROR ADDR
    |
    BANK NO.
```

- Z80 ROM ERROR

        NG   :   Z80 BIOS ROM (IN THE U35)

- VDC RAM ERROR

        NG RAM CPY

            VDC(8563) VIDEO RAM / COLOR RAM ERROR

- INTERRUPT ERROR

```
        1 X  =  TIMER A INTERRUPT
        2 X  =  TIMER B INTERRUPT
        3 X  =  SP INTERRUPT
        4 X  =  ALARM INTERRUPT OR TOD CLOCK
        5 X  =  FLAG INTERRUPT
          |
          |
          CIA NO.
```

- ROM ERROR

     1 = ROM LO (BASIC LO) U33
     2 = ROM MID(BASIC HI) U33
     3 = ROM HI (EDITOR)   U35
     4 = CHAR ROM (C-128)   U18
     5 = ROM HI (KERNAL)   U35
    (0) = INTERNAL FUNCTION U36

- TIMER ERROR

     1 = LO LIMIT (TIMER TOO FAST)
     2 = TIMER OUT
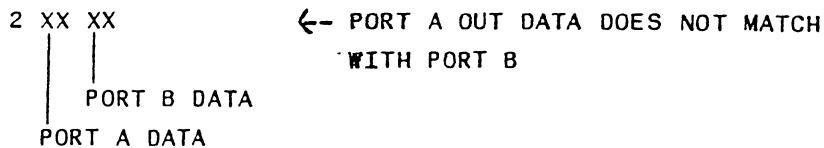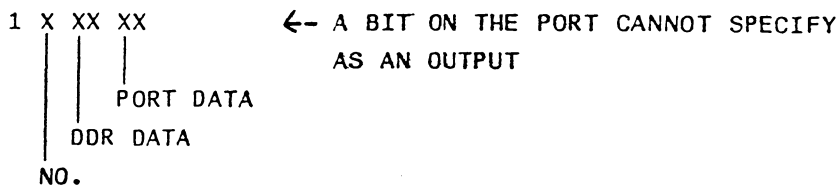
- I/O PORT ERROR

    NG : CARTRIDGE SLOT
          I/O1, I/O2, HIROM

- CASSETTE ERROR

     1 = CAS SENSE OR SERIAL SRQIN
     2 = CAS MOTOR OFF OR +5V IS NOT
            SUPPLIED FOR TEST FIXTURE
     3 = CAS MOTOR ON

- KEY PORT ERROR   (CIA1)

```
1 X XX XX        <- A BIT ON THE PORT CANNOT SPECIFY
  | |  |              AS AN OUTPUT
  | |  |
  | |  PORT DATA
  | |
  | DDR DATA
  |
  NO.


2 XX XX          <- PORT A OUT DATA DOES NOT MATCH
  |  |                WITH PORT B
  |  |
  |  PORT B DATA
  |
  PORT A DATA
```

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```
3 X X                    <-  VIC CHIP KEY PORT
  | |
  | WRITE DATA
  READ DATA
```

- CONTROL PORT ERROR

```
1 X X X   XXX            <-  POTX OR POTY
  | | |    |
  | | |    DATA
  | | H/L
  | X/Y
  NO.
```

```
2 XX XX                  <-  JOY PORT
  |  |
  |  B PORT DATA
  A PORT DATA
```
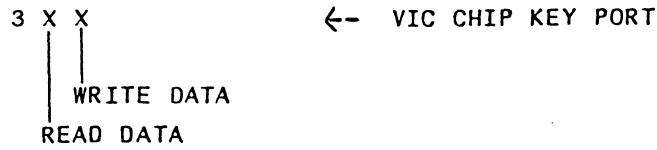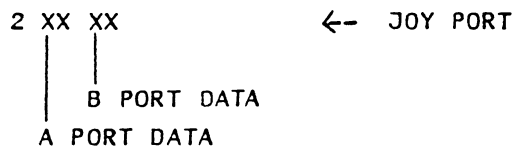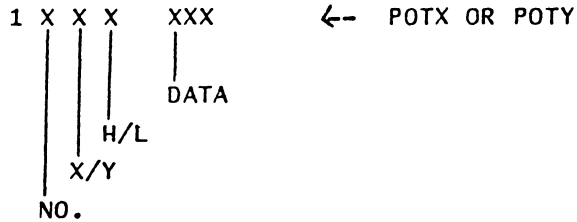
- SERIAL PORT ERROR

```
    1  =  DATA(OUT) / SRQIN
    2  =  DATA(OUT) / DATA(IN)
    3  =  ATN,CLK(OUT) / CLK(IN)
```

- FAST SERIAL ERROR

```
    1 X : CIA1 -- CIA2
    2 X : CIA2 -- CIA1

    A = SP OUT OR TIMER A/CNT   (SP SEND FAIL)
    B = SP OUT CNT OR SP IN CNT (SP RECEIVE FAIL)
    C = SP OUT SP OR SP IN SP   (SEND/RCV DATA MISMATCH)

    (SP = SER DATA / CNT = SER SRQIN)
```

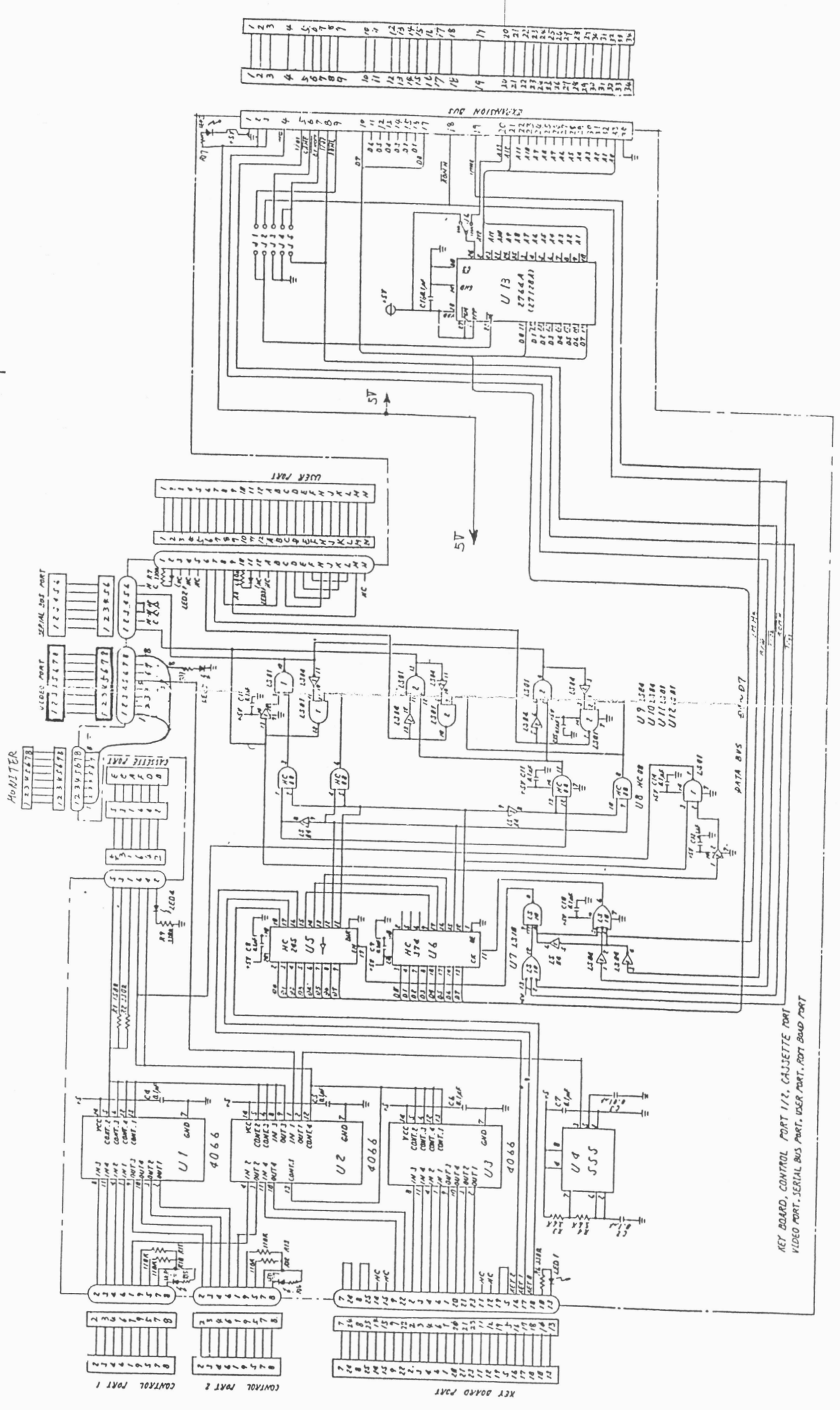**Commodore**

- USER'S PORT ERROR

     1   :   ATN, PA2

     2 X X : B PORT
```
      | |
      | IN DATA
      OUT DATA
```
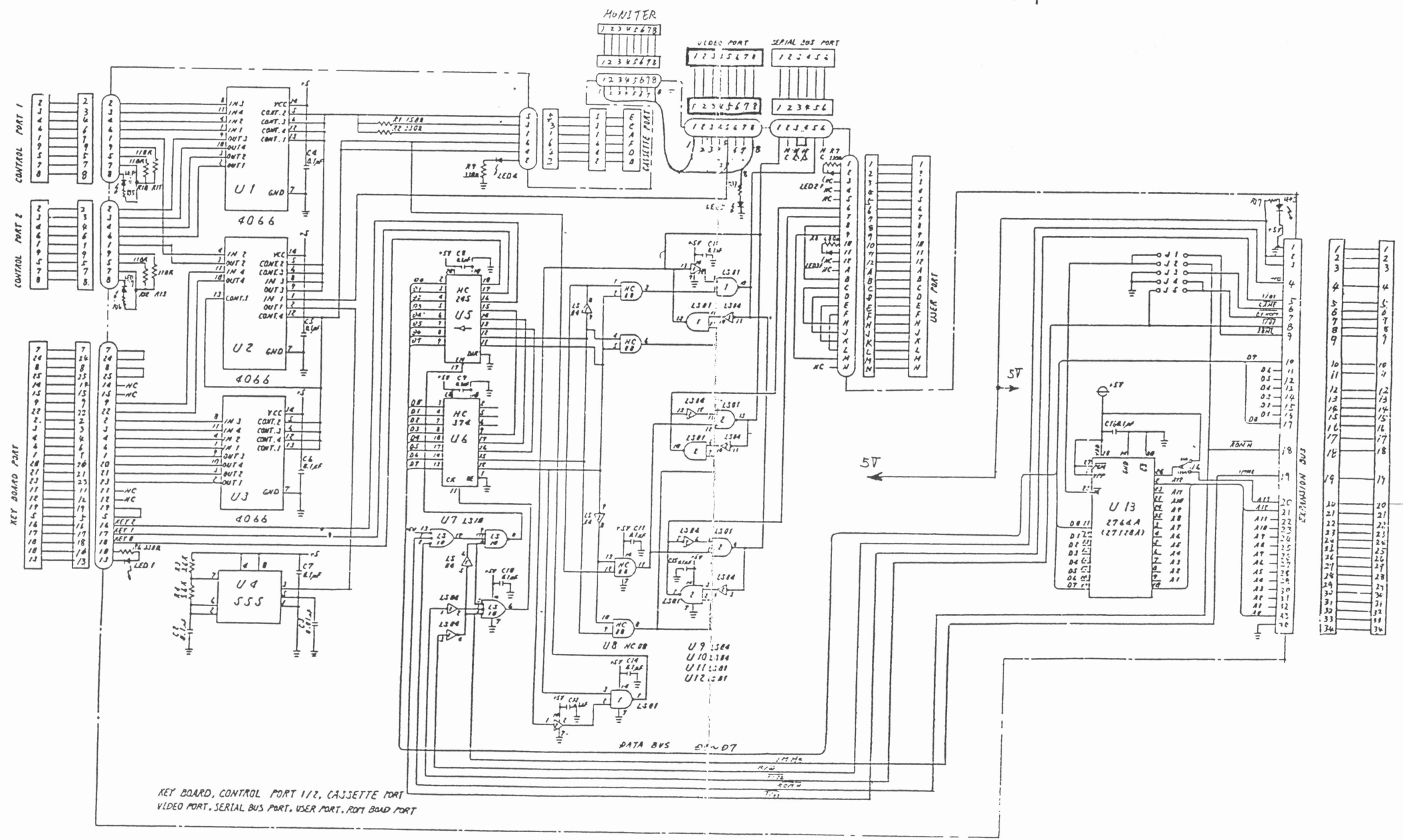
     3   :   PC2, FLAG2

5. SCREEN FORMAT

アドレス・オフセット	Screen content (columns 0–39)	行 (10進)	行 (16進)
10進 / 16進			
000 / 0000		0	0
040 / 0028	C-128 DIAGNOSTIC REV 1.x	1	1
080 / 0050		2	2
120 / 0078	RAM TEST1 OK	3	3
160 / 00A0	RAM TEST2 OK	4	4
200 / 00C8	COLOR RAM OK	5	5
240 / 00F0	ROM CHECK OK	6	6
280 / 0118		7	7
320 / 0140	TIMER 1 A OK	8	8
360 / 0168	B OK	9	9
400 / 0190	TIMER 2 A OK	10	A
440 / 01B8	B OK	11	B
480 / 01E0	I/O PORT OK	12	C
520 / 0208	CASSETTE OK	13	D
560 / 0230	KEY PORT OK	14	E
600 / 0258	CONTROL PORT OK XXX-XXX XXX-XXX	15	F
640 / 0280	SERIAL PORT OK	16	10
680 / 02A8	FAST SERIAL OK	17	11
720 / 02D0	USER'S PORT OK	18	12
760 / 02F8		19	13
800 / 0320	Z80 ROM TEST OK	20	14
840 / 0348	VDC RAM TEST OK	21	15
880 / 0370	INTERRUPT OK AM XX:XX:XX	22	16
920 / 0398	PM XX:XX:XX	23	17
960 / 03C0		24	18

Column header offsets (10進): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39

Column header offsets (16進): 0 1 2 3 4 5 6 7 8 9 A B C D E F 10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F 20 21 22 23 24 25 26 27

C128 DIAG TEST FIXTURE

KEY BOARD, CONTROL PORT 1/2, CASSETTE PORT
VIDEO PORT, SERIAL BUS PORT, USER PORT, ROM BOARD PORT

commodore
~C128 DIAG
TEST FIXTURE

MONITER

VIDEO PORT   SERIAL BUS PORT

CONTROL PORT 1

CONTROL PORT 2

KEY BOARD PORT

U1 4066

U2 4066

U3 4066

U4 555

U5 HC 245

U6 HC 374

U7 LS10

U8 HC00

U9 LS04
U10 LS04
U11 LS01
U12 LS01

U13 2764A (27128A)

USER PORT

EXTENSION

5V

DATA BUS D0~D7

1MHz
R/W
I/O
RESET
I/O

KEY BOARD, CONTROL PORT 1/2, CASSETTE PORT
VIDEO PORT, SERIAL BUS PORT, USER PORT, ROM BOAD PORT