

# MITSUBISHI MICROCOMPUTERS M50458-XXXSP/FP

## SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

### DESCRIPTION

The M50458-XXXSP/FP is a TV screen display control IC which uses the silicon gate CMOS process, and has a 32-pin shrink plastic molded package.

A built-in character ROM is included; the ROM mask makes possible character settings in alphanumerics as desired. These can be used to display information such as program schedules, the date and messages on the TV screen.

### FEATURES

Screen composition ..... 12 lines X 24 columns  
 Number of characters displayed ..... 288 (Max.)  
 Character composition ..... 12 X 18 dot matrix  
 Characters available ..... 128 characters  
 Character sizes available ..... 4 (horizontal) X 4 (vertical)  
 Display locations available ..... 62 horizontal locations,  
 64 vertical locations

#### Blinking

Blinking may be defined in individual character units

Cycle : approximately 1 second, approximately 0.5 seconds

Duty : 25%, 50%, 75%

Data input ..... 16 bit serial input

#### Coloring

Color of character units may be defined in individual character units (composite video signal and RGB output)

Background coloring (composite video signal and RGB output)

#### Blanking

Blanking can be modified in software for individual lines

Total blanking (14 X 18 dots)

Border size

Character size blanking

#### Border

Horizontal : One-dot or two-dot border can be specified.

Vertical : One-dot border

Form of character display

#### Cursor

Reverse characters

Reverse blinking

Alternate blinking

Underline

Overline and underline can be specified for the first and 18th dots on each line

Scrolling

Vertical scrolling from second line onwards (first line is fixed)

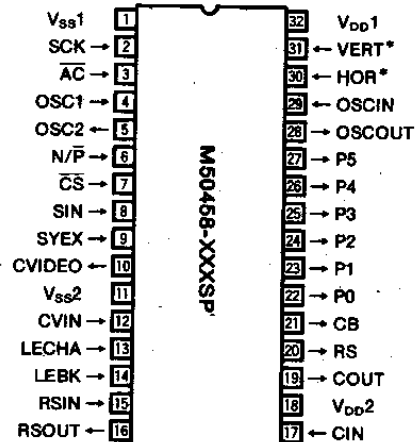
Video RAM displaying ..... External font

Port output

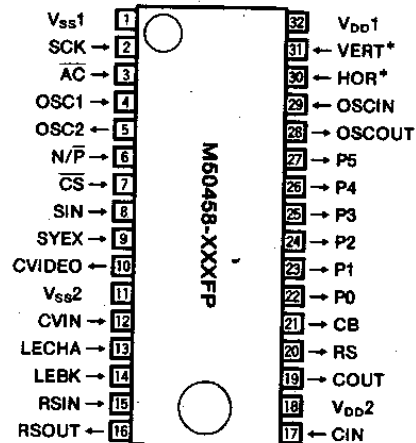
6 ports

(software can switch between R\*, G\*, B\*, YM\*, BLNK\* and CSYN)

### PIN CONFIGURATION (TOP VIEW)



Outline 32P4B



Outline 32P2W

Note : The pins remarked "\*" are selectable the input or output polarity when the character ROM masked.

- Composite video signal generation ..... NTSC and PAL
- Video mixer ..... Built-in
- Component signal output  
 ..... Y (luminance) - C (color signal) output

### APPLICATION

TVs, VCRs

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

PIN DESCRIPTION

Pin Number	Symbol	Pin name	Input /Output	Function
1	V <sub>ss1</sub>	Earthing pin	—	Please connect to GND using digital circuit earthing pin.
2	SCK	Serial clock input	Input	When $\overline{CS}$ pin is "L", SIN serial data is taken in when SCK rises. Hysteresis input. Includes built-in pull-up resistor.
3	$\overline{AC}$	Auto-clear input	Input	When "L", this pin resets the internal IC circuit. Hysteresis input. Includes built-in pull-up resistor.
4	OSC1	Pin for attachment of external oscillator circuit	Input	There are the pins for attaching an external display oscillator circuit. The standard oscillation frequency is approximately 7MHz. This oscillation frequency determines the horizontal position of the display on the TV screen and the width of the characters. LC oscillation and CR oscillation are possible.
5	OSC2		Output	
6	N/P	NTSC/PAL switching input	Input	This is an NTSC and PAL synchronizing signal generation switching pin. When "H", it generates NTSC synchronizing signals, and when "L" it generates PAL synchronizing signals. Includes built-in pull-up resistor.
7	$\overline{CS}$	Chip select input	Input	This is the chip select pin, and when serial data transmission is being carried out, it goes to "L". Includes built-in pull-up resistor.
8	SIN	Serial data input	Input	This is the pin for serial input of data and addresses for the display control register and the display data memory. Includes built-in pull-up resistor.
9	SYEX	Synchronization signal switching input	Input	This is the pin which switches the external and internal synchronization signals. When "H", this pin specifies external synchronization signals and when "L" it specifies internal synchronization signals. SYEX is determined by the logical sum of the internal synchronization priority and the EX register at address 295 within the display control register. When SYEX is "L", it specifies internal synchronization signals regardless of the value in the EX register. Includes built-in pull-up resistor.
10	CVIDEO	Composite video signal output	Output	This is the output pin for composite video signals. It outputs 2V <sub>p-p</sub> composite video signals. In superimpose mode, character output etc. is superimposed on the external composite video signals from CVIN. With independent Y-C output, this pin outputs Y (luminance) signals.
11	V <sub>ss2</sub>	Earthing pin	—	Please earth to GND using analog earthing pin.
12	CVIN	Composite video signal input	Input	This is the input pin for composite video signals. Please clamp 2V <sub>p-p</sub> composite video signals externally before input. In superimpose mode, character output etc. is superimposed on these composite video signals. With independent Y-C output, this pin inputs Y (luminance) signals.
13	LECHA	Character level input	Input	This is the input pin which determines the "white" character color level in the composite video signal.
14	LEBK	Blanking level input	Input	This is the input pin which determines the "black" character color and blanking level in the composite video signal.
15	RSIN	Video signal input	Input	This is the input pin for the video signal with internal synchronization. Input the RSOUT pin output signal to this pin.
16	RSOUT	Video signal output	Output	This is the output pin for the video signal with internal synchronization. Connect to the RSIN pin.
17	CIN	Chroma signal input	Input	This is the input pin for C (chroma) signals during independent Y-C output.
18	V <sub>DD2</sub>	Power pin	—	Please connect to +5V with the analog circuit power pin.
19	COU	Chroma signal output	Output	This is the output pin for C (chroma) signals for independent Y-C output.
20	RS	Carrier color signal output	Output	This is the output pin for the carrier color signal in the video signal. This pin outputs the signal with phase angle for the color burst signal CB. Amplitude 5V.

MITSUBISHI MICROCOMPUTERS  
**M50458-XXXSP/FP**

**SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS**

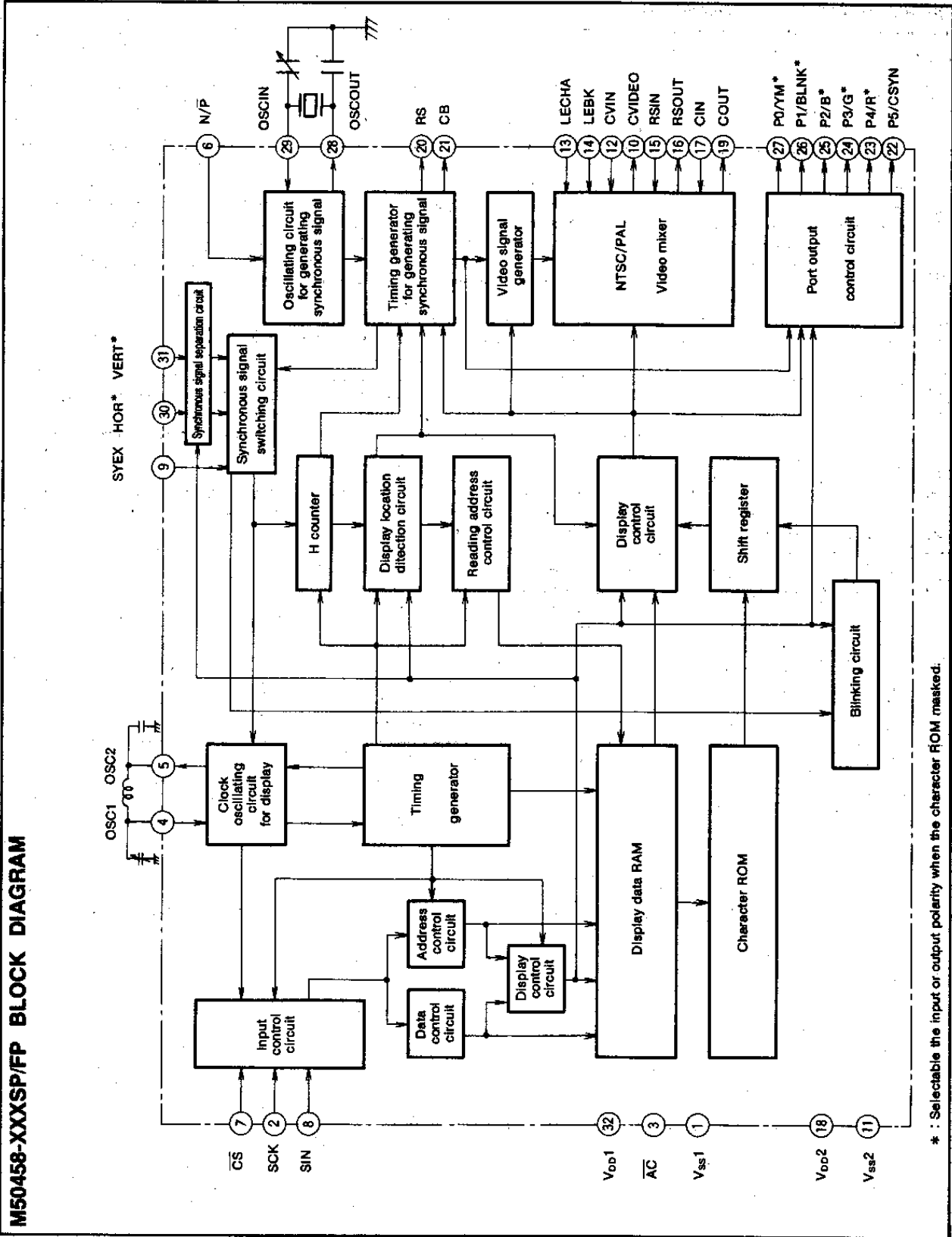
**PIN DESCRIPTION (Continued)**

Pin Number	Symbol	Pin name	Input /Output	Function
21	CB	Color burst signal output	Output	This pin outputs a 3.58MHz color burst signal for NTSC and a 4.43MHz color burst signal for PAL. Amplitude 5V.
22	P0	Port 0 output	Output	This pin can be toggled between port pin output and YM* (brightness) signal output. With YM* signal output, polarity can be selected when determining the character ROM.
23	P1	Port 1 output	Output	This pin can be toggled between port pin output and BLNK* (display blanking) signal output. With BLNK* signal output, polarity can be selected when determining the character ROM.
24	P2	Port 2 output	Output	This pin can be toggled between port pin output and B* (blue) signal output. With B* signal output, polarity can be selected when determining the character ROM.
25	P3	Port 3 output	Output	This pin can be toggled between port pin output and G* (green) signal output. With G* signal output, polarity can be selected when determining the character ROM.
26	P4	Port 4 output	Output	This pin can be toggled between port pin output and R* (red) signal output. With R* signal output, polarity can be selected when determining the character ROM.
27	P5	Port 5 output	Output	This pin can be toggled between port pin output and CSYN (composite synchronization) signal output.
28	OSCOU	Oscillator circuit for synchronization signal generation	Output	This is the pin for attaching an external oscillator circuit for generating the synchronization signal. An oscillation of 14.32MHz is needed for NTSC, and an oscillation of 17.73MHz is needed for PAL, using a crystal oscillator.
29	OSCIN		Input	
30	HOR*	Horizontal synchronization signal input	Input	This pin inputs the horizontal synchronization signal. Hysteresis input. Polarity can be selected when the character ROM is determined.
31	VERT*	Vertical synchronization signal input	Input	This pin inputs the vertical synchronization signal. Hysteresis input. Polarity can be selected when the character ROM is determined.
32	V <sub>DD1</sub>	Power pin	—	Please connect to +5V with the digital circuit power pin.

Note : The pins remarked "\*" are selectable the input or output polarity when the character ROM masked.

**SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS**

**M50458-XXXSP/FP BLOCK DIAGRAM**



\* : Selectable the input or output polarity when the character ROM masked.

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

DISPLAY CONSTRUCTION

The display construction is selectable the fixation display mode or the vertical scrolling display mode.

Fixation display mode

The fixation display mode can be displayed the 24 characters by 12 lines.

		24 characters																							
Column	Line	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	1	000 <sub>16</sub>	001 <sub>16</sub>	002 <sub>16</sub>	003 <sub>16</sub>	004 <sub>16</sub>	005 <sub>16</sub>	006 <sub>16</sub>	007 <sub>16</sub>	008 <sub>16</sub>	009 <sub>16</sub>	00A <sub>16</sub>	00B <sub>16</sub>	00C <sub>16</sub>	00D <sub>16</sub>	00E <sub>16</sub>	00F <sub>16</sub>	010 <sub>16</sub>	011 <sub>16</sub>	012 <sub>16</sub>	013 <sub>16</sub>	014 <sub>16</sub>	015 <sub>16</sub>	016 <sub>16</sub>	017 <sub>16</sub>
	2	018 <sub>16</sub>	019 <sub>16</sub>	01A <sub>16</sub>	01B <sub>16</sub>	01C <sub>16</sub>	01D <sub>16</sub>	01E <sub>16</sub>	01F <sub>16</sub>	020 <sub>16</sub>	021 <sub>16</sub>	022 <sub>16</sub>	023 <sub>16</sub>	024 <sub>16</sub>	025 <sub>16</sub>	026 <sub>16</sub>	027 <sub>16</sub>	028 <sub>16</sub>	029 <sub>16</sub>	02A <sub>16</sub>	02B <sub>16</sub>	02C <sub>16</sub>	02D <sub>16</sub>	02E <sub>16</sub>	02F <sub>16</sub>
	3	030 <sub>16</sub>	031 <sub>16</sub>	032 <sub>16</sub>	033 <sub>16</sub>	034 <sub>16</sub>	035 <sub>16</sub>	036 <sub>16</sub>	037 <sub>16</sub>	038 <sub>16</sub>	039 <sub>16</sub>	03A <sub>16</sub>	03B <sub>16</sub>	03C <sub>16</sub>	03D <sub>16</sub>	03E <sub>16</sub>	03F <sub>16</sub>	040 <sub>16</sub>	041 <sub>16</sub>	042 <sub>16</sub>	043 <sub>16</sub>	044 <sub>16</sub>	045 <sub>16</sub>	046 <sub>16</sub>	047 <sub>16</sub>
	4	048 <sub>16</sub>	049 <sub>16</sub>	04A <sub>16</sub>	04B <sub>16</sub>	04C <sub>16</sub>	04D <sub>16</sub>	04E <sub>16</sub>	04F <sub>16</sub>	050 <sub>16</sub>	051 <sub>16</sub>	052 <sub>16</sub>	053 <sub>16</sub>	054 <sub>16</sub>	055 <sub>16</sub>	056 <sub>16</sub>	057 <sub>16</sub>	058 <sub>16</sub>	059 <sub>16</sub>	05A <sub>16</sub>	05B <sub>16</sub>	05C <sub>16</sub>	05D <sub>16</sub>	05E <sub>16</sub>	05F <sub>16</sub>
	5	060 <sub>16</sub>	061 <sub>16</sub>	062 <sub>16</sub>	063 <sub>16</sub>	064 <sub>16</sub>	065 <sub>16</sub>	066 <sub>16</sub>	067 <sub>16</sub>	068 <sub>16</sub>	069 <sub>16</sub>	06A <sub>16</sub>	06B <sub>16</sub>	06C <sub>16</sub>	06D <sub>16</sub>	06E <sub>16</sub>	06F <sub>16</sub>	070 <sub>16</sub>	071 <sub>16</sub>	072 <sub>16</sub>	073 <sub>16</sub>	074 <sub>16</sub>	075 <sub>16</sub>	076 <sub>16</sub>	077 <sub>16</sub>
	6	078 <sub>16</sub>	079 <sub>16</sub>	07A <sub>16</sub>	07B <sub>16</sub>	07C <sub>16</sub>	07D <sub>16</sub>	07E <sub>16</sub>	07F <sub>16</sub>	080 <sub>16</sub>	081 <sub>16</sub>	082 <sub>16</sub>	083 <sub>16</sub>	084 <sub>16</sub>	085 <sub>16</sub>	086 <sub>16</sub>	087 <sub>16</sub>	088 <sub>16</sub>	089 <sub>16</sub>	08A <sub>16</sub>	08B <sub>16</sub>	08C <sub>16</sub>	08D <sub>16</sub>	08E <sub>16</sub>	08F <sub>16</sub>
12	7	080 <sub>16</sub>	081 <sub>16</sub>	082 <sub>16</sub>	083 <sub>16</sub>	084 <sub>16</sub>	085 <sub>16</sub>	086 <sub>16</sub>	087 <sub>16</sub>	088 <sub>16</sub>	089 <sub>16</sub>	08A <sub>16</sub>	08B <sub>16</sub>	08C <sub>16</sub>	08D <sub>16</sub>	08E <sub>16</sub>	08F <sub>16</sub>	0A0 <sub>16</sub>	0A1 <sub>16</sub>	0A2 <sub>16</sub>	0A3 <sub>16</sub>	0A4 <sub>16</sub>	0A5 <sub>16</sub>	0A6 <sub>16</sub>	0A7 <sub>16</sub>
lines	8	0A8 <sub>16</sub>	0A9 <sub>16</sub>	0AA <sub>16</sub>	0AB <sub>16</sub>	0AC <sub>16</sub>	0AD <sub>16</sub>	0AE <sub>16</sub>	0AF <sub>16</sub>	0B0 <sub>16</sub>	0B1 <sub>16</sub>	0B2 <sub>16</sub>	0B3 <sub>16</sub>	0B4 <sub>16</sub>	0B5 <sub>16</sub>	0B6 <sub>16</sub>	0B7 <sub>16</sub>	0B8 <sub>16</sub>	0B9 <sub>16</sub>	0BA <sub>16</sub>	0BB <sub>16</sub>	0BC <sub>16</sub>	0BD <sub>16</sub>	0BE <sub>16</sub>	0BF <sub>16</sub>
	9	0C0 <sub>16</sub>	0C1 <sub>16</sub>	0C2 <sub>16</sub>	0C3 <sub>16</sub>	0C4 <sub>16</sub>	0C5 <sub>16</sub>	0C6 <sub>16</sub>	0C7 <sub>16</sub>	0C8 <sub>16</sub>	0C9 <sub>16</sub>	0CA <sub>16</sub>	0CB <sub>16</sub>	0CC <sub>16</sub>	0CD <sub>16</sub>	0CE <sub>16</sub>	0CF <sub>16</sub>	0D0 <sub>16</sub>	0D1 <sub>16</sub>	0D2 <sub>16</sub>	0D3 <sub>16</sub>	0D4 <sub>16</sub>	0D5 <sub>16</sub>	0D6 <sub>16</sub>	0D7 <sub>16</sub>
	10	0D8 <sub>16</sub>	0D9 <sub>16</sub>	0DA <sub>16</sub>	0DB <sub>16</sub>	0DC <sub>16</sub>	0DD <sub>16</sub>	0DE <sub>16</sub>	0DF <sub>16</sub>	0E0 <sub>16</sub>	0E1 <sub>16</sub>	0E2 <sub>16</sub>	0E3 <sub>16</sub>	0E4 <sub>16</sub>	0E5 <sub>16</sub>	0E6 <sub>16</sub>	0E7 <sub>16</sub>	0E8 <sub>16</sub>	0E9 <sub>16</sub>	0EA <sub>16</sub>	0EB <sub>16</sub>	0EC <sub>16</sub>	0ED <sub>16</sub>	0EE <sub>16</sub>	0EF <sub>16</sub>
	11	0F0 <sub>16</sub>	0F1 <sub>16</sub>	0F2 <sub>16</sub>	0F3 <sub>16</sub>	0F4 <sub>16</sub>	0F5 <sub>16</sub>	0F6 <sub>16</sub>	0F7 <sub>16</sub>	0F8 <sub>16</sub>	0F9 <sub>16</sub>	0FA <sub>16</sub>	0FB <sub>16</sub>	0FC <sub>16</sub>	0FD <sub>16</sub>	0FE <sub>16</sub>	0FF <sub>16</sub>	100 <sub>16</sub>	101 <sub>16</sub>	102 <sub>16</sub>	103 <sub>16</sub>	104 <sub>16</sub>	105 <sub>16</sub>	106 <sub>16</sub>	107 <sub>16</sub>
	12	108 <sub>16</sub>	109 <sub>16</sub>	10A <sub>16</sub>	10B <sub>16</sub>	10C <sub>16</sub>	10D <sub>16</sub>	10E <sub>16</sub>	10F <sub>16</sub>	110 <sub>16</sub>	111 <sub>16</sub>	112 <sub>16</sub>	113 <sub>16</sub>	114 <sub>16</sub>	115 <sub>16</sub>	116 <sub>16</sub>	117 <sub>16</sub>	118 <sub>16</sub>	119 <sub>16</sub>	11A <sub>16</sub>	11B <sub>16</sub>	11C <sub>16</sub>	11D <sub>16</sub>	11E <sub>16</sub>	11F <sub>16</sub>

The hexadecimal numbers in the boxes show the display RAM address.

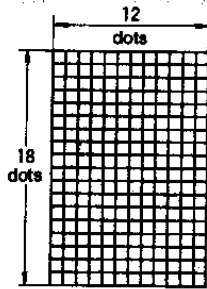


Fig. 1 Display configuration in fixation display mode

**SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS**

**Vertical scrolling display mode**

The vertical scrolling display mode can be displayed the 24

characters at fixed first line, and the other 10 lines can be scrolled with the 24 characters by each lines.

Column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Line	1	000 <sub>16</sub>	001 <sub>16</sub>	002 <sub>16</sub>	003 <sub>16</sub>	004 <sub>16</sub>	005 <sub>16</sub>	006 <sub>16</sub>	007 <sub>16</sub>	008 <sub>16</sub>	009 <sub>16</sub>	00A <sub>16</sub>	00B <sub>16</sub>	00C <sub>16</sub>	00D <sub>16</sub>	00E <sub>16</sub>	00F <sub>16</sub>	010 <sub>16</sub>	011 <sub>16</sub>	012 <sub>16</sub>	013 <sub>16</sub>	014 <sub>16</sub>	015 <sub>16</sub>	016 <sub>16</sub>	017 <sub>16</sub>
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
10																									
11																									
Dummy line	12																								

Fig. 2 Display configuration in vertical scrolling mode

# MITSUBISHI MICROCOMPUTERS M50458-XXXSP/FP

## SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

### MEMORY CONFIGURATION

Memory addresses and data consist of 16 bits. Addresses 0 to 287 contain display data.  
Addresses 288 to 295 form the display control register.

When it is reset by the  $\overline{AC}$  terminal, all the addresses in the display control register are set to "0".

The data bits DAF to DAD and the display RAM data bit DA7 should also be set to "0".

Address	Bit	DAF	DAE	DAD	DAC	DAB	DAA	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0	Remarks
000 <sub>16</sub>		0	0	0	EXP	BLINK	B	G	R	0	C <sub>6</sub>	C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>	Display RAM
					Extended bit	Blinking bit	Color bits			Character code bits								
11F <sub>16</sub>		0	0	0	EXP	BLINK	B	G	R	0	C <sub>6</sub>	C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>	
120 <sub>16</sub>		0	0	0	SYNC V	PTD 5	PTD 4	PTD 3	PTD 2	PTD 1	PTD 0	PTC 5	PTC 4	PTC 3	PTC 2	PTC 1	PTC 0	Normal port output
121 <sub>16</sub>		0	0	0	PALH	HSZ 31	HSZ 30	HSZ 21	HSZ 20	HSZ 11	HSZ 10	HP5	HP4	HP3	HP2	HP1	HP0	Horizontal display location
122 <sub>16</sub>		0	0	0	BLKK	VSZ 31	VSZ 30	VSZ 21	VSZ 20	VSZ 11	VSZ 10	VP5	VP4	VP3	VP2	VP1	VP0	Horizontal character size
123 <sub>16</sub>		0	0	0	PAL 25	SCRR 3	SCRR 2	SCRR 1	SCRR 0	STRSCB	SPACE 1	SPACE 0	SCRF 4	SCRF 3	SCRF 2	SCRF 1	SCRF 0	Vertical display location
124 <sub>16</sub>		0	0	0	LINE U	DSP B	DSP A	DSP 9	DSP 8	DSP 7	DSP 6	DSP 5	DSP 4	DSP 3	DSP 2	DSP 1	DSP 0	Vertical character size
125 <sub>16</sub>		0	0	0	TEST 2	TEST 1	TEST 0	SEPV	WCB	FSC	ALL24	EXP 1	EXP 0	SRND	BLINK 2	BLINK 1	BLINK 0	Lengthwise scroll
126 <sub>16</sub>		0	0	0	LC BTM	LC TOP	CRL B	CRL G	CRL R	B/W	BB	BG	BR	LEVEL 0	PHASE 2	PHASE 1	PHASE 0	RAM erase, and so on
127 <sub>16</sub>		0	0	0	INT / NON	SYMS	SCOR	STOP I	STOP IN	DSP ON	DSP ONV	RAMERS	EX	BLK 1	BLK 0	YM	BCOL	Blanking mode
																		Blinking
																		Composite-video signal
																		Display control

Fig. 3 Memory configuration

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

REGISTERS DESCRIPTION

(1) Address 288 (120<sub>16</sub>)

DA	Register	Contents		Remarks	
		Status	Function		
0	PTC0	0	P0 output (port 0)	Port output control	
		1	YM* output		
1	PTC1	0	P1 output (port 1)		
		1	BLNK* output		
2	PTC2	0	P2 output (port 2)		
		1	B* output		
3	PTC3	0	P3 output (port 3)		
		1	G* output		
4	PTC4	0	P4 output (port 4)		
		1	R* output		
5	PTC5	0	P5 output (port 5)		
		1	CSYN output		
6	PTD0	0	P0 output "L"		Port data control
		1	P0 output "H"		
7	PTD1	0	P1 output "L"		
		1	P1 output "H"		
8	PTD2	0	P2 output "L"		
		1	P2 output "H"		
9	PTD3	0	P3 output "L"		
		1	P3 output "H"		
A	PTD4	0	P4 output "L"		
		1	P4 output "H"		
B	PTD5	0	P5 output "L"		
		1	P5 output "H"		
C	SYNCV	0	Port output is not synchronized with vertical synchronizing signals	Synchronize port output with vertical synchronizing signals	
		1	Port output is synchronized with vertical synchronizing signals		
D	—	0	Set "0" only.		
E	—	0			
F	—	0			



SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(2) Address 289 (121<sub>16</sub>)

DA	Register	Contents		Remarks																				
		Status	Function																					
0	HP0 (LSB)	0	If HS is the horizontal display start location,  $HS = T \times \left( 4 \sum_{n=0}^5 2^n HP_n + N \right).$ T : The oscillation cycle of oscillator OSC1, 2	Horizontal display start location is specified using the 6 bits from HP5 to HP0. Note : HP0 ~ 5 = (000000 <sub>2</sub> ) and (100000 <sub>2</sub> ) setting is forbidden																				
		1																						
1	HP1	0																						
		1																						
2	HP2	0																						
		1																						
3	HP3	0			<table border="1"> <thead> <tr> <th>HSZ11</th> <th>HSZ10</th> <th rowspan="3">N</th> </tr> </thead> <tbody> <tr> <th>HSZ21</th> <th>HSZ20</th> </tr> <tr> <th>HSZ31</th> <th>HSZ30</th> </tr> <tr> <td>0</td> <td>0</td> <td>10</td> </tr> <tr> <td>0</td> <td>1</td> <td>11</td> </tr> <tr> <td>1</td> <td>0</td> <td>12</td> </tr> <tr> <td>1</td> <td>1</td> <td>13</td> </tr> </tbody> </table>	HSZ11	HSZ10	N	HSZ21	HSZ20	HSZ31	HSZ30	0	0	10	0	1	11	1	0	12	1	1	13
		HSZ11				HSZ10	N																	
HSZ21	HSZ20																							
HSZ31	HSZ30																							
0	0	10																						
0	1	11																						
1	0	12																						
1	1	13																						
4	HP4	0																						
		1																						
5	HP5 (MSB)	0																						
		1																						
6	HSZ10	0	<table border="1"> <thead> <tr> <th>HSZ10</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>HSZ11</th> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1T/dot</td> <td>2T/dot</td> </tr> <tr> <td>1</td> <td>3T/dot</td> <td>4T/dot</td> </tr> </tbody> </table>	HSZ10	0	1	HSZ11	0	1	0	1T/dot	2T/dot	1	3T/dot	4T/dot	Character size in the horizontal direction for the first line.								
		HSZ10		0	1																			
HSZ11	0	1																						
0	1T/dot	2T/dot																						
1	3T/dot	4T/dot																						
1																								
7	HSZ11	0	<table border="1"> <thead> <tr> <th>HSZ20</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>HSZ21</th> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1T/dot</td> <td>2T/dot</td> </tr> <tr> <td>1</td> <td>3T/dot</td> <td>4T/dot</td> </tr> </tbody> </table>	HSZ20	0	1	HSZ21	0	1	0	1T/dot	2T/dot	1	3T/dot	4T/dot	Character size in the horizontal direction for lines 2 to 11.								
		HSZ20		0	1																			
HSZ21	0	1																						
0	1T/dot	2T/dot																						
1	3T/dot	4T/dot																						
1																								
8	HSZ20	0	<table border="1"> <thead> <tr> <th>HSZ30</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>HSZ31</th> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1T/dot</td> <td>2T/dot</td> </tr> <tr> <td>1</td> <td>3T/dot</td> <td>4T/dot</td> </tr> </tbody> </table>	HSZ30	0	1	HSZ31	0	1	0	1T/dot	2T/dot	1	3T/dot	4T/dot	Character size in the horizontal direction for line 12.								
		HSZ30		0	1																			
HSZ31	0	1																						
0	1T/dot	2T/dot																						
1	3T/dot	4T/dot																						
1																								
9	HSZ21	0	<table border="1"> <thead> <tr> <th>HSZ30</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>HSZ31</th> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1T/dot</td> <td>2T/dot</td> </tr> <tr> <td>1</td> <td>3T/dot</td> <td>4T/dot</td> </tr> </tbody> </table>	HSZ30	0	1	HSZ31	0	1	0	1T/dot	2T/dot	1	3T/dot	4T/dot	Character size in the horizontal direction for line 12.								
		HSZ30		0	1																			
HSZ31	0	1																						
0	1T/dot	2T/dot																						
1	3T/dot	4T/dot																						
1																								
A	HSZ30	0	<table border="1"> <thead> <tr> <th>HSZ30</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>HSZ31</th> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1T/dot</td> <td>2T/dot</td> </tr> <tr> <td>1</td> <td>3T/dot</td> <td>4T/dot</td> </tr> </tbody> </table>	HSZ30	0	1	HSZ31	0	1	0	1T/dot	2T/dot	1	3T/dot	4T/dot	Character size in the horizontal direction for line 12.								
		HSZ30		0	1																			
HSZ31	0	1																						
0	1T/dot	2T/dot																						
1	3T/dot	4T/dot																						
1																								
B	HSZ31	0	<table border="1"> <thead> <tr> <th>HSZ30</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>HSZ31</th> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1T/dot</td> <td>2T/dot</td> </tr> <tr> <td>1</td> <td>3T/dot</td> <td>4T/dot</td> </tr> </tbody> </table>	HSZ30	0	1	HSZ31	0	1	0	1T/dot	2T/dot	1	3T/dot	4T/dot	Character size in the horizontal direction for line 12.								
		HSZ30		0	1																			
HSZ31	0	1																						
0	1T/dot	2T/dot																						
1	3T/dot	4T/dot																						
1																								
C	PALH	0	The vertical synchronizing is interlace 625 and noninterlace 626 of horizontal synchronizing.	It is available in PAL mode. In NTSC mode, status is "0".																				
		1	The vertical synchronizing is interlace 627 and noninterlace 628 of horizontal synchronizing.																					
D	—	0																						
E	—	0	Set "0" only.																					
F	—	0																						

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(3) Address 290 (122<sub>16</sub>)

DA	Register	Contents		Remarks											
		Status	Function												
0	VP0 (LSB)	0	If VS is the vertical display start location,  $VS = H \times (4 \sum_{n=0}^5 2^n VP_n + 3).$ H : Synchronized with the vertical synchronizing pulse	The vertical start location is specified using the 6 bits from VP5 to VP0.											
		1													
1	VP1	0													
		1													
2	VP2	0													
		1													
3	VP3	0													
		1													
4	VP4	0													
		1													
5	VP5 (MSB)	0													
		1													
6	VSZ10	0	<table border="1"> <tr> <td>VSZ10 \ VSZ11</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1H/dot</td> <td>2H/dot</td> </tr> <tr> <td>1</td> <td>3H/dot</td> <td>4H/dot</td> </tr> </table>	VSZ10 \ VSZ11	0	1	0	1H/dot	2H/dot	1	3H/dot	4H/dot	Character size in the vertical direction for the first line.		
		VSZ10 \ VSZ11		0	1										
0	1H/dot	2H/dot													
1	3H/dot	4H/dot													
1															
7	VSZ11	0													
		1													
8	VSZ20	0		<table border="1"> <tr> <td>VSZ20 \ VSZ21</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1H/dot</td> <td>2H/dot</td> </tr> <tr> <td>1</td> <td>3H/dot</td> <td>4H/dot</td> </tr> </table>	VSZ20 \ VSZ21	0	1	0	1H/dot	2H/dot	1	3H/dot		4H/dot	Character size in the vertical direction for lines 2 to 11.
		VSZ20 \ VSZ21			0	1									
0	1H/dot	2H/dot													
1	3H/dot	4H/dot													
1															
9	VSZ21	0													
		1													
A	VSZ30	0	<table border="1"> <tr> <td>VSZ30 \ VSZ31</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1H/dot</td> <td>2H/dot</td> </tr> <tr> <td>1</td> <td>3H/dot</td> <td>4H/dot</td> </tr> </table>		VSZ30 \ VSZ31	0	1	0	1H/dot	2H/dot	1	3H/dot	4H/dot	Character size in the vertical direction for line 12.	
		VSZ30 \ VSZ31			0	1									
0	1H/dot	2H/dot													
1	3H/dot	4H/dot													
1															
B	VSZ31	0													
		1													
C	BLKK	0		The halftone displaying "OFF" in superimpose.	This register is available in the superimpose displaying only.										
		1		The halftone displaying "ON" in superimpose.											
D	—	0		Set "0" only.											
E	—	0													
F	—	0													
		0													

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(4) Address 291 (123<sub>16</sub>)

DA	Register	Contents				Remarks																																																						
		Status	Function																																																									
0	SCRF0 (LSB)	0	<table border="1"> <thead> <tr> <th>SCRF4</th> <th>SCRF3</th> <th>SCRF2</th> <th>SCRF1</th> <th>SCRF0</th> <th>Dot setting in vertical direction within font</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>1st dot</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>2nd dot</td> </tr> <tr> <td colspan="6" style="text-align:center">⋮</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> <td>18th dot</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td rowspan="2">Setting is forbidden</td> </tr> <tr> <td colspan="6" style="text-align:center">⋮</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td></td> </tr> </tbody> </table>				SCRF4	SCRF3	SCRF2	SCRF1	SCRF0	Dot setting in vertical direction within font	0	0	0	0	0	1st dot	0	0	0	0	1	2nd dot	⋮						1	0	1	0	0	18th dot	1	1	1	0	0	Setting is forbidden	⋮						1	1	1	1	1		Dot setting in vertical direction within font when in vertical scrolling display mode. Setting range is from SCRF4 to SCRF0 (= "0000 <sub>2</sub> " to "10001 <sub>2</sub> ").					
		SCRF4					SCRF3	SCRF2	SCRF1	SCRF0	Dot setting in vertical direction within font																																																	
0	0	0					0	0	1st dot																																																			
0	0	0					0	1	2nd dot																																																			
⋮																																																												
1	0	1					0	0	18th dot																																																			
1	1	1					0	0	Setting is forbidden																																																			
⋮																																																												
1	1	1					1	1																																																				
1	SCRF1	0					<table border="1"> <thead> <tr> <th>SPACE0</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>SPACE1</th> <td>0</td> <td>No space</td> <td>18H (1 line) space</td> </tr> <tr> <td>1</td> <td>36H (2 line) space</td> <td>54H (3 line) space</td> </tr> </tbody> </table>				SPACE0	0	1	SPACE1	0	No space	18H (1 line) space	1	36H (2 line) space	54H (3 line) space	Vary the space between line 1 and line 2																																							
		SPACE0									0	1																																																
SPACE1	0	No space									18H (1 line) space																																																	
1	36H (2 line) space	54H (3 line) space																																																										
2	SCRF2	0									<table border="1"> <thead> <tr> <th>SCRF4</th> <th>SCRF3</th> <th>SCRF2</th> <th>SCRF1</th> <th>Scroll line setting</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>Scrolling OFF</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>2nd line</td> </tr> <tr> <td colspan="5" style="text-align:center">⋮</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>12th line</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td rowspan="3">Setting is forbidden</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td></td> </tr> </tbody> </table>				SCRF4	SCRF3	SCRF2	SCRF1	Scroll line setting	0		0	0	0	Scrolling OFF	0	0	0	1	2nd line	⋮					1	0	1	1	12th line	1	1	0	0	Setting is forbidden	1	1	0	1	1	1	1	0	1		1	1	1		Scroll line setting when system is in vertical scrolling display mode. Setting range is from SCRR3 to SCRR0 (= "0001 <sub>2</sub> " to "1011 <sub>2</sub> ").
		SCRF4													SCRF3	SCRF2	SCRF1	Scroll line setting																																										
0	0	0													0	Scrolling OFF																																												
0	0	0	1	2nd line																																																								
⋮																																																												
1	0	1	1	12th line																																																								
1	1	0	0	Setting is forbidden																																																								
1	1	0	1																																																									
1	1	1	0																																																									
1	1	1	1																																																									
3	SCRF3	0	<table border="1"> <thead> <tr> <th>SPACE0</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>SPACE1</th> <td>0</td> <td>No space</td> <td>18H (1 line) space</td> </tr> <tr> <td>1</td> <td>36H (2 line) space</td> <td>54H (3 line) space</td> </tr> </tbody> </table>												SPACE0	0	1	SPACE1	0	No space		18H (1 line) space	1	36H (2 line) space	54H (3 line) space	Vary the space between line 1 and line 2																																		
		SPACE0													0	1																																												
SPACE1	0	No space					18H (1 line) space																																																					
1	36H (2 line) space	54H (3 line) space																																																										
4	SCRF4 (MSB)	0					<table border="1"> <thead> <tr> <th>SCRF4</th> <th>SCRF3</th> <th>SCRF2</th> <th>SCRF1</th> <th>Scroll line setting</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>Scrolling OFF</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>2nd line</td> </tr> <tr> <td colspan="5" style="text-align:center">⋮</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>12th line</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td rowspan="3">Setting is forbidden</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td></td> </tr> </tbody> </table>								SCRF4	SCRF3	SCRF2	SCRF1	Scroll line setting	0	0	0	0	Scrolling OFF	0		0	0	1	2nd line	⋮					1	0	1	1	12th line	1	1	0	0	Setting is forbidden	1	1	0	1	1	1	1	0	1	1	1	1		Scroll line setting when system is in vertical scrolling display mode. Setting range is from SCRR3 to SCRR0 (= "0001 <sub>2</sub> " to "1011 <sub>2</sub> ").	
		SCRF4													SCRF3	SCRF2	SCRF1	Scroll line setting																																										
0	0	0									0	Scrolling OFF																																																
0	0	0									1	2nd line																																																
⋮																																																												
1	0	1									1	12th line																																																
1	1	0									0	Setting is forbidden																																																
1	1	0									1																																																	
1	1	1									0																																																	
1	1	1									1																																																	
5	SPACE0	0									<table border="1"> <thead> <tr> <th>SPACE0</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>SPACE1</th> <td>0</td> <td>No space</td> <td>18H (1 line) space</td> </tr> <tr> <td>1</td> <td>36H (2 line) space</td> <td>54H (3 line) space</td> </tr> </tbody> </table>				SPACE0	0	1	SPACE1	0	No space	18H (1 line) space	1	36H (2 line) space	54H (3 line) space	Vary the space between line 1 and line 2																																			
		SPACE0													0	1																																												
SPACE1	0	No space	18H (1 line) space																																																									
1	36H (2 line) space	54H (3 line) space																																																										
6	SPACE1	0	<table border="1"> <thead> <tr> <th>SPACE0</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>SPACE1</th> <td>0</td> <td>No space</td> <td>18H (1 line) space</td> </tr> <tr> <td>1</td> <td>36H (2 line) space</td> <td>54H (3 line) space</td> </tr> </tbody> </table>												SPACE0	0	1	SPACE1	0	No space	18H (1 line) space	1	36H (2 line) space	54H (3 line) space		Vary the space between line 1 and line 2																																		
		SPACE0													0	1																																												
SPACE1	0	No space					18H (1 line) space																																																					
1	36H (2 line) space	54H (3 line) space																																																										
7	STRSCB	0					RS, CB terminals OFF.								RS, CB terminals control.																																													
		1					RS, CB terminals ON.																																																					
8	SCRR0 (LSB)	0					<table border="1"> <thead> <tr> <th>SCRF4</th> <th>SCRF3</th> <th>SCRF2</th> <th>SCRF1</th> <th>Scroll line setting</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>Scrolling OFF</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>2nd line</td> </tr> <tr> <td colspan="5" style="text-align:center">⋮</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>12th line</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td rowspan="3">Setting is forbidden</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td></td> </tr> </tbody> </table>								SCRF4	SCRF3	SCRF2	SCRF1	Scroll line setting	0	0	0	0	Scrolling OFF			0	0	0	1	2nd line	⋮					1	0	1	1	12th line	1	1	0	0	Setting is forbidden	1	1	0	1	1	1	1	0	1	1	1	1		Scroll line setting when system is in vertical scrolling display mode. Setting range is from SCRR3 to SCRR0 (= "0001 <sub>2</sub> " to "1011 <sub>2</sub> ").
		SCRF4													SCRF3	SCRF2	SCRF1	Scroll line setting																																										
0	0	0													0	Scrolling OFF																																												
0	0	0													1	2nd line																																												
⋮																																																												
1	0	1													1	12th line																																												
1	1	0									0	Setting is forbidden																																																
1	1	0									1																																																	
1	1	1									0																																																	
1	1	1									1																																																	
9	SCRR1	0	<table border="1"> <thead> <tr> <th>SPACE0</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>SPACE1</th> <td>0</td> <td>No space</td> <td>18H (1 line) space</td> </tr> <tr> <td>1</td> <td>36H (2 line) space</td> <td>54H (3 line) space</td> </tr> </tbody> </table>								SPACE0	0	1	SPACE1	0	No space	18H (1 line) space	1	36H (2 line) space	54H (3 line) space	Vary the space between line 1 and line 2																																							
		SPACE0									0	1																																																
SPACE1	0	No space									18H (1 line) space																																																	
1	36H (2 line) space	54H (3 line) space																																																										
A	SCRR2	0									<table border="1"> <thead> <tr> <th>SCRF4</th> <th>SCRF3</th> <th>SCRF2</th> <th>SCRF1</th> <th>Scroll line setting</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>Scrolling OFF</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>2nd line</td> </tr> <tr> <td colspan="5" style="text-align:center">⋮</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>12th line</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td rowspan="3">Setting is forbidden</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td></td> </tr> </tbody> </table>				SCRF4	SCRF3	SCRF2	SCRF1	Scroll line setting	0		0	0	0	Scrolling OFF	0	0	0	1	2nd line	⋮					1	0	1	1	12th line	1	1	0	0	Setting is forbidden	1	1	0	1	1	1	1	0	1	1	1	1		Scroll line setting when system is in vertical scrolling display mode. Setting range is from SCRR3 to SCRR0 (= "0001 <sub>2</sub> " to "1011 <sub>2</sub> ").	
		SCRF4													SCRF3	SCRF2	SCRF1	Scroll line setting																																										
0	0	0					0	Scrolling OFF																																																				
0	0	0					1	2nd line																																																				
⋮																																																												
1	0	1					1	12th line																																																				
1	1	0					0	Setting is forbidden																																																				
1	1	0					1																																																					
1	1	1					0																																																					
1	1	1					1																																																					
B	SCRR3 (MSB)	0					<table border="1"> <thead> <tr> <th>SPACE0</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <th>SPACE1</th> <td>0</td> <td>No space</td> <td>18H (1 line) space</td> </tr> <tr> <td>1</td> <td>36H (2 line) space</td> <td>54H (3 line) space</td> </tr> </tbody> </table>								SPACE0	0	1	SPACE1	0	No space		18H (1 line) space	1	36H (2 line) space	54H (3 line) space	Vary the space between line 1 and line 2																																		
		SPACE0													0	1																																												
SPACE1	0	No space	18H (1 line) space																																																									
1	36H (2 line) space	54H (3 line) space																																																										
C	PAL25	0	Not revise the 25Hz vertical synchronizing.												This is available PAL mode only																																													
		1	Revise the 25Hz vertical synchronizing.																																																									
D	—	0	Set "0" only.																																																									
E	—	0																																																										
F	—	0																																																										

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(5) Address 292 (124<sub>16</sub>)

DA	Register	Contents		Remarks																												
		Status	Function																													
0	DSP0	0	Line 1 is in the display mode specified by BLK0 and BLK1	DSP0 to DSPB are each controlled independently.  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>BLK0</th> <th>BLK1</th> <th>DSPn</th> <th>Display mode for line n</th> </tr> </thead> <tbody> <tr> <td rowspan="2">0</td> <td rowspan="2">0</td> <td>0</td> <td>Character</td> </tr> <tr> <td>1</td> <td>Border (Note)</td> </tr> <tr> <td rowspan="2">0</td> <td rowspan="2">1</td> <td>0</td> <td>Character</td> </tr> <tr> <td>1</td> <td>Border</td> </tr> <tr> <td rowspan="2">1</td> <td rowspan="2">0</td> <td>0</td> <td>Border</td> </tr> <tr> <td>1</td> <td>Matrix-outline</td> </tr> <tr> <td rowspan="2">1</td> <td rowspan="2">1</td> <td>0</td> <td>Matrix-outline</td> </tr> <tr> <td>1</td> <td>Character</td> </tr> </tbody> </table>	BLK0	BLK1	DSPn	Display mode for line n	0	0	0	Character	1	Border (Note)	0	1	0	Character	1	Border	1	0	0	Border	1	Matrix-outline	1	1	0	Matrix-outline	1	Character
		BLK0	BLK1		DSPn	Display mode for line n																										
0	0	0	Character																													
		1	Border (Note)																													
0	1	0	Character																													
		1	Border																													
1	0	0	Border																													
		1	Matrix-outline																													
1	1	0	Matrix-outline																													
		1	Character																													
1	DSP1	0	Line 2 is in the display mode specified by BLK0 and BLK1																													
		1	Line 2 is in a different display mode																													
2	DSP2	0	Line 3 is in the display mode specified by BLK0 and BLK1																													
		1	Line 3 is in a different display mode																													
3	DSP3	0	Line 4 is in the display mode specified by BLK0 and BLK1																													
		1	Line 4 is in a different display mode																													
4	DSP4	0	Line 5 is in the display mode specified by BLK0 and BLK1																													
		1	Line 5 is in a different display mode																													
5	DSP5	0	Line 6 is in the display mode specified by BLK0 and BLK1																													
		1	Line 6 is in a different display mode																													
6	DSP6	0	Line 7 is in the display mode specified by BLK0 and BLK1																													
		1	Line 7 is in a different display mode																													
7	DSP7	0	Line 8 is in the display mode specified by BLK0 and BLK1																													
		1	Line 8 is in a different display mode																													
8	DSP8	0	Line 9 is in the display mode specified by BLK0 and BLK1																													
		1	Line 9 is in a different display mode																													
9	DSP9	0	Line 10 is in the display mode specified by BLK0 and BLK1																													
		1	Line 10 is in a different display mode																													
A	DSPA	0	Line 11 is in the display mode specified by BLK0 and BLK1																													
		1	Line 11 is in a different display mode																													
B	DSPB	0	Line 12 is in the display mode specified by BLK0 and BLK1																													
		1	Line 12 is in a different display mode																													
C	LINEU	0	Underline display OFF	Depends on registers DSP0 to DSPB																												
		1	Underline display ON																													
D	—	0	Set "0" only.																													
E	—	0																														
F	—	0																														

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(6) Address 293 (125<sub>16</sub>)

DA	Register	Contents		Remarks												
		Status	Function													
0	BLINK0	0	<table border="1"> <tr> <td></td> <td>BLINK0</td> <td>0</td> <td>1</td> </tr> <tr> <td>BLINK1</td> <td>0</td> <td>Blinking OFF</td> <td>Duty 25%</td> </tr> <tr> <td>1</td> <td>Duty 50%</td> <td>Duty 75%</td> <td></td> </tr> </table>		BLINK0	0	1	BLINK1	0	Blinking OFF	Duty 25%	1	Duty 50%	Duty 75%		Blinking duty ratio can be altered
				BLINK0	0	1										
BLINK1	0	Blinking OFF		Duty 25%												
1	Duty 50%	Duty 75%														
1																
1	BLINK1	0														
		1														
2	BLINK2	0	Division of vertical synchronization signal into 1/64. Cycle-approximately 1 second	Blinking cycle can be altered												
		1	Division of vertical synchronization signal into 1/32. Cycle-approximately 0.5 second													
3	SRND	0	Border size of horizontal direction : 1 dot	Horizontal border size can be altered.												
		1	Border size of horizontal direction : 2 dot													
4	EXP0	0	<table border="1"> <tr> <td></td> <td>EXP0</td> <td>0</td> <td>1</td> </tr> <tr> <td>EXP1</td> <td>0</td> <td>Cursor</td> <td>Reversed character</td> </tr> <tr> <td>1</td> <td>Reversed blinking</td> <td>Alternate blinking</td> <td></td> </tr> </table>		EXP0	0	1	EXP1	0	Cursor	Reversed character	1	Reversed blinking	Alternate blinking		This register is to be used for extending the functions of EXP bits 0 to 287 in the display data memory.
				EXP0	0	1										
EXP1	0	Cursor		Reversed character												
1	Reversed blinking	Alternate blinking														
1																
5	EXP1	0														
		1														
6	ALL24	0	Blanking with all 24 characters in matrix-outline size.	Horizontal display range can be altered when all characters are in matrix-outline size.												
		1	Horizontal display period fully blanked with all characters in matrix-outline size.													
7	FSC	0	OSCIN oscillation frequency 4 × fsc	Oscillation frequency setting for OSCIN terminal (only effective with NTSC)												
		1	OSCIN oscillation frequency 2 × fsc													
8	WCB	0	Color burst width standard.	Color burst signal width can be altered. Variable width-can be extended by the equivalent of one clock pulse on front side of standard width												
		1	Color burst (CB) width altered.													
9	SEPV	0	Synchronization separated circuit OFF.	Vertical synchronization signal is separated from composite synchronization signal (digital).												
		1	Synchronization separated circuit ON.													
A	TEST0	0	Usually, set "0" only.	Test register Exception video RAM display mode.												
B	TEST1	0														
C	TEST2	0														
D	—	0	Set "0" only.													
E	—	0														
F	—	0														

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(7) Address 294 (126<sub>16</sub>)

DA	Register	Contents					Remarks																																														
		Status	Function																																																		
0	PHASE0	0	<table border="1"> <thead> <tr> <th>PHASE2</th> <th>PHASE1</th> <th>PHASE0</th> <th>NTSC Phase angle</th> <th>PAL phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>(Black)</td> <td>(Black)</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td><math>\pi/2</math> [rad.]</td> <td><math>\pm\pi/2</math> [rad.]</td> </tr> </tbody> </table>					PHASE2	PHASE1	PHASE0	NTSC Phase angle	PAL phase angle	0	0	0	(Black)	(Black)	0	0	1	$\pi/2$ [rad.]	$\pm\pi/2$ [rad.]	Raster color setting. Coloring by composite video signals means that the phase angle of the background color signals for the color burst signals can be varied. The angle can be varied in units of $\pi/4$ rad. This differs from coloring by RGB output.																														
		PHASE2	PHASE1	PHASE0	NTSC Phase angle	PAL phase angle																																															
0	0	0	(Black)	(Black)																																																	
0	0	1	$\pi/2$ [rad.]	$\pm\pi/2$ [rad.]																																																	
1	<table border="1"> <thead> <tr> <th>PHASE2</th> <th>PHASE1</th> <th>PHASE0</th> <th>NTSC Phase angle</th> <th>PAL phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>0</td> <td><math>7\pi/4</math> [rad.]</td> <td><math>\mp\pi/4</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>same phase</td> <td>same phase</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td><math>\pi</math> [rad.]</td> <td><math>\pm\pi</math> [rad.]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td><math>3\pi/4</math> [rad.]</td> <td><math>\pm 3\pi/4</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td><math>3\pi/2</math> [rad.]</td> <td><math>\mp\pi/2</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>(White)</td> <td>(White)</td> </tr> </tbody> </table>					PHASE2	PHASE1	PHASE0	NTSC Phase angle	PAL phase angle	0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]	0	1	1	same phase	same phase	1	0		0	$\pi$ [rad.]	$\pm\pi$ [rad.]	1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]	1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]	1	1	1	(White)	(White)												
PHASE2	PHASE1	PHASE0	NTSC Phase angle	PAL phase angle																																																	
0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]																																																	
0	1	1	same phase	same phase																																																	
1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]																																																	
1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]																																																	
1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]																																																	
1	1	1	(White)	(White)																																																	
1	PHASE1	0	<table border="1"> <thead> <tr> <th>PHASE2</th> <th>PHASE1</th> <th>PHASE0</th> <th>NTSC Phase angle</th> <th>PAL phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>0</td> <td><math>7\pi/4</math> [rad.]</td> <td><math>\mp\pi/4</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>same phase</td> <td>same phase</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td><math>\pi</math> [rad.]</td> <td><math>\pm\pi</math> [rad.]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td><math>3\pi/4</math> [rad.]</td> <td><math>\pm 3\pi/4</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td><math>3\pi/2</math> [rad.]</td> <td><math>\mp\pi/2</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>(White)</td> <td>(White)</td> </tr> </tbody> </table>					PHASE2	PHASE1	PHASE0	NTSC Phase angle	PAL phase angle	0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]	0	1	1	same phase	same phase	1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]	1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]	1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]	1	1	1	(White)	(White)											
		PHASE2	PHASE1	PHASE0	NTSC Phase angle	PAL phase angle																																															
0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]																																																	
0	1	1	same phase	same phase																																																	
1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]																																																	
1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]																																																	
1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]																																																	
1	1	1	(White)	(White)																																																	
2	PHASE2	0	<table border="1"> <thead> <tr> <th>PHASE2</th> <th>PHASE1</th> <th>PHASE0</th> <th>NTSC Phase angle</th> <th>PAL phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>0</td> <td><math>7\pi/4</math> [rad.]</td> <td><math>\mp\pi/4</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>same phase</td> <td>same phase</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td><math>\pi</math> [rad.]</td> <td><math>\pm\pi</math> [rad.]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td><math>3\pi/4</math> [rad.]</td> <td><math>\pm 3\pi/4</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td><math>3\pi/2</math> [rad.]</td> <td><math>\mp\pi/2</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>(White)</td> <td>(White)</td> </tr> </tbody> </table>					PHASE2	PHASE1	PHASE0	NTSC Phase angle	PAL phase angle	0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]	0	1	1	same phase	same phase	1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]	1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]	1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]	1	1	1	(White)	(White)											
		PHASE2	PHASE1	PHASE0	NTSC Phase angle	PAL phase angle																																															
0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]																																																	
0	1	1	same phase	same phase																																																	
1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]																																																	
1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]																																																	
1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]																																																	
1	1	1	(White)	(White)																																																	
3	LEVEL0	0	Internal bias OFF					Generation of composite video signal bias potential																																													
		1	Internal bias ON																																																		
4	BR	0	<table border="1"> <thead> <tr> <th>BB</th> <th>BG</th> <th>BR</th> <th>NTS phase angle</th> <th>PAL phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>(Black)</td> <td>(Black)</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td><math>\pi/2</math> [rad.]</td> <td><math>\pm\pi/2</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td><math>7\pi/4</math> [rad.]</td> <td><math>\mp\pi/4</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>same phase</td> <td>same phase</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td><math>\pi</math> [rad.]</td> <td><math>\pm\pi</math> [rad.]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td><math>3\pi/4</math> [rad.]</td> <td><math>\pm 3\pi/4</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td><math>3\pi/2</math> [rad.]</td> <td><math>\mp\pi/2</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>(White)</td> <td>(White)</td> </tr> </tbody> </table>					BB	BG	BR	NTS phase angle	PAL phase angle	0	0	0	(Black)	(Black)	0	0	1	$\pi/2$ [rad.]	$\pm\pi/2$ [rad.]	0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]	0	1	1	same phase	same phase	1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]	1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]	1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]	1	1	1	(White)	(White)	Character background color setting
		BB	BG	BR	NTS phase angle	PAL phase angle																																															
0	0	0	(Black)	(Black)																																																	
0	0	1	$\pi/2$ [rad.]	$\pm\pi/2$ [rad.]																																																	
0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]																																																	
0	1	1	same phase	same phase																																																	
1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]																																																	
1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]																																																	
1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]																																																	
1	1	1	(White)	(White)																																																	
1	<table border="1"> <thead> <tr> <th>BB</th> <th>BG</th> <th>BR</th> <th>NTS phase angle</th> <th>PAL phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>0</td> <td><math>7\pi/4</math> [rad.]</td> <td><math>\mp\pi/4</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>same phase</td> <td>same phase</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td><math>\pi</math> [rad.]</td> <td><math>\pm\pi</math> [rad.]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td><math>3\pi/4</math> [rad.]</td> <td><math>\pm 3\pi/4</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td><math>3\pi/2</math> [rad.]</td> <td><math>\mp\pi/2</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>(White)</td> <td>(White)</td> </tr> </tbody> </table>					BB	BG	BR	NTS phase angle	PAL phase angle	0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]	0	1	1	same phase	same phase	1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]	1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]	1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]	1	1	1	(White)	(White)													
BB	BG	BR	NTS phase angle	PAL phase angle																																																	
0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]																																																	
0	1	1	same phase	same phase																																																	
1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]																																																	
1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]																																																	
1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]																																																	
1	1	1	(White)	(White)																																																	
5	BG	0	<table border="1"> <thead> <tr> <th>BB</th> <th>BG</th> <th>BR</th> <th>NTS phase angle</th> <th>PAL phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>0</td> <td><math>7\pi/4</math> [rad.]</td> <td><math>\mp\pi/4</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>same phase</td> <td>same phase</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td><math>\pi</math> [rad.]</td> <td><math>\pm\pi</math> [rad.]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td><math>3\pi/4</math> [rad.]</td> <td><math>\pm 3\pi/4</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td><math>3\pi/2</math> [rad.]</td> <td><math>\mp\pi/2</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>(White)</td> <td>(White)</td> </tr> </tbody> </table>					BB	BG	BR	NTS phase angle	PAL phase angle	0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]	0	1	1	same phase	same phase	1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]	1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]	1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]	1	1	1	(White)	(White)											
		BB	BG	BR	NTS phase angle	PAL phase angle																																															
0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]																																																	
0	1	1	same phase	same phase																																																	
1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]																																																	
1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]																																																	
1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]																																																	
1	1	1	(White)	(White)																																																	
6	BB	0	<table border="1"> <thead> <tr> <th>BB</th> <th>BG</th> <th>BR</th> <th>NTS phase angle</th> <th>PAL phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>0</td> <td><math>7\pi/4</math> [rad.]</td> <td><math>\mp\pi/4</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>same phase</td> <td>same phase</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td><math>\pi</math> [rad.]</td> <td><math>\pm\pi</math> [rad.]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td><math>3\pi/4</math> [rad.]</td> <td><math>\pm 3\pi/4</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td><math>3\pi/2</math> [rad.]</td> <td><math>\mp\pi/2</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>(White)</td> <td>(White)</td> </tr> </tbody> </table>					BB	BG	BR	NTS phase angle	PAL phase angle	0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]	0	1	1	same phase	same phase	1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]	1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]	1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]	1	1	1	(White)	(White)											
		BB	BG	BR	NTS phase angle	PAL phase angle																																															
0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]																																																	
0	1	1	same phase	same phase																																																	
1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]																																																	
1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]																																																	
1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]																																																	
1	1	1	(White)	(White)																																																	
7	B/W	0	Blanking level : white					Blanking level can be toggled between black and white																																													
		1	Blanking level : black																																																		
8	CRLR	0	<table border="1"> <thead> <tr> <th>CRLB</th> <th>CRLG</th> <th>CRLR</th> <th>NTSC phase angle</th> <th>NTSC phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>(Black)</td> <td>(Black)</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td><math>\pi/2</math> [rad.]</td> <td><math>\pm\pi/2</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td><math>7\pi/4</math> [rad.]</td> <td><math>\mp\pi/4</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>same phase</td> <td>same phase</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td><math>\pi</math> [rad.]</td> <td><math>\pm\pi</math> [rad.]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td><math>3\pi/4</math> [rad.]</td> <td><math>\pm 3\pi/4</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td><math>3\pi/2</math> [rad.]</td> <td><math>\mp\pi/2</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>(White)</td> <td>(White)</td> </tr> </tbody> </table>					CRLB	CRLG	CRLR	NTSC phase angle	NTSC phase angle	0	0	0	(Black)	(Black)	0	0	1	$\pi/2$ [rad.]	$\pm\pi/2$ [rad.]	0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]	0	1	1	same phase	same phase	1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]	1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]	1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]	1	1	1	(White)	(White)	Color setting for cursor display and underline display
		CRLB	CRLG	CRLR	NTSC phase angle	NTSC phase angle																																															
0	0	0	(Black)	(Black)																																																	
0	0	1	$\pi/2$ [rad.]	$\pm\pi/2$ [rad.]																																																	
0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]																																																	
0	1	1	same phase	same phase																																																	
1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]																																																	
1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]																																																	
1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]																																																	
1	1	1	(White)	(White)																																																	
1	<table border="1"> <thead> <tr> <th>CRLB</th> <th>CRLG</th> <th>CRLR</th> <th>NTSC phase angle</th> <th>NTSC phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>0</td> <td><math>7\pi/4</math> [rad.]</td> <td><math>\mp\pi/4</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>same phase</td> <td>same phase</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td><math>\pi</math> [rad.]</td> <td><math>\pm\pi</math> [rad.]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td><math>3\pi/4</math> [rad.]</td> <td><math>\pm 3\pi/4</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td><math>3\pi/2</math> [rad.]</td> <td><math>\mp\pi/2</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>(White)</td> <td>(White)</td> </tr> </tbody> </table>					CRLB	CRLG	CRLR	NTSC phase angle	NTSC phase angle	0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]	0	1	1	same phase	same phase	1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]	1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]	1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]	1	1	1	(White)	(White)													
CRLB	CRLG	CRLR	NTSC phase angle	NTSC phase angle																																																	
0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]																																																	
0	1	1	same phase	same phase																																																	
1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]																																																	
1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]																																																	
1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]																																																	
1	1	1	(White)	(White)																																																	
9	CRLG	0	<table border="1"> <thead> <tr> <th>CRLB</th> <th>CRLG</th> <th>CRLR</th> <th>NTSC phase angle</th> <th>NTSC phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>0</td> <td><math>7\pi/4</math> [rad.]</td> <td><math>\mp\pi/4</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>same phase</td> <td>same phase</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td><math>\pi</math> [rad.]</td> <td><math>\pm\pi</math> [rad.]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td><math>3\pi/4</math> [rad.]</td> <td><math>\pm 3\pi/4</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td><math>3\pi/2</math> [rad.]</td> <td><math>\mp\pi/2</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>(White)</td> <td>(White)</td> </tr> </tbody> </table>					CRLB	CRLG	CRLR	NTSC phase angle	NTSC phase angle	0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]	0	1	1	same phase	same phase	1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]	1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]	1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]	1	1	1	(White)	(White)											
		CRLB	CRLG	CRLR	NTSC phase angle	NTSC phase angle																																															
0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]																																																	
0	1	1	same phase	same phase																																																	
1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]																																																	
1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]																																																	
1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]																																																	
1	1	1	(White)	(White)																																																	
A	CRLB	0	<table border="1"> <thead> <tr> <th>CRLB</th> <th>CRLG</th> <th>CRLR</th> <th>NTSC phase angle</th> <th>NTSC phase angle</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> <td>0</td> <td><math>7\pi/4</math> [rad.]</td> <td><math>\mp\pi/4</math> [rad.]</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>same phase</td> <td>same phase</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td><math>\pi</math> [rad.]</td> <td><math>\pm\pi</math> [rad.]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td><math>3\pi/4</math> [rad.]</td> <td><math>\pm 3\pi/4</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td><math>3\pi/2</math> [rad.]</td> <td><math>\mp\pi/2</math> [rad.]</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>(White)</td> <td>(White)</td> </tr> </tbody> </table>					CRLB	CRLG	CRLR	NTSC phase angle	NTSC phase angle	0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]	0	1	1	same phase	same phase	1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]	1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]	1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]	1	1	1	(White)	(White)											
		CRLB	CRLG	CRLR	NTSC phase angle	NTSC phase angle																																															
0	1	0	$7\pi/4$ [rad.]	$\mp\pi/4$ [rad.]																																																	
0	1	1	same phase	same phase																																																	
1	0	0	$\pi$ [rad.]	$\pm\pi$ [rad.]																																																	
1	0	1	$3\pi/4$ [rad.]	$\pm 3\pi/4$ [rad.]																																																	
1	1	0	$3\pi/2$ [rad.]	$\mp\pi/2$ [rad.]																																																	
1	1	1	(White)	(White)																																																	
B	LCTOP	0	Dot 1 : same color as characters					Coloring for cursor display and underline display																																													
		1	Dot 1 : color specified by CRLB to CRLR																																																		
C	LCBTM	0	Dot 18 : same color as characters																																																		
		1	Dot 18 : color specified by CRLB to CRLR																																																		
D	—	0	Set "0" only.																																																		
E	—	0																																																			
F	—	0																																																			

MITSUBISHI MICROCOMPUTERS  
M50458-XXXSP/FP

ON SCREEN DISPLAY CONTROLLER

(8) Address 295 (127<sub>16</sub>)

DA	Register	Contents		Remarks												
		Status	Function													
0	BCOL	0	Blanking specified by display mode	Variable blanking for reater area												
		1	Coloring for whole TV screen (full raster)													
1	Y <sub>M</sub>	0	Character color and background color brightness identical	Background color brightness variable. Only effective for RGB output												
		1	Background color brightness variable													
2	BLK0	0	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td></td> <td>BLK0</td> <td>0</td> <td>1</td> </tr> <tr> <td>BLK1</td> <td>0</td> <td>Blanking OFF</td> <td>Character size</td> </tr> <tr> <td></td> <td>1</td> <td>Border size</td> <td>Matrix-outline size</td> </tr> </table>		BLK0	0	1	BLK1	0	Blanking OFF	Character size		1	Border size	Matrix-outline size	Display mode variable
				BLK0	0	1										
BLK1	0	Blanking OFF	Character size													
	1	Border size	Matrix-outline size													
1																
3	BLK1	0														
		1														
4	EX	0	External synchronization	Synchronization signal switching												
		1	Internal synchronization													
5	RAMERS	0	RAM not erased	Display RAM is erased. This register does not exist.												
		1	RAM erased													
6	DSPONV	0	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td></td> <td>DSPONV</td> <td>0</td> <td>1</td> </tr> <tr> <td>DSPON</td> <td>0</td> <td>RGB output : OFF Composite video output : OFF</td> <td>RGB output : OFF Composite video output : ON</td> </tr> <tr> <td></td> <td>1</td> <td>RGB output : ON Composite video output : OFF</td> <td>RGB output : ON Composite video output : ON</td> </tr> </table>		DSPONV	0	1	DSPON	0	RGB output : OFF Composite video output : OFF	RGB output : OFF Composite video output : ON		1	RGB output : ON Composite video output : OFF	RGB output : ON Composite video output : ON	RGB output and composite video output display can be independently toggled ON/OFF
				DSPONV	0	1										
DSPON	0	RGB output : OFF Composite video output : OFF	RGB output : OFF Composite video output : ON													
	1	RGB output : ON Composite video output : OFF	RGB output : ON Composite video output : ON													
1																
7	DSPON	0														
		1														
8	STOPIN	0	Oscillaion of OSCIN, OSCOUT for synchronization signals	OSCIN oscillation stop												
		1	Stop oscillation of OSCIN, OSCOUT, for synchronization signals													
9	STOP1	0	Oscillation of OSC1, OSC2 for display	OSC1 oscillation stop												
		1	Stop the oscillation OSC1, OSC2 for display													
A	SCOR	0	Normal mode.	Usually "0" fix. It is possible SVHS register is set to "1".												
		1	External C (chroma) is exchanged internal C during independent Y-C output.													
B	SVHS	0	Composite video signal output	Either composite video output or Y-C output selection.												
		1	Y-C output													
C	INT / NON	0	Interlace	Interlace and non-interlace display switching is only possible with internal synchronization.												
		1	Non-interlace													
D	—	0	Set "0" only.													
E	—	0														
F	—	0														

**ON SCREEN DISPLAY CONTROLLER**

**BLINKING and CURSOR**

Register		RAM		Displaying Form	Remark	Mode
EXP1	EXP0	EXP	BLINK			
0	0	0	0	A	Blinking OFF	Cursor
0	0	0	1	A ↔ □	Blinking	
0	0	1	0	<u>A</u>	Cursor	
0	0	1	1	<u>A</u> ↔ A	Cursor is blinking	
0	1	0	0	A	Blinking OFF	Reversed character
0	1	0	1	A ↔ □	Blinking	
0	1	1	0	▣	Reversed character	
0	1	1	1	▣ ↔ A	Reversed character is blinking	
1	0	0	0	A	Blinking OFF	Reversed blinking
1	0	0	1	A ↔ □	Blinking	
1	0	1	0	▣	Reversed character	
1	0	1	1	▣ ↔ A	Reversed blinking	
1	1	0	0	A	Blinking OFF	Alternate blinking
1	1	0	1	A ↔ □	Blinking	
1	1	1	0	□ ↔ A	Alternate blinking	
1	1	1	1	A ↔ <u>  </u>	Normal (blinking OFF) and cursor are alternated	

Note : □ shows the no displayed status. For example  
 "A ↔ □" shows the turning on and off.



**ON SCREEN DISPLAY CONTROLLER**

**DISPLAY FORMS at EACH DISPLAY MODE**

The display control circuit controls the display of color information data and character font data according to each display mode when RGB is output, and outputs BLNK\* (signal to put video signal into blanking state), YM\* (luminance control signal), R\* (red output signal), G\* (green output signal), and B\* (blue output signal).

The diagram below shows the display format in each display mode. There are five blanking functions when RGB is output as follows :

- (1) Blanking OFF : Blanking output signal (BLNK\*) is cut off.
- (2) Character size : Blanking same as the character size.
- (3) Border size : Blanking the background as a size from character.
- (4) Matrix-outline size : Blanking the background as a size from all character font size.
- (5) All raster size : Blanking all raster area size

This display format allows each line (from the first line to the twelfth line) to be controlled independently, so that two kinds of display formats can be combined on the same screen.

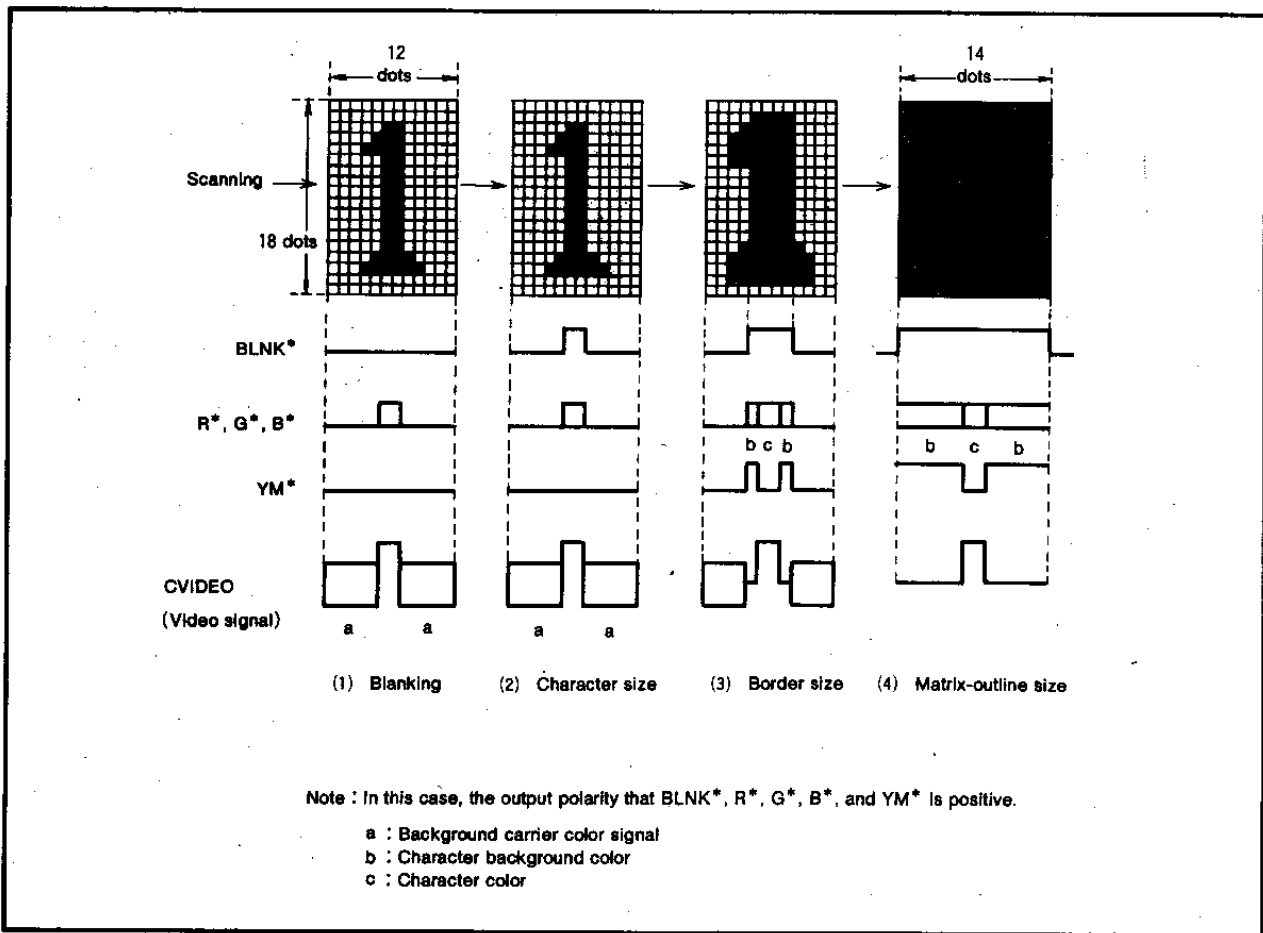
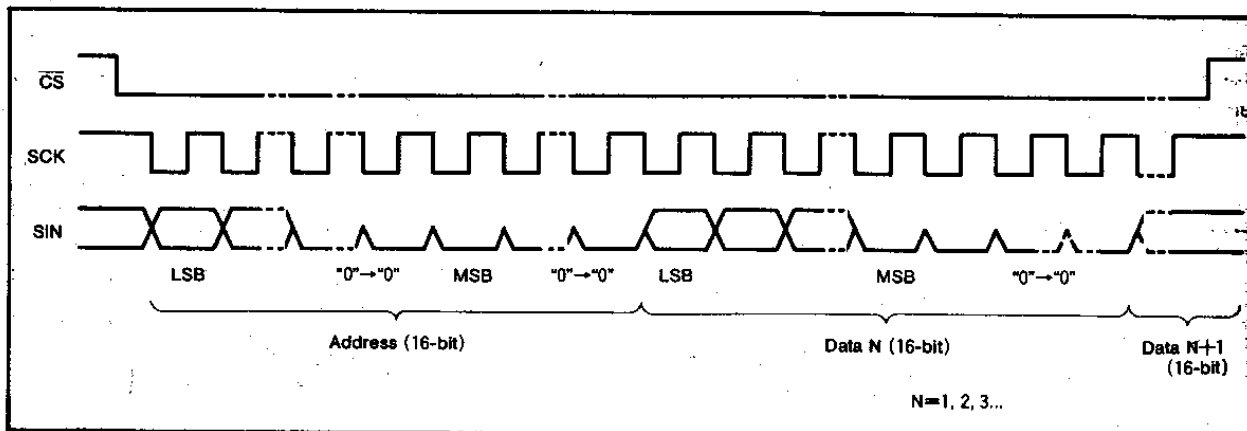


Fig. 4 Display forms at each display mode

ON SCREEN DISPLAY CONTROLLER

**DATA INPUT TIMING**

- (1) Serial data should be input with the LSB first. The address consists of 16 bits and the effective address is the lower 9 bits.
- (2) The upper 7 bits remaining should be set to "0".
- (3) The data consists of 16 bits, but only the data in the lower 13 bits is valid. The 3 upper bits remaining should all be set to "0".
- (4) The 16 bits in the SCK after the CS signal has fallen are the address, and for succeeding input data, the address is incremented every 16 bits.



**Data input**

Serial input mode (Example)

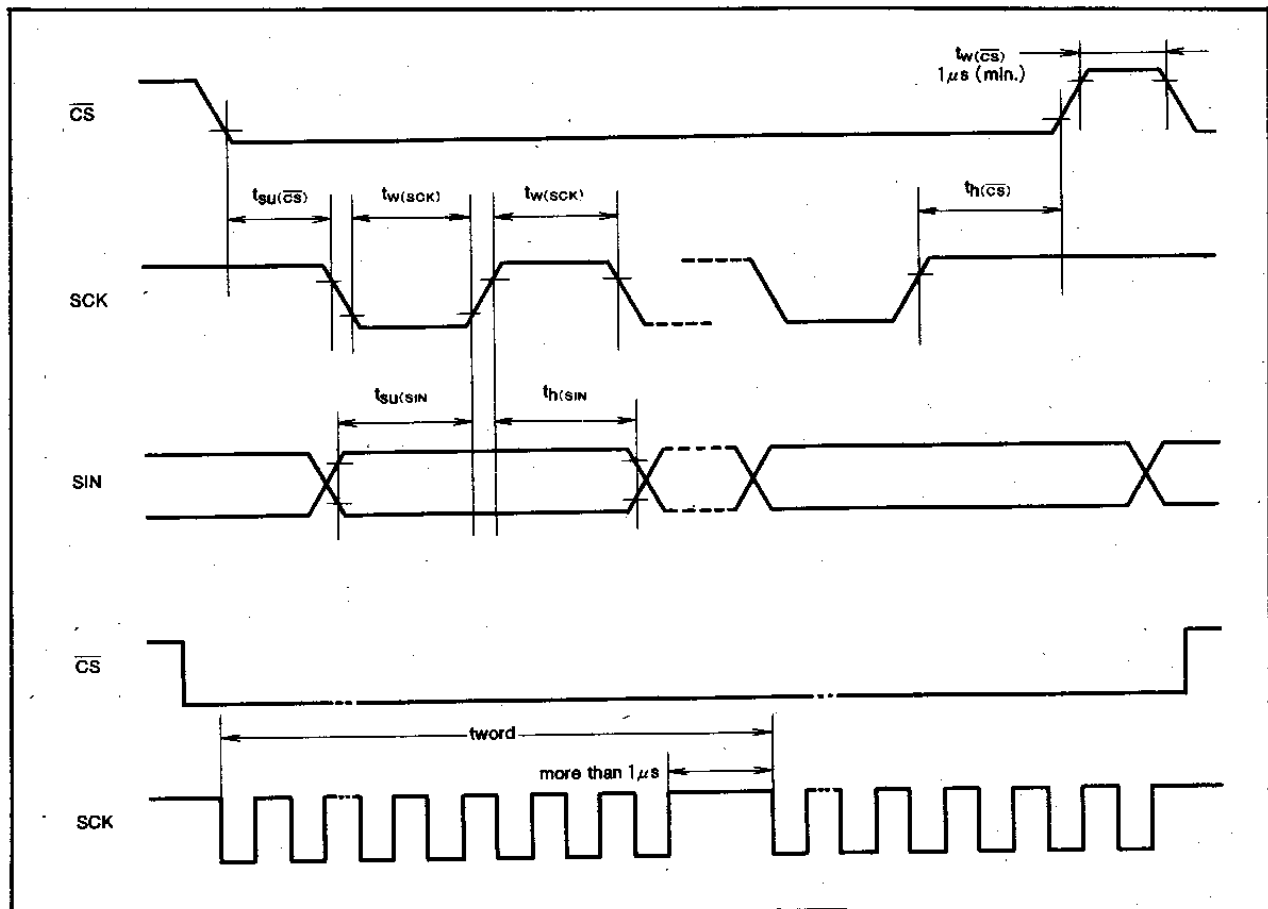
When using ports in SVHS mode and setting the ports output data.

No.	Memory Contents		DAF	DAE	DAD	DAC	DAB	DAA	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0	
	Address Data	Addition																	
1	Address 295	Address Setting	0	0	0	0	0	0	0	1	0	0	1	0	0	1	1	1	
2	Data (295)	Displaying OFF	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
3	Data (0)	Set memory 0~287, and register 288~295	0	0	0	EXP	BLI NK	B	G	R	0	C <sub>6</sub>	C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>	
4	Data (1)		0	0	0	EXP	BLI NK	B	G	R	0	C <sub>6</sub>	C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>	
↓	↓		↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
290	Data (287)		0	0	0	EXP	BLI NK	B	G	R	0	C <sub>6</sub>	C <sub>5</sub>	C <sub>4</sub>	C <sub>3</sub>	C <sub>2</sub>	C <sub>1</sub>	C <sub>0</sub>	
291	Data (288)		0	0	0	SYNC V	PTD 5	PTD 4	PTD 3	PTD 2	PTD 1	PTD 0	0	0	0	0	0	0	0
292	Data (289)		0	0	0	PALH	HSZ 31	HSZ 30	HSZ 21	HSZ 20	HSZ 11	HSZ 10	HP5	HP4	HP3	HP2	HP1	HP0	
293	Data (290)		0	0	0	BLKK	VSZ 31	VSZ 30	VSZ 21	VSZ 20	VSZ 11	VSZ 10	VP5	VP4	VP3	VP2	VP1	VP0	
294	Data (291)		0	0	0	PAL25	SCRR 3	SCRR 2	SCRR 1	SCRR 0	STRS CB	SPACE 1	SPACE 0	SCRF 4	SCRF 3	SCRF 2	SCRF 1	SCRF 0	
295	Data (292)		0	0	0	LINE U	DSP B	DSP A	DSP 9	DSP 8	DSP 7	DSP 6	DSP 5	DSP 4	DSP 3	DSP 2	DSP 1	DSP 0	
296	Data (293)		0	0	0	TEST 2	TEST 1	TEST 0	SEPV	WCB	FSC	ALL24	EXP 1	EXP 0	SRND	BLINK 2	BLINK 1	BLINK 0	
297	Data (294)	0	0	0	LC BTM	LC TOP	CRL B	CRL G	CRL R	B/W	BB	BG	BR	LEVEL 0	PHASE 2	PHASE 1	PHASE 0		
298	Data (295)	Displaying ON	0	0	0	INT/ NON	1	0	STOP1	STOP IN	1	1	0	EX	BLK 1	BLK 0	YM	SCOL	

**ON SCREEN DISPLAY CONTROLLER**

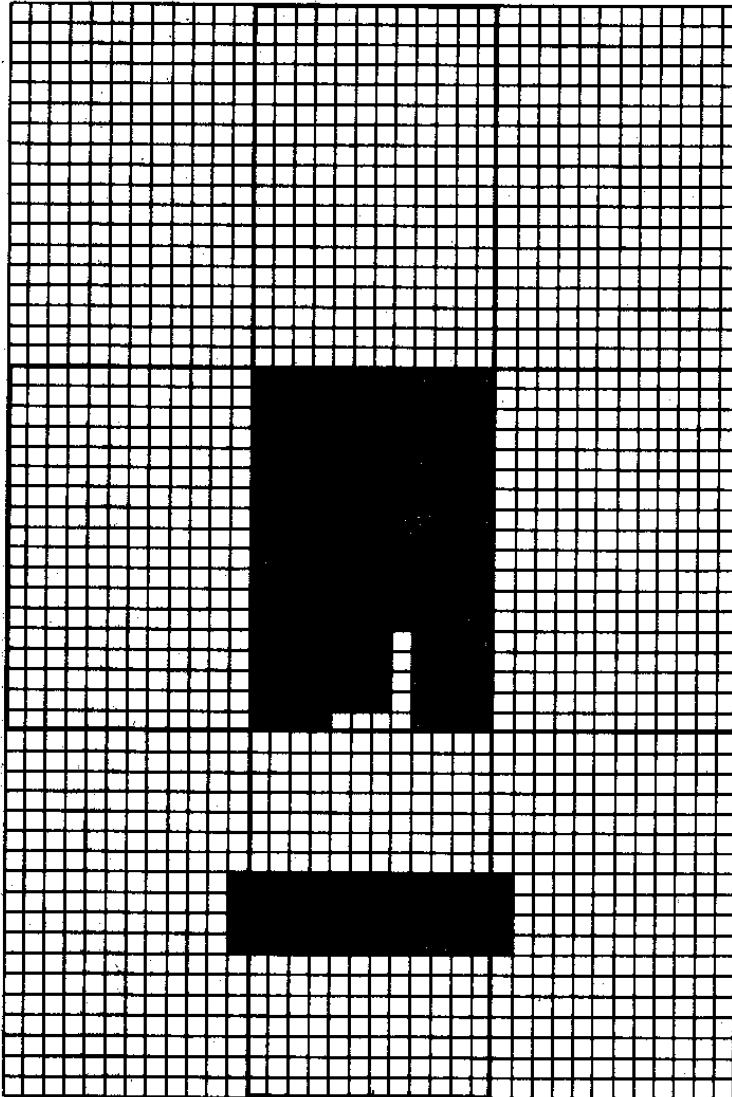
**Timing Requirements** ( $T_a = -20^\circ\text{C} \sim +70^\circ\text{C}$ ,  $V_{DD} = 5 \pm 0.5\text{V}$ , unless otherwise noted)

Symbol	Parameter	Limit			Unit
		Min.	Typ.	Max.	
$t_w(\text{SCK})$	SCK width	200	—	—	ns
$t_{su}(\overline{\text{CS}})$	CS setup time	200	—	—	ns
$t_h(\overline{\text{CS}})$	CS hold time	2	—	—	$\mu\text{s}$
$t_{su}(\text{SIN})$	SIN hold time	200	—	—	ns
$t_h(\text{SIN})$	SIN setup	200	—	—	ns
$t_{\text{word}}$	1 word writing time	10	—	—	$\mu\text{s}$



### CHARACTER FONT

Images are composed on a 12 × 18 dot matrix, and characters can be linked vertically and horizontally with other characters to allow the display of kanji and continuous symbols.



← When the character extends to the top line of the matrix, no border is left at the top.

← When the character extends to the bottom (18th) line of the matrix, no border is left at the bottom.

Note : Hatching represents broder.

Character code 7F<sub>16</sub> is fixed as blank, without a background.

**MITSUBISHI MICROCOMPUTERS**  
**M50458-XXXSP/FP**

**ON SCREEN DISPLAY CONTROLLER**

**ABSOLUTE MAXIMUM RATINGS** ( $V_{DD}=5V$ ,  $T_a=-20\sim 70^\circ C$ , unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
$V_{DD}$	Supply voltage	With respect to $V_{SS}$	-0.3~6	V
$V_i$	Input voltage		$V_{SS}-0.3 \leq V_i \leq V_{DD}+0.3$	V
$V_o$	Output voltage		$V_{SS} \leq V_o \leq V_{DD}$	V
$P_d$	Power dissipation	$T_a=25^\circ C$	300	mW
$T_{opr}$	Operating temperature		-20~70	$^\circ C$
$T_{stg}$	Storage temperature		-40~125	$^\circ C$

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Limits			Unit
		Min.	Typ.	Max.	
$V_{DD}$	Supply voltage	4.5	5.0	5.5	V
$V_{IH}$	"H" level input voltage N/P, $\overline{CS}$ , SIN, SYEX	0.7 $V_{DD}$	$V_{DD}$	$V_{DD}$	V
$V_{IL}$	"L" level input voltage N/P, $\overline{CS}$ , SIN, SYEX	0	0	0.3 $V_{DD}$	V
$V_{IH}$	"H" level input voltage SCK, AC, HOR*, VERT*	0.8 $V_{DD}$	$V_{DD}$	$V_{DD}$	V
$V_{IL}$	"L" level input voltage SCK, AC, HOR*, VERT*	0	0	0.2 $V_{DD}$	V
$V_{CVIN}$	Composite-video signal input voltage CVIN	—	2 $V_{P-P}$	—	V
$V_{YIN}$	Luminance signal input voltage CVIN	—	2 $V_{P-P}$	—	V
$f_{OSC1}$	Oscillating frequency for display	6.3	7.0	7.7	MHz
$f_{OSCIN}$	Oscillating frequency for synchronized signal	—	14.32 17.73	—	MHz

**ELECTRICAL CHARACTERISTICS** ( $V_{DD}=5V$ ,  $f_{OSC1}=7.0MHz$ ,  $T_a=25^\circ C$ , unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
$V_{DD}$	Supply voltage	$T_a=-20\sim 70^\circ C$	4.5	5.0	5.5	V
$I_{DD}$	Supply current	$V_{DD}=5.5V$	—	15	30	mA
$V_{OH}$	"H" level output voltage RS, CB, P0~P5	$V_{DD}=4.5V$ , $I_{OH}=0.4mA$	3.5	—	—	V
$V_{OL}$	"L" level output voltage RS, CB, P0~P5	$V_{DD}=4.5V$ , $I_{OL}=0.4mA$	—	—	0.4	V
$R_i$	Pull-up resistance SCK, AC, N/P, $\overline{CS}$ , SIN, SYEX	$V_{DD}=5.0V$	10	30	100	k $\Omega$

**VIDEO SIGNAL INPUT CONDITIONS** ( $V_{DD}=5V$ ,  $T_a=-20\sim 70^\circ C$ , unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
$V_{IN-CU}$	Composite-video signal input clamp voltage	Sync-tip voltage	—	1.5	—	V
$V_{IN-Y}$	Luminance signal input clamp voltage	Sync-tip voltage	—	1.5	—	V
$V_{IN-C}$	Chrominance signal input clamp voltage	Center voltage	—	2.1	—	V

**Note for Supplying Power**

Timing of power supplying to  $\overline{AC}$  pin

The internal circuit of M50458-XXXSP is reset when the level of the auto clear input pin  $\overline{AC}$  is "L". This pin is hysteresis input with the pull-up resistor. The timing about power supplying of  $\overline{AC}$  pin is shown in Figure 11.

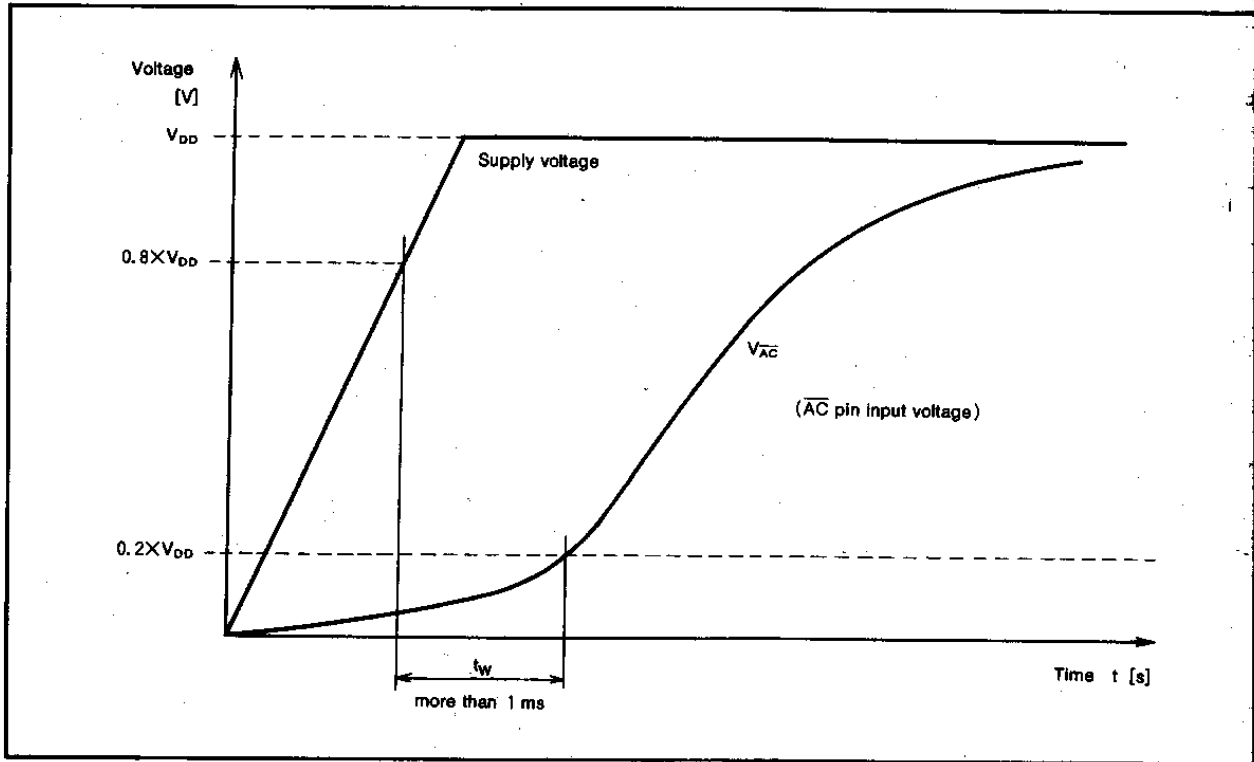


Fig. 11 Timing of power supplying to  $\overline{AC}$  pin

After supplying the power ( $V_{DD}$  and  $V_{SS}$ ) to M50458-XXXSP and the supply voltage becomes more than  $0.8 \times V_{DD}$ , it needs to keep  $V_{IL}$  time;  $t_w$  of the  $\overline{AC}$  pin for more than 1ms.

Power supply timing about  $V_{DD1}$  pin and  $V_{DD2}$  pin.

The power need to supply to  $V_{DD1}$  and  $V_{DD2}$  at a time, though it is separated perfectly between the  $V_{DD1}$  as the digital line and the  $V_{DD2}$  as the analog line.