NEC

MOS INTEGRATED CIRCUIT
μPD6451A

CMOS LSI FOR 12 lines × 24 columns CHARACTER DISPLAY ON SCREEN

μPD6451A is the CMOS LSI for on-screen character display that can be used in combination with a microcomputer to display time, channel numbers, and chapter numbers on the screen.

Use of this LSI for the video camera and VTR allows recording of video signals with the time and date.

The display character format is 12 x 18 dots. Because there is no space between characters, this LSI enables display of a combination of two or more characters, kanji characters, and graphs.

Both μPD6451ACX-001 and μPD6451AGT-101 display the same characters. μPD6451AGT-301 displays characters differ from μPD6451ACX-001, μPD6451AGT-101. μPD6451ACX-001 is enclosed in a 18-pin DIP (Dual In-line Package), while μPD6451AGT-101 and μPD6451AGT-301 are enclosed in a 20-pin SOP (Small Out-line Package).

FEATURES

- Number of characters displayed : 12 lines x 24 columns
- Number of character types : 112
- Character size : Any one of 1H, 2H, 3H, and 4H per dot can be selected.
- Character color : Any one of 8 colors can be selected for each character.
- Background : One of No Background, Black fringe, Square Background, or Solid Background can be selected for each image. (For Square Background and Solid Background, any one of eight colors can be selectable.)
- Dot matrix : 12-by-18 dot pattern with no space between characters.
- Blink : Selectable at 1:1, 3:1, or 1:3.
- Mask pulse (Code Option) : To be output in vertical direction for each line.
- Progressive scan TV mode (Switching by Command) : Switching of the vertical-scan lines counter adapts to a system in which one field contains 525 scan lines.
- Blanking signal output : 1 blanking signal output (V_{BLK}) or 3 blanking signal output (R_{BLK}, G_{BLK}, (B_{BLK}) are selectable by mask code option.
- Interface with microprocessor : 8-bit serial input format
- Power supply : +5 V single power supply
- Construction : Low-power-consumption CMOS

ORDERING INFORMATION

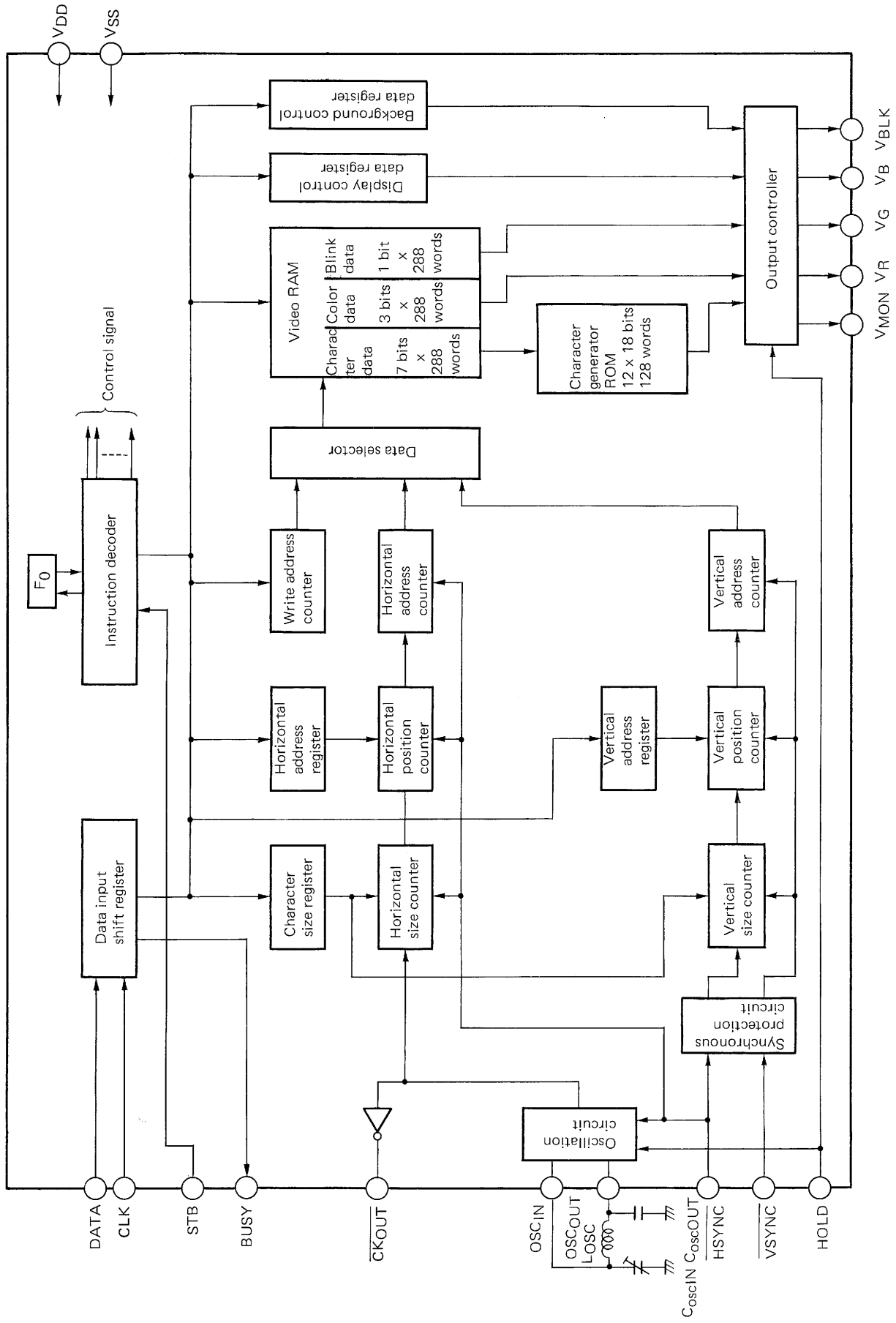
PART NUMBER	PACKAGE	QUALITY GRADE
μPD6451ACX-001	18-pin plastic DIP (300 mil)	standard
μPD6451AGT-101	20-pin plastic SOP (375 mil)	standard
μPD6451AGT-301	20-pin plastic SOP (375 mil)	standard

Please refer to "Quality grade on NEC Semiconductor Devices" (Document number IEI-1209) published by NEC Corporation to know the specification of quality grade on the devices and its recommended applications.

Document No. IC-2337A
(O. D. No. IC-7812A)
Data Published December 1995 P
Printed in Japan

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BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (T_a = 25 °C)

Supply Voltage	$V_{DD}-V_{SS}$	7.0	V
Input Voltage	V_{IN}	$V_{DD}+0.3 > V_{IN} > V_{SS}-0.3$	V
Output Voltage	V_{OUT}	$V_{DD}+0.3 > V_{OUT} > V_{SS}-0.3$	V
Operating Temperature	T_{opt}	−20 to +75	°C
Storage Temperature	T_{stg}	−40 to +125	°C
Output Current	I_O	±5	mA

RECOMMENDED OPERATING RANGE

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage	$V_{DD}-V_{SS}$	4.5	5.0	5.5	V
Oscillation Frequency	f_{osc}	4.5		7.0 (12) Note	MHz

Note: The parenthesized value in the double-speed mode.

ELECTRICAL CHARACTERISTICS

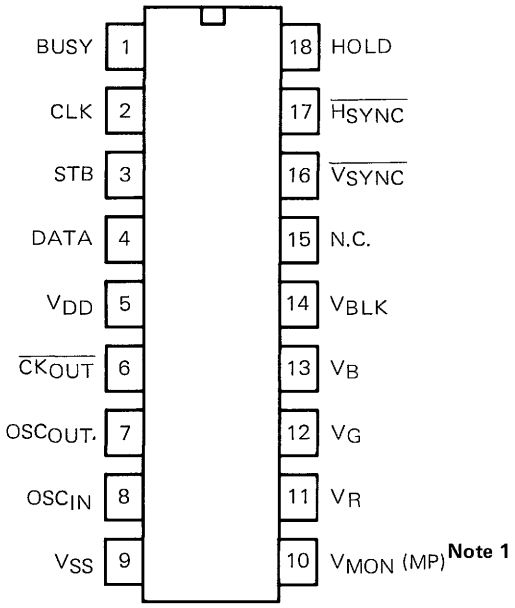
(T_a = 25 °C, V_{DD} = 5.0 V, V_{SS} = 0 V, L_{osc} = 39/56 μH, $C_{osc\ OUT}$ = 30 pF, $C_{osc\ IN}$ = 5 to 30 pF)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
Supply Voltage	$V_{DD}-V_{SS}$	4.5	5.0	5.5	V	
Current Consumption	I_{DD}			10	mA	
Control Input High Level Voltage	V_{IH}	2.4			V	
Control Input Low level Voltage	V_{IL}			0.8	V	
Synchronous Signal Input High level Voltage	V_{IH}	2.4			V	
Synchronous Signal Input Low level Voltage	V_{IL}			0.8	V	
Signal Output High level Voltage	V_{OH}	4.5			V	I_{OH} = −1.0 mA
Signal Output Low level Voltage	V_{OL}			0.5	V	I_{OL} = 1.0 mA
Clock Output High level Voltage	V_{OH}	4.5			V	I_{OH} = −0.5 mA
Clock Output Low level Voltage	V_{OL}			0.5	V	I_{OL} = 0.5 mA
Hold Signal Input High level Voltage	V_{HHOLD}	4.5			V	
Hold Signal Input Low level Voltage	V_{LHOLD}			2.5	V	

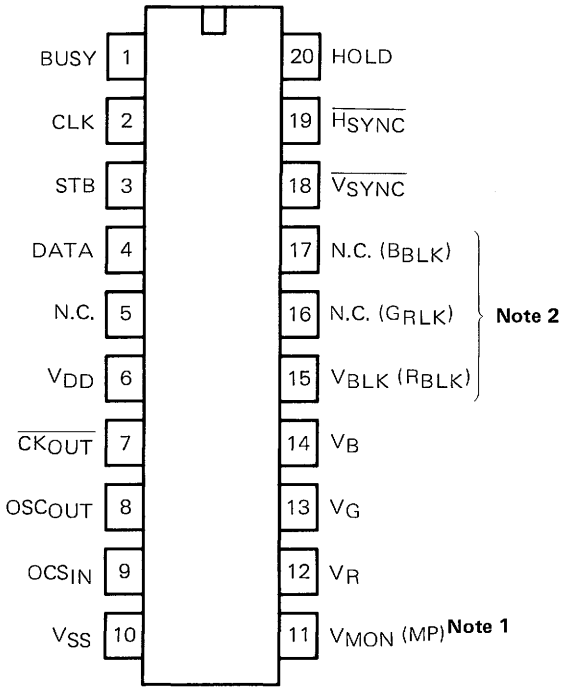
Note Control input . . . . . DATA, CLK, STB
Synchronous signal input . . . . . $\overline{HSYNC}$, $\overline{VSYNC}$
Signal output . . . . . V_R, V_G, V_B, V_{BLK}, V_{MON}, BUSY
Clock output . . . . . $\overline{CK_{OUT}}$
Hold signal input . . . . . HOLD

CONNECTION DIAGRAM (Top View)

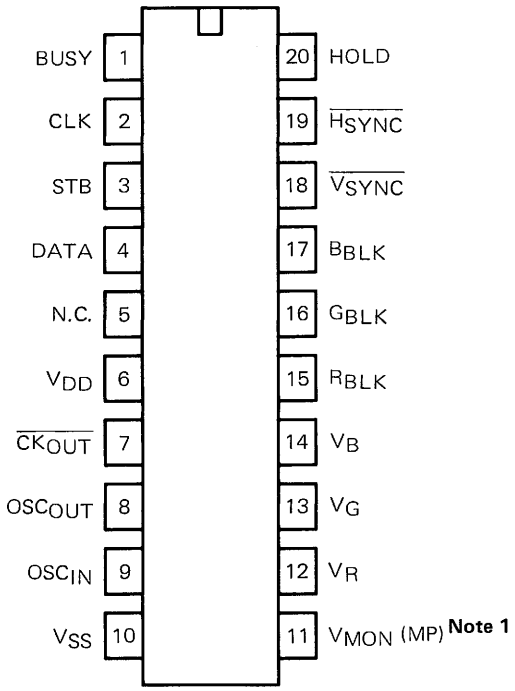
(1) μPD6451ACX-001



(2) μPD6451AGT-101



(3) μPD6451AGT-301



Note 1: Pin 10 (μPD6451ACX) or 11 (μPD6451AGT) within parentheses is the mask code option to be used as the mask pulse. However, μPD6451ACX-001, μPD6451AGT-101, μPD6451AGT-301 do not use the mask pulse, so pin 10 or 11 is used as monitor output VMON.

2: When 3 blanking signal output is selected by mask code option.

PIN DESCRIPTION

SYMBOL	PIN NAME	FUNCTION
V_{DD}	Power supply terminal	This terminal supplies +5 V power.
V_{SS}	Grounding terminal	This is connected to the system GND.
DATA	Serial data input terminal	This terminal inputs control data. It reads data synchronizing with the clock input to the CLK terminal.
CLK	Clock input terminal	This terminal inputs the clock for reading data. At the rise of this clock, the data input to the DATA terminal is read.
STB	Strobe input terminal	This terminal inputs the strobe pulse after input of serial data. The 8-bit data is read at the rise of the strobe pulse input to the STB terminal. If the 8-bit data is a character, the data address is incremented by 1 at the fall of the strobe pulse.
OSC_{IN} OSC_{OUT}	Oscillation terminals	These terminals are connected to the oscillation capacitor or coil.
$\overline{H_{SYNC}}$	Horizontal synchronous signal input terminal	This terminal inputs the horizontal synchronizing signal. The oscillator ocsillates when this signal is high, synchronizing with the rise of the signal. Be sure to input the horizontal synchronizing signal when it is active low.
$\overline{V_{SYNC}}$	Vertical synchronizing signal input terminal	This terminal inputs the vertical synchronizing signal. Be sure to input this signal when it is active low.
V_R V_G V_B	Character signal output terminals	These terminals output the character data corresponding to R, G, and B.
V_{BLK}	Blanking signal output terminal	This terminal outputs the blanking signal to cut the video signal.
R_{BLK} G_{BLK} B_{BLK}	Blanking signal output terminal	These terminals output the blanking signal correspond to the character signal (V_R, V_G, V_B).
$\overline{CK_{OUT}}$	Clock output terminal	This is the inverted output of OSC OUT. To connect another type of on-screen IC in parallel, be sure to connect this terminal to OSCIN of the IC.
HOLD	Hold terminal	Oscillation stops when this signal is low. At this time, the signals output from V_R, V_G, V_B, and VBLK all become low. (Be sure to normally set this signal high.)
BUSY	Data input enable terminal	Output terminal to notify the microcomputer that data is enabled or disabled for input. Data can be input at a low level.
V_{MON} Note	Character signal output monitor terminal	If any of character signal outputs V_R, V_G, and V_B is High, the high-level signal is output.

Note:

The mask code option enables this terminal to be used as the mask pulse output terminal.

However, μPD6451ACX-001, μPD6451AGT-101, μPD6451AGT-301 does not use the mask pulse, so pin 10 or 11 is used as monitor output V_{MON}.

Command Format

All the control commands are in 8-bit serial input format.

Each control command is executed when a strobe pulse is input after 8-bit data has been input.

Before starting the program, be sure to input the format reset command ("FR = 1", set by the format selection command) to release the test mode.

μPD6451ACX-xxx/6451AGT-xxx Command List

Content	F_0	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
Display character data	0	0	C_6	C_5	C_4	C_3	C_2	C_1	C_0
Color blink data for each character	0	1	0	0	0	Blink	R	G	B
Character display line address	0	1	0	0	1	AR_3	AR_2	AR_1	AR_0
Character display column address	0	1	0	1	AC_4	AC_3	AC_2	AC_1	AC_0
Background specification	0	1	1	0	BS_4	BS_3	R_b	G_b	B_b
Blink, oscillation, Display ON/OFF	0	1	1	1	0	D_0	BL_2	BL_1	OSC
Fringing Control	0	1	1	1	1	0	0	Eg_1	Eg_2
Format selection	X	1	1	1	1	1	1	F_0	FR
Display position vertical address, Double-speed selector	1	0	1	V_D	V_4	V_3	V_2	V_1	V_0
Display position horizontal address	1	1	1	0	H_4	H_3	H_2	H_1	H_0
Character size specification **Note**	1	1	0	S_5	S_4	AR_3	AR_2	AR_1	AR_0
Test mode setting	1	1	1	1	0	T_3	T_2	T_1	T_0

Note:

Change of a command by using a mask pulse (mask code option).

If the mask code option allows pin 10 (6451ACX) or 11 (6451AGT) to be used as the mask pulse output terminal (MP), the character size specification command is changed as follows and used as the mask pulse selection command. (The number of selectable character sizes is changed from 4 to 2.)

Content	F_0	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
Character size/mask pulse	1	1	0	MP	S_4	AR_3	AR_2	AR_1	AR_0

Format Selection/Reset (Test Mode Releasing)

The μPD6451A commands consist of 9 bits, but the shift registers for serial interfacing with external units consist of 8 bits. Therefore, instructions are divided into two banks. One of these banks is selected by one bit of the format selection command.

Bank-0 commands (F_0 = 0)

- Display character data
- Color/blink data for each character
- Character display line address
- Character display column address
- Background specification
- Blink, Oscillation control, Display ON/OFF
- Fringing control

Bank-1 commands (F_0 = 1)

- Vertical display position address, Double-speed selector
- Horizontal display position address
- Character size specification

Format Reset (Test Mode Releasing)

When bit 1 (FR) of the format reset command is set to "1", the test command mode is released to reset the contents of the following command. A normal command cannot be accepted in the test command mode. Therefore, be sure to release the test command mode by resetting the format before starting the program.

Command to Be Reset

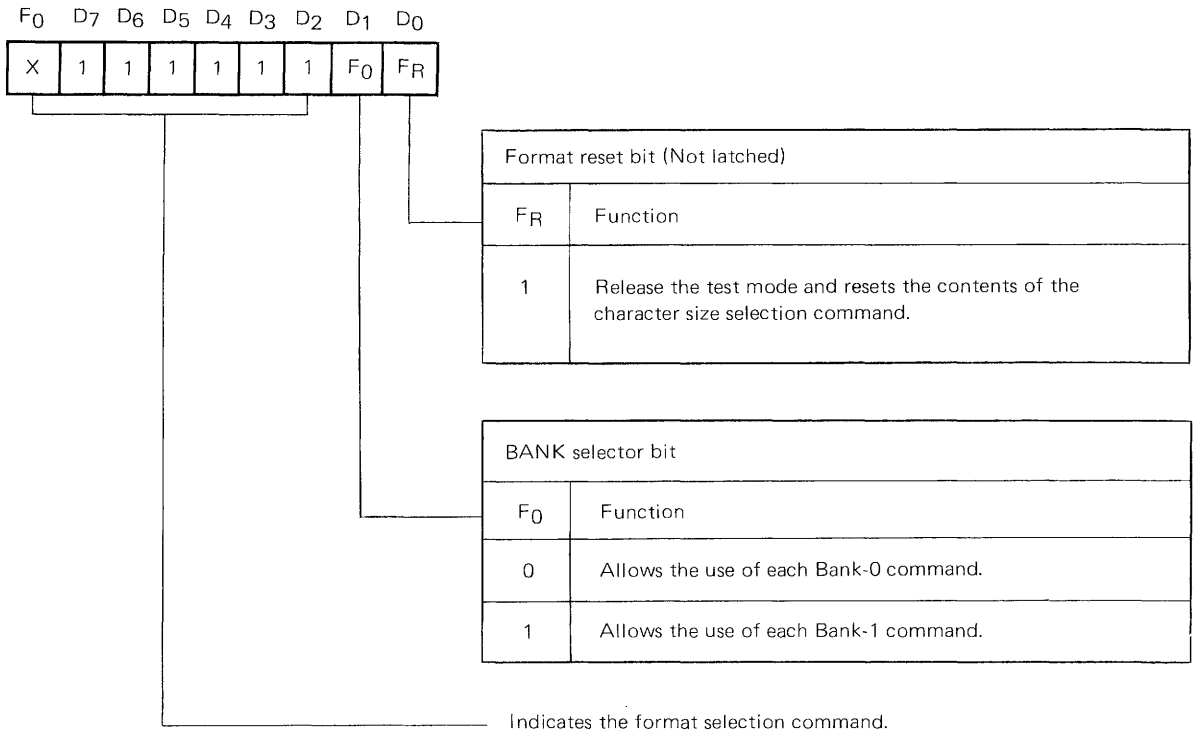
The contents of all the line size registers ($AR_{0\text{-}3}$) are set to (S_5, S_4) = (0, 0).

[All the lines are specified in the minimum size.]

If the mask option allows pin 10 (μPD6451ACX) or pin 11 (μPD6451AGT) to be used as the mask pulse output terminal, the contents of all the line size registers ($AR_{0\text{-}3}$) are set to "(S_4) = (0)" to disable the mask pulse output from any line. (MP) = (0).

To release the test command mode without resetting the above command, use the test command mode release instruction (F_0, D_7, D_6, D_5, D_4, D_3, D_2, D_1, D_0) = (1, 1, 1, 1, 0, 0, 0, 0, 0).

Format Selection Command

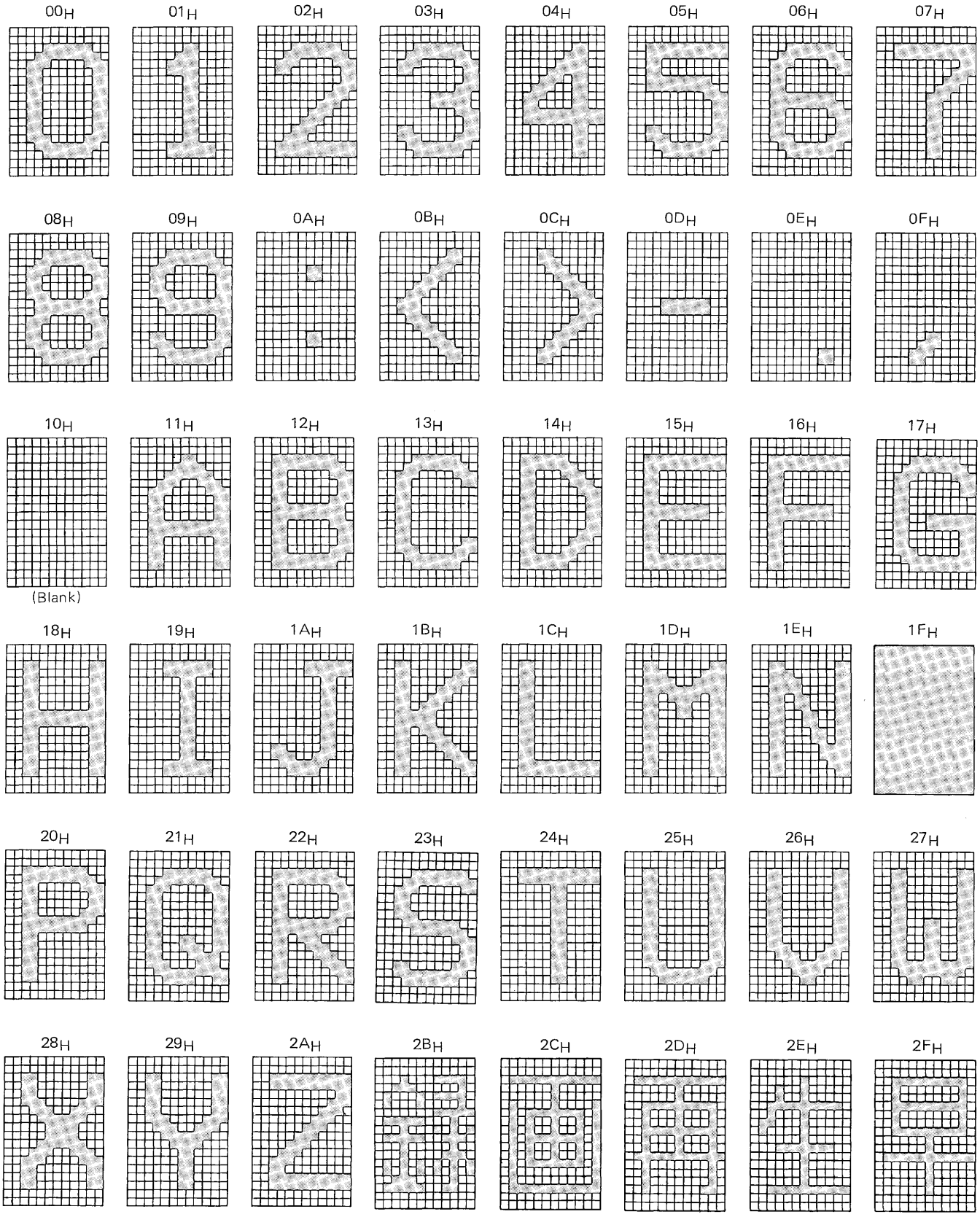


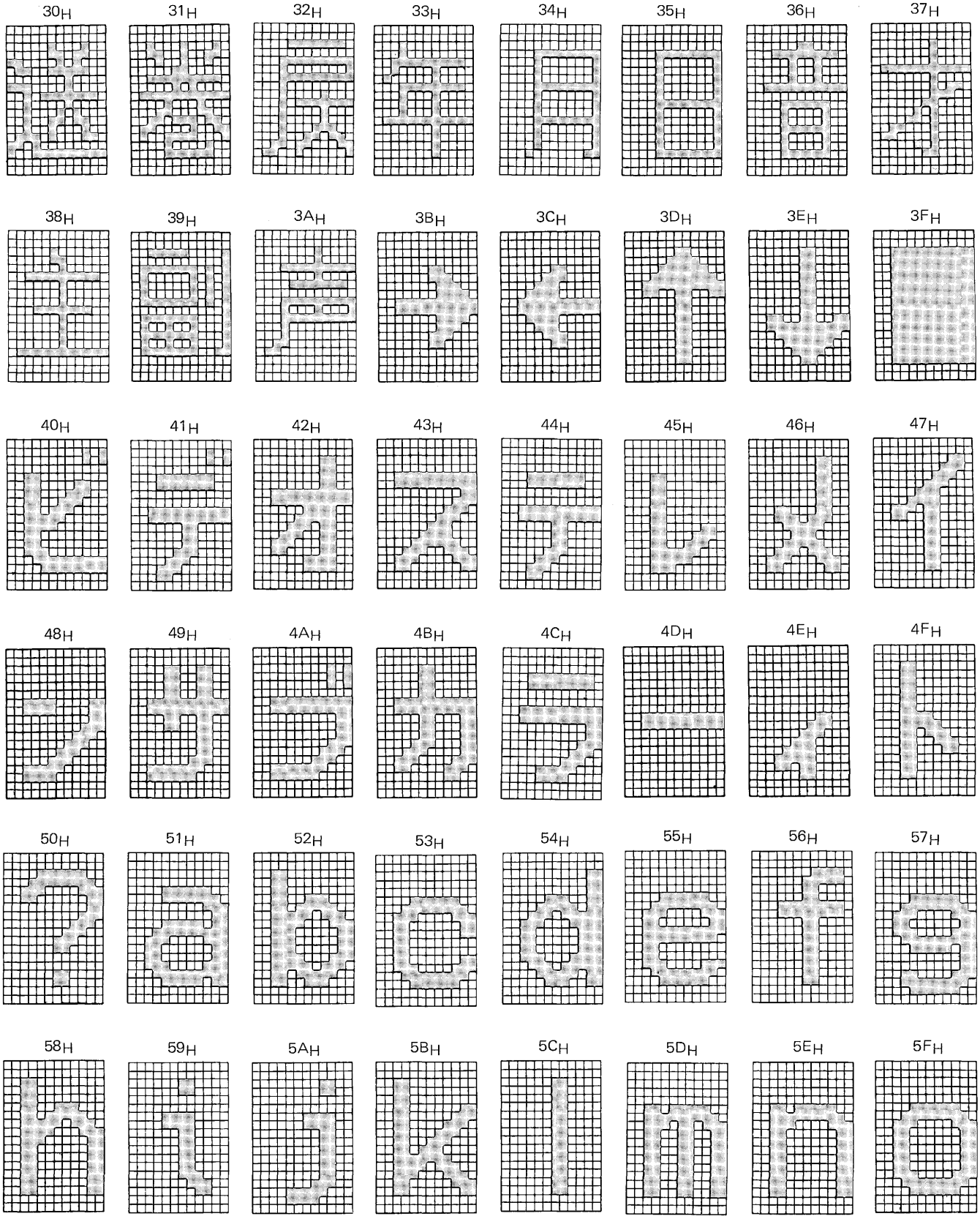
μPD6451ACX-001, μPD6451AGT-101, μPD6451AGT-301 Character Pattern

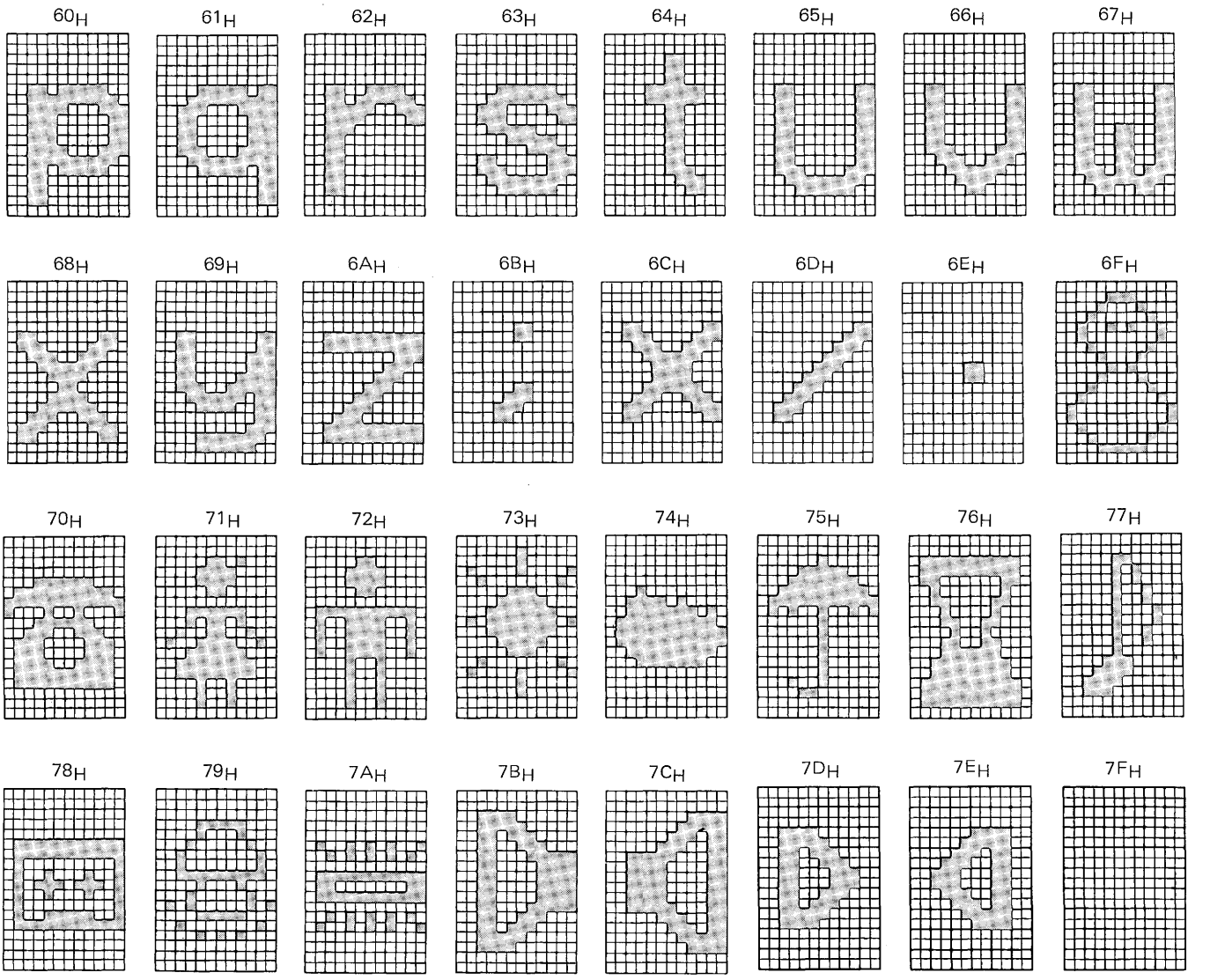
As shown in the following, μPD6451ACX-001, μPD6451AGT-101, μPD6451AGT-301 enables display of 128 character generator ROM patterns. The 128 character generator ROM patterns can be changed by the mask code option. However, character code "7FH" is fixed to the display OFF code so that no character pattern can be input to this code.

μPD6451CX-001 and μPD6451AGT-101 have the same character patterns in the character generator ROM though their packages are different. μPD6451AGT-101 and μPD6451AGT-301 have the same package though their character patterns are different.

μPD6451ACX-001, μPD6451AGT-101 Character Patterns

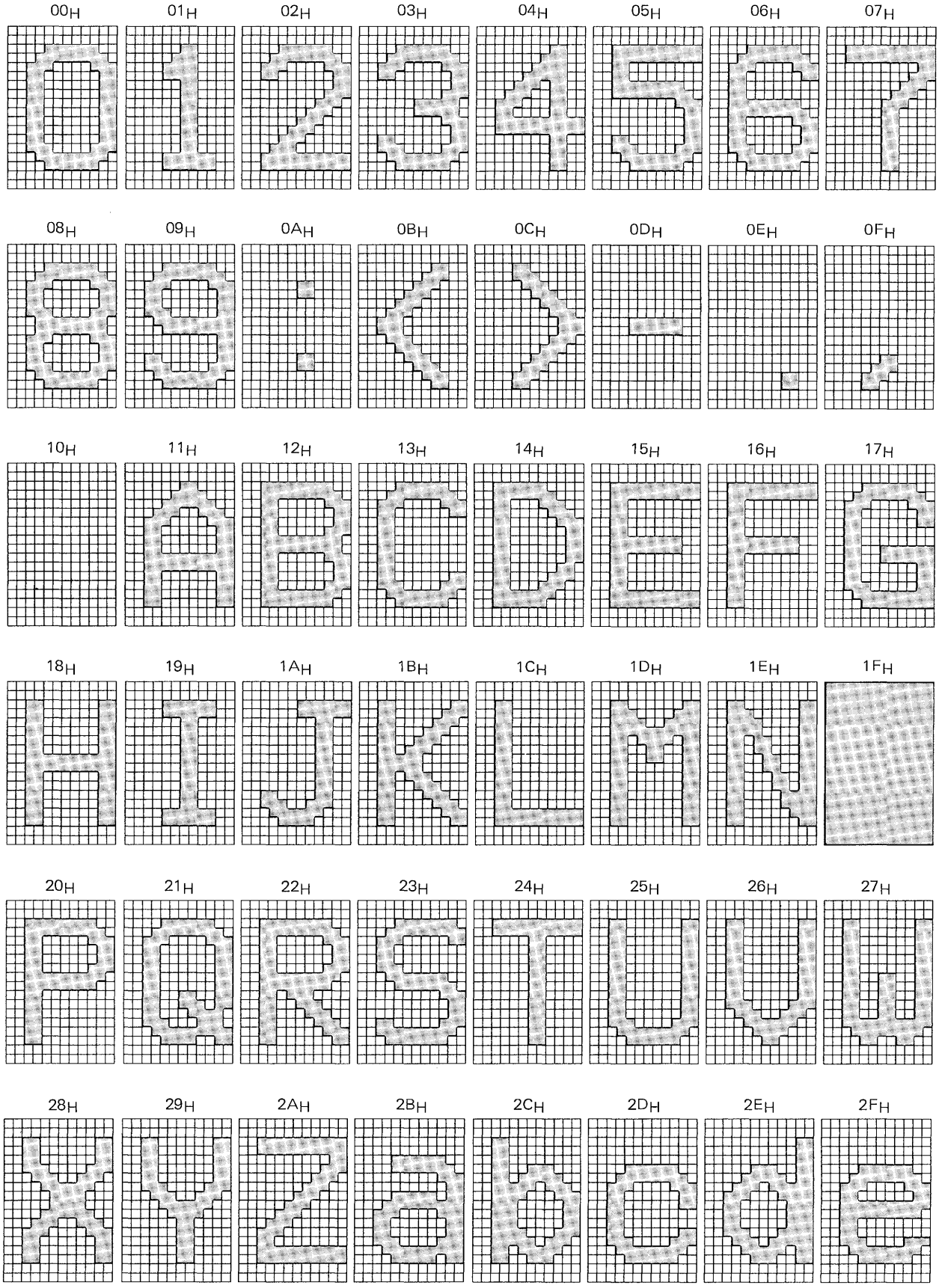


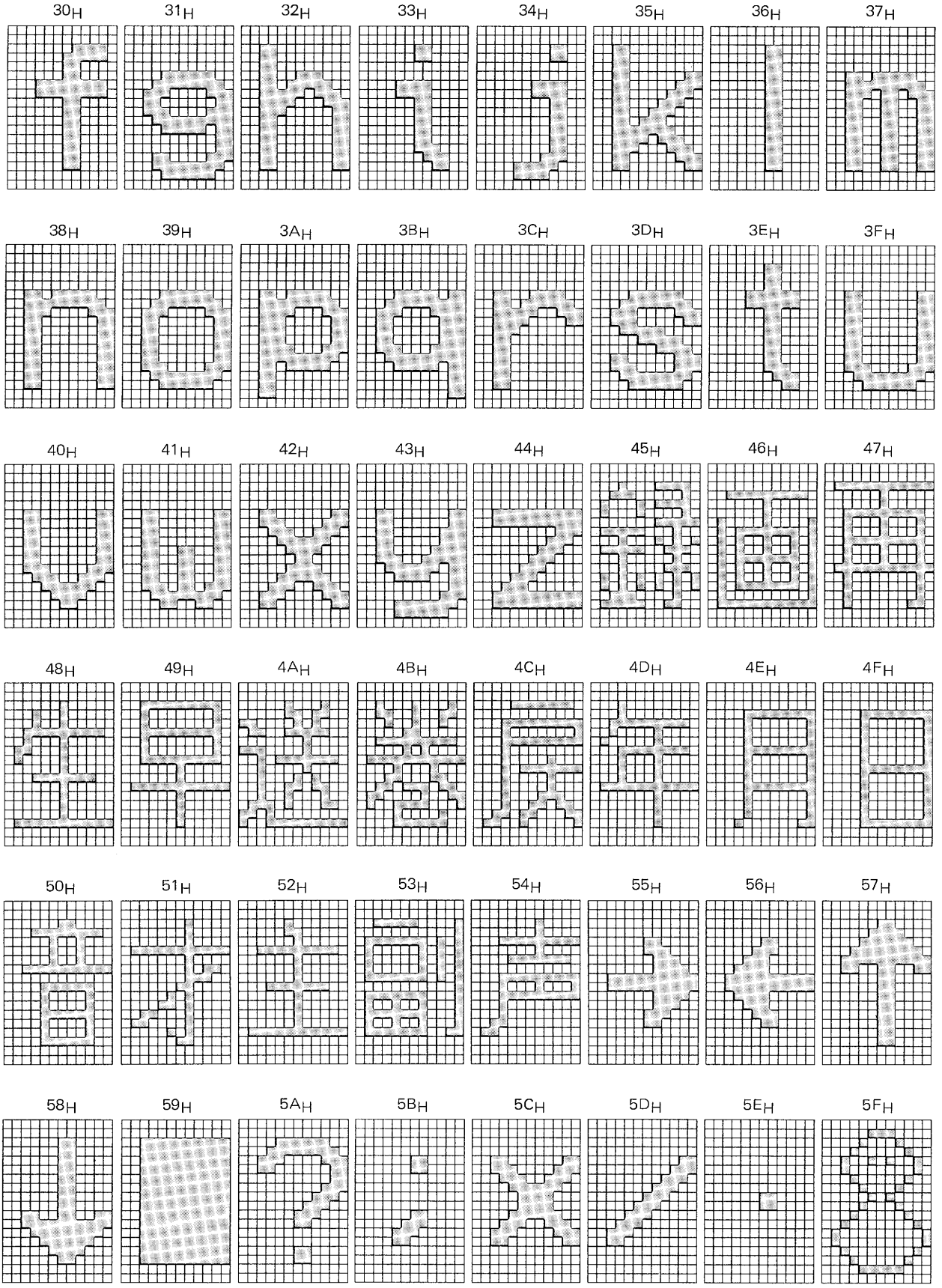

30H
31H
32H
33H
34H
35H
36H
37H
38H
39H
3AH
3BH
3CH
3DH
3EH
3FH
40H
41H
42H
43H
44H
45H
46H
47H
48H
49H
4AH
4BH
4CH
4DH
4EH
4FH
50H
51H
52H
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54H
55H
56H
57H
58H
59H
5AH
5BH
5CH
5DH
5EH
5FH

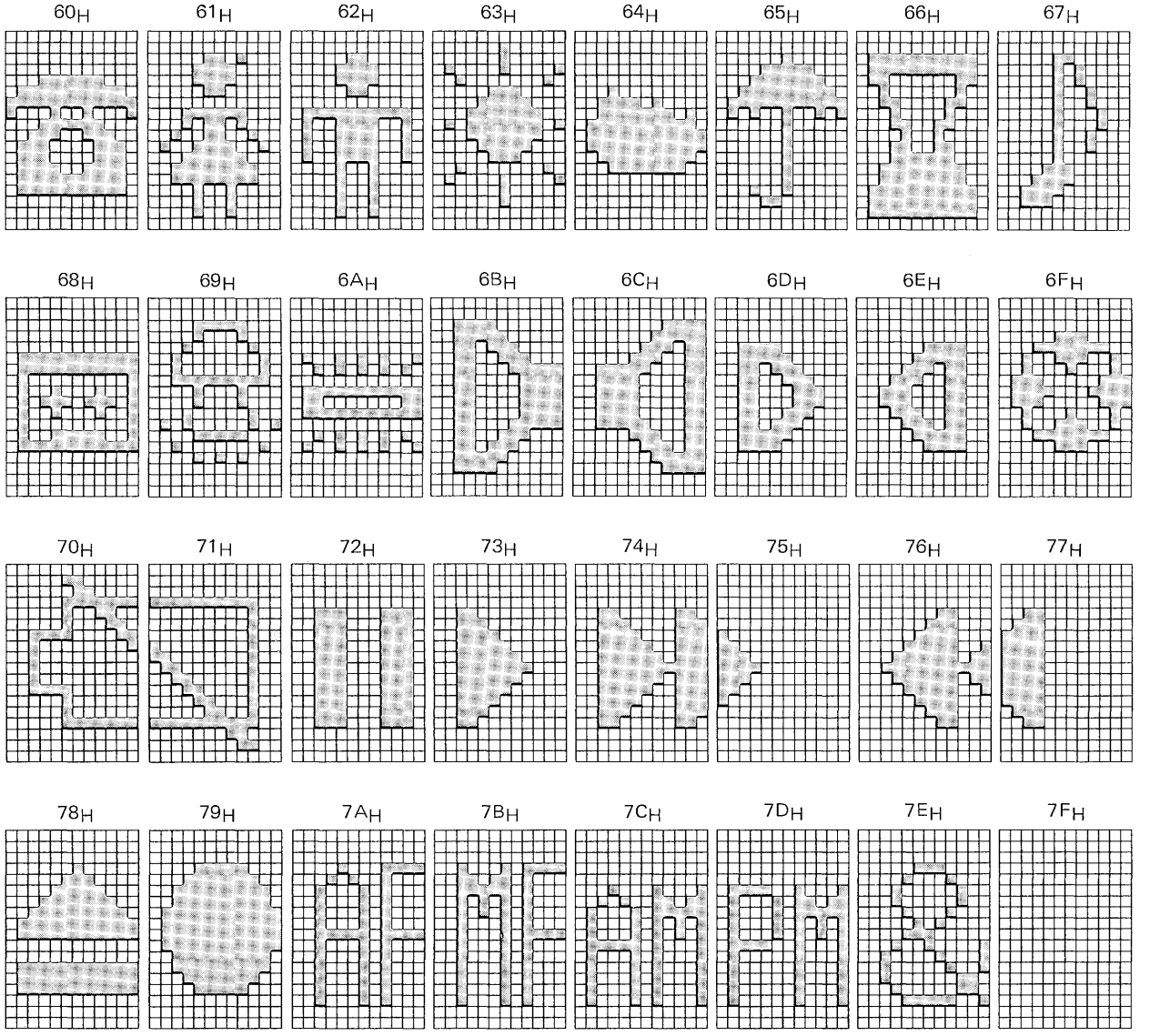


Display off data
(No character pattern can be entered)

μPD6451AGT-301 Character Patterns




30H
31H
32H
33H
34H
35H
36H
37H
38H
39H
3AH
3BH
3CH
3DH
3EH
3FH
40H
41H
42H
43H
44H
45H
46H
47H
48H
49H
4AH
4BH
4CH
4DH
4EH
4FH
50H
51H
52H
53H
54H
55H
56H
57H
58H
59H
5AH
5BH
5CH
5DH
5EH
5FH



Display off data
(No character pattern can be entered)

Character Display

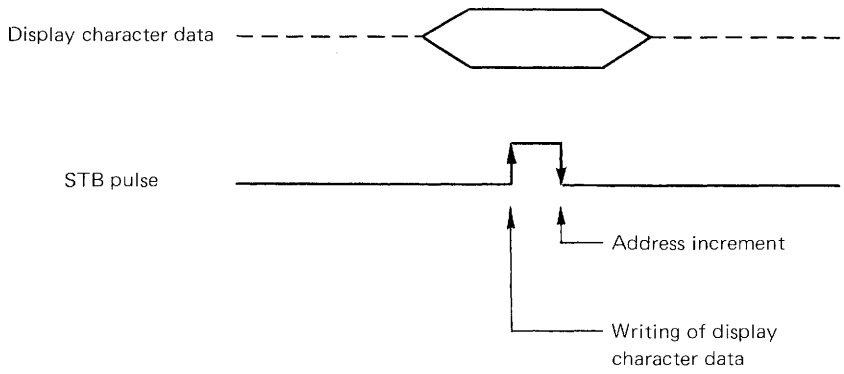
The number of characters displayed is 12 lines x 24 columns; that is, 288 as shown below:

AC4, AC3, AC2, AC1, AC0	00000	00001	00010	00011	00100	00101	00110	00111	01000	01001	01010	01011	01100	01101	01110	01111	10000	10001	10010	10011	10100	10101	10110	10111
AR3 AR2 AR1 AR0 0000																								
0001																								
0010																								
0011																								
0100																								
0101																								
0110																								
0111																								
1000																								
1001																								
1010																								
1011																								

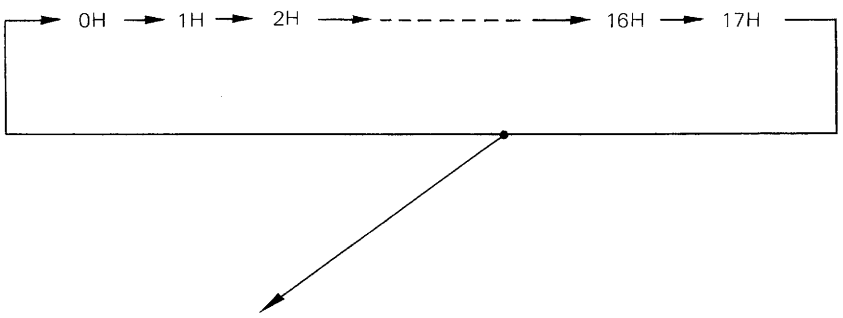
Writing of Display Character Data and Color/Blink Data for Each Character

The write address for data can be directly set in the address counter by the character display line address command and the character display column address command.

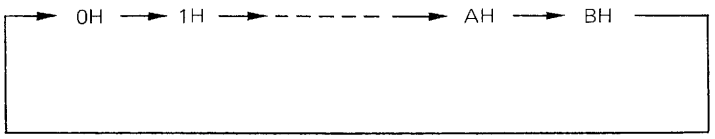
After the write address is set, the color/blink data for each character is input by the color/blink data command. The color or blink data for each character is saved in the internal register. Then, the display character data is input by the display character data command. At the rise of the STB pulse (to be input at completion of execution of the display character data command), the color/blink data and the display character data, which are saved in the internal register, are written to the video RAM. The write address is incremented as shown below at the fall of the STB pulse when the display character data is input. To write display character data continuously without changing the color/blink data for each character, just input the display character command.



Column address counter AC_4, AC_3, AC_2, AC_1, AC_0



Line address counters AR_3, AR_2, AR_1, AR_0



Example: Writing of the following data in lines/columns from line 0/column 0 to line 0/column F

Character color	Blue	Blue	Blue	Blue	Blue	Red	Red	Red	Red	Red	Red	Green	Green	Green	Green	Green
Character blinking	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
Display character	0	1	2	3	4	5	6	7	8	9	9	9	9	9	9	9

Set line 0 using the character display line address command.

↓

Set column 0 using the character display column address command.

↓

Set "blue" and "blinking off" using the color blink data for each character data command.

↓

Set data "0" using the display character data command.

↓

Set data "1" using the display character data command.

↓

Set data "2" using the display character data command.

↓

Set "blue" and "blinking off" using the color blink data for each character data command.

↓

Set data "3" using the display character data command.

↓

Set data "4" using the display character data command.

↓

Set data "red" and "blinking on" using the color blink data for each character data command.

↓

Set data "5" using the display character data command.

↓

Set data "6" using the display character data command.

↓

Set data "7" using the display character data command.

↓

Set data "8" using the display character data command.

↓

Set data "9" using the display character data command.

↓

Set data "9" using the display character data command.*

↓

Set "green" and "blinking off" using the color blink data for each character data command.

↓

Set data "9" using the display character data command.

↓

Set data "9" using the display character data command.*

↓

Set data "9" using the display character data command.*

↓

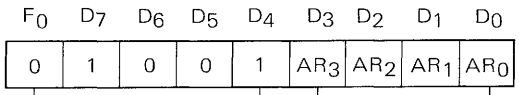
Set data "9" using the display character data command.*

↓

Set data "9" using the display character data command.*

*Data can be set by only sending the STB signal without sending 8-bit serial data.

Character Display Line Address Command

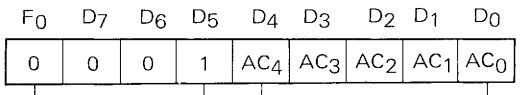


Line addressing bits				
AR_3	AR_2	AR_1	AR_0	Function
0	0	0	0	Set the 1st line.
0	0	0	0	Set the 2nd line.
⌇	⌇	⌇	⌇	⌇
1	0	1	1	Set the 12th line.

Do not set an address other than addresses 0H through BH.

Indicates the character display line address command.

Character Display Column Address Command

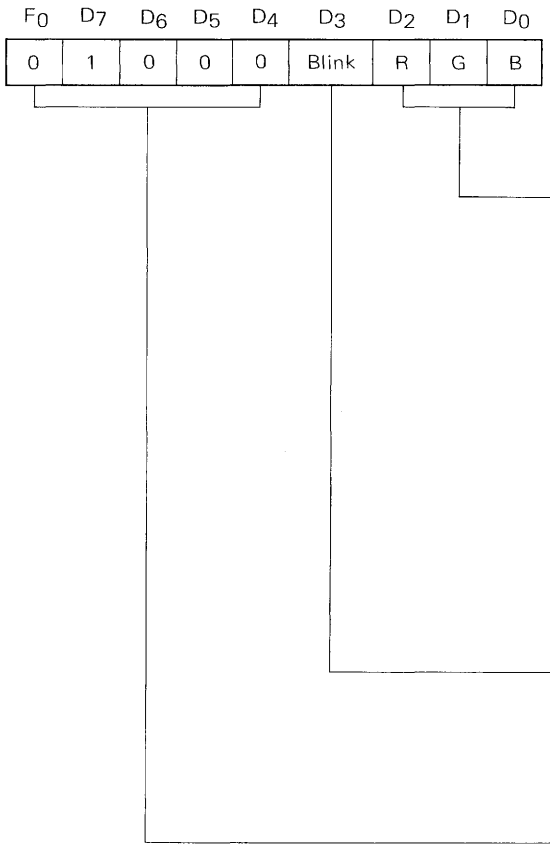


Column addressing bits					
AC_4	AC_3	AC_2	AC_1	AC_0	Function
0	0	0	0	0	Set the 1st line.
0	0	0	0	0	Set the 2nd line.
⌇	⌇	⌇	⌇	⌇	⌇
1	0	1	1	1	Set the 24th line.

Do not set an address other than the addresses 0H through 17H.

Indicates the character display column address command.

Color Blink Data for Each Character Command

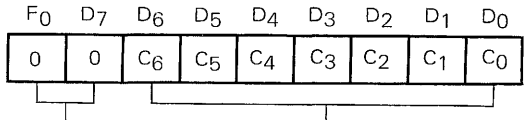


Character color selecting bits	
R G B	Character color
0 0 0	Black
0 0 1	Blue
0 1 0	Green
0 1 1	Cyan
1 0 0	Red
1 0 1	Magenta
1 1 0	Yellow
1 1 1	White

Blink selecting bits	
Blink	Function
0	No blinking
1	Blinking

Indicates the color blink data for each character.

Display Character Data Command



Character specification bits							
C_6	C_5	C_4	C_3	C_2	C_1	C_0	Function
0	0	0	0	0	0	0	Outputs the data for character code 00_H.
0	0	0	0	0	0	1	Outputs the data for character code 01_H.
1	1	1	1	1	1	1	Outputs the data for character code $7F_H$.

Indicates the display character data command.

Oscillation Control

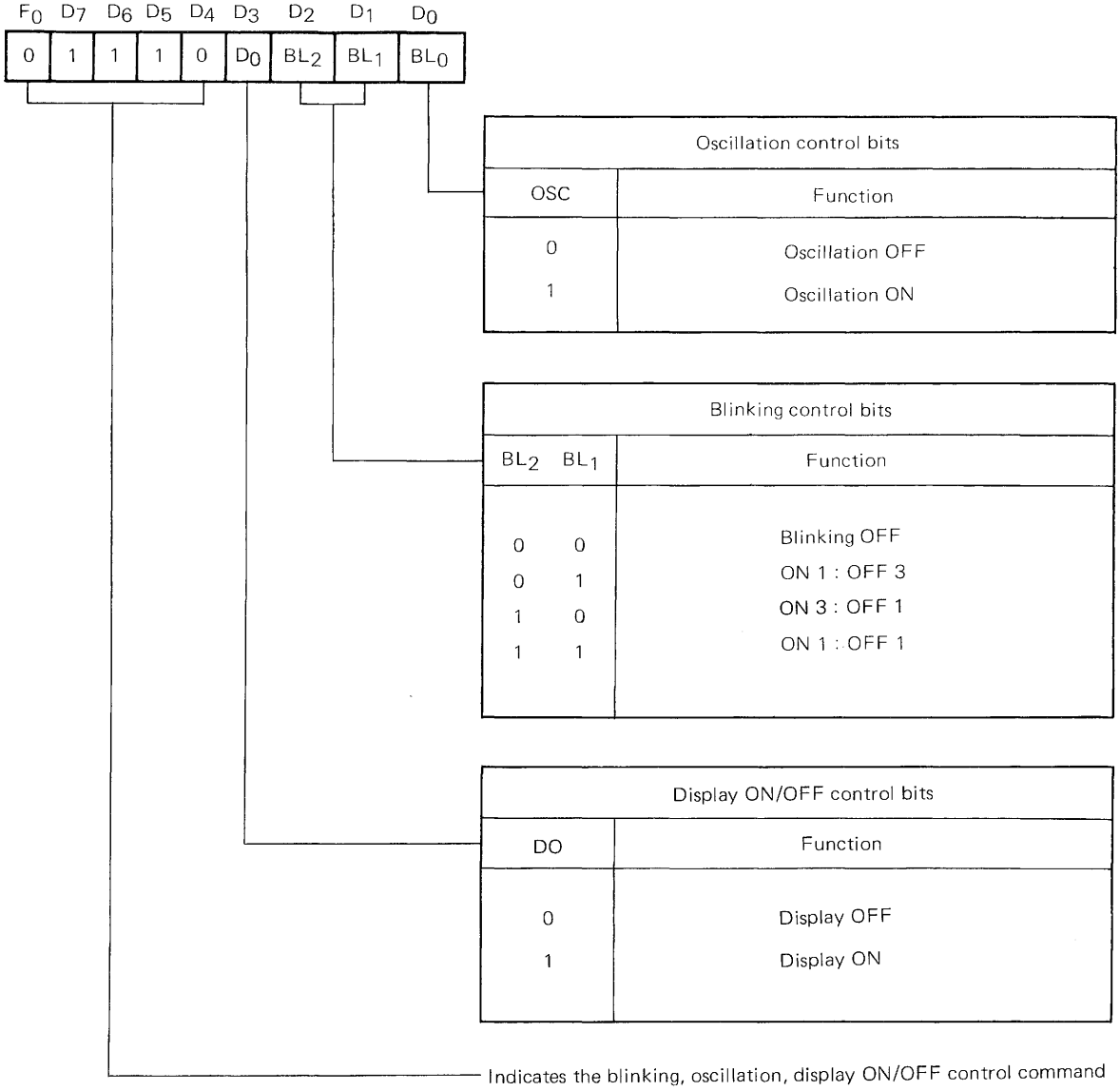
This IC allow oscillation to be turned ON/OFF with the blinking/oscillation control command so that it can stop oscillation during the period for displaying no character in order to save power. However, the character output remains executable even after oscillation has been stopped. Therefore, use the display control command in conjunction with this command. And the VRAM cannot be overwritten while oscillation is off.

Note: When display is ON, the oscillation synchronizes $\overline{H_{SYNC}}$, so the oscillation is stopping at the low level term of $\overline{H_{SYNC}}$. When display is OFF, the oscillation keeps on irrespective of $\overline{H_{SYNC}}$.

Character Blinking

This IC allow character-by-character blinking with the blinking/oscillation control command. Use the color blink data for each character command to specify the character or characters to be blinked. Select a blinking ratio of 1:1, 1:3, or 3:1. (A blinking cycle of approximately one second is equivalent to 64 times the vertical cycle.)

Blinking, Oscillation, Display ON/OFF Control Command



Oscillation control bits

OSC	Function
0	Oscillation OFF
1	Oscillation ON

Blinking control bits

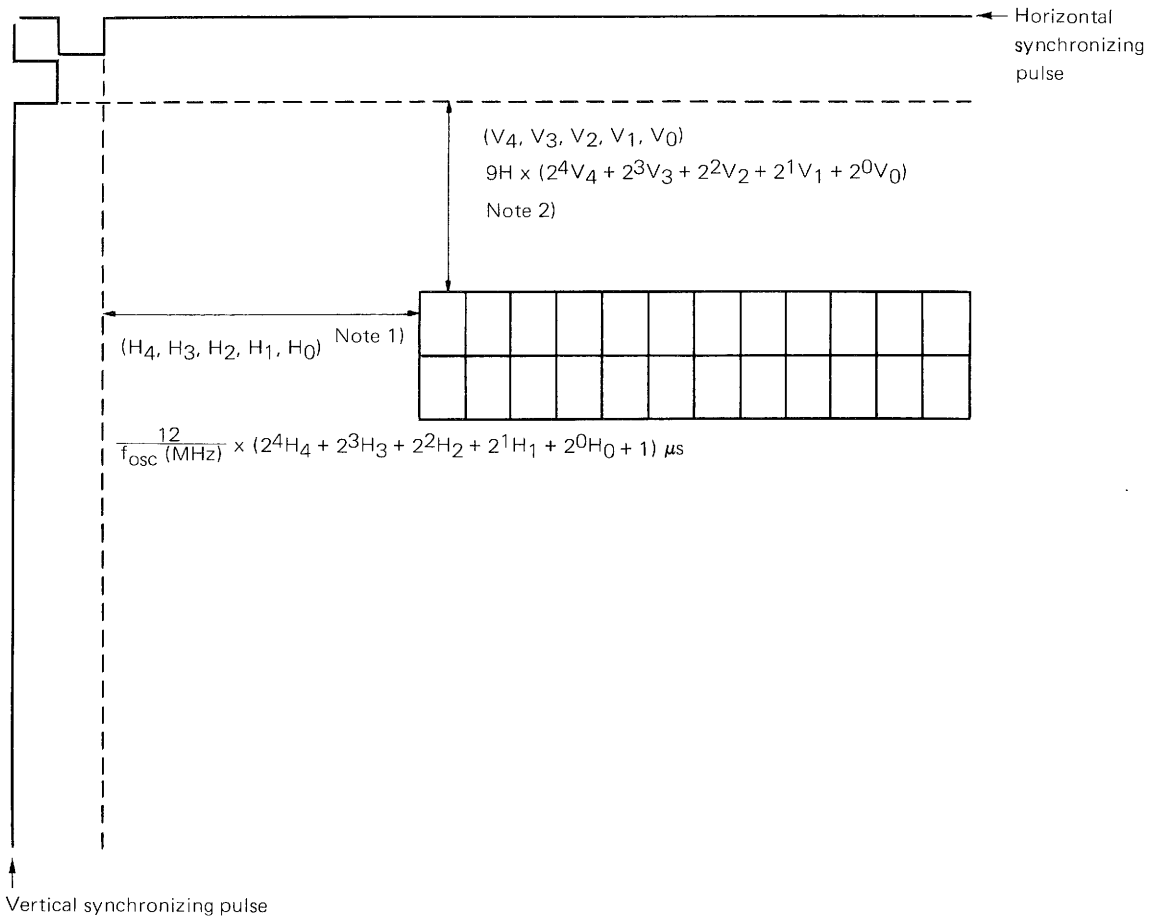
BL_2	BL_1	Function
0	0	Blinking OFF
0	1	ON 1 : OFF 3
1	0	ON 3 : OFF 1
1	1	ON 1 : OFF 1

Display ON/OFF control bits

DO	Function
0	Display OFF
1	Display ON

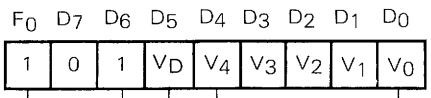
Character Display Address

The character display start address can be determined, as shown below, according to the values specified by the display position vertical address Progressive selector command (F_0, D_7, D_6, D_5, D_4, D_3, D_2, D_1, D_0) = (1, 0, 1, V_D, V_4, V_3, V_2, V_1, V_0) and the display position horizontal address command (F_0, D_7, D_6, D_5, D_4, D_3, D_2, D_1, D_0) = (1, 1, 1, 0, H_4, H_3, H_2, H_1, H_0):



Note 1: 9H is changed to 18H when the progressive scan TV mode is selected by the progressive selector command.

Display Position Vertical Address Command

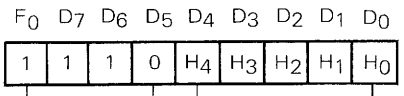


Vertical address assignment bits					
V_4	V_3	V_2	V_1	V_0	Start address
0	0	0	0	0	From the trailing edge of the vertical synchronizing pulse Note) 9 x 0H
0	0	0	0	1	From the trailing edge of the vertical synchronizing pulse 9 x 1H
⌇					⌇
1	1	1	1	1	From the trailing edge of the vertical synchronizing pulse 9 x 31H

Progressive scan selector bit	
V_D	Function
0	Normal TV
1	Progressive scan TV

Indicates the command for display position vertical address and double-speed switching.

Display Position Horizontal Address Command



Horizontal address assignment bits					
H_4	H_3	H_2	H_1	H_0	Start address
0	0	0	0	0	From the trailing edge of the horizontal synchronizing pulse $12/f_{osc}$(MHz) x 1 [μs]
0	0	0	0	1	From the trailing edge of the horizontal synchronizing pulse $12/f_{osc}$(MHz) x 2 [μs]
⌇					⌇
1	1	1	1	1	From the trailing edge of the horizontal synchronizing pulse $12/f_{osc}$(MHz) x 32 [μs]

Indicates the display position horizontal address command.

Note: 9H is changed to 18H when the progressive scan TV mode is selected by the progressive selector command.

Character Size Specification

As the character size, one dot 1H, 2H, 3H, or 4H can be selected for each line. Use the character size specification command to specify lines and their character sizes.

If, however, the mask pulse function is selected by the mask option, only two character sizes (one-dot 2H and 4H) can be selected. (See the section for the mask pulse.)

Character Size Specification Command

F_0	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
1	1	0	S_5	S_4	AR_3	AR_2	AR_1	AR_0

Line address selection bits

AR_3	AR_2	AR_1	AR_0	Function
0	0	0	0	Select the 1st line.
0	0	0	1	Select the 2nd line.
⋮				⋮
1	0	1	1	Select the 12th line.

Do not set an address other than addresses 0H through BH.

Character size specification bits

S_5	S_4	Character dot size	
0	0	Vertical 1H	Horizontal t_{dot}
0	1	2H	$2 \cdot t_{dot}$
1	0	3H	$3 \cdot t_{dot}$
1	1	4H	$4 \cdot t_{dot}$

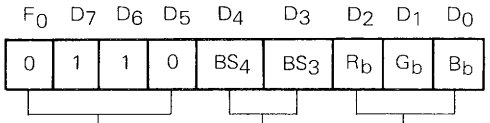
$$t_{dot} = \frac{1}{f_{osc}(MHz)}\ \mu s$$

Indicates the character size specification command.

Background Specification

The background type and color can be specified for each image using the background specification command. The background types available are: no background, black fringe, square background, and solid background. The background colors available are: black, blue, green, cyan, red, magenta, yellow, and white.

Background Specification Command



Background color specification bits			
R_b	G_b	B_b	Background color
0	0	0	Black
0	0	1	Blue
0	1	0	Green
0	1	1	Cyan
1	0	0	Red
1	0	1	Magenta
1	1	0	Yellow
1	1	1	White

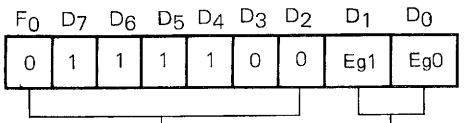
For no background or black border, set $(R_b, G_b, B_b) = (0, 0, 0)$.

Background format specification bits		
BS_4	BS_3	Background format
0	0	No background
1	0	Square background
1	1	Solid background

Note: Do not use $(BS_4, BS_3) = (0, 1)$

Indicates the background specification command.

Fringing Control Command

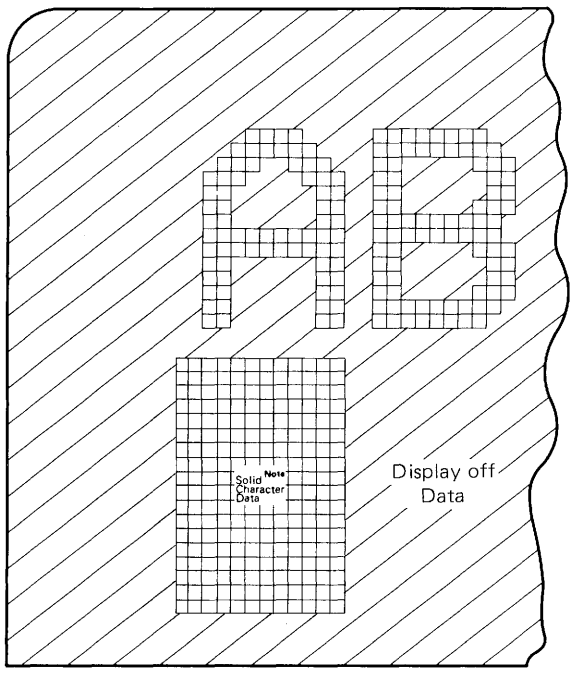


Fringing control bit		
Eg_1	Eg_0	Function
0	0	Fringing off
0	1	
1	0	Black fringing
1	1	White fringint

Indicate the fringing control command.

Display in Various Background Modes

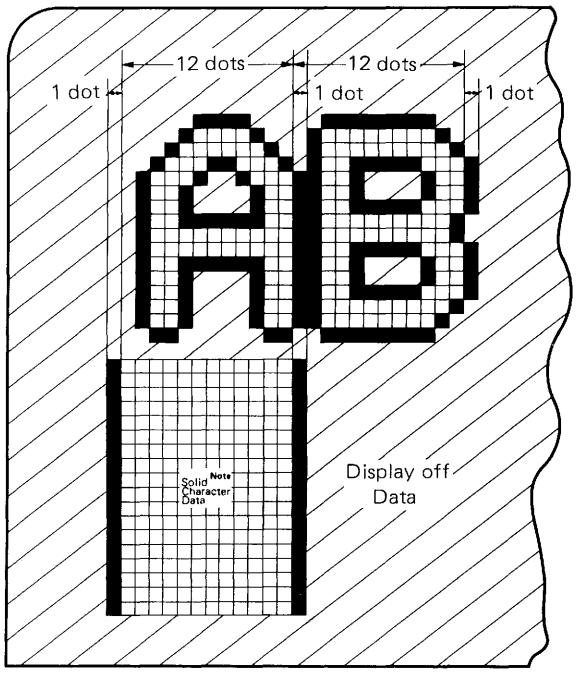
No background



Character

Video signal

Black fringe

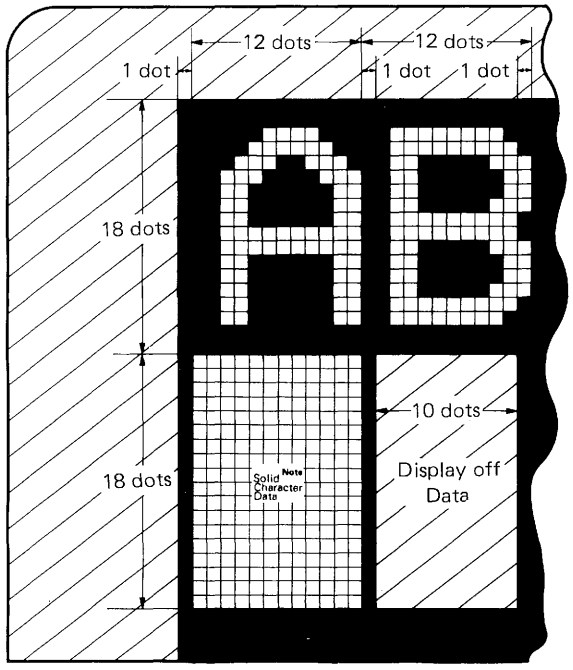


Character

Background

Video signal

Black Square background

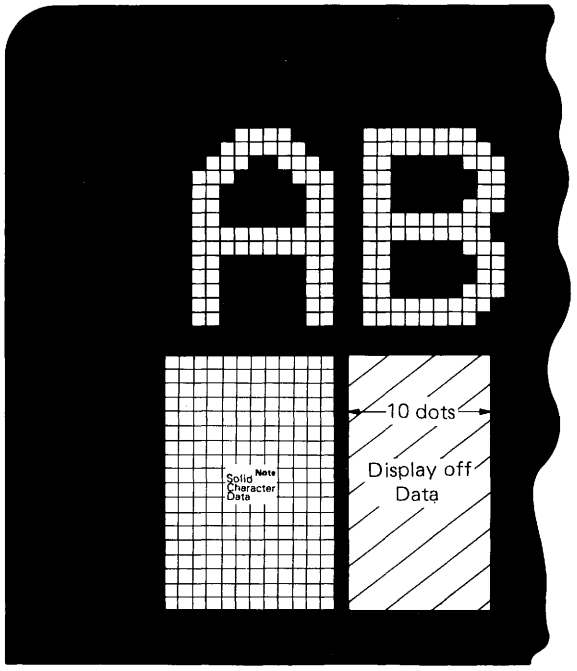


Character

Background

Video signal

Black Solid background



Character

Background

Video signal

Note: The solid character data means the data of character code 1FH (standard type of NEC).

1. No background
   Only characters are displayed.

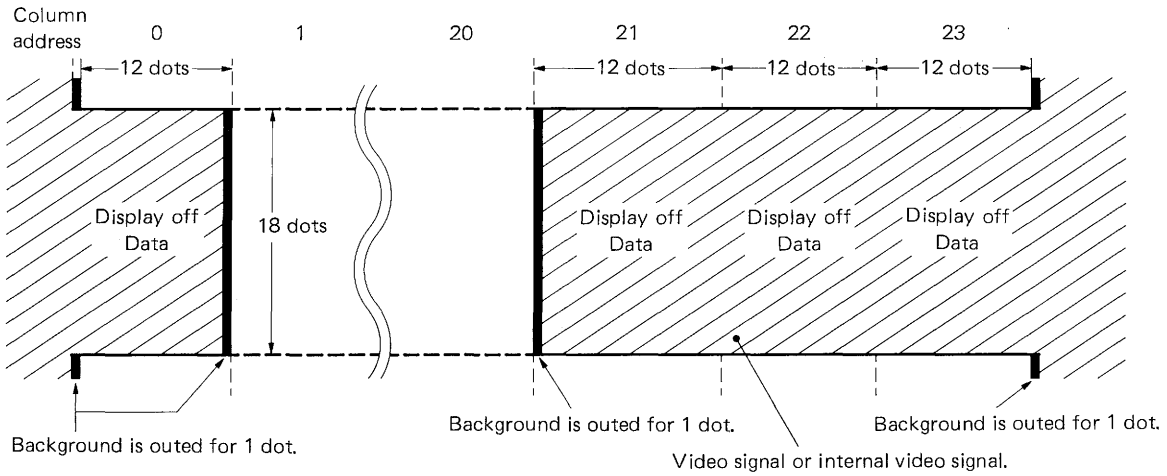
2. Fringe
   Characters with fringe are displayed. Fringe of a character which is used the edge of dot-matrix (right and left) is displayed in neighbor character area for 1 dot.
   The fringe is the dot of the smallest character size and irrespective of character size.

3. Square background
   The square background is displayed in character display area.
   In this case, the background is displayed in outside of character display area (right and left) for 1 dot.
   In case of using "Display OFF data", the background is displayed in the inside edge of "Display OFF data" for 1 dot.

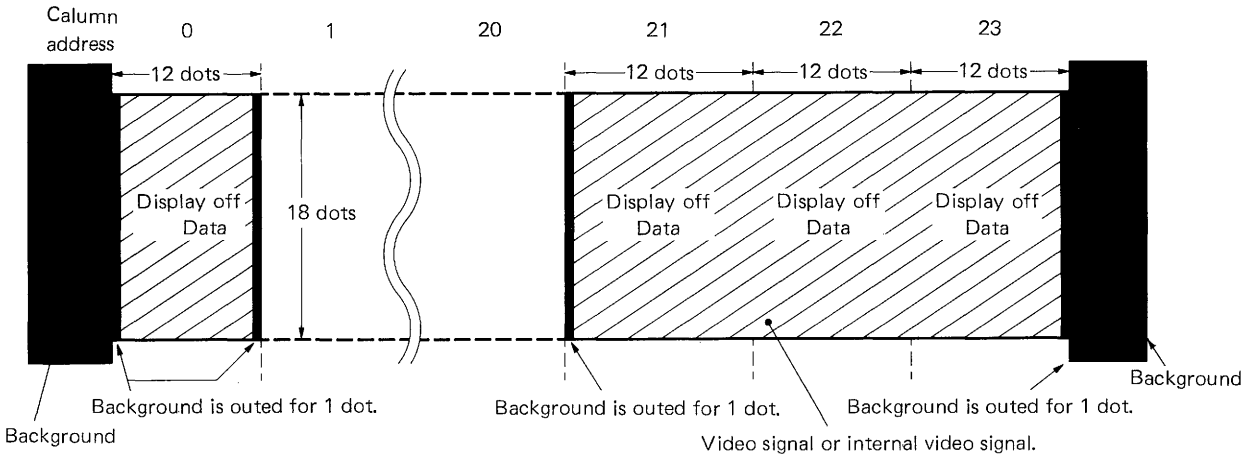
4. Solid background
   The solid background is displayed in the all area of screen.
   In case of using "Display OFF data", the background is displayed in the inside edge of "Display OFF data" for 1 dot.

In case of using "Display OFF data".

- Black square background



- Black solid background



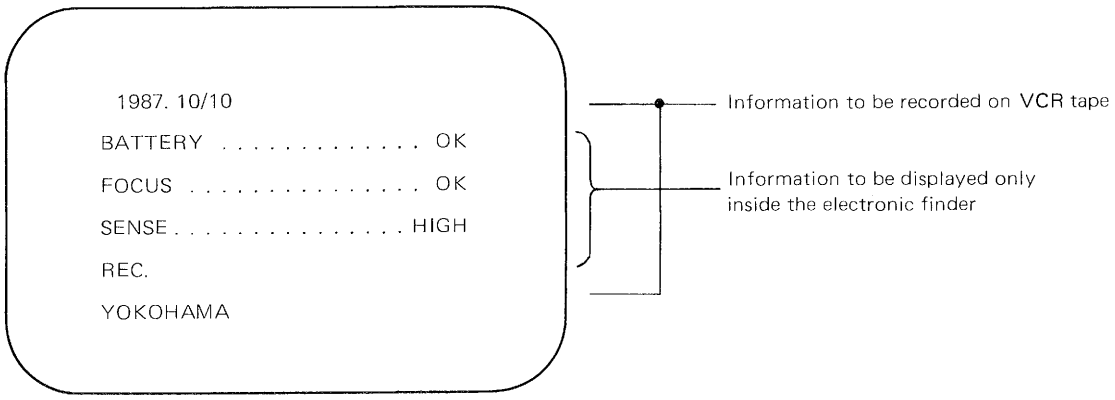
Note: The "1 dot" is the dot of the smallest character size and irrespective of character size.

Write Control

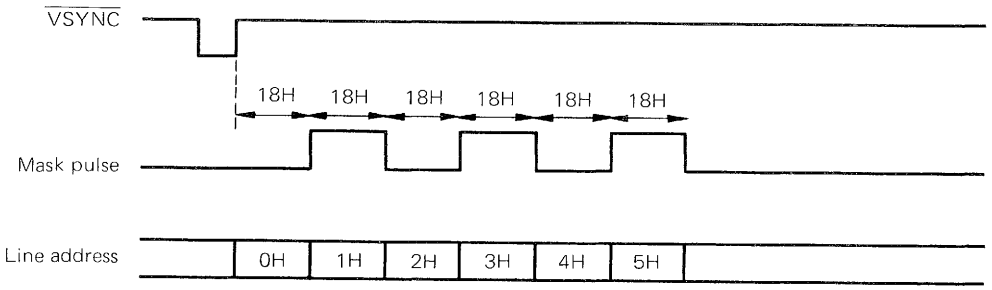
Data to be displayed is synchronized with the dot clock whether or not characters are being displayed on the screen according to the display on/off command. While the displayed data is being written, the BUSY terminal (terminal 1) becomes high to direct the microcomputer to stop sending data, to prevent the next data from being sent to the external source.

Mask Pulse Function (Mask Code Option)

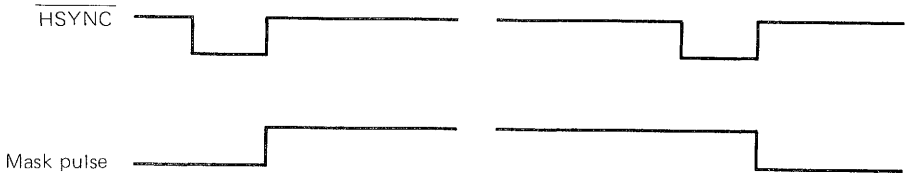
When used in a VCR camera, the on-screen ICs provide two types of information; information to be recorded on VCR tape, such as the date and title, and information to be displayed only inside the electronic view finder, such as the battery, focus, sensitivity, and mode. For proper use of these two types of information, the mask option allows the V_{MON} terminal to be used as the character-by-character signal output terminal.



Example: The mask pulse is to be output to line addresses 1H, 3H, and 5H with vertical address 0H and a character size of 1H/dot.



The leading and trailing edges of the mask pulse are synchronized with the trailing edge of HSYNC.



Mask Pulse/Character Size Specification Command

(Available only when the mask pulse function is selected by the mask code option.)

F_0	D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
1	1	0	MP	S_4	AR_3	AR_2	AR_1	AR_0

Line address selection bits

AR_3	AR_2	AR_1	AR_0	Function
0	0	0	0	Select the 1st line.
0	0	0	1	Select the 2nd line.
⋮				⋮
1	0	1	1	Select the 12th line.

Do not set an address other than addresses 0H through BH.

Character size specification bits

S_4	Character dot size
0	Vertical 1H Horizontal t dot
1	2H 2 · t dot

$$t_{dot} = \frac{1}{f_{osc}(MHz)}\ \mu s$$

Mask pulse specification bits

MP	Function
0	Mask pulse not generated
1	Mask pulse generated

Indicates the mask pulse/character size specification command.

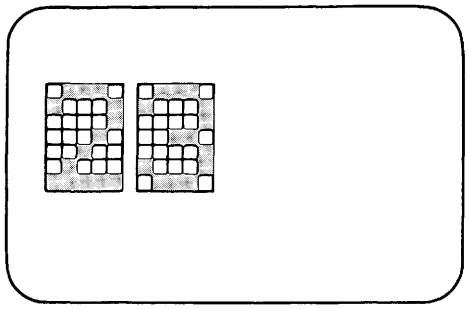
Note: The mask pulse is not used for μPD6451ACX-001, μPD6451AGT-101 and μPD6451AGT-01; therefore, this command cannot be used.

Double-Speed Scan TV Application (Mask Code Option)

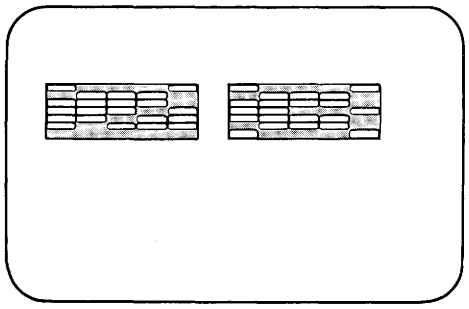
In general, if on-screen ICs are used in a television set with a progressive scanning function, the number of scan lines per field (twice the conventional number) and the time required for horizontal scan (half of the conventional time) are different from those for the conventional NTSC and PAL TV systems.

Character output is doubled in width, halved in height, and halved in time lag with respect to the vertical synchronizing pulse. The character width can be adjusted according to oscillation frequency (but the maximum permissive value of f_{osc} is 7.0 MHz in the case of progressive scan TV it is 10.0 MHz), but neither the character height nor the vertical position can be changed because they are automatically determined by the number of horizontal lines.

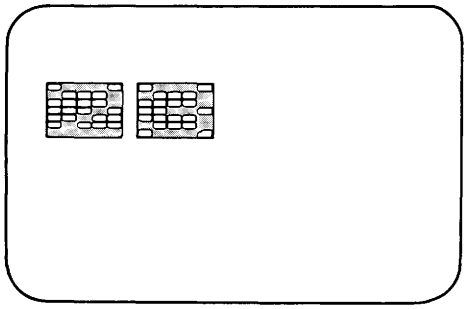
The μPD6451A is therefore designed so that the character height and vertical position can be changed by inserting a single stage of 1/2-cycle dividers in the vertical address counter section using a mask code option. This, however, involves the following changes to the display-position vertical address assignment command and the character size specification command.



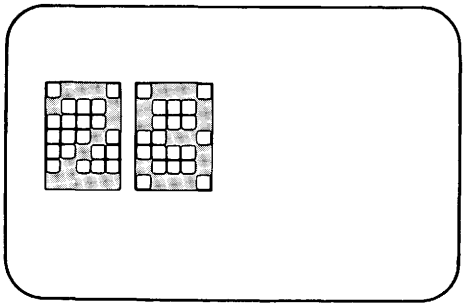
When an on-screen IC is used in a system with one field equivalent to 262.5 H (or 312.5 H).



When an on-screen IC is used directly in a system with one field equivalent to 525 H (or 625 H).



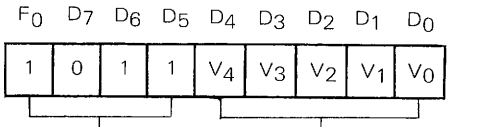
When an on-screen IC with its oscillation frequency doubled is used in a system with one field equivalent to 525 H (or 625 H).



When μPD6451ACX/AGT is used in a system applying the double-speed scanning TV mode with a mask option.

Display-Position Vertical Address Assignment Command

(Available only when the system is set in a progressive scanning TV mode by mounting a mask code option)



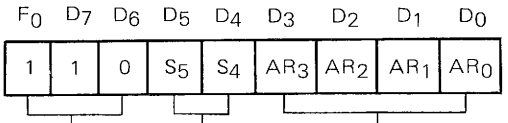
Vertical address specification bits					
V_4	V_3	V_2	V_1	V_0	Start address
0	0	0	0	0	From the tailing edge of the vertical synchronizing pulse 18 x 0H
0	0	0	0	1	From the trailing edge of the vertical synchronizing pulse 18 x 1H
)				)	
1	1	1	1	1	From the trailing edge of the vertical synchronizing pulse 18 x 31H

Indicates the display-position vertical address assignment command.

Note: Neither the μPD6451ACX-001, μPD6451AGT-101 nor μPD6451AGT-301 are optional in the double-speed scanning TV mode.

Character Size Specification Command

(Available only when the system is set in progressive scanning TV mode)



Line address selection bits				
AR_3	AR_2	AR_1	AR_0	Function
0	0	0	0	Select the 1st line.
0	0	0	1	Select the 2nd line.
⋮				⋮
1	0	1	1	Select the 12th line.

Do not set an address other than addresses 0H through BH.

Character size specification bits				
S_5	S_4	Character dot size		
0	0	Vertical **2H**	Horizontal	t dot
0	1	**4H**		2 · t dot
1	0	**6H**		3 · t dot
1	1	**8H**		4 · t dot

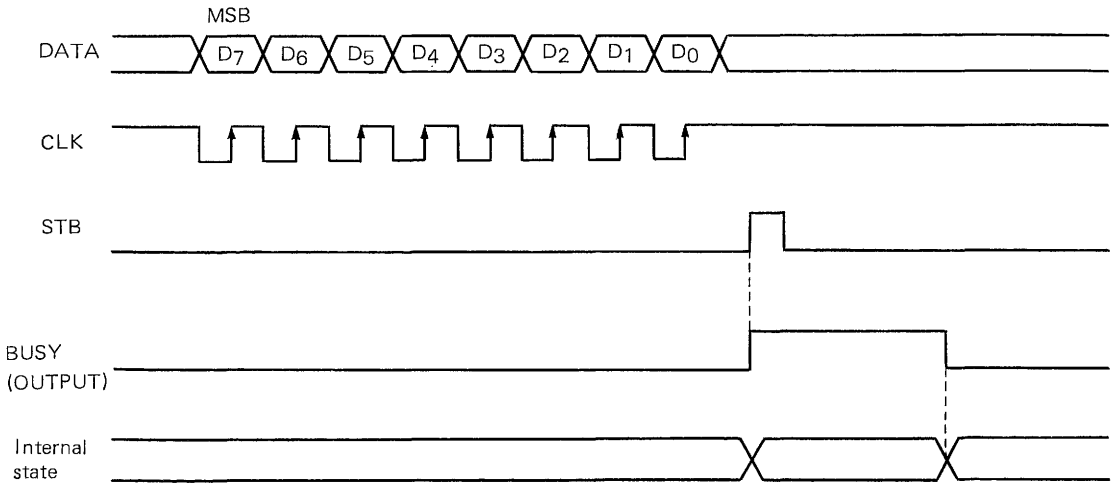
$$t_{dot} = \frac{1}{f_{osc}(MHz)} = \mu s$$

Indicates the character size specification command.

RECOMMENDED CONDITIONS FOR OPERATION TIMING

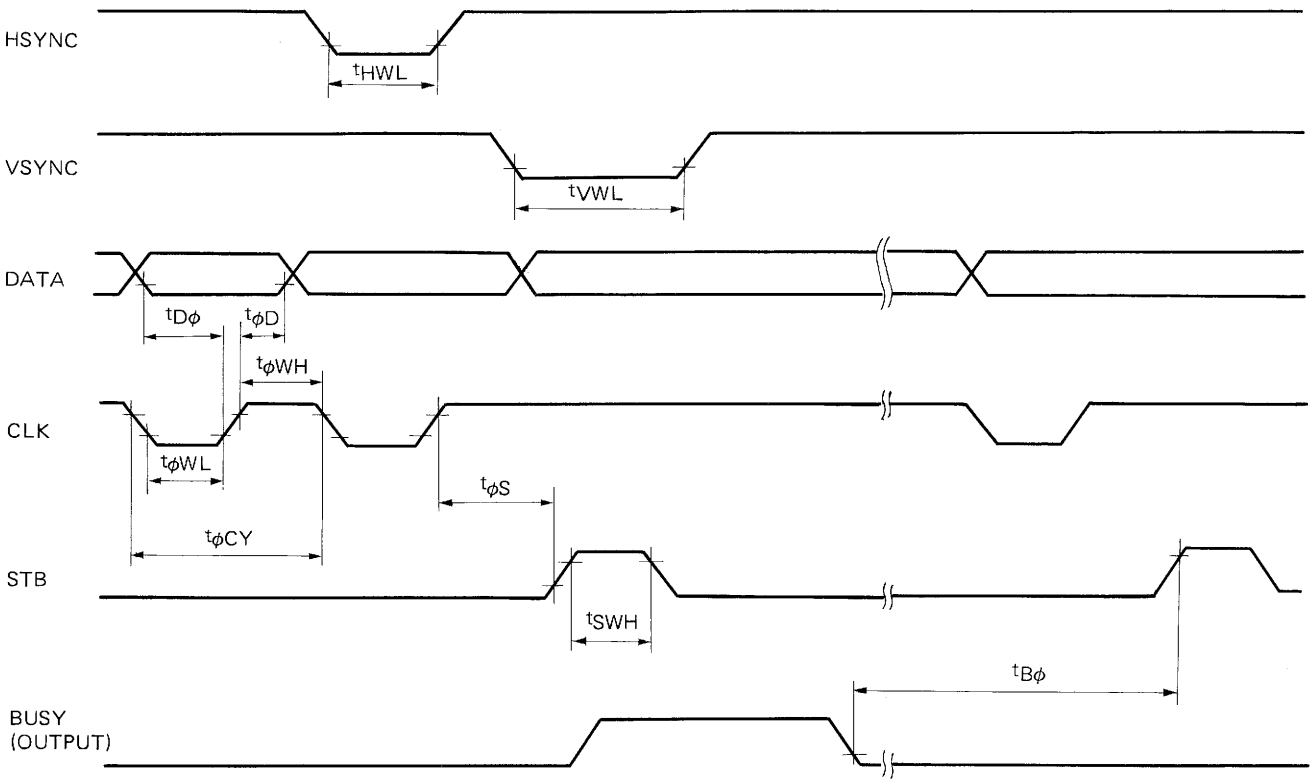
(T_a = 25 °C, V_{DD} – V_{SS} = 5.0 V)

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Minimum setup time	$t_{D\phi}$		200			ns
Minimum hold time	$t_{\phi D}$		200			ns
Minimum clock width at low level	$t_{\phi WL}$		700			ns
Minimum clock width at high level	$t_{\phi WH}$		700			ns
Minimum clock-to-strobe time	$t_{\phi S}$		400			ns
Minimum strobe width at high level	t_{SWH}		1			μs
Clock cycle	$t_{\phi CY}$		1.6			μs
Minimum Busy-to-strobe time	$t_{B\phi}$	During display OFF	100			ns
Minimum $\overline{VSYNC}$ width at low level	t_{VWL}		4			μs
Minimum $\overline{HSYNC}$ width at high level	t_{HWL}		4			μs

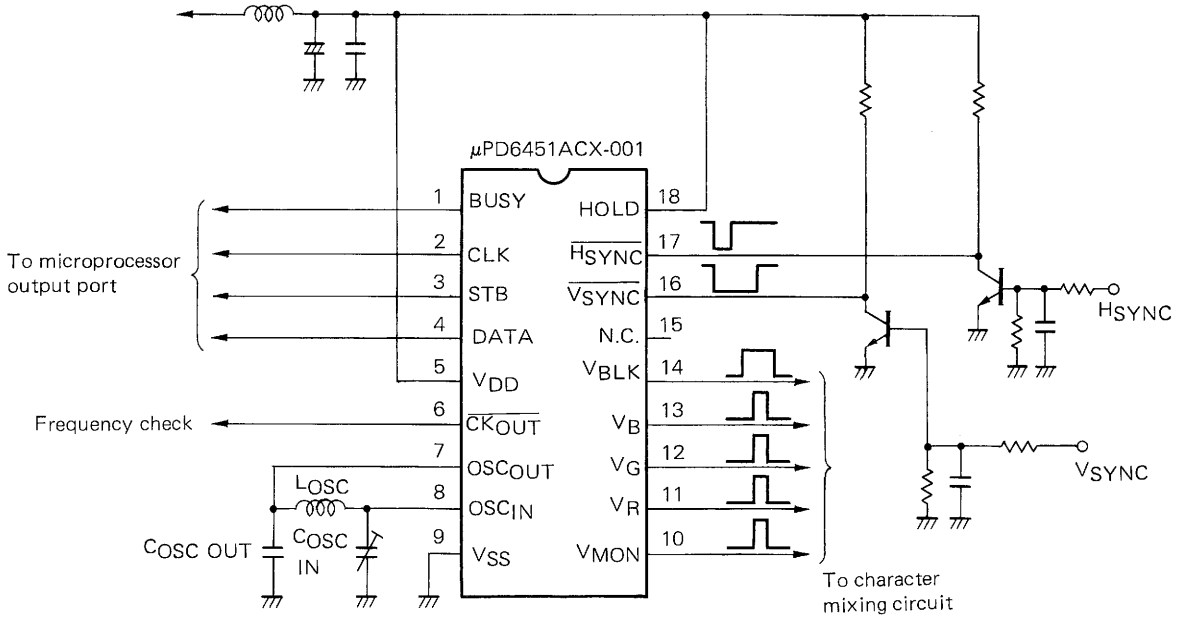


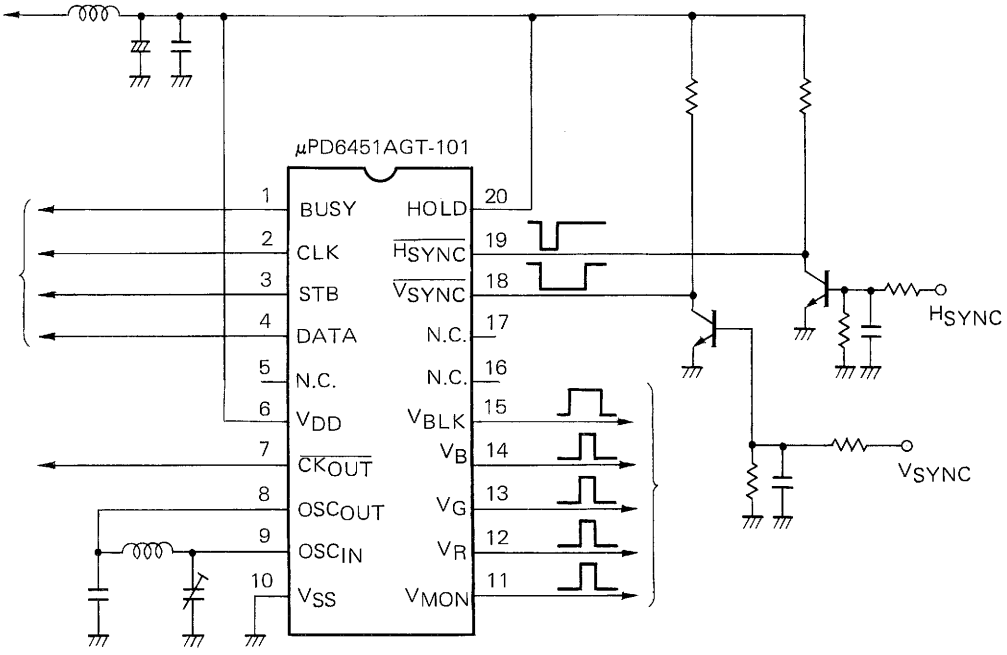
For format data, the BUSY signal goes low after the internal state is completely established. It also goes low when writing data into the VRAM is finished.

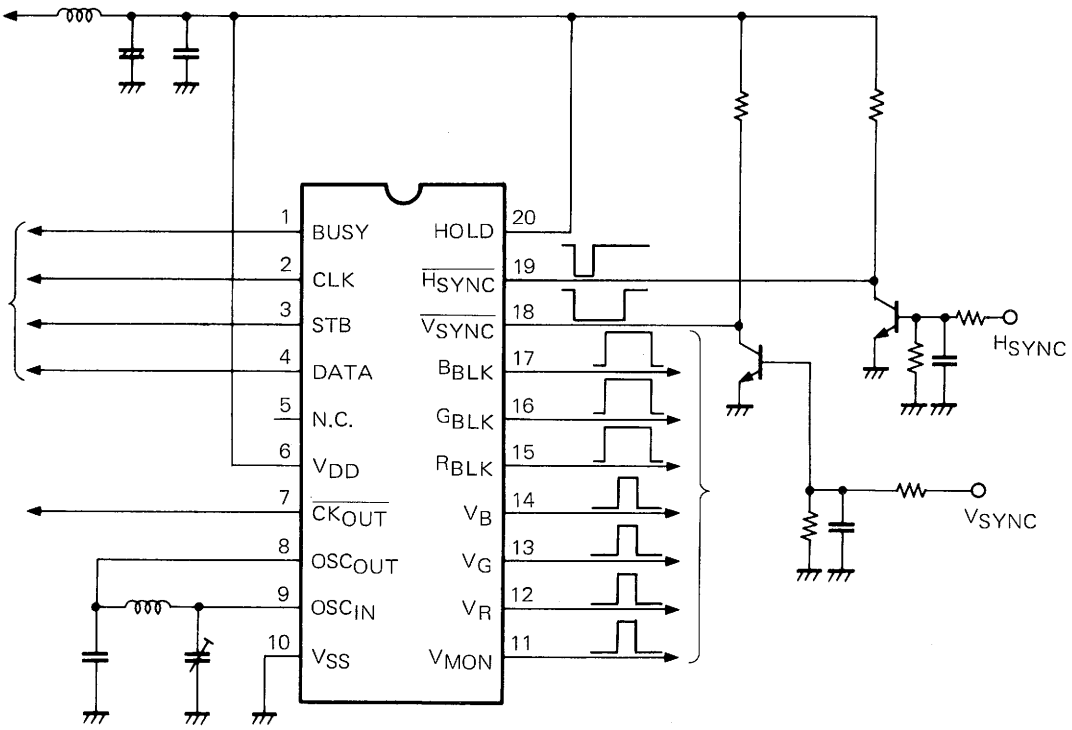
When writing data into the VRAM extends to the horizontal flyback time, the BUSY signal lasts longer than usual. (This is because oscillation is off and data cannot be written into the VRAM during the horizontal flyback time.)


HSYNC
tHWL
VSYNC
tVWL
DATA
tDφ
tφD
tφWH
CLK
tφWL
tφS
tφCY
STB
tSWH
tBφ
BUSY
(OUTPUT)

APPLICATION CIRCUIT CONFIGURATION

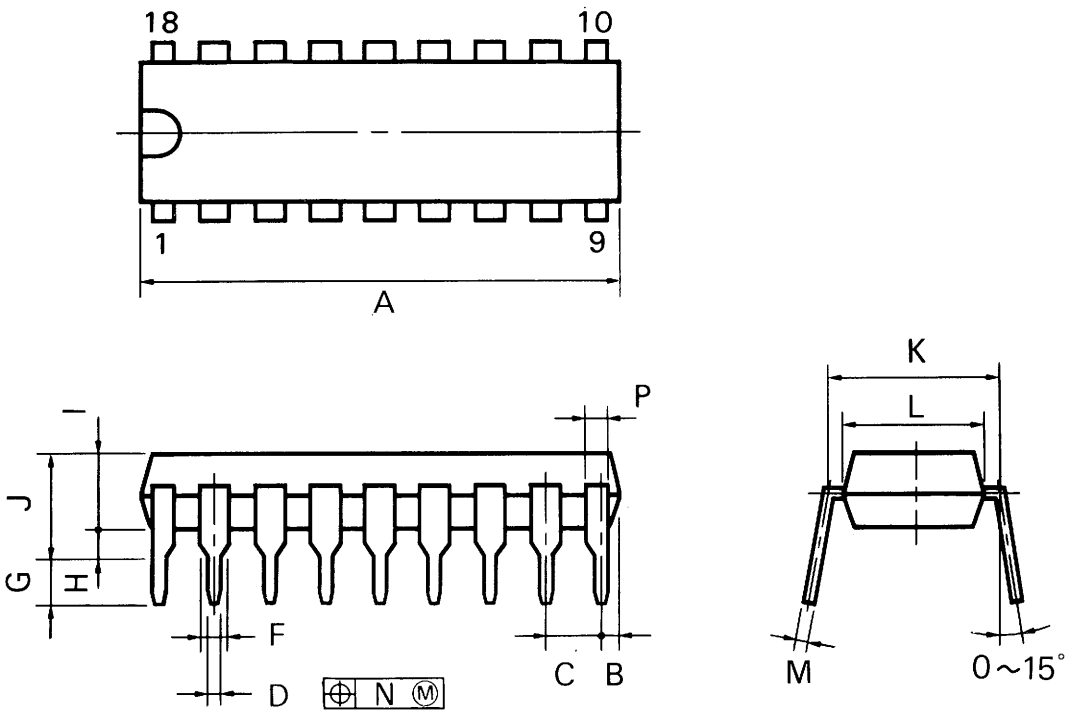





1 BUSY
2 CLK
3 STB
4 DATA
5 N.C.
6 VDD
7 CKOUT
8 OSCOUT
9 OSCIN
10 VSS
20 HOLD
19 HSYNC
18 VSYNC
17 BBLK
16 GBLK
15 RBLK
14 VB
13 VG
12 VR
11 VMON
HSYNC
VSYNC

μPD6451ACX-001

18-pin plastic DIP (300 mil)



P18C-100-300B

NOTES

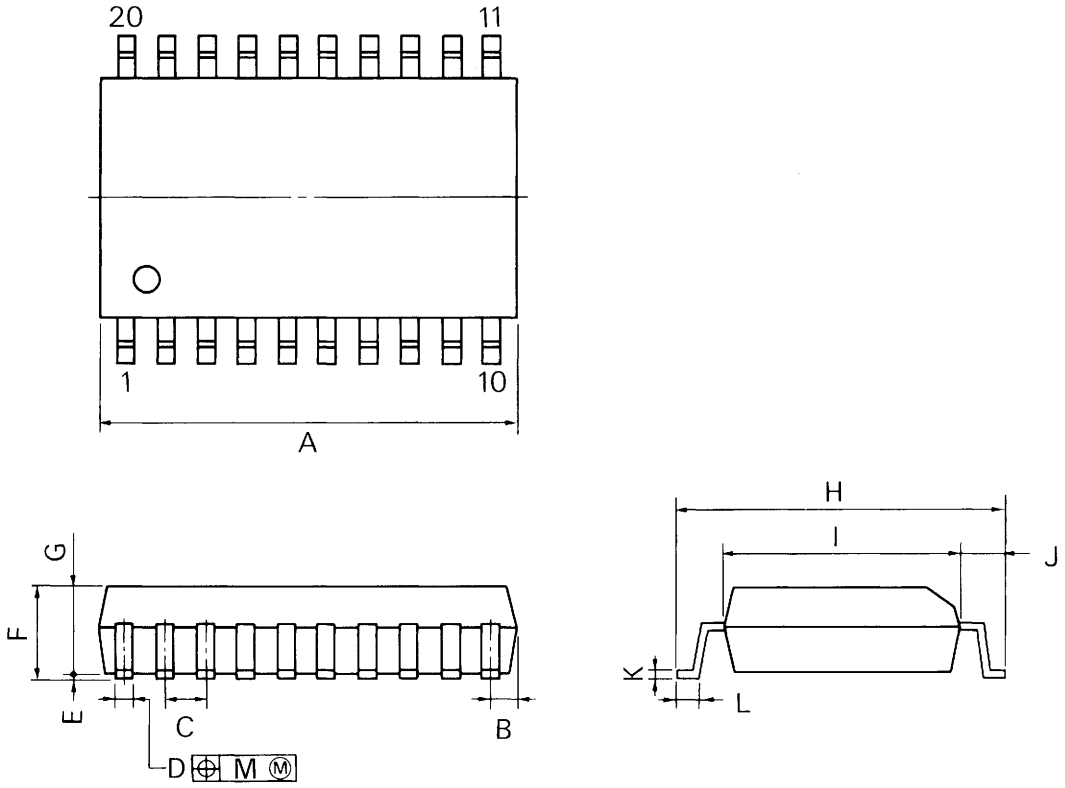
1) Each lead centerline is located within 0.25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.

2) Item "K" to center of leads when formed parallel.

ITEM	MILLIMETERS	INCHES
A	22.86 MAX.	0.900 MAX.
B	1.27 MAX.	0.050 MAX.
C	2.54 (T.P.)	0.100 (T.P.)
D	$0.50^{\pm 0.10}$	$0.020^{+0.004}_{-0.005}$
F	1.2 MIN.	0.047 MIN.
G	$3.2^{\pm 0.3}$	$0.126^{\pm 0.012}$
H	0.51 MIN.	0.020 MIN.
I	4.31 MAX.	0.170 MAX.
J	5.08 MAX.	0.200 MAX.
K	7.62 (T.P.)	0.300 (T.P.)
L	6.4	0.252
M	$0.25^{+0.10}_{-0.05}$	$0.010^{+0.004}_{-0.003}$
N	0.25	0.01
P	1.0 MIN.	0.039 MIN.

μPD6451AGT-101, μPD6451AGT-301

20-pin plastic SOP (375 mil)



P20GM-50-375B-1

NOTE

Each lead centerline is located within 0.12 mm (0.005 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	13.00 MAX.	0.512 MAX.
B	0.78 MAX.	0.031 MAX.
C	1.27 (T.P.)	0.050 (T.P.)
D	$0.40^{+0.10}_{-0.05}$	$0.016^{+0.004}_{-0.003}$
E	$0.1^{+0.2}_{-0.1}$	$0.004^{+0.008}_{-0.004}$
F	2.9 MAX.	0.115 MAX.
G	2.50	0.098
H	$10.3^{\pm 0.3}$	$0.406^{+0.012}_{-0.013}$
I	7.2	0.283
J	1.6	0.063
K	$0.15^{+0.10}_{-0.05}$	$0.006^{+0.004}_{-0.002}$
L	$0.8^{\pm 0.2}$	$0.031^{+0.009}_{-0.008}$
M	0.12	0.005

〔MEMO〕

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While NEC Corporation has been making continuous effort to enhance the reliability of its semiconductor devices, the possibility of defects cannot be eliminated entirely. To minimize risks of damage or injury to persons or property arising from a defect in an NEC semiconductor device, customer must incorporate sufficient safety measures in its design, such as redundancy, fire-containment, and anti-failure features.

NEC devices are classified into the following three quality grades:

"Standard", "Special", and "Specific". The Specific quality grade applies only to devices developed based on a customer designated "quality assurance program" for a specific application. The recommended applications of a device depend on its quality grade, as indicated below. Customers must check the quality grade of each device before using it in a particular application.

Standard: Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

Special: Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

Specific: Aircrafts, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems or medical equipment for life support, etc.

The quality grade of NEC devices in "Standard" unless otherwise specified in NEC's Data Sheets or Data Books. If customers intend to use NEC devices for applications other than those specified for Standard quality grade, they should contact NEC Sales Representative in advance.

Anti-radioactive design is not implemented in this product.

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