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LR67151 On-Screen Display Driver LSI

Description

The LR67151 is an on-screen display driver LSI fabricated using NMOS process.

It receives 12 bits of serial data and selects from 123 characters to display 126 characters on the CRT screen of a TV set.

Features

1. NMOS process

2. Control input :

Both display control signal and display data are controlled by a 12-bit serial data input on the pins DATA, CLOCK and STRB.

3. On-screen display function

1) Number of display characters :

21 characters $\times$ 6 lines

2) Selectable characters :

123 kinds (alphanumeric and simple graphic characters)

3) Character font :

12 dots (V) by 12 dots (H)

1 dot consists of $1/262.5$ lines (V) and $1/f_{osc}$ sec (H)

4) Color specifications :

4 colors can be specified on each character.

The range can be specified for changing display colors irrespective of character pattern.

5) Character size :

Double-size character, twice in vertical and horizontal on each line is available.

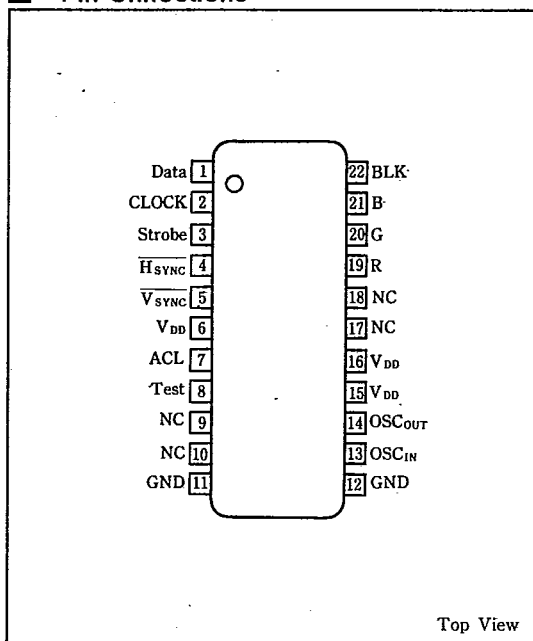
6) Display position

Display position can be set to any position of 32 steps (V) at $8/262.5$ by 32 steps (H) at $8/f_{osc}$ unit. The 6 lines can be divided vertically into two of 3-line sections.

7) Display output :

R, G, B output...Character output
Blanking output...Background

Pin Connections



8) Line space :

The line space can be specified from 1H to 31H at 1H unit

9) Background :

One of no-background, full-background and half-background can be selected. The background color is specified by the command.

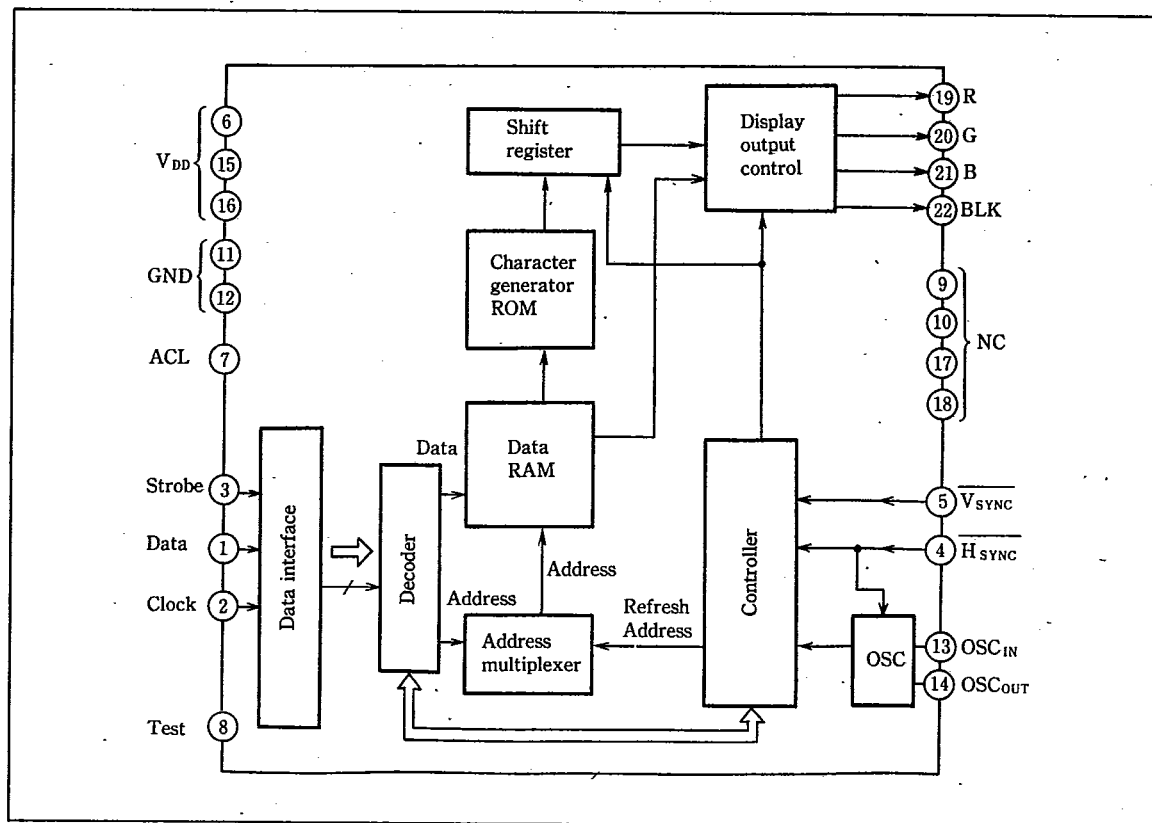
10) Display ON/OFF :

The overall display can be switched ON or OFF by a command.

4. +5V single power supply

5. 22-pin dual-in-line package

Block Diagram



Pin Functions

Pin No.	Symbol	I/O	Function	Pin No.	Symbol	I/O	Function
1	Data	I	Data input	12	GND	—	Reference power
2	Clock	I	Clock input	13	OSC _{IN}	—	Clock
3	Strobe	I	Strobe input	14	OSC _{OUT}	—	Clock
4	H _{SYNC}	I	Horizontal sync.	15	V _{DD}	—	Power supply
5	V _{SYNC}	I	Vertical sync.	16	V _{DD}	—	Power supply
6	V _{DD}	—	Power supply	17	NC	—	Non connection
7	ACL	I	Auto-clear	18	NC	—	Non connection
8	Test	I	Test	19	R	O	Display out (Red)
9	NC	—	Non connection	20	G	O	Display out (Green)
10	NC	—	Non connection	21	B	O	Display out (Blue)
11	GND	—	Reference power	22	BLK	O	Blanking out

Note : NC pin must be used with non-connection.

V_{DD} and GND pins must be used with connection.

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Applicable voltage *	V _T	-0.5 to +7.0	V
Operating temperature	T _{opr}	0 to +60	°C
Storage temperature	T _{stg}	-55 to +150	°C

* The maximum applicable voltage on all input/output pins with respect to GND.

DC Characteristics

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	Note
Input voltage	V_{IL}				0.8	V	1
	V_{IH}		2.0			V	
Input leakage current	I_{LI}	$V_{IN}=0V$ to V_{DD}			10	μA	
Output voltage	V_{OL}	$I_{OL}=1.0mA$			0.4	V	2
	V_{OH}	$I_{OH}=-0.3mA$	2.4			V	
Current consumption	I_{DD}	$V_{DD}=5.0V$			120	mA	
Oscillator frequency	f_{osc}	External C=50pF, R=5k Ω variable resistor			6.2	MHz	3
Horizontal sync. pulse width	t_H	Low cycle of horizontal sync. signal from TV set	5			μs	4

Note 1 : Applied to all input pins.

Note 2 : Applied to all output pins.

Note 3 : Applied to pins OSC_{IN} and OSC_{OUT}.Note 4 : Applied to H_{SYNC} pin.

Functional Description

(1) Data read-in

Each data is serially input to the data input pin. The relation between CLK and STRB inputs is as follows. (DATA=1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0)

Timing Characteristics

- 1) CLK High signal : t_{HC} 2 μs (MIN.)
- 2) CLK frequency : t_{WC} 4 μs (MIN.)
- 3) STRB High frequency : t_{HS} 4 μs (MIN.)
- 4) Interval between fall of 12th CLK and rise of STRB : t_{ICS} 4 μs (MIN.)
- 5) Interval between STRB signals (Serial data frequency) : t_{IS} 100 μs (MIN.)

Data is stored into the internal 12-bit shift register at the rising edge of clock (CLK), and latched to the internal register at the rising edge of strobe signal.

If the data is used as character data, the character address should be automatically increment at the falling edge of strobe signal after latched.

(2) Data input signal configuration and data line up

Character data is set by a reset circuit as below :

(BL, C₁, C₀, C₅, D₄, D₃, D₂, D₁, D₀)

= (0, 0, 0, 1, 1, 1, 1, 1, 1)

Line space is set as below :

(RS₄, RS₃, RS₂, RS₁, RS₀) = (0, 1, 0, 1, 1)

The other registers are reset to "0".

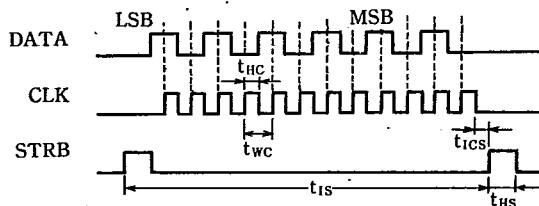


Fig. 1 DATA, CLK and STRB input timing

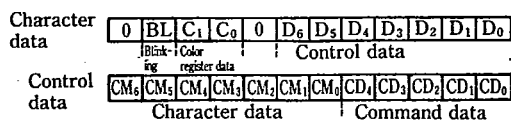


Fig. 2 Data input signal configuration

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Table 1 Data line-up

12	11	10	9	8	7	6	5	4	3	2	1	Descriptions
0	BL	C ₁	C ₀	0	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁	D ₀	Character data
0	×	×	×	1	0	1	CA ₄	CA ₃	CA ₂	CA ₁	CA ₀	Figure address
0	×	×	×	1	1	0	×	×	RA ₂	RA ₁	RA ₀	Line address
1	1	0	0	0	1	1	H ₄	H ₃	H ₂	H ₁	H ₀	Horizontal start address
1	1	0	0	1	0	0	V ₄	V ₃	V ₂	V ₁	V ₀	1st vertical start address
1	1	0	0	1	0	1	RS ₄	RS ₃	RS ₂	RS ₁	RS ₀	Line space
0	×	×	×	1	0	0	×	×	B ₂	B ₁	B ₀	Blinking
0	×	×	×	1	1	1	×	×	×	DS ₁	DS ₀	Display ON/OFF switch
1	1	0	1	0	0	0	R	G	B	BD ₁	BD ₀	Background specification
1	1	0	1	0	0	1	V ₄	V ₃	V ₂	V ₁	V ₀	2nd vertical start address
1	1	0	1	0	1	0	×	SR	RA ₂	RA ₁	RA ₀	Line character size specification
1	1	0	1	0	1	1	×	×	×	M _R	F _R	Format specification
1	1	0	1	1	0	0	C ₁	C ₀	R	G	B	Color register set
1	1	0	1	1	0	1	×	×	CC ₂	CC ₁	CC ₀	Color select switch
1	0	0	0	DC ₇	DC ₆	DC ₅	DC ₄	DC ₃	DC ₂	DC ₁	DC ₀	Horizontal color select start dot
1	0	0	1	DC ₇	DC ₆	DC ₅	DC ₄	DC ₃	DC ₂	DC ₁	DC ₀	Horizontal color select end dot
1	0	1	0	DR ₇	DR ₆	DR ₅	DR ₄	DR ₃	DR ₂	DR ₁	DR ₀	Vertical color select start dot
1	0	1	1	DR ₇	DR ₆	DR ₅	DR ₄	DR ₃	DR ₂	DR ₁	DR ₀	Vertical color select end dot

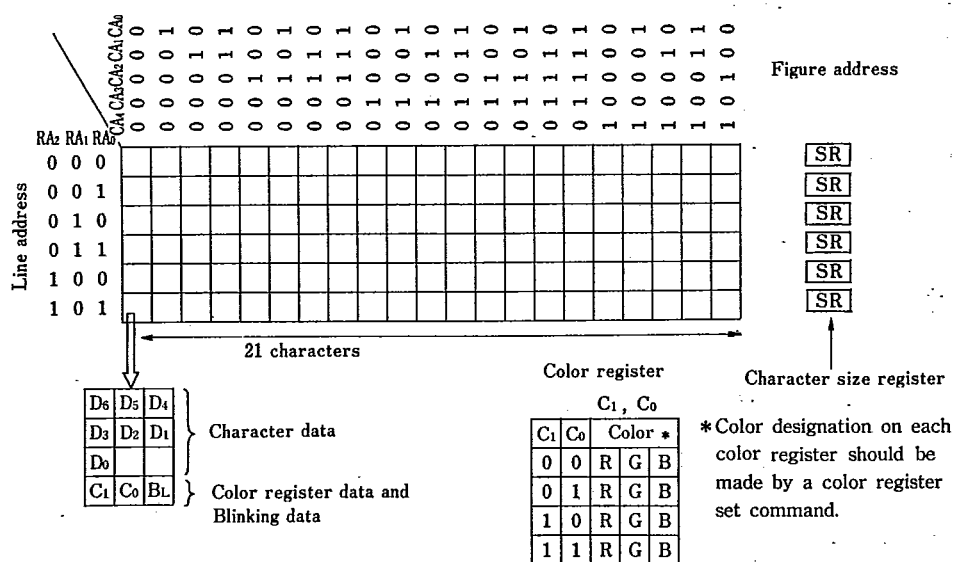


Fig. 3 Relation between screen and display

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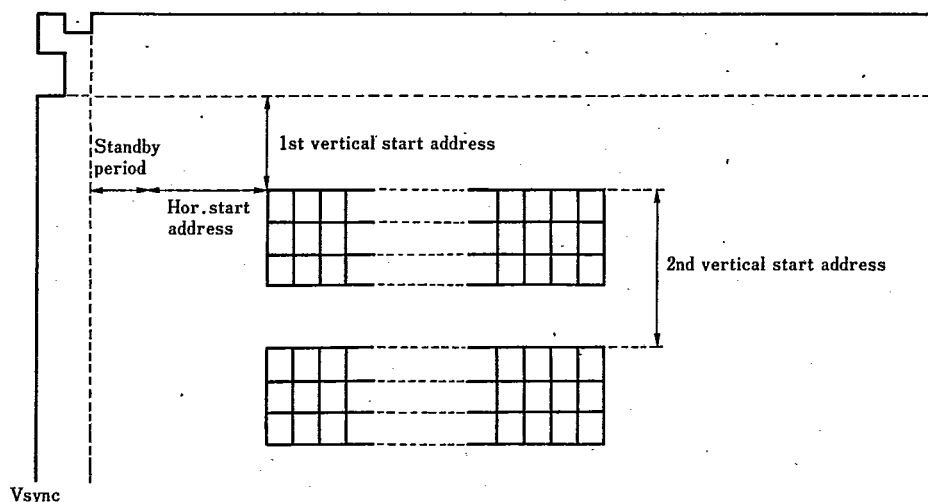


Fig. 4

(3) Character data read-in

Character data is directly addressed with the figure address data and Row address data set. Then, the address is automatically increment with the character data write. (It is applied only in the case of character data.) See Fig.3 for the RAM address in which the character data is stored. It corresponds to the address on the screen shown in Fig. 4.

(4) Display position

32 kinds of initial display position can be set to the vertical direction at 8H unit and the horizontal direction at $8/f_{osc}$ sec unit.

It is executed by the horizontal and vertical start address command.

The address can also be divided into three lines to vertical direction by executing the 2nd vertical start address command.

Be sure not to overlap the data of the 1st and the 2nd vertical start addresses.

The standby period shown in Fig. 4 is defined by the time as below, if the oscillator frequency is f_{osc} .

$$(1/f_{osc} \times 49) \text{ ns}$$

$$8.17 \mu\text{s, if } f_{osc} = 6\text{MHz.}$$

The other addresses on the screen are shown below according to the specified data.

- 1) Horizontal start address : $(8/f_{osc} \text{ sec}) \times (00000 - 11111)$
- 2) 1st vertical start address : $(8/262.5) \times (00000 - 11111)$
- 3) 2nd vertical start address : $(8/262.5 \times (00000 - 11111))$

If the 2nd vertical start address is set to 00000, screen division for every three lines is released.

(5) Line space

Line space can be set by 31 pitches within 1H through 31H at 1H unit. As for an upper-case letter, it can be set within 2H through 62H at 2H unit.

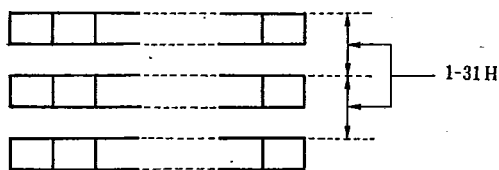


Fig. 5

(6) Blinking

To execute a blinking command blinks the character data with the BLK being set to "1". And the blinking cycle can be selected by either 0.5sec or 1sec.

(7) Display ON/OFF

It switches ON and OFF of total screen or characters excepting background.

(8) Assignment of background

The screen is assigned with or without background which can be selected by one of the two patterns as below.

Background 1 : Colored total background of the screen

Background 2 : Colored the background every 1H

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(9) Assignment of character size at each line

Two different character font can be selected in size to be assigned by one of the two on each line. Each line has a register in accordance with the character size. The register assigned by "0" causes a small-size character (12×12 dots) and by "1" causes a large-size character (24×24 dots) to be displayed. (See Fig. 3)

(10) Color register set

Specify a color to the register assigned by C_1 and C_0 in the character data. To assign C_1 or C_0 by the character data displays the color specified in the register.

(11) Assignment of format

With the F_R in this command to be set to "1", each commands are set as below.

- No line space
($RS_4, RS_3, RS_2, RS_1, RS_0$)=(0, 1, 0, 1, 1)
- No blink
(B_1, B_0)=(0, 0)
- No division to vertical direction
2nd vertical start address (V_4, V_3, V_2, V_1, V_0)
=(0, 0, 0, 0, 0)
- Character size is assigned by a small-size character in every lines.
Line address (RA_2, RA_1, RA_0)=(0, 0, 0)–(1,

0, 1) and $SR=0$

- Character data is set without background (blank)

With the M_R in this command to be set to "1", last entered character data is written into every addresses in the RAM. Data input is inhibited for 60ms after executing this command.

Executing M_R and F_R simultaneously causes the character data in the RAM to be blank without background.

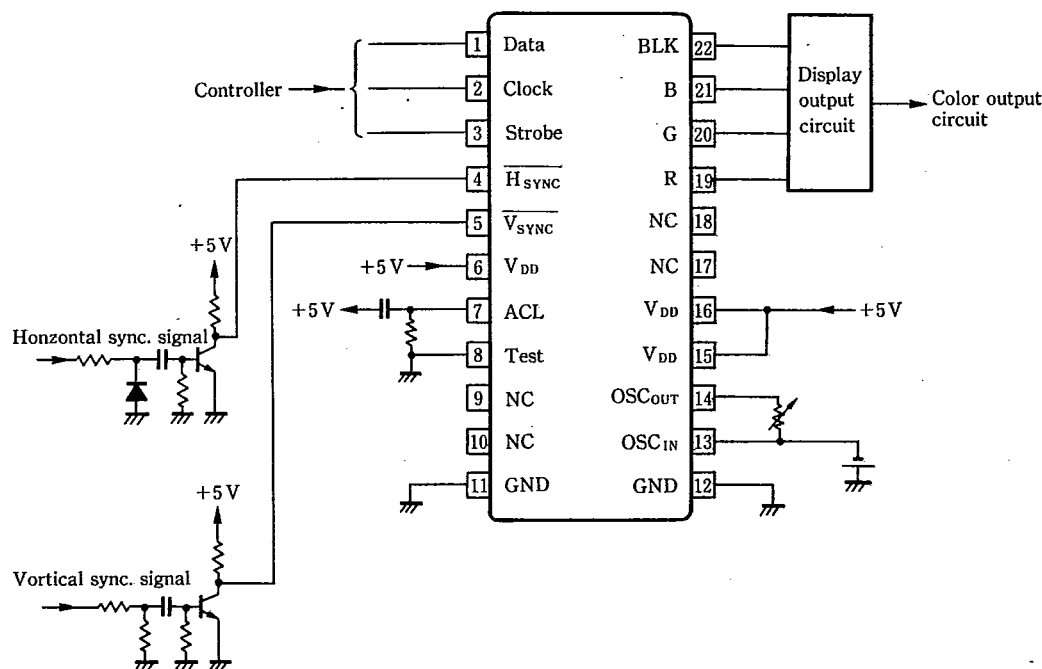
(12) Assignment of color selection

Color can be selected irrespective of character data in the area assigned at the dot unit.

To define the area, assign the address for selecting colors by dot data including Horizontal, Vertical, Start and End.

With the color select switch CC_1 to be set to "1", the character color within the assigned area are specified by a color register (C_1, C_0)=(0, 0). However, the background color is kept unchanged. Note that the character color specified by a color register can not be changed.

The color dot range can be accepted from 0 to 256 pitches (0-256/ f_{osc} sec) to horizontal direction and from 0 to 256 pitches (0-256/262.5 dot) to vertical direction.

Basic Connection Diagram

SHARP

Command Application Example

Command format for use in the on-screen display shown in the Fig. 6.

Display OFF	0 × × × 1 1 1 × × × 0 0	
Format reset	1 1 0 1 0 1 1 × × × 0 1	
Horizontal start	1 1 0 0 0 1 1 0 0 0 1 1	← $8/f_{osc} \times 3$
Vertical start	1 1 0 0 1 0 0 0 0 1 1 0	← $8H \times 6$
Color register 1	1 1 0 1 1 0 0 0 0 1 0 0	← Reg. 0, set red
Color register 2	1 1 0 1 1 0 0 0 1 0 1 0	← Reg. 1, set green
Color register 3	1 1 0 1 1 0 0 1 0 0 0 1	← Reg. 2, set blue
Color register 4	1 1 0 1 1 0 0 1 1 1 1 0	← Reg. 3, set yellow
Figure address	0 × × × 1 0 1 0 0 0 0 0	← Figure address 0
Line address	0 × × × 1 1 0 × × × 0 0	← Line address 0
Character data		
Blinking	0 × × × 1 0 0 × × × 1 0	← 1s sync. blinking
Background spec.	1 1 0 1 0 0 0 0 1 1 1 0	← Background with Cy
	1 0 0 0 0 0 1 0 1 0 1 1	← $1/f_{osc} \times 43$
	1 0 1 0 0 1 0 0 1 0 0 0	← $1H \times 72$
	1 0 0 1 0 1 0 0 0 1 0 1	← $1/f_{osc} \times 69$
	1 0 1 1 0 1 1 0 0 0 0 0	← $1H \times 96$
Color select SW	1 1 0 1 1 0 1 × × 0 1 0	
Display ON	0 × × × 1 1 1 × × × 1 ×	

Applicable character data input (auto-increment address)
21 × 6 data input

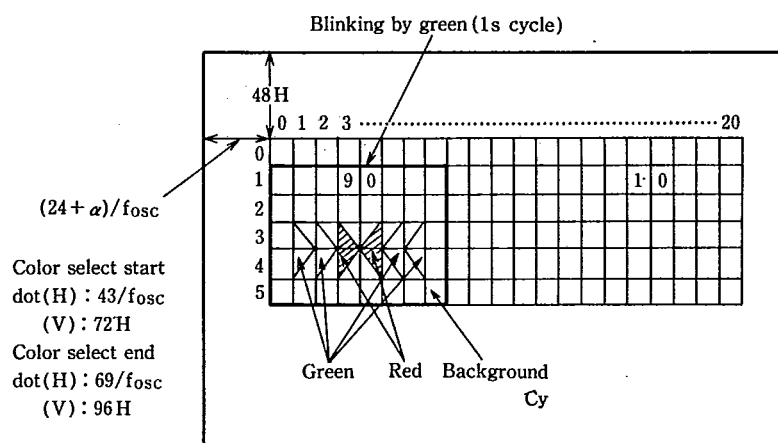
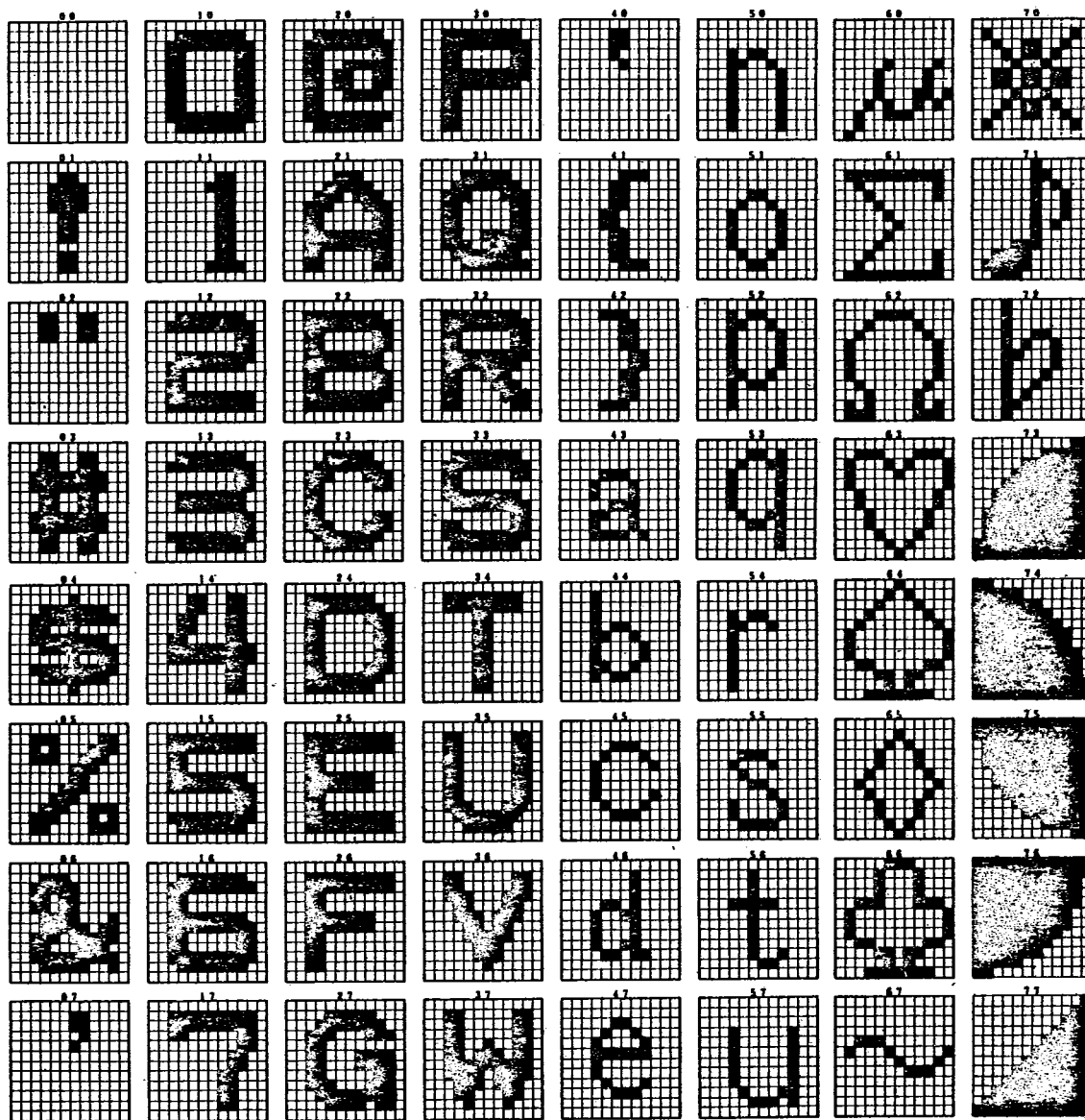


Fig. 6 On-screen layout

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■ Display Characters



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