

# MOS DIGITAL INTEGRATED CIRCUIT

## $\mu$ PD6104C-001

### CMOS LSI FOR CHARACTER DISPLAY ON SCREEN

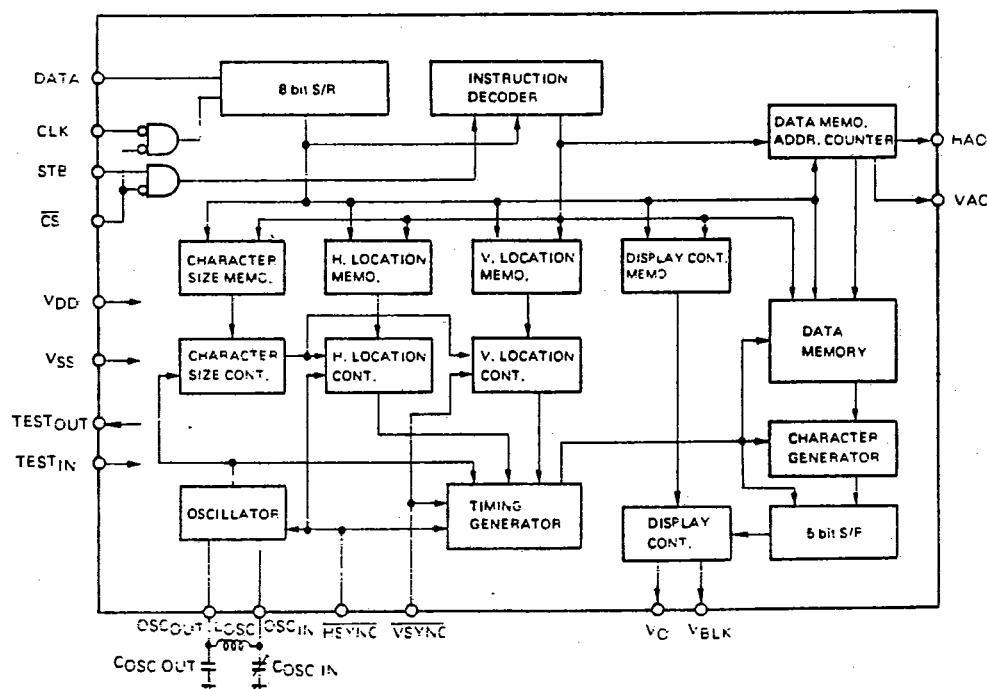
#### DESCRIPTION

The  $\mu$ PD6104C-001 is a character display CMOS LSI used in combination with a microcomputer; it displays characters such as the time and channel number on a TV screen. If this LSI is used in a video camera or a VTR, the date, time, and so forth can be recorded overlapping the video signals. 5 x 7 dots format. The characters are made easy to see with the smoothing function for smoothing connection between dots and the background function for display on a black square background and black fringe.

#### FEATURES

- Number of characters displayed: 2 lines x 6 columns
- Number of character types: 16
- Character size: 14 H, 28 H, 42 H, or 56 H (selective)
- Display position: 32 horizontal positions and 16 vertical positions (selective)
- Character format: 5 x 7 dots with smoothing function
- Address output terminals for specifying the color for four independent blocks
- No background, black square background, or black fringe can be selected.
- 8-bit serial input for easy interfacing with a microcomputer
- Single +5 V supply voltage, CMOS with low power requirement 16-Pin dual in-line package (DIP).

#### BLOCK DIAGRAM



**ABSOLUTE MAXIMUM RATINGS (T<sub>a</sub>=25 °C)**

Supply Voltage	V <sub>DD</sub> -V <sub>SS</sub>	7	V
Input Voltage	V <sub>IN</sub>	V <sub>DD</sub> +0.3>V <sub>IN</sub> >V <sub>SS</sub> -0.3	V
Output Voltage	V <sub>OUT</sub>	V <sub>DD</sub> +0.3>V <sub>OUT</sub> >V <sub>SS</sub> -0.3	V
Operating Temperature	T <sub>opt</sub>	-20 to +75	°C
Storage Temperature	T <sub>stg</sub>	-40 to +125	°C
Power Dissipation	P <sub>d</sub>	250	mW
Output Current	I <sub>O</sub>	5	mA

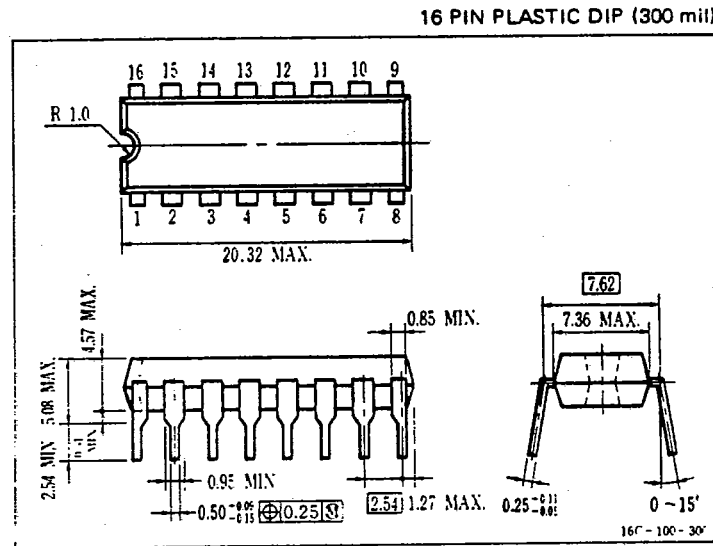
**RECOMMENDED OPERATING CONDITIONS (T<sub>a</sub>=0~45 °C)**

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V <sub>DD</sub> -V <sub>SS</sub>	4.5	5.0	5.5	V
Oscillation Frequency	f <sub>OSC</sub>		4.8	5.2	MHz

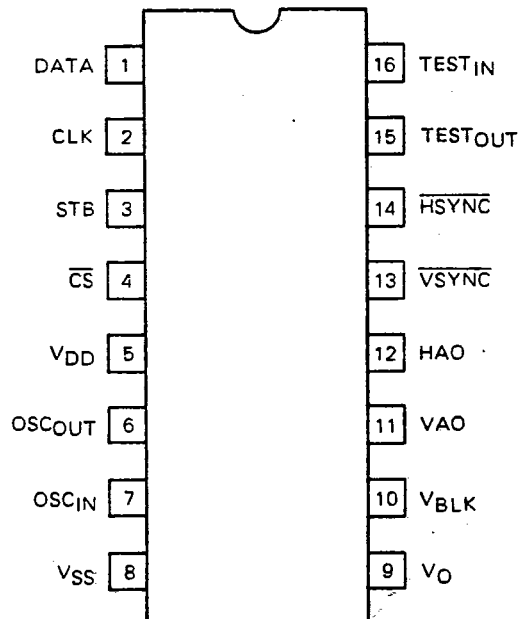
**ELECTRICAL CHARACTERISTICS (T<sub>a</sub>=25 °C, V<sub>DD</sub>-V<sub>SS</sub>=5 V, V<sub>SS</sub>=0 V)**

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V <sub>DD</sub> -V <sub>SS</sub>	f <sub>OSC</sub> =4.8 MHz	4.5	5.0	5.5	V
Current Consumption	I <sub>DD</sub>	No Load, L <sub>OSC</sub> =56 μH, C <sub>OSC IN</sub> =5~30 pF, C <sub>OSC OUT</sub> =300 pF			15	mA
DATA, CLK, TEST IN, STB, CS High Level Input Current	I <sub>IH</sub>	V <sub>IH</sub> =2.4 V			200	μA
DATA, CLK, TEST IN, STB, CS Low Level Input Current	I <sub>IL</sub>	V <sub>IL</sub> =0.8 V			300	μA
V <sub>SYNC</sub> , H <sub>SYNC</sub> High Level Input Current	I <sub>IH</sub>	V <sub>IH</sub> =3.0 V			200	μA
V <sub>SYNC</sub> , H <sub>SYNC</sub> Low Level Input Current	I <sub>IL</sub>	V <sub>IL</sub> =0.8 V			300	μA
V <sub>O</sub> , V <sub>BLK</sub> High Level Output Voltage	V <sub>OH</sub>	I <sub>OH</sub> =-2 mA	4.5			V
V <sub>O</sub> , V <sub>BLK</sub> Low Level Output Voltage	V <sub>OL</sub>	I <sub>OL</sub> =2 mA			0.5	V
LC Oscillation Frequency	f <sub>OSC</sub>	L <sub>OSC</sub> =56 μH, C <sub>OSC IN</sub> =5~30 pF, C <sub>OSC OUT</sub> =300 pF		4.8		MHz
High Level Input Leak Current	I <sub>LH</sub>	Except TEST IN			1	μA
Low Level Input Leak Current	I <sub>LL</sub>				1	μA
V <sub>AO</sub> , H <sub>AO</sub> High Level Output Voltage	V <sub>OH</sub>	I <sub>OH</sub> =-1 mA	4.5			V
V <sub>AO</sub> , H <sub>AO</sub> Low Level Output Voltage	V <sub>OL</sub>	I <sub>OL</sub> =1 mA			0.5	V

PACKAGE DIMENSIONS (Unit: mm)



CONNECTION DIAGRAM (Top View)

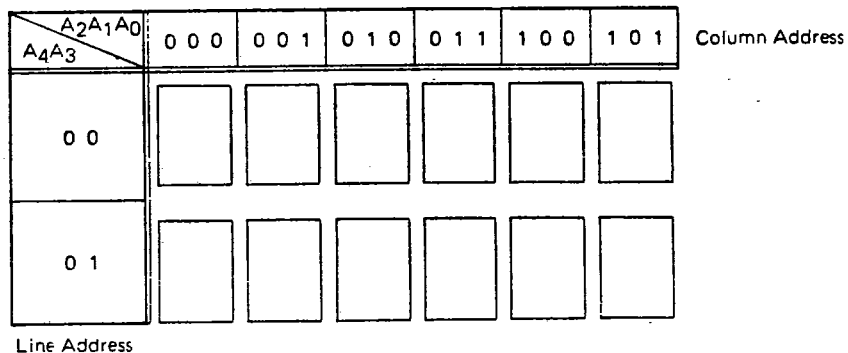


## Pin description

Symbol	Pin name	Function
VDD	Power supply	+5 V Power supply terminal
VSS	Ground	System ground
DATA	Serial data input	Control data input terminal. Data is read in synchronization with the clocks input to the CLK terminal
CLK	Shift clock input	Data read clock input terminal. The data input to the DATA terminal is read at the leading edge of the clock. (Normally, set this pin at the high level.)
STB	Strobe input	This pin is used to input strobe signals after inputting serial data. Eight-bit data is read at the leading edge of a pulse input to the STB pin. In case of the 8 bit data is a character data the data address is incremented at the STB pulse trailing edge. (Normally, set this pin at the low level.)
$\overline{\text{CS}}$	Chip selection	When this pin is at the low level, ordinary operation is performed; when set at the high level, shift clock input (CLK) and strobe input (STB) are inhibited.
OSCIN OSCOU	Oscillation pins	These pins are connected to oscillation LC. The oscillator starts oscillation at the HSYNC leading edge.
$\overline{\text{HSYNC}}$	Horizontal synchronization signal input	Use to input horizontal synchronization signals. When it is at the low level, oscillation stops.
$\overline{\text{VSYNC}}$	Vertical synchronization signal input	Use to input vertical synchronization signal
V <sub>O</sub>	Character signal output	This pin generates character signal. The signal is active when high.
VBLK	Back ground signal output	This pin generates a back ground signal for cutting video signals. The signal is active when high.
HAO VAO	Horizontal address output Vertical address output	These pins generate the address information of the character currently being displayed. The address information (HAO, VAO) is output as follows according to the address where the character currently displayed. HAO: L (columns 1-4), H (columns 5 and 6) VAO: L (line 1), H (line 2)
TESTIN TESTOUT	Test terminals	Normally, connect TESTIN to VSS and open TESTOUT.

**Display format**

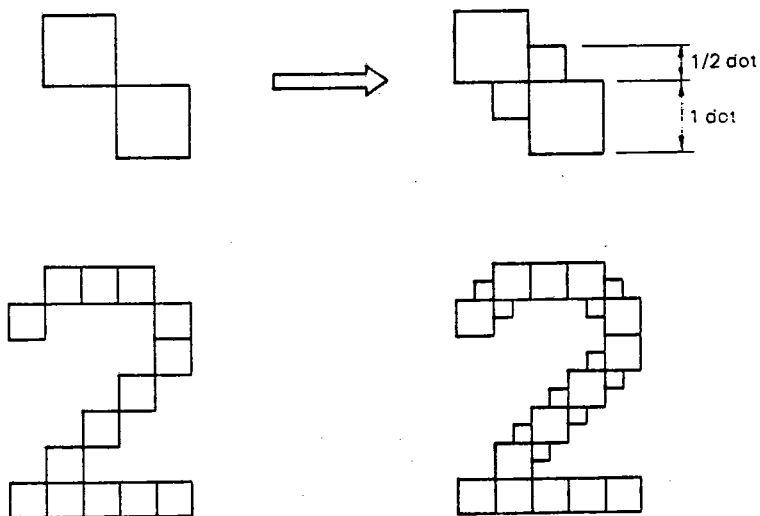
The number of characters displayed is 12 (2 lines x 6 columns) as shown in the following figure. There is a one-dot space between characters and a two-dot space between lines.



**Character format**

A character is displayed in the 5 x 7 dot matrix format.

The smoothing function for smoothing connection between dots makes the displayed characters easy to see.



Without smoothing function

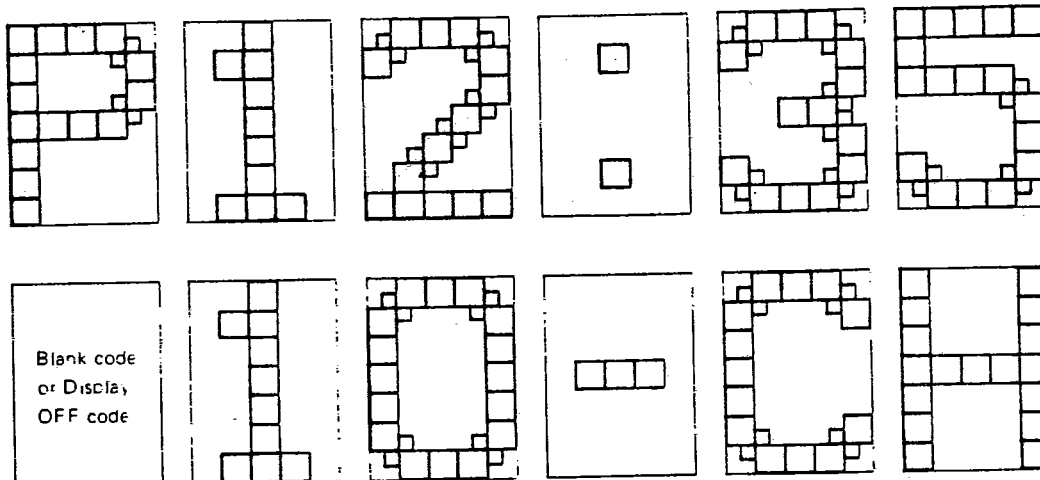
With smoothing function  
( $\mu$ PD6104C-001)

Type of Characters

$C_4C_3C_2$ \ $C_1C_0$	0 0	0 1	1 0	1 1
0 0 0				
0 0 1				
0 1 0				
0 1 1				

In addition to the above characters, a blank code ( $C_4C_3C_2C_1C_0=11110$ ) and a display off code ( $C_4C_3C_2C_1C_0=11111$ ) are provided as display character data.

Example of Display



**Command format**

A control command is input in the 8-bit serial format.

Character data, display address, display location character size, and background can be controlled with control commands.

**Command Specification**

D7	D6	D5	D4	D3	D2	D1	D0	FUNCTION
0	0	0	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>	Character Data
0	0	1	A <sub>4</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	Display Address Data
0	1	0	V <sub>4</sub>	V <sub>3</sub>	V <sub>2</sub>	V <sub>1</sub>	V <sub>0</sub>	Vertical Location Address
0	1	1	H <sub>4</sub>	H <sub>3</sub>	H <sub>2</sub>	H <sub>1</sub>	H <sub>0</sub>	Horizontal Location Address
1	0	1	S <sub>4</sub>	S <sub>3</sub>	X	X	X	Character Size Specification
1	1	0	0	0	X	X	X	Display off (Test Mode Reset)
1	1	0	0	1	X	X	X	Display on
1	1	0	1	0	X	X	X	Without Back Ground
1	1	0	1	1	X	X	X	With Back Ground
1	1	1	0	0	X	X	X	Black Square Back Ground
1	1	1	0	1	X	X	X	Black Fringe Back Ground
1	0	0	1	0	X	X	X	Test Mode Set

X : 1 or 0

**Character Data**

(D7, D6, D5) = (0, 0, 0)

C4	C3	C2	C1	C0	
0	0	0	0	0	16 types
0	1	1	1	1	
1	1	1	1	1	Display off (The display at the address having this code is set off.)
1	1	1	1	0	Blank (For black square background display, only characters are set off and the background is displayed.)

**Display Address Data**

(D7, D6, D5) = (0, 0, 1)

A4	A3	A2	A1	A0	HEXA	
0	0	0	0	0	00	6 digits of first line
0	0	0	0	1	01	
0	0	1	0	1	05	
0	1	0	0	0	08	6 digits of second line
0	1	0	0	1	09	
0	1	1	0	1	0D	

**Display Address Assignment**

column line	0	1	2	3	4	5
A3 = 0	0	1	2	3	4	5
A3 = 1	8	9	A	B	C	D



## Display Location

## Vertical Location Address

(D7, D6, D5) = (0, 1, 0)

V4	V3	V2	V1	V0	HEXA	V. Location
0	0	0	0	0	0	0
0	0	0	0	1	1	1
0	0	0	1	0	2	2
		}			}	}
0	1	1	0	0	C	12
0	1	1	0	1	D	13
0	1	1	1	0	E	14
0	1	1	1	1	F	15

## Horizontal Location Address

(D7, D6, D5) = (0, 1, 1)

H4	H3	H2	H1	H0	HEXA	H. Location
0	0	0	0	0	00	0
0	0	0	0	1	01	1
0	0	0	1	0	02	2
		}			}	}
0	1	1	1	1	0F	15
1	0	0	0	0	10	16
		}			}	}
1	1	1	1	0	1E	30
1	1	1	1	1	1F	31

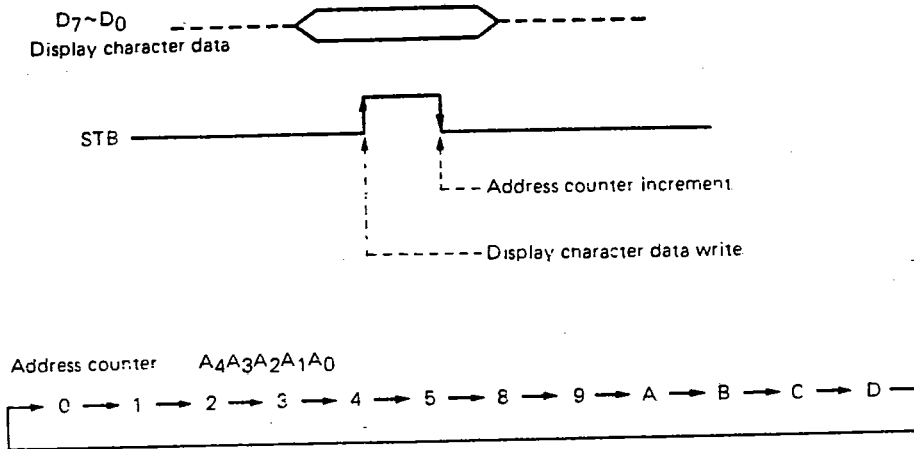
**Data write**

The character data write address can be set directly in the address counter by data address set command as follows. (Only 0-5, 8-D addresses can be set.)

$$(D_7D_6D_5D_4D_3D_2D_1D_0) = (0\ 0\ 1\ C_4C_3C_2C_1C_0)$$

After setting the address, the address is automatically incremented by writing a display character data command as follows:

$$(D_7D_6D_5D_4D_3D_2D_1D_0) = (0\ 0\ 0\ C_4C_3C_2C_1C_0)$$



**Character size**

The character size can be specified in a character size specification command as follows:

$$(D_7D_6D_5D_4D_3D_2D_1D_0) = (1\ 0\ 1\ S_4S_3\ x\ x\ x)$$

Code		Character size (dots)	
$S_4$	$S_3$	Vertical	Horizontal
0	0	14 H (2 H)	5 tdot (tdot)
0	1	28 H (4 H)	10 tdot (2tdot)
1	0	42 H (6 H)	15 tdot (3tdot)
1	1	56 H (8 H)	20 tdot (4tdot)

$$tdot = \frac{2}{f_{OSC} \text{ (MHz)}} \mu s$$

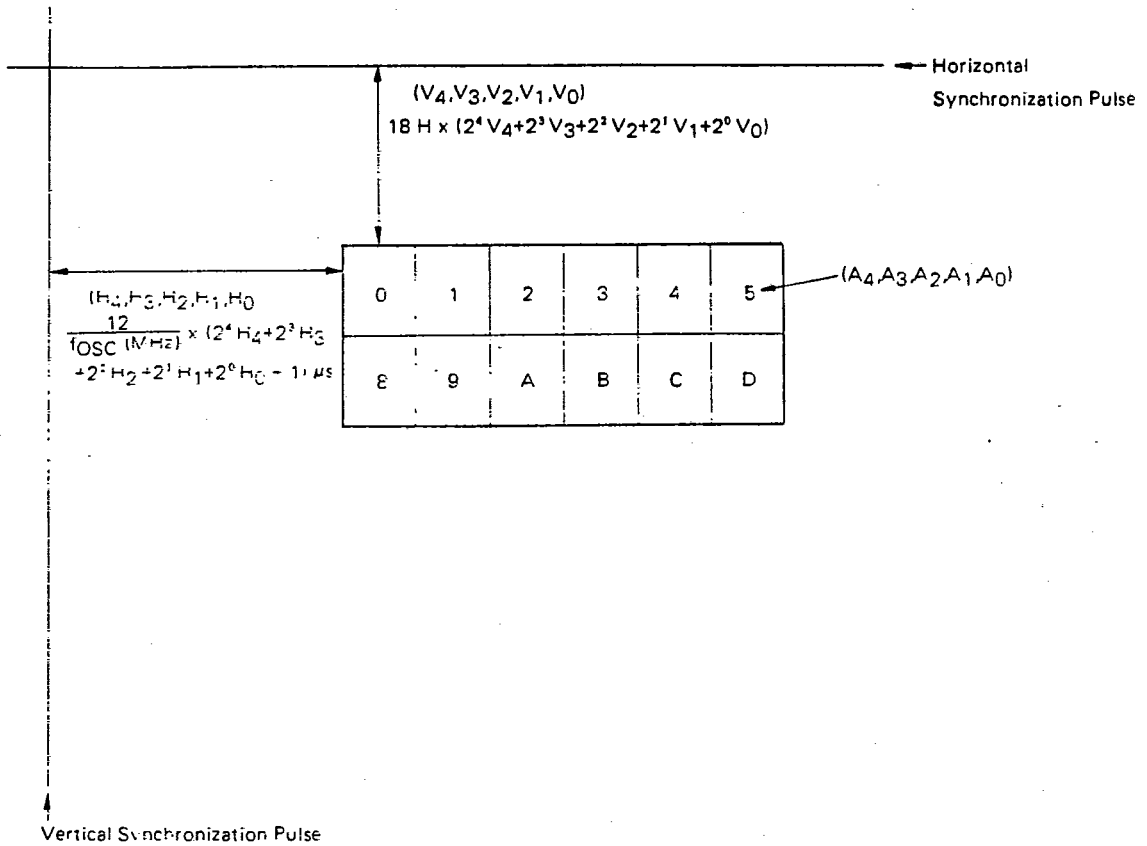
**Character display address**

The character display starting address is decided as follows according to the values specified in display position vertical address command

$(D_7D_6D_5D_4D_3D_2D_1D_0) = (0\ 1\ 0\ V_4V_3V_2V_1V_0)$  and display

position horizontal address command

$(D_7D_6D_5D_4D_3D_2D_1D_0) = (01\ 1\ H_4H_3H_2H_1H_0) :$



**Display control**

The entire display on/off, existence of background, black square background, and black fringe can be specified with the following commands:

D7	D6	D5	D4	D3	D2	D1	D0	Function
1	1	0	0	0	X	X	X	Display OFF
1	1	0	0	1	X	X	X	Display ON
1	1	0	1	0	X	X	X	Without Back Ground
1	1	0	1	1	X	X	X	With Back Ground
1	1	1	0	0	X	X	X	Black Square Back Ground
1	1	1	0	1	X	X	X	Black Fringe

The display can be set off partially with a display-set-off character data command as follows:

$(D_7D_6D_5D_4D_3D_2D_1D_0) = (0\ 0\ 0\ C_4C_3C_2C_1C_0)$

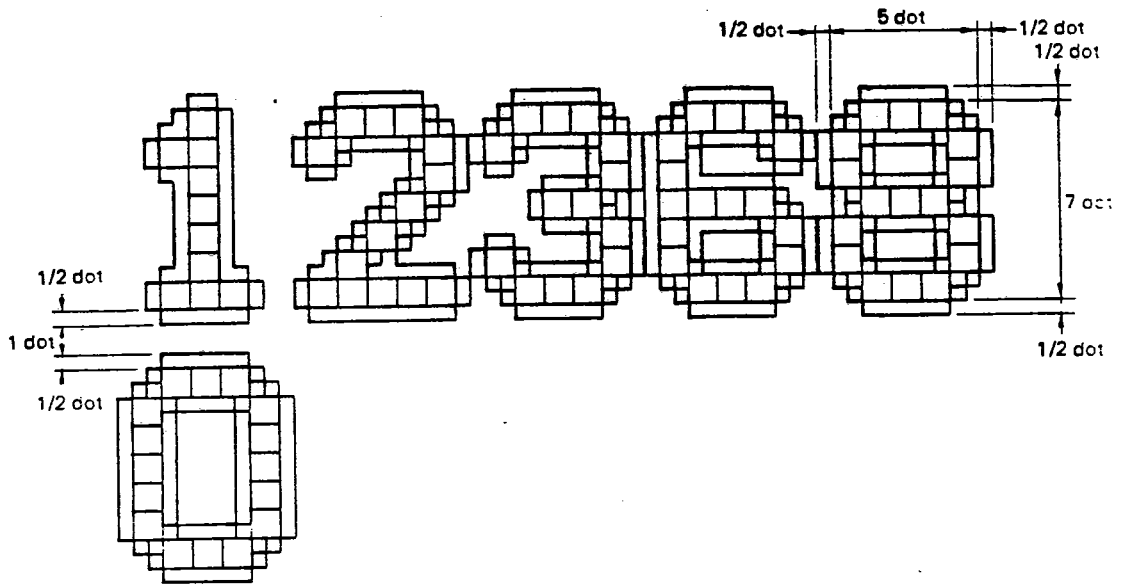
$(C_4C_3C_2C_1C_0) = (11111)$

The character and background are not displayed at the address where display-off data is set. To inhibit display of a character while displaying the background in case of black square background, set blank data

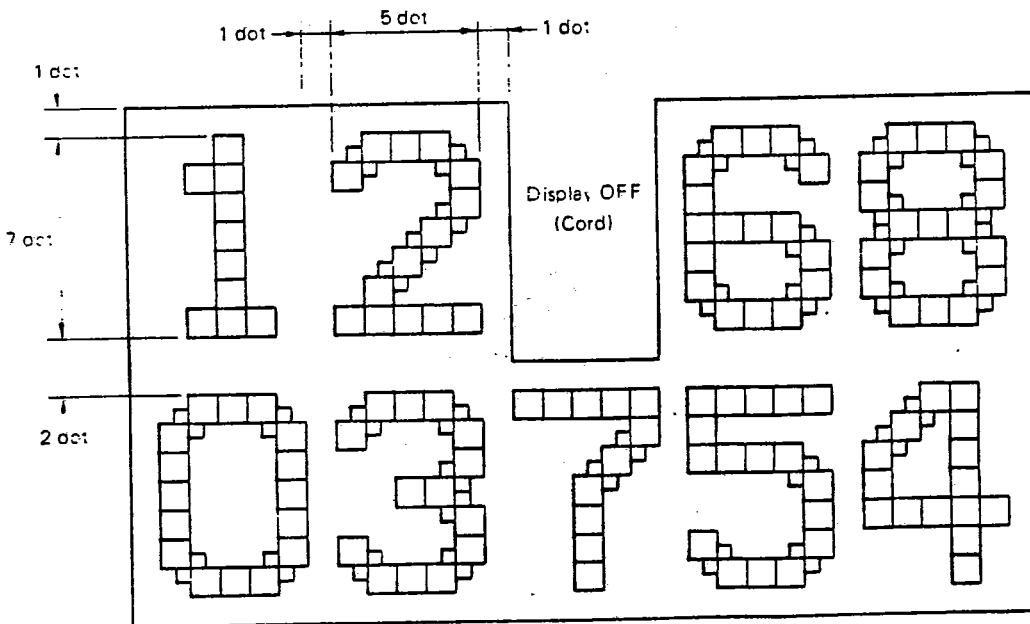
$(C_4C_3C_2C_1C_0) = (11110)$ .

**Back Ground**

**Black Fringe**

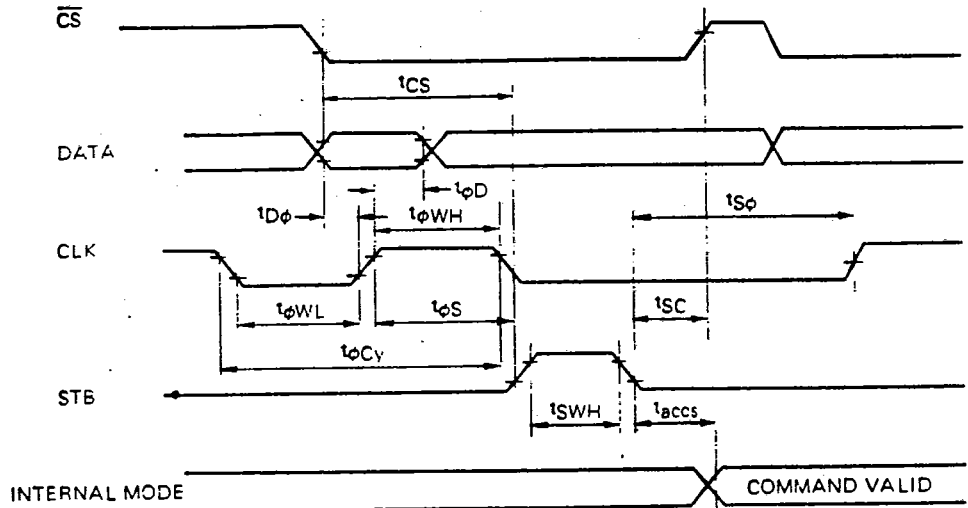
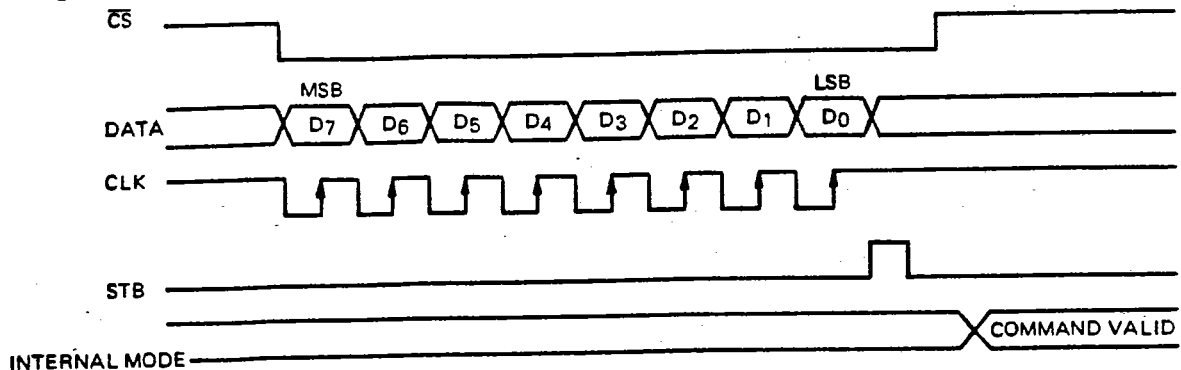


**Black Square (7 x 9 dot) Back Ground**



Letters and numbers are indicated with the square black back ground super imposed on the screen.

Timing Diagram of Data Input



SYMBOL	MIN.	TYP.	MAX.	UNIT
$t_{D\phi}$	100			ns
$t_{\phi D}$	100			ns
$t_{\phi WL}$	350			ns
$t_{\phi WH}$	350			ns
$t_{\phi S}$	200			ns
$t_{SWH}$	500			ns
$t_{CS}$	200			ns
$t_{SC}$	100			ns
$t_{accs}$	500			ns
$t_{\phi Cy}$	800			ns
$t_{S\phi}$	2 000			ns

Application Circuit

