

To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

MITSUBISHI MICROCOMPUTERS M35053-XXXSP/FP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

DESCRIPTION

The M35053-XXXSP/FP is TV screen display control IC which can be used to display information such as number of channels, the date and messages and program schedules on the TV screen.

In particular, owing to the built-in SYNC-SEP (synchronous separation) circuit, the synchronous correction circuit, the Decoder circuit, and to the Encoder circuit, external circuits can be decrease and character turbulence that occurs when superimposing can be reduced. The processor can conform to the EDS broadcast service and is suitable for AV systems such as VTRs, LDs, and so on.

It is a silicon gate CMOS process and M35053-XXXSP is housed in a 20-pin shrink DIP package, M35053-XXXFP is housed in a 20-pin shrink SOP package.

For M35053-001SP/FP that is a standard ROM version of M35053-XXXSP/FP respectively, the character pattern is also mentioned.

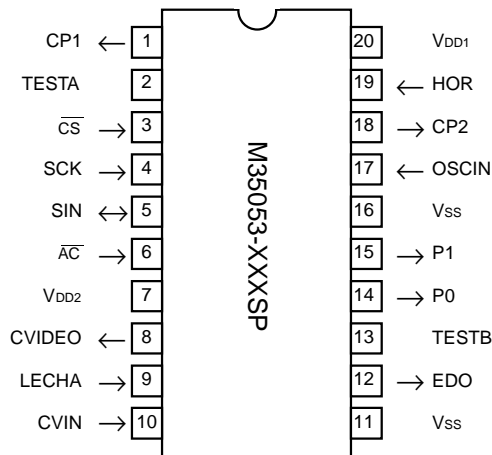
FEATURES

- Screen composition 24 characters X 10 lines,
32 characters X 7 lines
- Number of characters displayed 240 (Max.)
- Character composition 12 X 18 dot matrix
- Characters available 256 characters
- Character sizes available 4 (horizontal) X 4 (vertical)
- Display locations available
Horizontal direction 240 locations
Vertical direction 256 locations
- Blinking Character units
Cycle : approximately 1 second, or approximately 0.5 seconds
Duty : 25%, 50%, or 75%
- Data input By the serial input function (16 bits)
- Coloring
Background coloring (composite video signal)
- Blanking
Total blanking (14 X 18 dots)
Border size blanking
Character size blanking
- Synchronizing signal
Composite synchronizing signal generation
(PAL, NTSC, M-PAL)
- 2 output ports (1 digital line)
- Oscillation stop function
It is possible to stop the oscillation for synchronizing signal generation
- Built-in half-tone display function
- Built-in reversed character display function
- Built-in Decoder (NTSC only)
- Built-in Encoder (NTSC only)
- Built-in synchronous correction circuit
- Built-in synchronous separation circuit

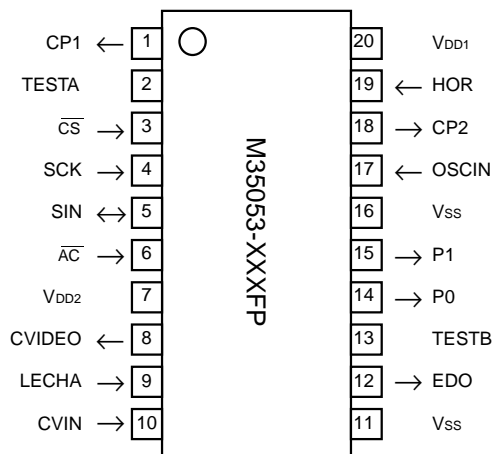
APPLICATION

TV, VCR, Movie

PIN CONFIGURATION (TOP VIEW)



Outline 20P4B

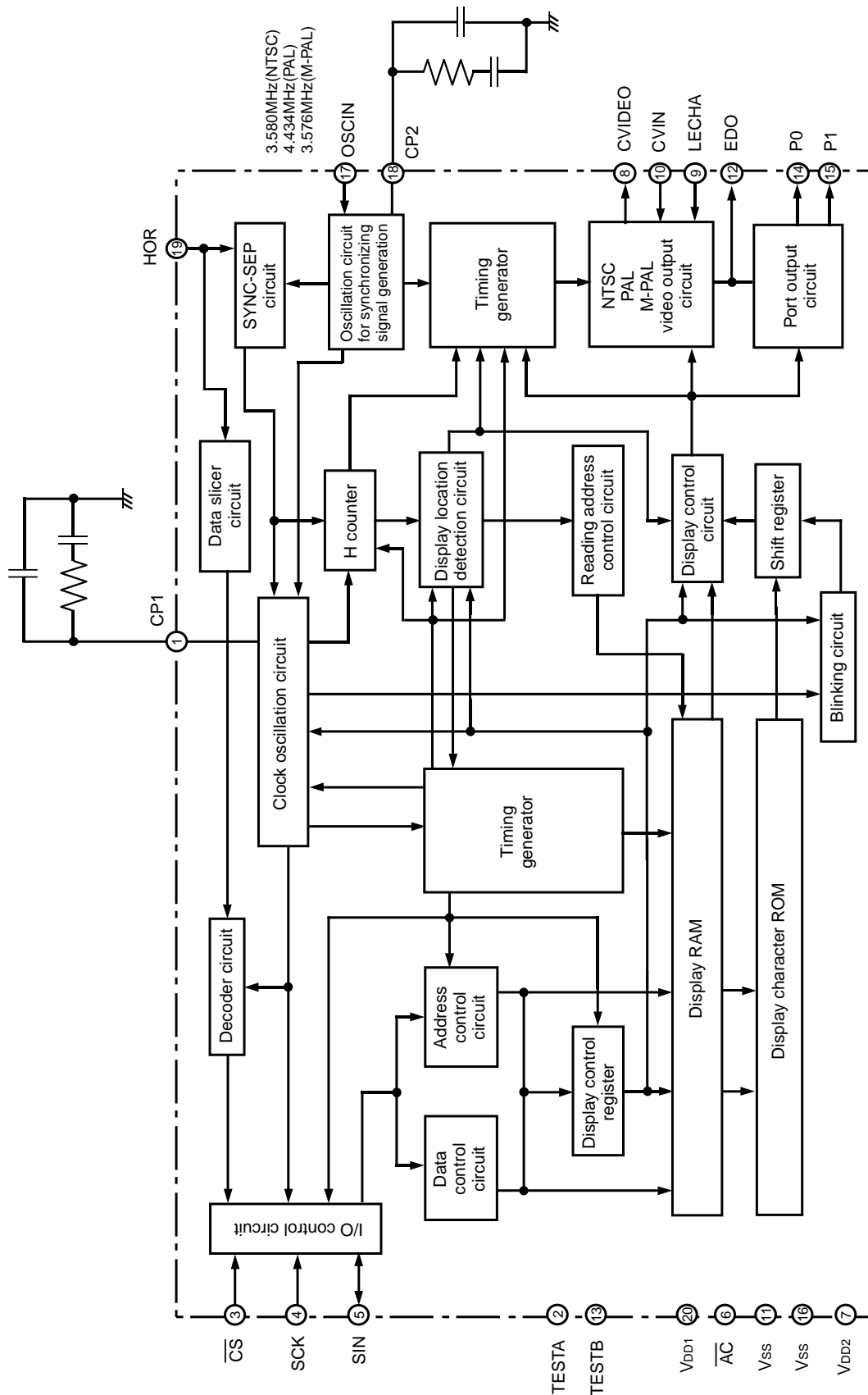


Outline 20P2Q-A

PIN DESCRIPTION

Symbol	Pin name	Input/ Output	Function
OSC1	Clock input	Input	This is the filter output pin 1.
TESTA	Test pin	—	This is the pin for test. Connect this pin to GND during normal operation.
$\overline{\text{CS}}$	Chip select input	Input	This is the chip select pin, and when serial data transmission is being carried out, it goes to "L". Hysteresis input. Includes built-in pull-up resistor.
SCK	Serial clock input	Input	When $\overline{\text{CS}}$ pin is "L", SIN serial data is taken in when SCK rises. Hysteresis input. Built-in pull-up resistor is included.
SIN	Serial data input/ output	Input/ Output	This is the pin for serial input of data and addresses for the display control register and the display data memory. Also, serially outputs decode data according to the settings in the relevant registers (serial I/O).
$\overline{\text{AC}}$	Auto-clear input	Input	When "L", this pin resets the internal IC circuit. Hysteresis input. Includes built-in pull-up resistor.
VDD2	Power pin	—	Please connect to +5V with the analog circuit power pin.
CVIDEO	Composite video signal output	Output	This is the output pin for composite video signals. It outputs 2V _{P-P} composite video signals. In superimpose mode, character output etc. is superimposed on the external composite video signals from CVIN.
LECHA	Character level input	Input	This is the input pin which determines the "white" character color level in the composite video signal.
CVIN	Composite video signal input	Input	This is the input pin for external composite video signals. In superimpose mode, character output etc. is superimposed on these external composite video signals.
Vss	Earthing pin	—	Please connect to GND using circuit earthing pin.
EDO	Encode data output	Output	This is the output pin for encode data. It outputs digital three-value data or composite video signals.
TESTB	Test pin	—	This is the pin for test. Connect this pin to GND during normal operation.
P0	Port P0 output	Output	This pin outputs the port output or BLNK1 (character background) signal.
P1	Port P1 output	Output	This pin outputs the port output or CO1(character) signal.
Vss	Earthing pin	—	Please connect to GND using circuit earthing pin (Analog side).
OSCIN	fsc input pin for synchronous signal generation	Input	This is the input pin for the sub-carrier frequency (fsc) for generating a synchronous signal. A frequency of 3.580MHz is needed for NTSC, and a frequency of 4.434MHz is needed for PAL and 3.576MHz is needed for M-PAL.
CP2	Filter output	Output	Filter output pin 2.
HOR	Horizontal synchro- nizing signal input	Input	This is the input pin for external composite video signals. This pin inputs the external video signal clamped sync-chip to 1.5V, and internally carries out synchronous separation.
VDD1	Power pin	—	Please connect to +5V with the digital circuit power pin.

BLOCK DIAGRAM



SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

MEMORY CONSTITUTION

Address 00₁₆ to EF₁₆ are assigned to the display RAM, address F0₁₆ to F8₁₆ are assigned to the display control registers. The internal circuit is reset and all display control registers (address F0₁₆ to F8₁₆) are set to "0" and display RAM (address 00₁₆ to EF₁₆) are RAM erased when the AC pin level is "L".

Set "0" in any of bits DAD through DAF of addresses 00₁₆ through EF₁₆, and of bits DAE and DAF of addresses F0₁₆ through F8₁₆. TEST_n (n : a number) is MITSUBISHI test memory, so be sure to observe the setting conditions.

Bit Address	DAF	DAE	DAD	DAC	DAB	DAA	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0	Remarks
00 ₁₆	0	0	0	REV	BLINK	EC2	EC1	EC0	C7	C6	C5	C4	C3	C2	C1	C0	Display RAM
}	⋮	⋮	⋮	Reversed character	Blinking	Encode data or character color			Character code								
EF ₁₆	0	0	0	REV	BLINK	EC2	EC1	EC0	C7	C6	C5	C4	C3	C2	C1	C0	
F0 ₁₆	0	0	TEST25	W/R	TEST11	TEST10	DECB1	DECB0	SYSEP1	SYSEP0	SEPV1	SEPV0	PTD1	PTD0	PTC1	PTC0	Port output specify and so on
F1 ₁₆	0	0	TEST26	DVP4	DVP3	DVP2	DVP1	DVP0	HP7	HP6	HP5	HP4	HP3	HP2	HP1	HP0	Horizontal display start position and Decode position specify
F2 ₁₆	0	0	TEST27	EVP4	EVP3	EVP2	EVP1	EVP0	VP7	VP6	VP5	VP4	VP3	VP2	VP1	VP0	Vertical display start position and Encode position specify
F3 ₁₆	0	0	TEST28	D/V	EFLD1	EFLD0	DFLD1	DFLD0	VSZ21	VSZ20	VSZ11	VSZ10	HSZ21	HSZ20	HSZ11	HSZ10	Character size and Encode/Decode specify
F4 ₁₆	0	0	TEST29	TEST14	TEST13	SPACE	DSP9	DSP8	DSP7	DSP6	DSP5	DSP4	DSP3	DSP2	DSP1	DSP0	Display mode specify
F5 ₁₆	0	0	TEST30	TEST19	MB/LB	TEST17	TEST16	TEST15	EQP	PALH	MPAL	INT/NON	N/P	BLINK2	BLINK1	BLINK0	Blinking specify and so on
F6 ₁₆	0	0	TEST31	TEST2	TEST1	TEST0	LBLACK	LIN24/32	BLKHF	BB	BG	BR	LEVEL0	PHASE2	PHASE1	PHASE0	Raster color specify
F7 ₁₆	0	0	TEST32	TEST24	RGBON	TEST22	CL17/18	CBLINK	CURS7	CURS6	CURS5	CURS4	CURS3	CURS2	CURS1	CURS0	Cursor display specify
F8 ₁₆	0	0	LEVEL1	EHP4	EHP3	EHP2	EHP1	EHP0	RAMERS	DSPON	STOP1	STOPIN	SCOR	EX	BLK1	BLK0	Control display and so on

Fig. 1 Memory constitution (M35053-XXXSP/FP)

SCREEN CONSTITUTION

The screen lines and rows are determined from each address of the display RAM. The screen constitution (24 characters X 10 lines) is shown in Figure 2 the screen constitution (32 characters X 7 lines) is shown in 3.

Rows Lines	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	00 ₁₆	01 ₁₆	02 ₁₆	03 ₁₆	04 ₁₆	05 ₁₆	06 ₁₆	07 ₁₆	08 ₁₆	09 ₁₆	0A ₁₆	0B ₁₆	0C ₁₆	0D ₁₆	0E ₁₆	0F ₁₆	10 ₁₆	11 ₁₆	12 ₁₆	13 ₁₆	14 ₁₆	15 ₁₆	16 ₁₆	17 ₁₆
2	18 ₁₆	19 ₁₆	1A ₁₆	1B ₁₆	1C ₁₆	1D ₁₆	1E ₁₆	1F ₁₆	20 ₁₆	21 ₁₆	22 ₁₆	23 ₁₆	24 ₁₆	25 ₁₆	26 ₁₆	27 ₁₆	28 ₁₆	29 ₁₆	2A ₁₆	2B ₁₆	2C ₁₆	2D ₁₆	2E ₁₆	2F ₁₆
3	30 ₁₆	31 ₁₆	32 ₁₆	33 ₁₆	34 ₁₆	35 ₁₆	36 ₁₆	37 ₁₆	38 ₁₆	39 ₁₆	3A ₁₆	3B ₁₆	3C ₁₆	3D ₁₆	3E ₁₆	3F ₁₆	40 ₁₆	41 ₁₆	42 ₁₆	43 ₁₆	44 ₁₆	45 ₁₆	46 ₁₆	47 ₁₆
4	48 ₁₆	49 ₁₆	4A ₁₆	4B ₁₆	4C ₁₆	4D ₁₆	4E ₁₆	4F ₁₆	50 ₁₆	51 ₁₆	52 ₁₆	53 ₁₆	54 ₁₆	55 ₁₆	56 ₁₆	57 ₁₆	58 ₁₆	59 ₁₆	5A ₁₆	5B ₁₆	5C ₁₆	5D ₁₆	5E ₁₆	5F ₁₆
5	60 ₁₆	61 ₁₆	62 ₁₆	63 ₁₆	64 ₁₆	65 ₁₆	66 ₁₆	67 ₁₆	68 ₁₆	69 ₁₆	6A ₁₆	6B ₁₆	6C ₁₆	6D ₁₆	6E ₁₆	6F ₁₆	70 ₁₆	71 ₁₆	72 ₁₆	73 ₁₆	74 ₁₆	75 ₁₆	76 ₁₆	77 ₁₆
6	78 ₁₆	79 ₁₆	7A ₁₆	7B ₁₆	7C ₁₆	7D ₁₆	7E ₁₆	7F ₁₆	80 ₁₆	81 ₁₆	82 ₁₆	83 ₁₆	84 ₁₆	85 ₁₆	86 ₁₆	87 ₁₆	88 ₁₆	89 ₁₆	8A ₁₆	8B ₁₆	8C ₁₆	8D ₁₆	8E ₁₆	8F ₁₆
7	90 ₁₆	91 ₁₆	92 ₁₆	93 ₁₆	94 ₁₆	95 ₁₆	96 ₁₆	97 ₁₆	98 ₁₆	99 ₁₆	9A ₁₆	9B ₁₆	9C ₁₆	9D ₁₆	9E ₁₆	9F ₁₆	A0 ₁₆	A1 ₁₆	A2 ₁₆	A3 ₁₆	A4 ₁₆	A5 ₁₆	A6 ₁₆	A7 ₁₆
8	A8 ₁₆	A9 ₁₆	AA ₁₆	AB ₁₆	AC ₁₆	AD ₁₆	AE ₁₆	AF ₁₆	B0 ₁₆	B1 ₁₆	B2 ₁₆	B3 ₁₆	B4 ₁₆	B5 ₁₆	B6 ₁₆	B7 ₁₆	B8 ₁₆	B9 ₁₆	BA ₁₆	BB ₁₆	BC ₁₆	BD ₁₆	BE ₁₆	BF ₁₆
9	C0 ₁₆	C1 ₁₆	C2 ₁₆	C3 ₁₆	C4 ₁₆	C5 ₁₆	C6 ₁₆	C7 ₁₆	C8 ₁₆	C9 ₁₆	CA ₁₆	CB ₁₆	CC ₁₆	CD ₁₆	CE ₁₆	CF ₁₆	D0 ₁₆	D1 ₁₆	D2 ₁₆	D3 ₁₆	D4 ₁₆	D5 ₁₆	D6 ₁₆	D7 ₁₆
10	D8 ₁₆	D9 ₁₆	DA ₁₆	DB ₁₆	DC ₁₆	DD ₁₆	DE ₁₆	DF ₁₆	E0 ₁₆	E1 ₁₆	E2 ₁₆	E3 ₁₆	E4 ₁₆	E5 ₁₆	E6 ₁₆	E7 ₁₆	E8 ₁₆	E9 ₁₆	EA ₁₆	EB ₁₆	EC ₁₆	ED ₁₆	EE ₁₆	EF ₁₆

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

Fig. 2 Screen constitution (24 characters X 10 lines)

Rows Lines	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	00 ₁₆	01 ₁₆	02 ₁₆	03 ₁₆	04 ₁₆	05 ₁₆	06 ₁₆	07 ₁₆	08 ₁₆	09 ₁₆	0A ₁₆	0B ₁₆	0C ₁₆	0D ₁₆	0E ₁₆	0F ₁₆	10 ₁₆	11 ₁₆	12 ₁₆	13 ₁₆	14 ₁₆	15 ₁₆	16 ₁₆	17 ₁₆	18 ₁₆	19 ₁₆	1A ₁₆	1B ₁₆	1C ₁₆	1D ₁₆	1E ₁₆	1F ₁₆
2	20 ₁₆	21 ₁₆	22 ₁₆	23 ₁₆	24 ₁₆	25 ₁₆	26 ₁₆	27 ₁₆	28 ₁₆	29 ₁₆	2A ₁₆	2B ₁₆	2C ₁₆	2D ₁₆	2E ₁₆	2F ₁₆	30 ₁₆	31 ₁₆	32 ₁₆	33 ₁₆	34 ₁₆	35 ₁₆	36 ₁₆	37 ₁₆	38 ₁₆	39 ₁₆	3A ₁₆	3B ₁₆	3C ₁₆	3D ₁₆	3E ₁₆	3F ₁₆
3	40 ₁₆	41 ₁₆	42 ₁₆	43 ₁₆	44 ₁₆	45 ₁₆	46 ₁₆	47 ₁₆	48 ₁₆	49 ₁₆	4A ₁₆	4B ₁₆	4C ₁₆	4D ₁₆	4E ₁₆	4F ₁₆	50 ₁₆	51 ₁₆	52 ₁₆	53 ₁₆	54 ₁₆	55 ₁₆	56 ₁₆	57 ₁₆	58 ₁₆	59 ₁₆	5A ₁₆	5B ₁₆	5C ₁₆	5D ₁₆	5E ₁₆	5F ₁₆
4	60 ₁₆	61 ₁₆	62 ₁₆	63 ₁₆	64 ₁₆	65 ₁₆	66 ₁₆	67 ₁₆	68 ₁₆	69 ₁₆	6A ₁₆	6B ₁₆	6C ₁₆	6D ₁₆	6E ₁₆	6F ₁₆	70 ₁₆	71 ₁₆	72 ₁₆	73 ₁₆	74 ₁₆	75 ₁₆	76 ₁₆	77 ₁₆	78 ₁₆	79 ₁₆	7A ₁₆	7B ₁₆	7C ₁₆	7D ₁₆	7E ₁₆	7F ₁₆
5	80 ₁₆	81 ₁₆	82 ₁₆	83 ₁₆	84 ₁₆	85 ₁₆	86 ₁₆	87 ₁₆	88 ₁₆	89 ₁₆	8A ₁₆	8B ₁₆	8C ₁₆	8D ₁₆	8E ₁₆	8F ₁₆	90 ₁₆	91 ₁₆	92 ₁₆	93 ₁₆	94 ₁₆	95 ₁₆	96 ₁₆	97 ₁₆	98 ₁₆	99 ₁₆	9A ₁₆	9B ₁₆	9C ₁₆	9D ₁₆	9E ₁₆	9F ₁₆
6	A0 ₁₆	A1 ₁₆	A2 ₁₆	A3 ₁₆	A4 ₁₆	A5 ₁₆	A6 ₁₆	A7 ₁₆	A8 ₁₆	A9 ₁₆	AA ₁₆	AB ₁₆	AC ₁₆	AD ₁₆	AE ₁₆	AF ₁₆	B0 ₁₆	B1 ₁₆	B2 ₁₆	B3 ₁₆	B4 ₁₆	B5 ₁₆	B6 ₁₆	B7 ₁₆	B8 ₁₆	B9 ₁₆	BA ₁₆	BB ₁₆	BC ₁₆	BD ₁₆	BE ₁₆	BF ₁₆
7	C0 ₁₆	C1 ₁₆	C2 ₁₆	C3 ₁₆	C4 ₁₆	C5 ₁₆	C6 ₁₆	C7 ₁₆	C8 ₁₆	C9 ₁₆	CA ₁₆	CB ₁₆	CC ₁₆	CD ₁₆	CE ₁₆	CF ₁₆	D0 ₁₆	D1 ₁₆	D2 ₁₆	D3 ₁₆	D4 ₁₆	D5 ₁₆	D6 ₁₆	D7 ₁₆	D8 ₁₆	D9 ₁₆	DA ₁₆	DB ₁₆	DC ₁₆	DD ₁₆	DE ₁₆	DF ₁₆

Notes
1. The hexadecimal numbers in the boxes show the display RAM address.
2. When 32 characters X 7 lines are displayed, set blank code "FF₁₆" to character code of addresses E0₁₆ to EF₁₆.

Fig. 3 Screen constitution (32 characters X 7 lines)

Display RAM DESCRIPTION

Display RAM Address 0016 to EF16

DA 0-C	Name	Contents		Remarks		
		Status	Function			
0	C0 (LSB)	0	Set ROM-held character code of a character needed to display.			
		①				
		1			C1	0
		①				
		2			C2	0
		①				
		3			C3	0
		①				
4	C4	0				
①						
5	C5	0				
①						
6	C6	0				
①						
7	C7 (MSB)	0				
①						
8	EC0	0	When EFILD1, 0=1, 0 or 0, 1, set code of the data needed to encode.	Refer to encode function.		
		①				
9	EC1	0	When RGBON=1, set background color by character unit.	Refer to supplemental explanation (4).		
		①				
A	EC2	0				
		①				
B	BLINK	0	No blinking	Refer to BLINK2 to 0 (address F516)		
		①	Blinking			
C	REV	①	Normal character			
		1	Reversed character			

Note. Resetting at the AC pin RAM-erases the display RAM, and the status turns as indicated by the mark ○ around in the status column.

Display control register

(1) Address F016

DA 0-D	Register	Contents			Remarks										
		Status	Function												
0	PTC0	0	P0 output (port 0)		Port output control										
		1	BLNK1 output												
1	PTC1	0	P1 output (port 1)		Refer to supplemental explanation (5).										
		1	CO1 output												
2	PTD0	0	It is negative polarity at P0 output "L", BLINK1 output.		Control the port data										
		1	It is positive polarity at P0 output "H", BLINK1 output.												
3	PTD1	0	It is negative polarity at P01 output "L", CO1 output.		Refer to supplemental explanation (5).										
		1	It is positive polarity at P01 output "H", CO1 output.												
4	SEPV0	0	It should be fixed to "0".		Specifies the vertical synchronous separation criterion										
		1	Can not be used.												
5	SEPV1	0	It should be fixed to "0".		Refer to supplemental explanation (1).										
		1	Can not be used.												
6	SYSEP0	0	<table border="1"> <tr> <td>SYSEP1</td> <td>SYSEP0</td> <td>Bias potential</td> </tr> <tr> <td>0</td> <td>0</td> <td>Can not be used.</td> </tr> <tr> <td>0</td> <td>1</td> <td>Can not be used.</td> </tr> </table>			SYSEP1	SYSEP0	Bias potential	0	0	Can not be used.	0	1	Can not be used.	Specifies the sync-bias potential
		SYSEP1	SYSEP0	Bias potential											
0	0	Can not be used.													
0	1	Can not be used.													
1	<table border="1"> <tr> <td>1</td> <td>0</td> <td>1.75V</td> </tr> <tr> <td>1</td> <td>1</td> <td>Can not be used.</td> </tr> </table>			1	0	1.75V	1	1	Can not be used.						
1	0	1.75V													
1	1	Can not be used.													
7	SYSEP1	0	<table border="1"> <tr> <td>DECB1</td> <td>DECB0</td> <td>Bias potential</td> </tr> <tr> <td>0</td> <td>0</td> <td>2.35V</td> </tr> <tr> <td>0</td> <td>1</td> <td>Can not be used.</td> </tr> </table>			DECB1	DECB0	Bias potential	0	0	2.35V	0	1	Can not be used.	Specifies the decoding bias potential
		DECB1	DECB0	Bias potential											
0	0	2.35V													
0	1	Can not be used.													
1	<table border="1"> <tr> <td>1</td> <td>0</td> <td>Can not be used.</td> </tr> <tr> <td>1</td> <td>1</td> <td>Can not be used.</td> </tr> </table>			1	0	Can not be used.	1	1	Can not be used.						
1	0	Can not be used.													
1	1	Can not be used.													
8	DECB0	0	<table border="1"> <tr> <td>DECB1</td> <td>DECB0</td> <td>Bias potential</td> </tr> <tr> <td>0</td> <td>0</td> <td>2.35V</td> </tr> <tr> <td>0</td> <td>1</td> <td>Can not be used.</td> </tr> </table>			DECB1	DECB0	Bias potential	0	0	2.35V	0	1	Can not be used.	Specifies the decoding bias potential
		DECB1	DECB0	Bias potential											
0	0	2.35V													
0	1	Can not be used.													
1	<table border="1"> <tr> <td>1</td> <td>0</td> <td>Can not be used.</td> </tr> <tr> <td>1</td> <td>1</td> <td>Can not be used.</td> </tr> </table>			1	0	Can not be used.	1	1	Can not be used.						
1	0	Can not be used.													
1	1	Can not be used.													
9	DECB1	0	<table border="1"> <tr> <td>DECB1</td> <td>DECB0</td> <td>Bias potential</td> </tr> <tr> <td>0</td> <td>0</td> <td>2.35V</td> </tr> <tr> <td>0</td> <td>1</td> <td>Can not be used.</td> </tr> </table>			DECB1	DECB0	Bias potential	0	0	2.35V	0	1	Can not be used.	Specifies the decoding bias potential
		DECB1	DECB0	Bias potential											
0	0	2.35V													
0	1	Can not be used.													
1	<table border="1"> <tr> <td>1</td> <td>0</td> <td>Can not be used.</td> </tr> <tr> <td>1</td> <td>1</td> <td>Can not be used.</td> </tr> </table>			1	0	Can not be used.	1	1	Can not be used.						
1	0	Can not be used.													
1	1	Can not be used.													
A	TEST10	0	Can not be used.												
		1	It should be fixed to "1".												
B	TEST11	0	It should be fixed to "0".												
		1	Can not be used.												
C	W/R	0	Input data from SIN pin		Control data I/O										
		1	Output data from SIN pin (Note 2)		Refer to decode data output timing.										
D	TEST25	0	It should be fixed to "0".												
		1	Can not be used.												

Notes 1. The mark 0 around the status value means the reset status by the "L" level is input to AC pin.

2. Not necessary to release after setting W/R to "1". Turn CS to "H" to switch over to input mode.

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(2) Address F116

DA 0~D	Register	Contents		Remarks
		Status	Function	
0	HP0 (LSB)	0	<p>Let horizontal display start position be HS,</p> $HS = T \times \left(\sum_{n=0}^7 2^n HP_{n+6} \right)$ <p>T : The oscillation cycle of display clock</p>	<p>Set the horizontal display start position by use of HP7 through HP0. HP7 to HP0 = (00000000) to (00001111) setting is forbidden.</p> <p>It can be set this up to 240 steps in increments of one T.</p>
		1		
1	HP1	0		
		1		
2	HP2	0		
		1		
3	HP3	0		
		1		
4	HP4	0		
		1		
5	HP5	0		
		1		
6	HP6	0		
		1		
7	HP7 (MSB)	0		
		1		
8	DVP0 (LSB)	0	<p>Let the slice lines be DVS,</p> $DVS = \sum_{n=0}^4 2^n DVP_{n+6}$	<p>Set the slice lines (horizontal scanning lines) under decoding by use of DVP4 through DVP0. DVP4 to DVP0 = (00000) to (00011) setting is forbidden.</p> <p>Thus, it can be defined a setting up to 26 steps covered by a range from line 10 to line 35.</p> <p>Refer to supplemental explanation (2) about slice lines (DVS).</p>
		1		
9	DVP1	0		
A	DVP2	0		
		1		
B	DVP3	0		
		1		
C	DVP4 (MSB)	0		
		1		
D	TEST26	0		
		1	Can not be used.	

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(3) Address F216

DA 0~D	Register	Contents		Remarks
		Status	Function	
0	VP0 (LSB)	0	<p>Let vertical display start position be VS,</p> $VS = H \times \sum_{n=0}^7 2^n VP_n$ <p>H : The oscillation cycle of horizontal synchronous signal</p>	<p>Set the vertical display start position by use of VP7 through VP0. VP7 to VP0 = (00000000) to (00000110) setting is forbidden.</p> <p>It can be set this up to 249 steps in increments of one H.</p> <p>VP7 to VP0 = (00000000) to (00100011) setting is forbidden under encoding or decoding.</p>
		1		
1	VP1	0		
		1		
2	VP2	0		
		1		
3	VP3	0		
		1		
4	VP4	0		
		1		
5	VP5	0		
		1		
6	VP6	0		
		1		
7	VP7 (MSB)	0		
		1		
8	EVP0 (LSB)	0	<p>Let the encode lines be EVS,</p> $EVS = \sum_{n=0}^4 2^n EVP_n + 6$	<p>Sets the lines (horizontal scanning lines) under encoding by use of EVP4 through EVP0. EVP4 to EVP0 = (00000) to (00011) setting is forbidden.</p> <p>Thus, it can be defined a setting up to 26 steps covered by a range from line 10 to line 35.</p> <p>Refer to supplemental explanation (2) about the encode lines (EVS).</p>
		1		
9	EVP1	0		
		1		
A	EVP2	0		
		1		
B	EVP3	0		
		1		
C	EVP4 (MSB)	0		
		1		
D	TEST27	0	It should be fixed to "0".	
		1	Can not be used.	

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(4) Address F316

DA 0~D	Register	Contents			Remarks		
		Status	Function				
0	HSZ10	0	HSZ11	HSZ10	Horizontal direction size	Character size setting in the horizontal direction for the first line.	
		1	0	0			1T/dot
1	HSZ11	0	0	1	2T/dot		
		1	1	0	3T/dot		
2	HSZ20	0	0	1	4T/dot		
		1	0	0	1T/dot		
3	HSZ21	0	0	1	2T/dot		
		1	1	0	3T/dot		
4	VSZ10	0	0	1	4T/dot	Character size setting in the horizontal direction for the 2nd line to 10th line.	
		1	0	0	1T/dot		
5	VSZ11	0	0	1	2T/dot		
		1	1	0	3T/dot		
6	VSZ20	0	0	1	4T/dot		
		1	0	0	1H/dot		
7	VSZ21	0	0	1	2H/dot		Character size setting in the vertical direction for the first line.
		1	1	0	3H/dot		
8	DFLD0	0	0	1	4H/dot		
		1	0	0	1H/dot		
9	DFLD1	0	0	1	2H/dot	Character size setting in the vertical direction for the 2nd line to 10th line.	
		1	1	0	3H/dot		
A	EFILD0	0	0	1	4H/dot		
		1	0	0	1H/dot		
B	EFLD1	0	0	1	2H/dot		Specifies the field determination procedure in relation to the Decoding functions. Refer to supplemental explanation (2).
		1	1	0	3H/dot		
C	D/V	0	0	1	4H/dot		
		1	0	0	1H/dot		
D	TEST28	0	0	1	2H/dot	Specifies the field determination procedure in relation to the Encoding functions. Refer to supplemental explanation (2).	
		1	1	0	3H/dot		
8	DFLD0	0	0	1	4H/dot		
		1	0	0	1H/dot		
9	DFLD1	0	0	1	2H/dot		Specifies the field determination procedure in relation to the Decoding functions. Refer to supplemental explanation (2).
		1	1	0	3H/dot		
A	EFILD0	0	0	1	4H/dot		
		1	0	0	1H/dot		
B	EFLD1	0	0	1	2H/dot	Specifies the field determination procedure in relation to the Encoding functions. Refer to supplemental explanation (2).	
		1	1	0	3H/dot		
C	D/V	0	0	1	4H/dot		
		1	0	0	1H/dot		
D	TEST28	0	0	1	2H/dot		Encode (EDO) output control. Refer to encode function (3).
		1	1	0	3H/dot		
8	DFLD0	0	0	1	4H/dot		
		1	0	0	1H/dot		
9	DFLD1	0	0	1	2H/dot	Specifies the field determination procedure in relation to the Decoding functions. Refer to supplemental explanation (2).	
		1	1	0	3H/dot		
A	EFILD0	0	0	1	4H/dot		
		1	0	0	1H/dot		
B	EFLD1	0	0	1	2H/dot		Specifies the field determination procedure in relation to the Encoding functions. Refer to supplemental explanation (2).
		1	1	0	3H/dot		
C	D/V	0	0	1	4H/dot		
		1	0	0	1H/dot		
D	TEST28	0	0	1	2H/dot	Encode (EDO) output control. Refer to encode function (3).	
		1	1	0	3H/dot		

Note. Output buffer is needed with EDO (12-pin) at D/V= "1". (Refer to example of peripheral circuit)

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(5) Address F416

DA 0~D	Register	Contents		Remarks																				
		Status	Function																					
0	DSP0	0	<table border="1" style="margin-left: 20px;"> <thead> <tr> <th>BLK1</th> <th>BLK0</th> <th>DSPn= "1"</th> <th>DSPn= "0"</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Matrix-outline border size</td> <td>Matrix-outline size</td> </tr> <tr> <td>0</td> <td>1</td> <td>Border size</td> <td>Character size</td> </tr> <tr> <td>1</td> <td>0</td> <td>Matrix-outline size</td> <td>Border size</td> </tr> <tr> <td>1</td> <td>1</td> <td>Character size</td> <td>Matrix-outline size</td> </tr> </tbody> </table> <p>Depends on BLK0 and BLK1 (address F816) DSPn in the generic name for DSP0 to DSP9. DSP0 to DSP9 are each controlled independently.</p>	BLK1	BLK0	DSPn= "1"	DSPn= "0"	0	0	Matrix-outline border size	Matrix-outline size	0	1	Border size	Character size	1	0	Matrix-outline size	Border size	1	1	Character size	Matrix-outline size	Set the display mode of line 1.
		BLK1		BLK0	DSPn= "1"	DSPn= "0"																		
0	0	Matrix-outline border size		Matrix-outline size																				
0	1	Border size		Character size																				
1	0	Matrix-outline size		Border size																				
1	1	Character size		Matrix-outline size																				
1	DSP1	1		Set the display mode of line 2.																				
2	DSP2	0		Set the display mode of line 3.																				
		1																						
3	DSP3	0		Set the display mode of line 4.																				
		1																						
4	DSP4	0	Set the display mode of line 5.																					
		1																						
5	DSP5	0	Set the display mode of line 6.																					
		1																						
6	DSP6	0	Set the display mode of line 7.																					
		1																						
7	DSP7	0	Set the display mode of line 8.																					
		1																						
8	DSP8	0	Set the display mode of line 9.																					
		1																						
9	DSP9	0	Set the display mode of line 10.																					
		1																						
A	SPACE	0	Normal display	Put a space line between line 2 and line 3 in displaying 32 characters.																				
		1	Put a space line between line 2 and line 3, and between line 8 and line 9.																					
B	TEST13	0	It should be fixed to "0".																					
		1	Can not be used.																					
C	TEST14	0	It should be fixed to "0".																					
		1	Can not be used.																					
D	TEST29	0	It should be fixed to "0".																					
		1	Can not be used.																					

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(6) Address F516

DA 0~D	Register	Contents			Remarks															
		Status	Function																	
0	BLINK0	0	<table border="1"> <thead> <tr> <th>BLINK0</th> <th>BLINK1</th> <th>Duty</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Blinking off</td> </tr> <tr> <td>0</td> <td>1</td> <td>25%</td> </tr> <tr> <td>1</td> <td>0</td> <td>50%</td> </tr> <tr> <td>1</td> <td>1</td> <td>75%</td> </tr> </tbody> </table>		BLINK0	BLINK1	Duty	0	0	Blinking off	0	1	25%	1	0	50%	1	1	75%	Blinking duty ratio can be altered. (Note)
		BLINK0	BLINK1	Duty																
0	0	Blinking off																		
0	1	25%																		
1	0	50%																		
1	1	75%																		
1																				
1	BLINK1	0																		
		1																		
2	BLINK2	0	Division of vertical synchronizing signal into 1/64. Cycle approximately 1 second.		Blinking cycle can be altered.															
		1	Division of vertical synchronizing signal into 1/32. Cycle approximately 0.5 second.																	
3	N/P	0	NTSC, M-PAL mode		Refer to register MPAL															
		1	PAL mode																	
4	INT/NON	0	Interlace		Scanning lines control (only in internal synchronization)															
		1	Non interlace																	
5	MPAL	0	<table border="1"> <thead> <tr> <th>N/P</th> <th>MPAL</th> <th>Synchronous mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>NTSC</td> </tr> <tr> <td>0</td> <td>1</td> <td>M-PAL</td> </tr> <tr> <td>1</td> <td>0</td> <td>PAL</td> </tr> <tr> <td>1</td> <td>1</td> <td>Not available</td> </tr> </tbody> </table>		N/P	MPAL	Synchronous mode	0	0	NTSC	0	1	M-PAL	1	0	PAL	1	1	Not available	Synchronizing signal is selected with this register and N/P register.
		N/P	MPAL	Synchronous mode																
0	0	NTSC																		
0	1	M-PAL																		
1	0	PAL																		
1	1	Not available																		
1																				
6	PALH	0	<table border="1"> <thead> <tr> <th>PALH</th> <th>INT/NON</th> <th>Number of scanning lines</th> </tr> </thead> <tbody> <tr> <td rowspan="2">0</td> <td>0</td> <td>625H lines</td> </tr> <tr> <td>1</td> <td>626H lines</td> </tr> <tr> <td rowspan="2">1</td> <td>0</td> <td>627H lines</td> </tr> <tr> <td>1</td> <td>628H lines</td> </tr> </tbody> </table>		PALH	INT/NON	Number of scanning lines	0	0	625H lines	1	626H lines	1	0	627H lines	1	628H lines	It should be fixed to "0" at NTSC		
		PALH	INT/NON	Number of scanning lines																
0	0	625H lines																		
	1	626H lines																		
1	0	627H lines																		
	1	628H lines																		
1																				
7	EQP	0	Not include the equivalent pulse.		Effective only at non-interlace															
		1	Include the equivalent pulse.																	
8	TEST15	0	It should be fixed to "0".																	
		1	Can not be used.																	
9	TEST16	0	It should be fixed to "0".																	
		1	Can not be used.																	
A	TEST17	0	It should be fixed to "0".																	
		1	Can not be used.																	
B	MB/LB	0	Output from MSB side		Setting the decode data output form															
		1	Output from LSB side																	
C	TEST19	0	It should be fixed to "0".																	
		1	Can not be used.																	
D	TEST30	0	It should be fixed to "0".																	
		1	Can not be used.																	

Note. To blink a character, set 1 to DAB (the blinking bit) of the display RAM.

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(7) Address F616

DA 0~D	Register	Contents				Remarks																																			
		Status	Function																																						
0	PHASE0	0	<table border="1"> <thead> <tr> <th>PHASE2</th> <th>PHASE1</th> <th>PHASE0</th> <th>Raster</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>Black</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>Red</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>Green</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>Yellow</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>Blue</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>Magenta</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>Cyan</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>White</td></tr> </tbody> </table>	PHASE2	PHASE1	PHASE0	Raster	0	0	0	Black	0	0	1	Red	0	1	0	Green	0	1	1	Yellow	1	0	0	Blue	1	0	1	Magenta	1	1	0	Cyan	1	1	1	White		Raster color setting Refer to supplemental explanation (3) about video signal level
		PHASE2		PHASE1	PHASE0	Raster																																			
0	0	0		Black																																					
0	0	1		Red																																					
0	1	0		Green																																					
0	1	1		Yellow																																					
1	0	0		Blue																																					
1	0	1		Magenta																																					
1	1	0		Cyan																																					
1	1	1		White																																					
1																																									
1	PHASE1	0																																							
		1																																							
2	PHASE2	0																																							
		1																																							
3	LEVEL0	0	Internal bias off			Generates bias potential for composite video signals																																			
		1	Internal bias on																																						
4	BR	0	<table border="1"> <thead> <tr> <th>BB</th> <th>BG</th> <th>BR</th> <th>Character back-ground color</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>Black</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>Red</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>Green</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>Yellow</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>Blue</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>Magenta</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>Cyan</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>White</td></tr> </tbody> </table>	BB	BG	BR	Character back-ground color	0	0	0	Black	0	0	1	Red	0	1	0	Green	0	1	1	Yellow	1	0	0	Blue	1	0	1	Magenta	1	1	0	Cyan	1	1	1	White		Character background color setting. Refer to supplemental explanation (3) about video signal level
		BB		BG	BR	Character back-ground color																																			
0	0	0		Black																																					
0	0	1		Red																																					
0	1	0		Green																																					
0	1	1		Yellow																																					
1	0	0		Blue																																					
1	0	1		Magenta																																					
1	1	0		Cyan																																					
1	1	1		White																																					
1																																									
5	BG	0																																							
		1																																							
6	BB	0																																							
		1																																							
7	BLKHF	0	The halftone displaying "OFF" in superimpose			This register is available in the superimpose displaying only. (Note)																																			
		1	The halftone displaying "ON" in superimpose																																						
8	LIN $\overline{24}$ /32	0	24 characters 5 10 lines display			"1" setting is forbidden under encoding.																																			
		1	32 characters 5 7 lines display																																						
9	LBLACK	0	Blanking level I 2.3V			Set a blackness level																																			
		1	Blanking level II 2.1V																																						
A	TEST0	0	It should be fixed to "0".																																						
		1	Can not be used.																																						
B	TEST1	0	It should be fixed to "0".																																						
		1	Can not be used.																																						
C	TEST2	0	It should be fixed to "0".																																						
		1	Can not be used.																																						
D	TEST31	0	Can not be used.																																						
		1	It should to be fixed to "1".																																						

Note. It is necessary to input the external composite video signal to the CVIN pin, and externally connect a 100 to 200Ω register in series.

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(8) Address F716

DA 0~D	Register	Contents		Remarks
		Status	Function	
0	CUR0	0	Let cursor displaying address be CURS, $\text{CURS} = \sum_{n=0}^7 2^n \text{CURn}$	Set the cursor displaying address by use of CUR7 through CUR0. CUR7 to CUR0 (11110000) setting is forbidden under 24 characters display. CUR7 to CUR0 (11100000) setting is forbidden under 32 characters display. Set CUR7 to CUR0 = (11111111) under cursor is not be displayed. The cursor displaying address (CURS) is correspond to display construction.
		1		
1	CUR1	0		
		1		
2	CUR2	0		
		1		
3	CUR3	0		
		1		
4	CUR4	0		
		1		
5	CUR5	0		
		1		
6	CUR6	0		
		1		
7	CUR7	0		
		1		
8	CBLINK	0	No blinking	The cursor blinking setting
		1	Blinking	
9	CL $\overline{17}$ /18	0	Cursor displaying at the 17th dot by vertical direction.	Refer to character construction.
		1	Cursor displaying at the 18th dot by vertical direction.	
A	TEST22	0	It should be fixed to "0".	
		1	Can not be used.	
B	RGBON	0	Normal	Refer to supplemental explanation (4).
		1	Character background coloring	
C	TEST24	0	It should be fixed to "0".	
		1	Can not be used.	
D	TEST32	0	It should be fixed to "0".	
		1	Can not be used.	

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(9) Address F816

DA 0~D	Register	Contents				Remarks																				
		Status	Function																							
0	BLK0	0	<table border="1"> <tr> <td>BLK1</td> <td>BLK0</td> <td>DSPn= "1"</td> <td>DSPn= "0"</td> </tr> <tr> <td>0</td> <td>0</td> <td>Matrix-outline border size</td> <td>Matrix-outline size</td> </tr> <tr> <td>0</td> <td>1</td> <td>Border size</td> <td>Character size</td> </tr> <tr> <td>1</td> <td>0</td> <td>Matrix-outline size</td> <td>Border size</td> </tr> <tr> <td>1</td> <td>1</td> <td>Character size</td> <td>Matrix-outline size</td> </tr> </table>				BLK1	BLK0	DSPn= "1"	DSPn= "0"	0	0	Matrix-outline border size	Matrix-outline size	0	1	Border size	Character size	1	0	Matrix-outline size	Border size	1	1	Character size	Matrix-outline size
		BLK1					BLK0	DSPn= "1"	DSPn= "0"																	
0	0	Matrix-outline border size					Matrix-outline size																			
0	1	Border size					Character size																			
1	0	Matrix-outline size					Border size																			
1	1	Character size					Matrix-outline size																			
1																										
1	BLK1	0																								
		1																								
2	EX	0	External synchronization			Synchronizing signal switching (Note1)																				
		1	Internal synchronization																							
3	SCOR	0	Superimpose monotone display			"1" setting is forbidden at internal synchronous or PAL, M-PAL mode displaying.																				
		1	Superimpose coloring display (only NTSC)																							
4	STOPIN	0	fsc input mode			OSCIN oscillation control																				
		1	Can not be used.																							
5	STOP1	0	Oscillation VCO for display			Control oscillation VCO for display																				
		1	Stop oscillation VCO for display																							
6	DSPON	0	Display OFF																							
		1	Display ON																							
7	RAMERS	0	RAM not erased			This register does not exist (Note 3).																				
		1	RAM erased																							
8	EHP0	0	Let encode data programming start position be EHS, $EHS = \sum_{n=0}^4 2^n EHP_n$			Set encode start position by use of EHP4 through EHP0. EHP4 to EHP0 = (00000) to (01111) is setting forbidden. Refer to encode function (3)																				
		1																								
9	EHP1	0																								
		1																								
A	EHP2	0																								
		1																								
B	EHP3	0																								
		1																								
C	EHP4	0																								
		1																								
D	LEVEL1	0	Internal bias OFF			Generates bias potential for decoding and synchronous separation.																				
		1	Internal bias ON																							

- Notes 1.** In dealing with the internal synchronization, cut off external video signals outside the IC. The leakage of external input video signals can be avoided.
- 2.** In displaying color superimposition, enter into the OSCIN pin the fsc signal that phase-synchronizes with the color burst of the composite video signals (input to the CVIN pin).
- 3.** Erases all the display RAM. The character code turns to blank-FF16, the encode data bit and the blinking bit turn to "1" respectively, and reversed character bit turns to "0".

Supplemental explanation about display control register

(1) How to effect synchronous separation from composite video signals

Synchronous separation is effected as follows depending on the width of L-level of the vertical synchronous period.

1. Less than 8.4μs Not to be determined to be a vertical synchronous signal.
2. Equal to or higher than 8.4μs but less than 15.6μs When two clocks continue, if take place, it is "L" period is determined to be a vertical synchronization signal.
3. Equal to or higher than 15.6μs It is "L" period is determined to be a vertical synchronous signal with no condition.

The determination is made at the timing indicated by V in Fig.3 either in case 2 or in case 3.

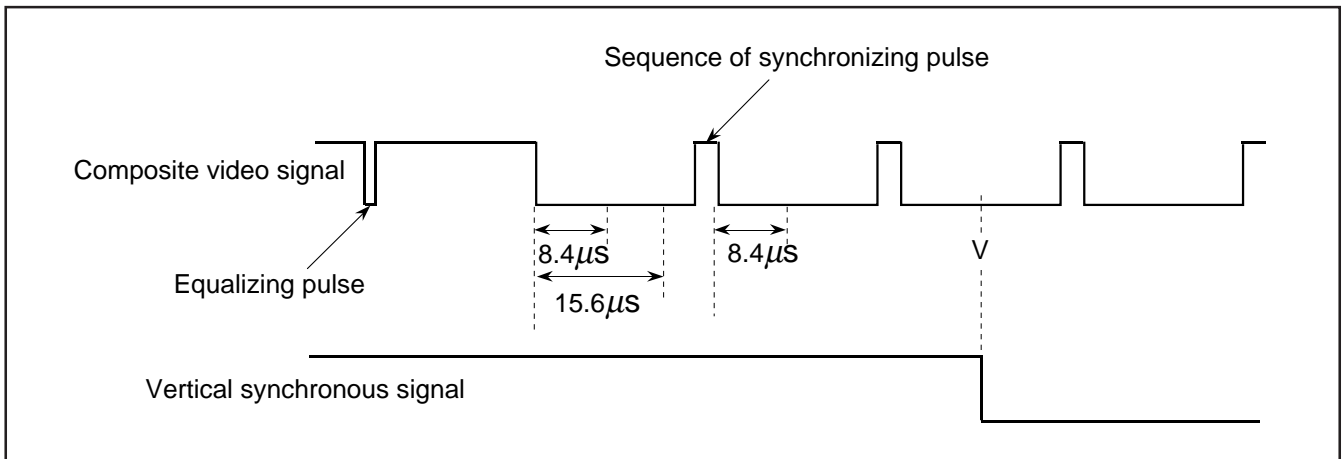


Fig. 4 The method of synchronous separation from composite video signal.

(2) Field definition

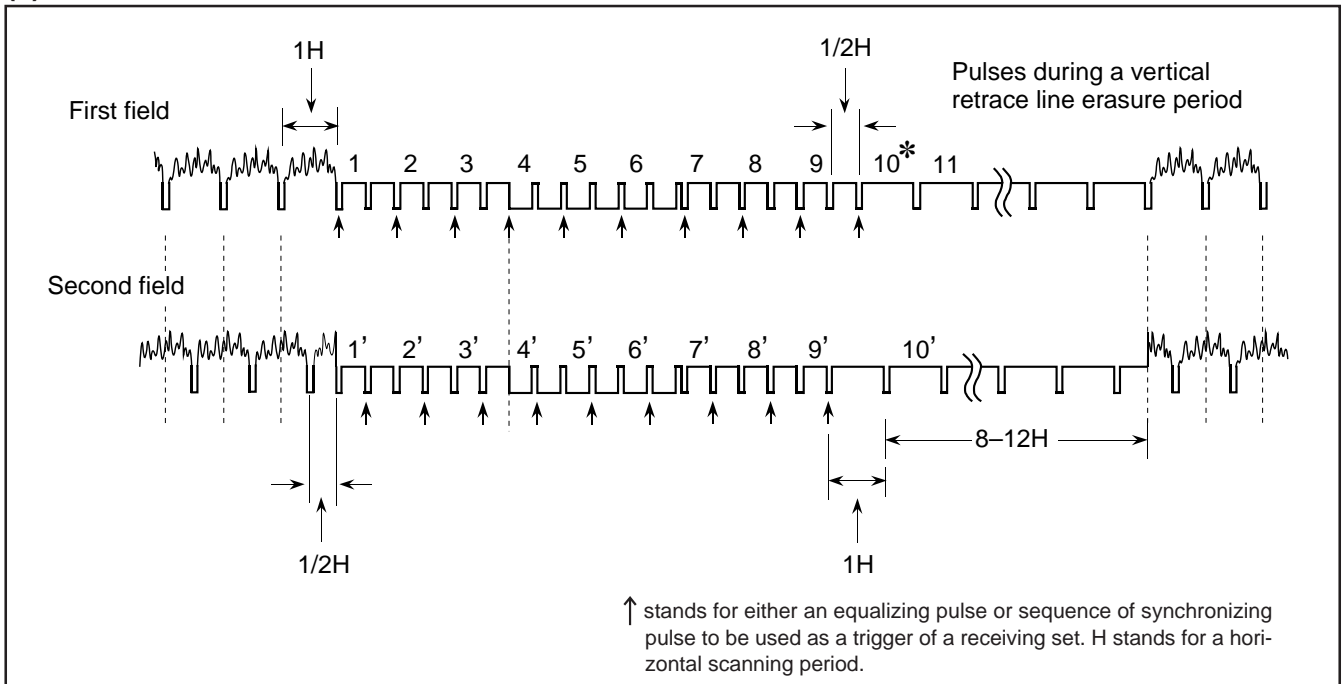


Fig. 5 Field definition

* A horizontal scanning line number corresponds to slice lines DVP4 through DVP0 (address F116) and to encode lines EVP4 through EVP0 (address F216).

(3) Video signal level

VDD : 5.0V, Ta : 25°C

Color	Phase angle (rad)		Brightness level (V)			Amplitude ratio (to color burst)		
	NTSC method	PAL, M-PAL method	Min.	Typ.	Max.	Min.	Typ.	Max.
Sync-chip	—	—	1.3	1.5	1.7	—	—	—
Pedestal	—	—	1.9	2.1	2.3	—	—	—
Color burst	0	$\pm 4\pi/16$	1.9	2.1	2.3	—	1.0	—
Black	—	—	2.1	2.3	2.5	—	—	—
Red	$7\pi/16 \pm 2\pi/16$	$\pm 7\pi/16 \pm 2\pi/16$	2.3	2.5	2.7	1.5	3.0	4.5
Green	$27\pi/16 \pm 2\pi/16$	$\mp 5\pi/16 \pm 2\pi/16$	2.7	2.9	3.1	1.4	2.8	4.2
Yellow	$\pi/16 \pm 2\pi/16$	$\pm\pi/16 \pm 2\pi/16$	3.1	3.3	3.5	1.0	2.0	3.0
Blue	$17\pi/16 \pm 2\pi/16$	$\mp 15\pi/16 \pm 2\pi/16$	2.0	2.2	2.4	1.0	2.0	3.0
Magenta	$11\pi/16 \pm 2\pi/16$	$\pm 11\pi/16 \pm 2\pi/16$	2.5	2.7	2.9	1.4	2.8	4.2
Cyan	$23\pi/16 \pm 2\pi/16$	$\mp 9\pi/16 \pm 2\pi/16$	2.9	3.1	3.3	1.5	3.0	4.5
White	—	—	3.1	3.3	3.5	—	—	—

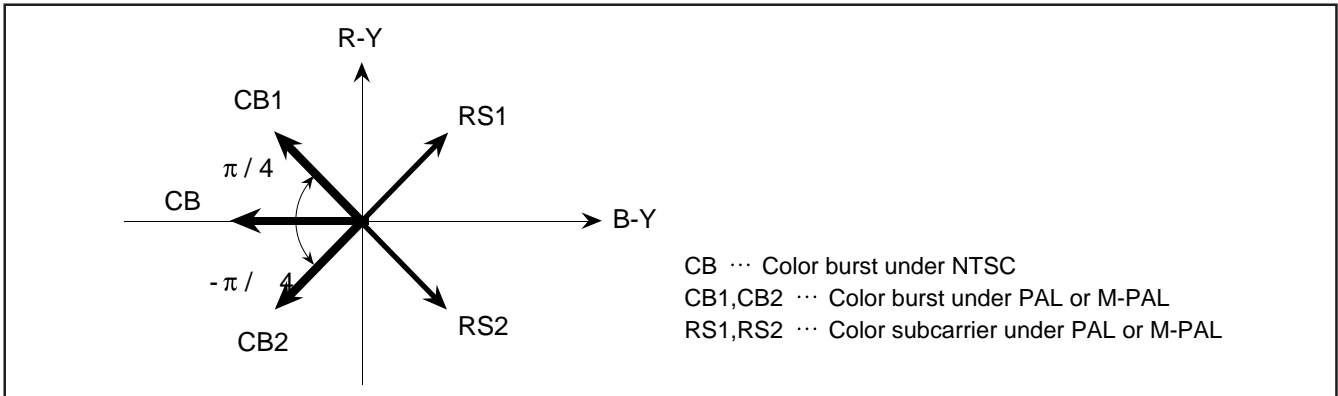


Fig. 6 Bector phases

(4) Setting RGBON (address F716)

- a) When encode is off EFILD1, 0 (address F316) = 0, 0
 Encode setting ... Not effected
 RGBON = "0" Sets background colors depending on BB, BG, and BR (address F616), screen by screen.
 RGBON = "1" Sets background colors depending on EC2 to EC0 (address 0016 to EF16), character by character. The color setting is shown below.
- b) When encode is on ... EFILD1, 0 (address F316) = 0, 1 or 1, 0
 Encode setting ... Sets encode data depending on EC2 through EC0. (Refer to the encode functions for details.)
 RGBON = "0" Sets background colors depending on BB, BG and BR (address F616) screen by screen.
 RGBON = "1" This setting can not be used.
 (When encode is on, setting RGBON to "1" results in setting both encode data and background colors depending on the same memory (EC2 through EC0), so this setting can not be used.

Color Setting

EC2	EC1	EC0	Color
0	0	0	Black
0	0	1	Red
0	1	0	Green
0	1	1	Yellow
1	0	0	Blue
1	0	1	Magenta
1	1	0	Cyan
1	1	1	White

(5) Port output and BLNK1, CO1 output

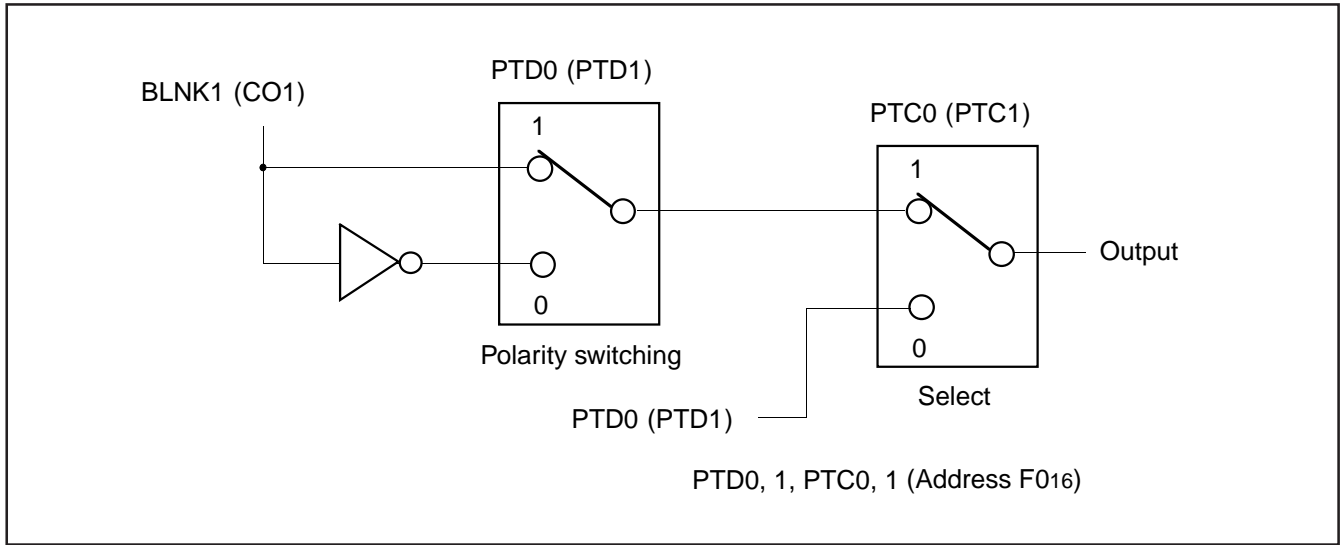


Fig. 7 Example of port control

(6) Setting conditions for oscillating or stopping the display clock

	at display clock operating	at display clock stop
STOP1	0	1
DSPON	1	0
CS pin	L	H

STOP1,DSPON (Address F816)

(7) Setting condition at LEVEL0,1

	Operation state (Character display)		Now-working condition (no characters are displayed)
	Internal synchronous	External synchronous	
LEVEL0	1	1	0
LEVEL1	0	1	0

LEVEL0 (address F616), LEVEL1 (address F816)

DISPLAY FORMS

M35052-XXXSP/FP has the following four display forms as the blanking function, when CO1 and BLNK1 are output.

- (1) Character size : Blanking same as the character size.
- (2) Border size : Blanking the background as a size from character.
- (3) Matrix-outline size: Blanking the background as a size from all character font size.
- (4) Matrix-outline border size : Blanking the background as a size from all character font size.
Border display.

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

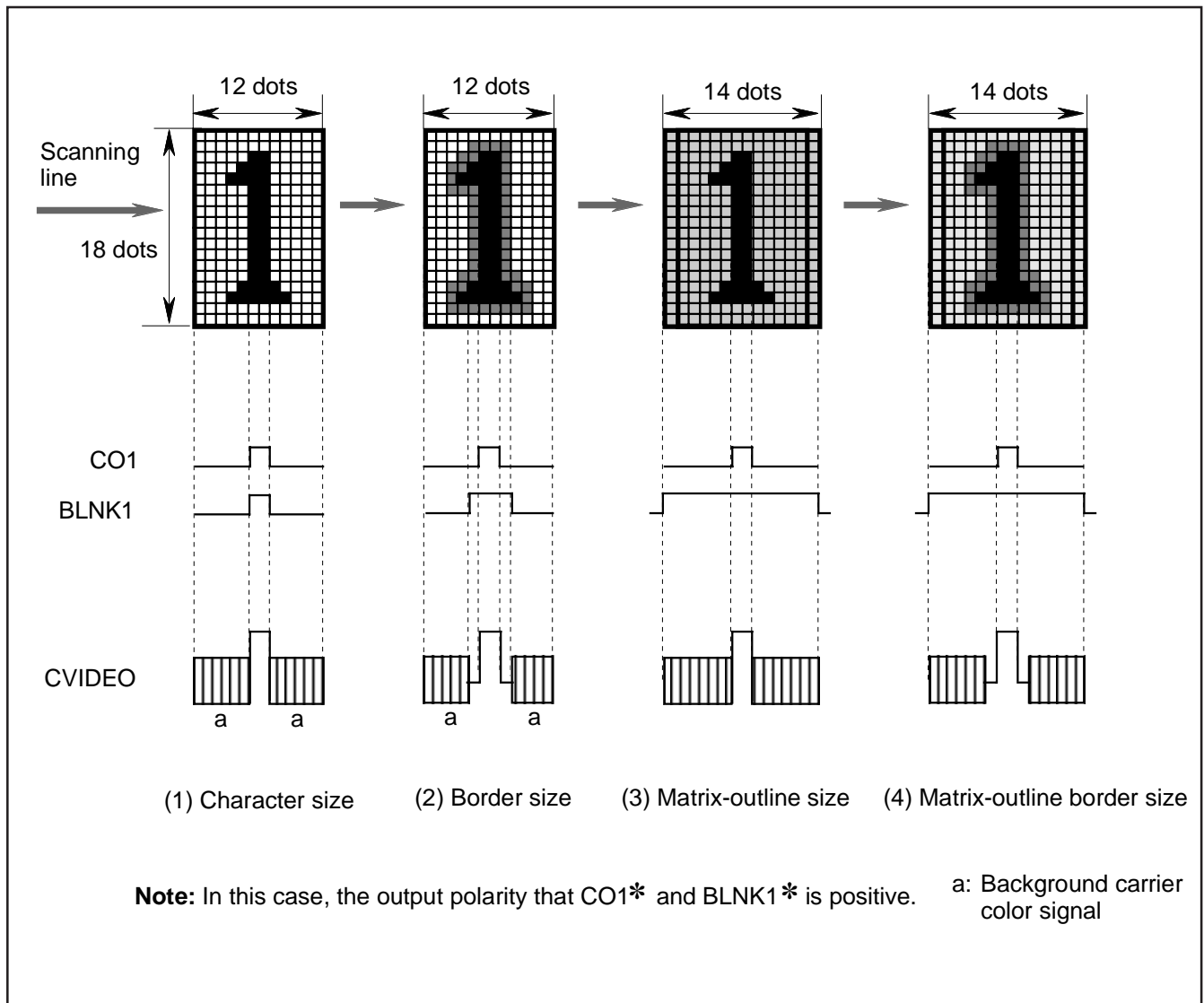


Fig. 8 Display forms at each display mode

DATA INPUT EXAMPLE

Data of display RAM and display control registers can be set by then serial input function. Example of data setting is shown in Figure 9.

Owing to automatic address increment, not necessary to enter addresses for the second and subsequent data.

In automatically, the next of address F8₁₆ is assigned to address 00₁₆.

Fig. 9 shows an example of data serially entered.

Address /Data	DA F	DA E	DA D	DA C	DA B	DA A	DA 9	DA 8	DA 7	DA 6	DA 5	DA 4	DA 3	DA 2	DA 1	DA 0	Remarks	
Address (F8 ₁₆)	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	Specify address	
Data (F8 ₁₆)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Display OFF	
Data (00 ₁₆)	0	0	0	REV	BLINK	EC2	EC1	EC0	C7	C6	C5	C4	C3	C2	C1	C0	Specify address display RAM 0 to EF ₁₆ .	
Data (01 ₁₆)	0	0	0	REV	BLINK	EC2	EC1	EC0	C7	C6	C5	C4	C3	C2	C1	C0		
}	}								}									
Data (EE ₁₆)	0	0	0	REV	BLINK	EC2	EC1	EC0	C7	C6	C5	C4	C3	C2	C1	C0		
Data (EF ₁₆)	0	0	0	REV	BLINK	EC2	EC1	EC0	C7	C6	C5	C4	C3	C2	C1	C0		
Data (F0 ₁₆)	0	0	0	W/R	0	1	0	0	1	0	0	0	PTD 1	PTD 0	PTC 1	PTC 0	Specify address register F0 ₁₆ to F7 ₁₆ .	
Data (F1 ₁₆)	0	0	0	DVP 4	DVP 3	DVP 2	DVP 1	DVP 0	HP 7	HP 6	HP 5	HP 4	HP 3	HP 2	HP 1	HP 0		
Data (F2 ₁₆)	0	0	0	EVP 4	EVP 3	EVP 2	EVP 1	EVP 0	VP 7	VP 6	VP 5	VP 4	VP 3	VP 2	VP 1	VP 0		
Data (F3 ₁₆)	0	0	0	D/V	EFLD 1	EFLD 0	DFLD 1	DFLD 0	VSZ 21	VSZ 20	VSZ 11	VSZ 10	HSZ 21	HSZ 20	HSZ 11	HSZ 10		
Data (F4 ₁₆)	0	0	0	0	0	SPACE	DSP 9	DSP 8	DSP 7	DSP 6	DSP 5	DSP 4	DSP 3	DSP 2	DSP 1	DSP 0		
Data (F5 ₁₆)	0	0	0	0	MB/LB	0	0	0	EQP	PALH	MPAL	INT /NON	N/P	BLINK 2	BLINK 1	BLINK 0		
Data (F6 ₁₆)	0	0	1	0	0	0	LBLACK	LIN 24/32	BLKHF	BB	BG	BR	LEVEL 0	PHASE 2	PHASE 1	PHASE 0		
Data (F7 ₁₆)	0	0	0	0	RGBON	0	CL 17/18	CBLINK	CURS 7	CURS 6	CURS 5	CURS 4	CURS 3	CURS 2	CURS 1	CURS 0		
Data (F8 ₁₆)	0	0	LEVEL 1	EHP 4	EHP 3	EHP 2	EHP 1	EHP 0	RAMERS	DSPON	STOP 1	STOP IN	SCOR	EX	BLK 1	BLK 0		Display ON

Fig. 9 Example of data setting by the serial input function

SERIAL DATA INPUT TIMING

- (1) The address consists of 16 bits.
- (2) The data consists of 16 bits.
- (3) The 16 bits in the SCK after the \overline{CS} signal has fallen are the address, and for succeeding input data, the address is incremented every 16 bits.

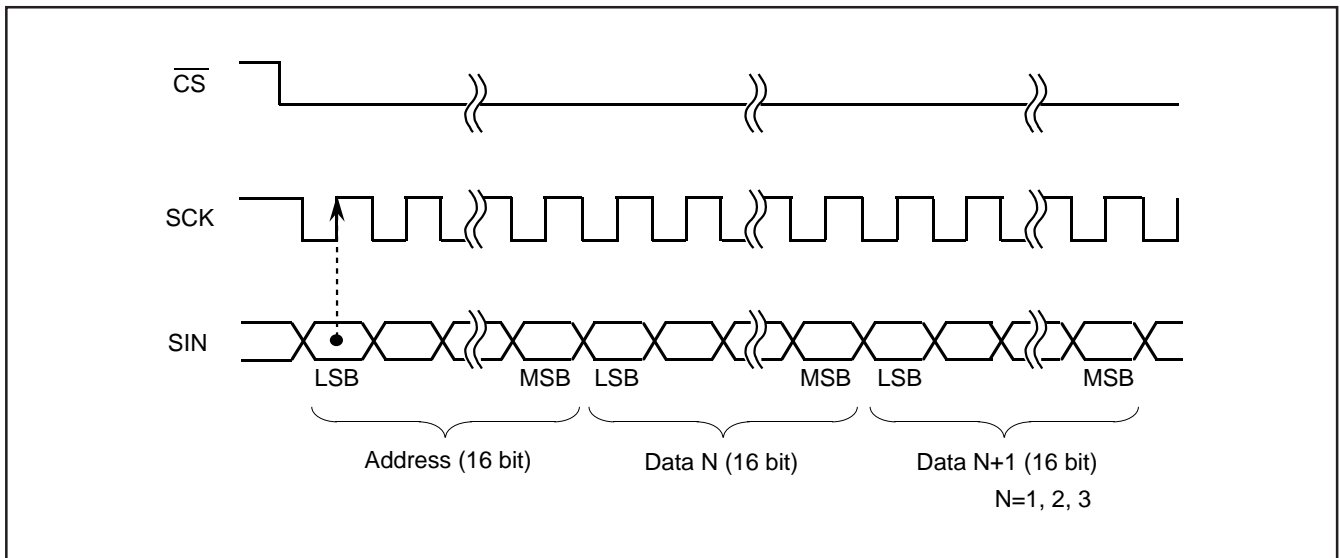


Fig. 10 Serial input timing

Output timing of decode data

- (1) Setting "1" in the W/R register activates output mode.
- (2) Outputs decode data in 16 clocks of the SCK after switching over to output mode. (Don't enter the SCK for more than 16 clocks.)
- (3) Raising the \overline{CS} signal deactivates output mode. (To switch over to input mode, cause \overline{CS} to fall.)
- (4) If no data are present, or if data have already been read, 0000₁₆ is output.

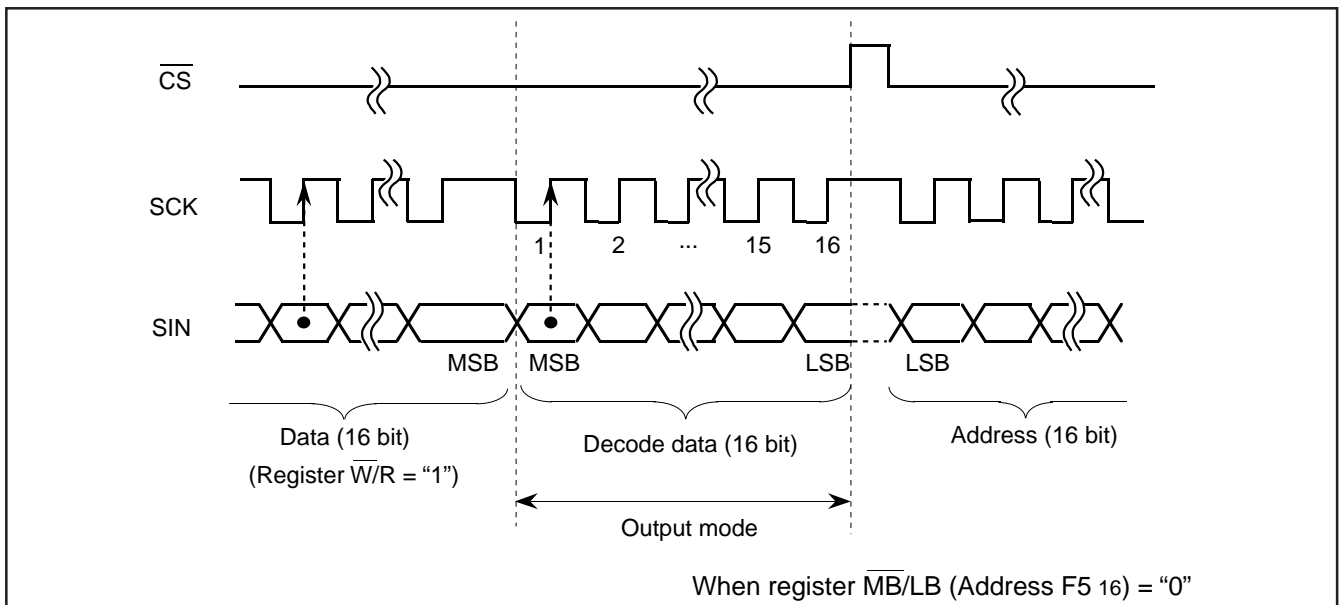


Fig. 11 Decode data output timing

Encode functions (effective for NTSC only)

(1) Setting encode data

Setting data code (000 – 111) in EC0 through EC2 (bits DA8 through DAA) of the display RAM (addresses 0 through EF16) encodes. A sample setting and data code are shown below.

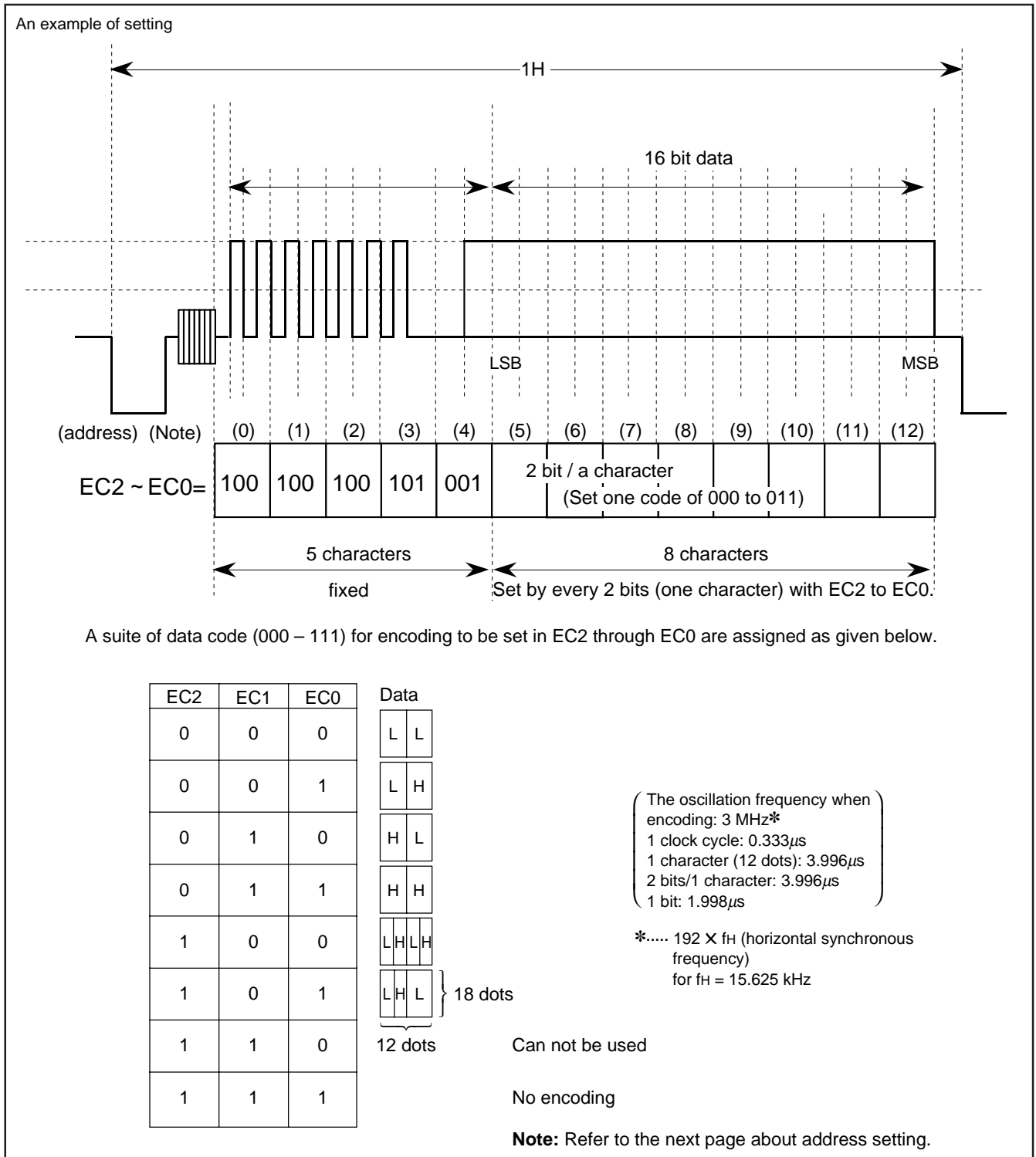


Fig. 12 An example of data code setting

(2) Setting addresses

Set encode data in EC0 through EC2 of addresses (that correspond to an extent from the first character to the thirteenth character in each line as appearing on the screen.) Set "111" to EC2 through EC0 of all the addresses in which you set no encode data.

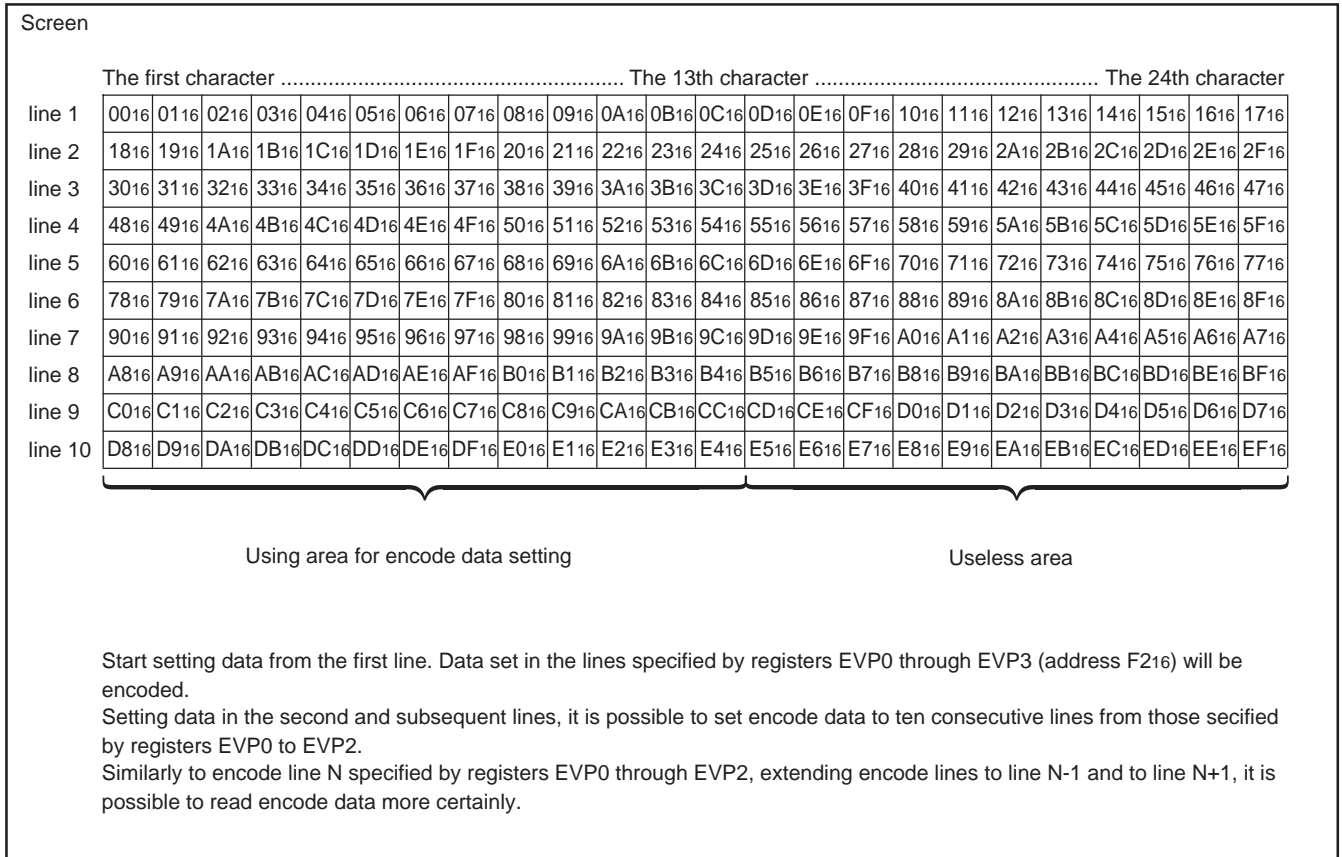
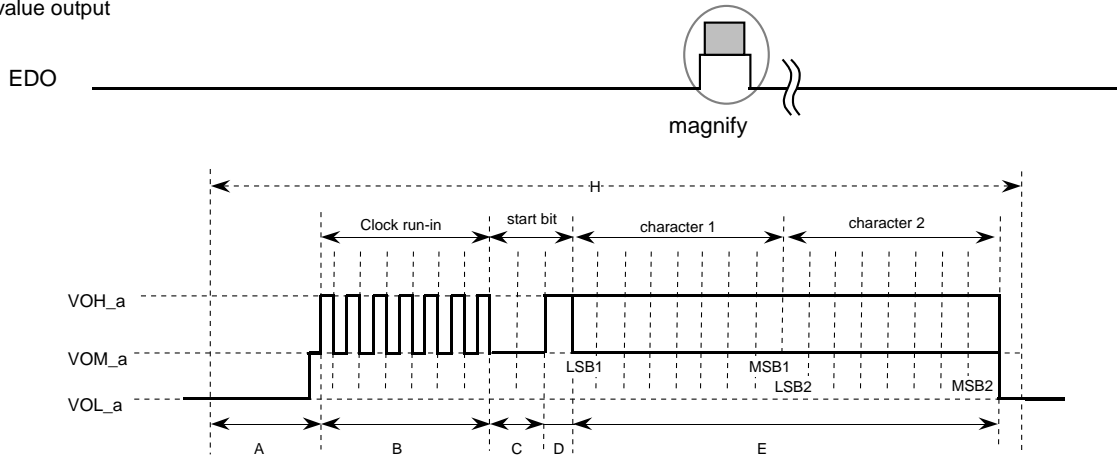


Fig.13 Display monitor

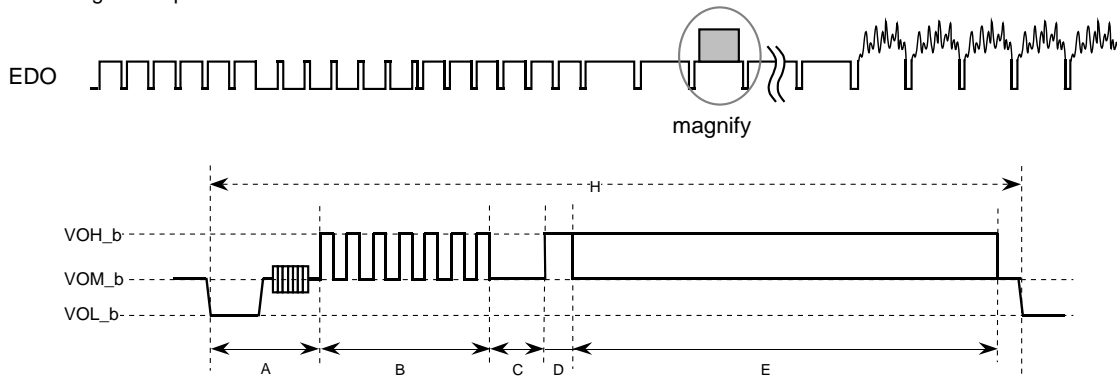
(3) Encode data output

Control encode data (EDO) output by register \bar{D}/V (address F316)

a) Register \bar{D}/V (address F316) = "0"
Digital 3 value output



b) Register \bar{D}/V (address F316) = "1"
Composite video signal output



VDD : 5.0V, Ta : 25°C

Symbol	Min.	Typ.	Max.	Unit	
A	—	$(EHS+9) \times 1/(fH \times 192) \text{ } \mu\text{s}$	—	μs	
B	—	6.5P	—	μs	
C	—	2P	—	μs	
D	—	1P	—	μs	
E	—	16P	—	μs	
H	—	1/fH	—	μs	
(a)	VOH_a	—	5.0	V	
	VOM_a	0.4	2.3	V	
	VOL_a	—	0	V	
(b)	VOH_b	3.1	3.3	3.5	V
	VOM_b	1.9	2.1	2.3	V
	VOL_b	1.3	1.5	1.7	V

$1P = 1/(fH \times 32)$

fH : Horizontal synchronous frequency (MHz)

* It is possible to make a fine adjustment (EHS=16 to 31, 16 settings, in increments of $1/(fH \times 192)$) by use of EHS (registers EHP4 to EHP0 of address F816). (EHS ≤ 15 setting is forbidden.)

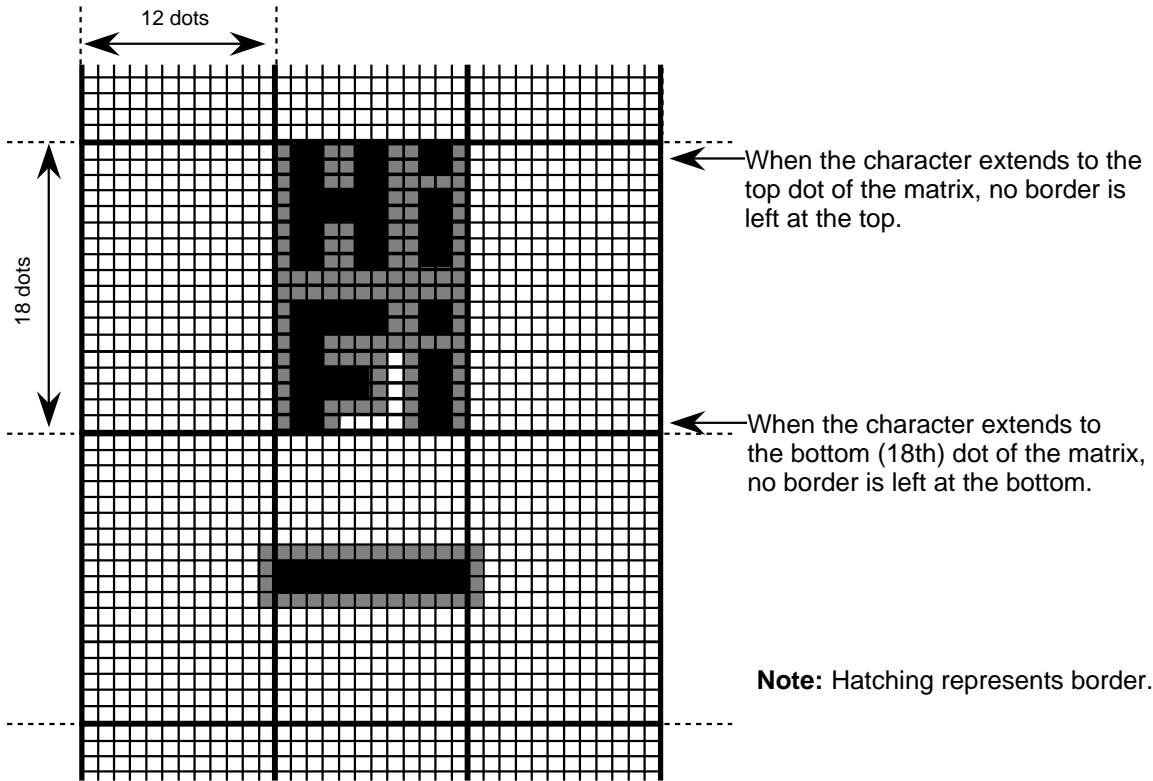
Fig. 14 Encode data output

CHARACTER FONT

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

Character code "FF16" is so fixed as to be blank and to have no background, thus cannot assign a character font to this code.

(1) Border display (set by register BLK0, 1 (address F816))



(2) Cursor display (Border display)

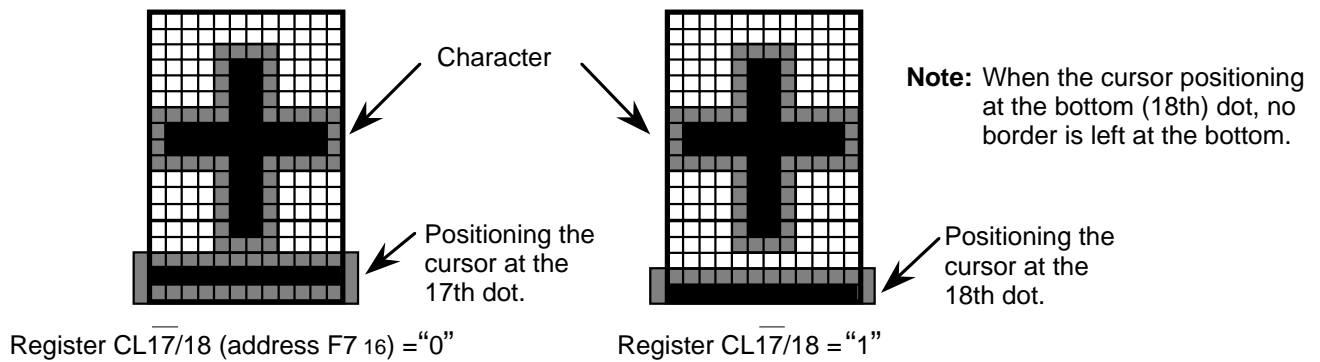


Fig. 15 Character font and border

Precautions

- (1) Points to note in setting the display RAMs
 - a) Be careful to the edges may sway depending on the combination of character's background color and raster color.

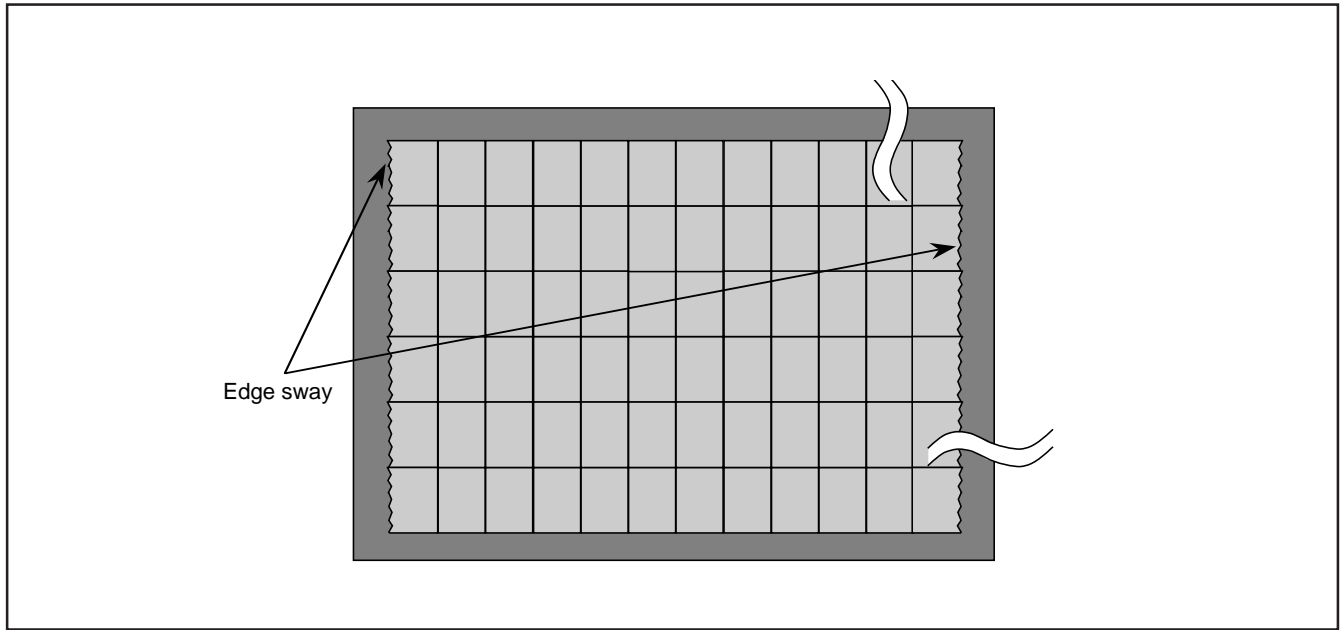


Fig. 16 Example of display

- b) If what display exceeds the display area in dealing with external synchronization, (if use double - size characters), set the character code of the addresses lying outside that display area blank code – "FF₁₆".

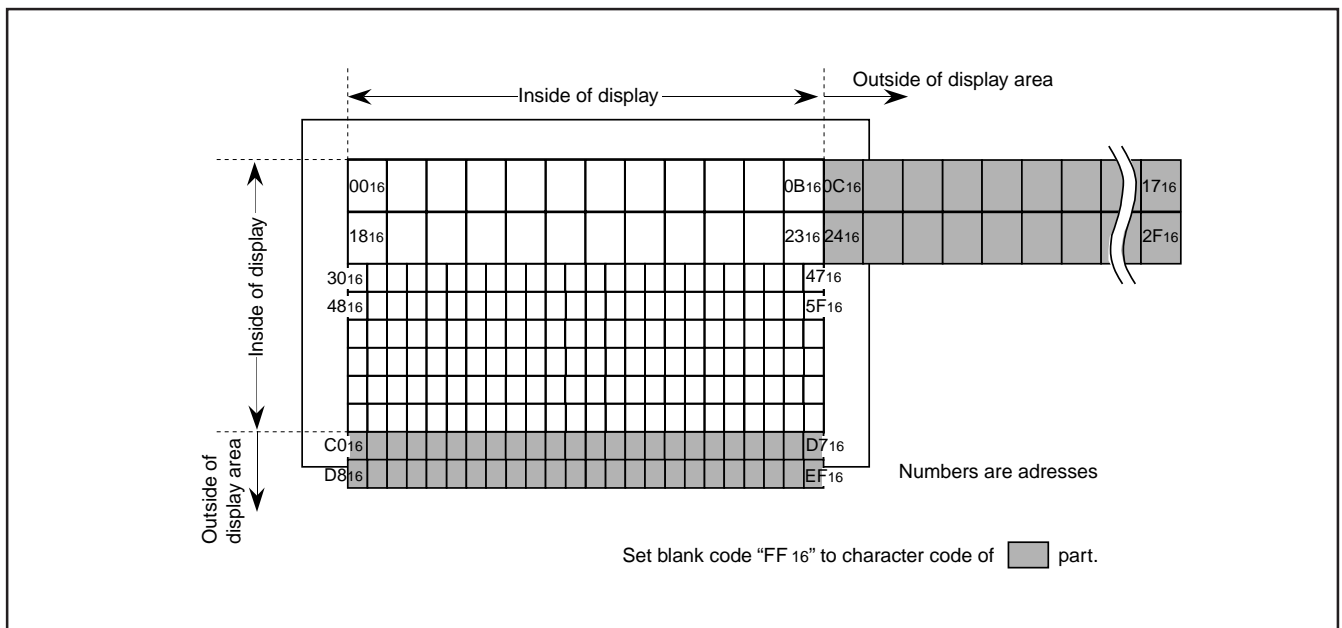


Fig. 17 Example of display

(2) Before setting registers at the starting of system, be sure to reset the M35052-XXXSP/FP by applying "L" level to the \overline{AC} pin.

(3) Power supply noise

When power supply noise is generated, the internal oscillator circuit does not stabilize, whereby causing horizontal jitters across the picture display. Therefore, connect a bypass capacitor between the power supply and GND.

(4) Synchronous correction action

When switching channel or in the special playback mode (quick playback, rewinding, and so on) of VTR, effect of synchronous correction becomes strong, and distortion of a character is apt to occur because the continuity of video signal is suddenly switched. When the continuity of video signal is out of order, erasure of displayed characters is recommended in a extreme short time to raise the quality of displayed characters.

(5) Notes on fsc signal input

This IC amplifies the subcarrier frequency (fsc) signal (NTSC, M-PAL system: 3.58MHz, PAL system: 4.43MHz) input to the OSCIN pin (17-pin) and generates the composite video signal internally. The amplified fsc signal can be destabilized in the following cases.

- a) When the fsc signal is outside of recommended operating conditions.
- b) When the waveform of the fsc signal is distorted.
- c) When DC level in the fsc waveform fluctuates.

When the amplified signal is unstable, the composite video signal generated inside the IC is also unstable in terms of synchronization with the subcarrier and phase.

Consequently, this results in color flicker and lost synchronization when the composite video signal is generated. Make note of the fact that this may prevent a stable blue background from being formed.

(6) Forbidding to stop entering the fsc signal

This IC doesn't properly work if the fsc signal is not entered into the OSCIN pin (pin 17), so don't stop the fsc signal so as to work the IC. To stop the IC, turn the display off (set 0 in the register DSPON (address F816).)

(7) Forbidding to set data during the period in which the internal oscillation circuit stabilizes

- a) To start entering the fsc signal when its input is stopped.
- b) To start oscillating the oscillation circuit for display when its oscillation is stopped. (to assign "1" to the register STOP1 (address F816) when it is assigned "0", or the like.)
- c) To turn on the internal bias when it is turned off. (to assign "1" to the register LEVEL1 (address F816) when it is assigned "0".)

There can be instances in which data are not properly set in the registers until the internal oscillation circuit stabilizes, so follow the steps in sequence as given below.

- 1) Set "0" in the register DSPON (address F816). (the display is turned off)
- 2) Effect the settings a), b), and c) given above.

3) Wait 20 ms (the period necessary for the internal oscillation circuit to stabilize) before entering data.

4) Set necessary data in other registers, and make the display RAM ready.

M35053-XXXSP/FP PERIPHERAL CIRCUIT

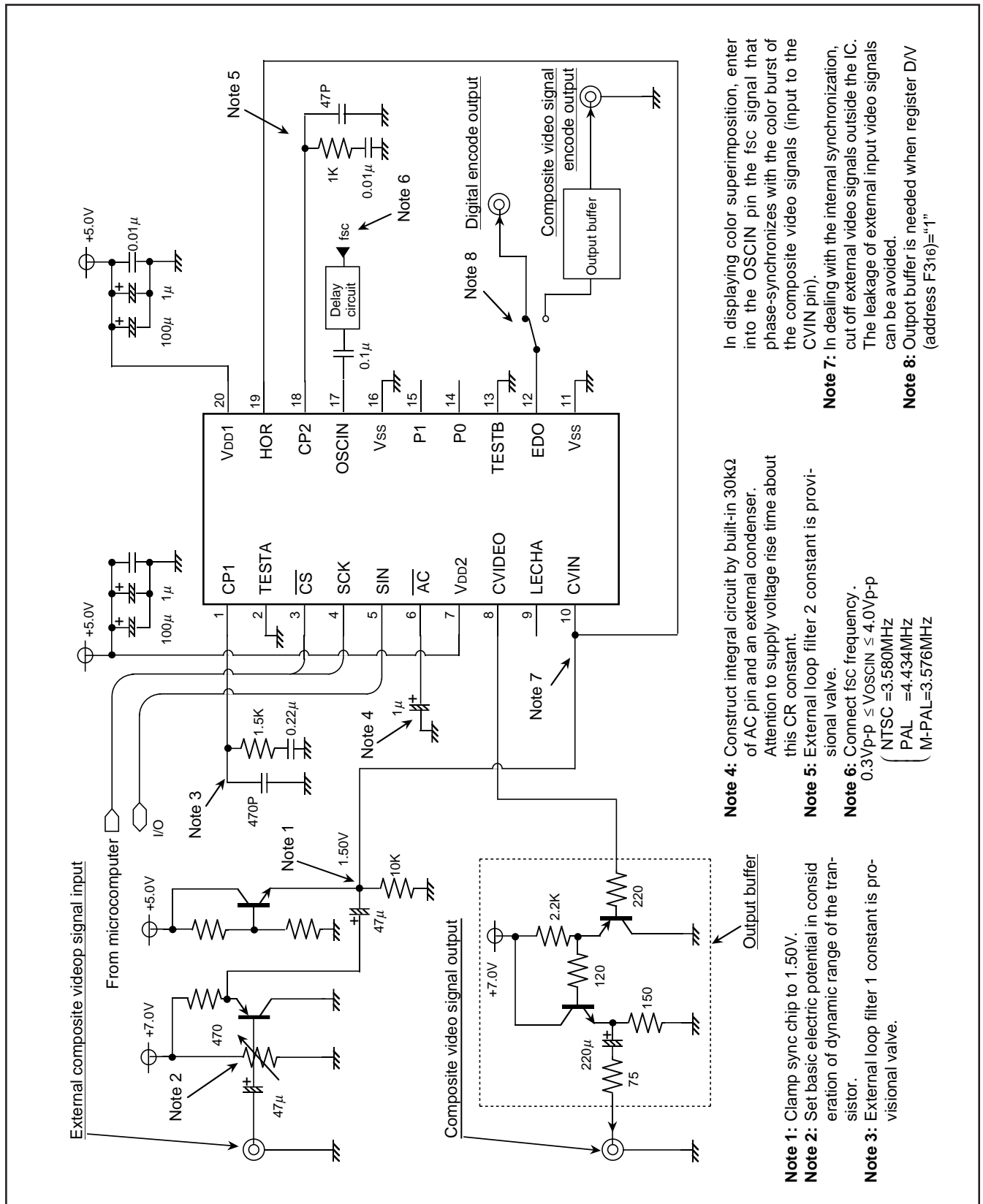


Fig. 18 M35053-XXXSP/FP example of peripheral circuit

In displaying color superimposition, enter into the OSCIN pin the fsc signal that phase-synchronizes with the color burst of the composite video signals (input to the CVIN pin).

Note 7: In dealing with the internal synchronization, cut off external video signals outside the IC. The leakage of external input video signals can be avoided.

Note 8: Output buffer is needed when register DV (address F316)^{“1”}

Note 4: Construct integral circuit by built-in 30kΩ of AC pin and an external condenser. Attention to supply voltage rise time about this CR constant.

Note 5: External loop filter 2 constant is provisional valve.

Note 6: Connect fsc frequency.
 0.3Vp-p ≤ VOSCIN ≤ 4.0Vp-p
 (NTSC =3.580MHz
 PAL =4.434MHz
 M-PAL=3.576MHz

Note 1: Clamp sync chip to 1.50V.

Note 2: Set basic electric potential in consideration of dynamic range of the transistor.

Note 3: External loop filter 1 constant is provisional valve.

TIMING REQUIREMENTS ($T_a = -20^{\circ}\text{C}$ to 70°C , $V_{DD} = 5 \pm 0.25\text{V}$, unless otherwise noted)

Symbol	Parameter	Limits			Unit
		Min.	Typ.	Max.	
$t_w(\text{SCK})$	SCK width	400	–	–	ns
$t_{su}(\overline{\text{CS}})$	$\overline{\text{CS}}$ setup time	200	–	–	ns
$t_h(\text{CS})$	$\overline{\text{CS}}$ hold time	2	–	–	μs
$t_{su}(\text{SIN})$	SIN setup time	200	–	–	ns
$t_h(\text{SIN})$	SIN hold time	200	–	–	ns
t_{word}	1 word writing time	12.8	–	–	μs

Note. When oscillation stop at register STOR1 (address F816), 1V (field term) or more of $t_{su}(\text{CS})$ and $t_h(\text{CS})$ are needed.

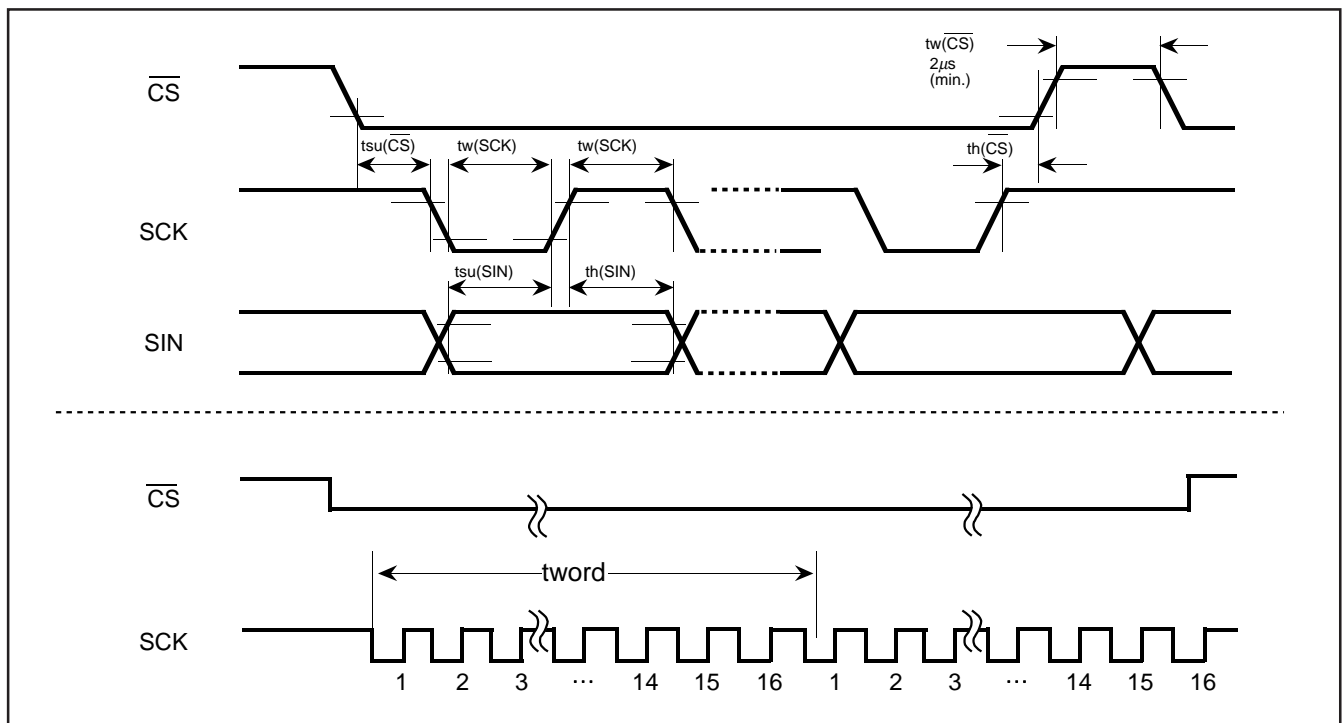


Fig. 19 Serial input timing requirements

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

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

Symbol	Parameter	Conditions	Ratings	Unit
VDD	Supply voltage	With respect to V_{SS}	-0.3~6.0	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	°C
T _{stg}	Storage temperature		-40~125	°C

RECOMMENDED OPERATING CONDITIONS ($V_{DD} = 5V$, $T_a = -20$ to $70^\circ C$, unless otherwise noted)

Symbol	Parameter	Limits			Unit	
		Min.	Typ.	Max.		
VDD	Supply voltage	4.75	5.00	5.25	V	
V _{IH}	"H" level input voltage A C, CS, SIN, SCK, TESTA, TESTB	$0.8 \times V_{DD}$	V_{DD}	V_{DD}	V	
V _{IL}	"L" level input voltage A C, CS, SIN, SCK, TESTA, TESTB	0	0	$0.2 \times V_{DD}$	V	
V _{CVIN}	CVIN, HOR	-	2.0V _{P-P}	-	V	
V _{OSCIN}	Input voltage OSCIN (Note 1)	0.3V _{P-P}	-	4.0V _{P-P}	V	
f _{OSCIN}	Synchronous signal oscillation frequency (Duty 40~60%)	-	3.580 4.434 3.576	-	MHz	
f _{OSC1}	Display oscillation frequency	24 characters X 10 lines	-	480xf _H (Note 2)	-	MHz
f _{OSC2}		32 characters X 7 lines	-	640xf _H (Note 2)	-	MHz

Notes 1. Noise component is within 30mV.

2. f_H: Horizontal synchronous frequency (MHz).

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

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
VDD	Supply voltage	$T_a=-20 \sim 70^\circ C$	4.75	5.00	5.25	V
I _{DD}	Supply current	$V_{DD}=5.00V$	-	30	50	mA
V _{OH}	"H" level output voltage P0, P1, SIN	$V_{DD}=4.75V, I_{OH}=-0.4mA$	3.75	-	-	V
V _{OL}	"L" level output voltage P0, P1, SIN	$V_{DD}=4.75V, I_{OL}=0.4mA$	-	-	0.4	V
R _i	Pull-up resistance AC, CS, SCK, SIN, TESTB	$V_{DD}=5.00V$	10	30	100	kΩ
V _{OH_a}	"H" level output voltage EDO	$V_{DD}=5.00V, I_{OH}=-0.04mA$	4.0	-	-	V
V _{OM_a}	"M" level output voltage EDO	$V_{DD}=5.00V, I_{OM}=\pm 0.04mA$	0.4	2.3	4.0	V
V _{OL_a}	"L" level output voltage EDO	$V_{DD}=5.00V, I_{OL}=0.04mA$	-	-	0.4	V

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

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
V _{IN-SC}	Composite video signal input clamp voltage	Sync-chip voltage	-	1.5	-	V

Note for Supplying Power

(1) Timing of power supplying to \overline{AC} pin

The internal circuit of M35052-XXXSP/FP 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 20. t_w is the interval after the supply voltage becomes $0.8 \times V_{DD}$ or more and before the supply voltage to the \overline{AC} pin ($V_{\overline{AC}}$) becomes $0.2 \times V_{DD}$ or more.

After supplying the power (V_{DD} and V_{SS}) to M35052-XXXSP/FP, the t_w time must be reserved for 1ms or more. Before starting

input from the microcomputer, the waiting time (t_s) must be reserved for 500ms after the supply voltage to the \overline{AC} pin becomes $0.8 \times V_{DD}$ or more.

(2) Timing of power supplying to 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.

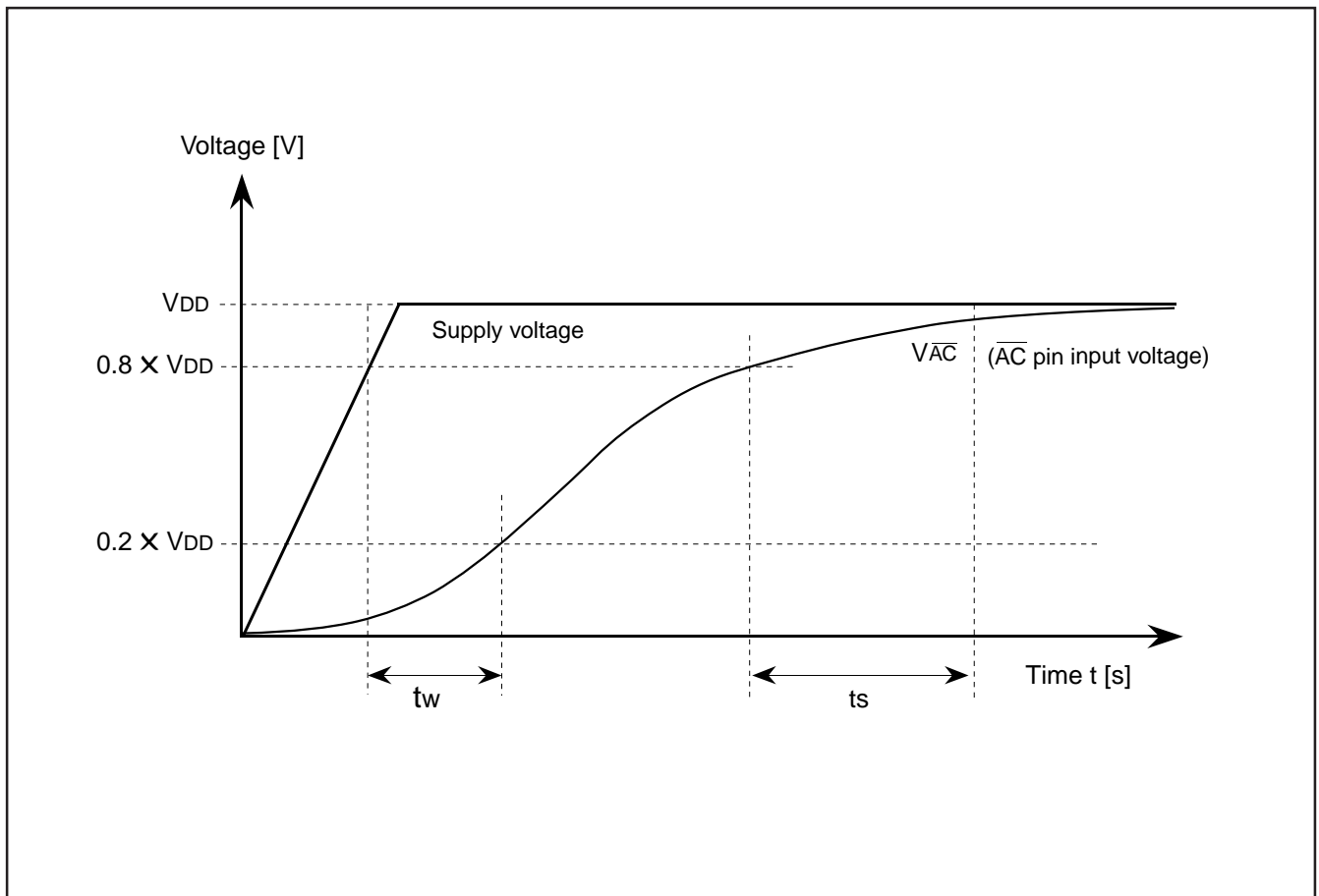


Fig. 20 Timing of power supplying to \overline{AC} pin

PRECAUTION FOR USE

Notes on noise and latch-up

Connect a capacitor (approx. $0.1 \mu F$) between pins V_{DD} and V_{SS} at the shortest distance using relatively thick wire to prevent noise and latch up.

ROM ORDERING METHOD

Please submit the information described below when ordering Mask ROM.

- (1) ROM Order Confirmation Form 1
- (2) Data to be written into mask ROM EPROM
(three sets containing the identical data)
- (3) Mark Specification Form 1
- (4) Program for character font generating + floppy disk in which character data is input

STANDARD ROM TYPE : M35053-001SP/FP

M35053-001SP/FP is a standard ROM type of M35053-XXXSP/FP character patterns are fixed to the contents of Figure 21 to 24.

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

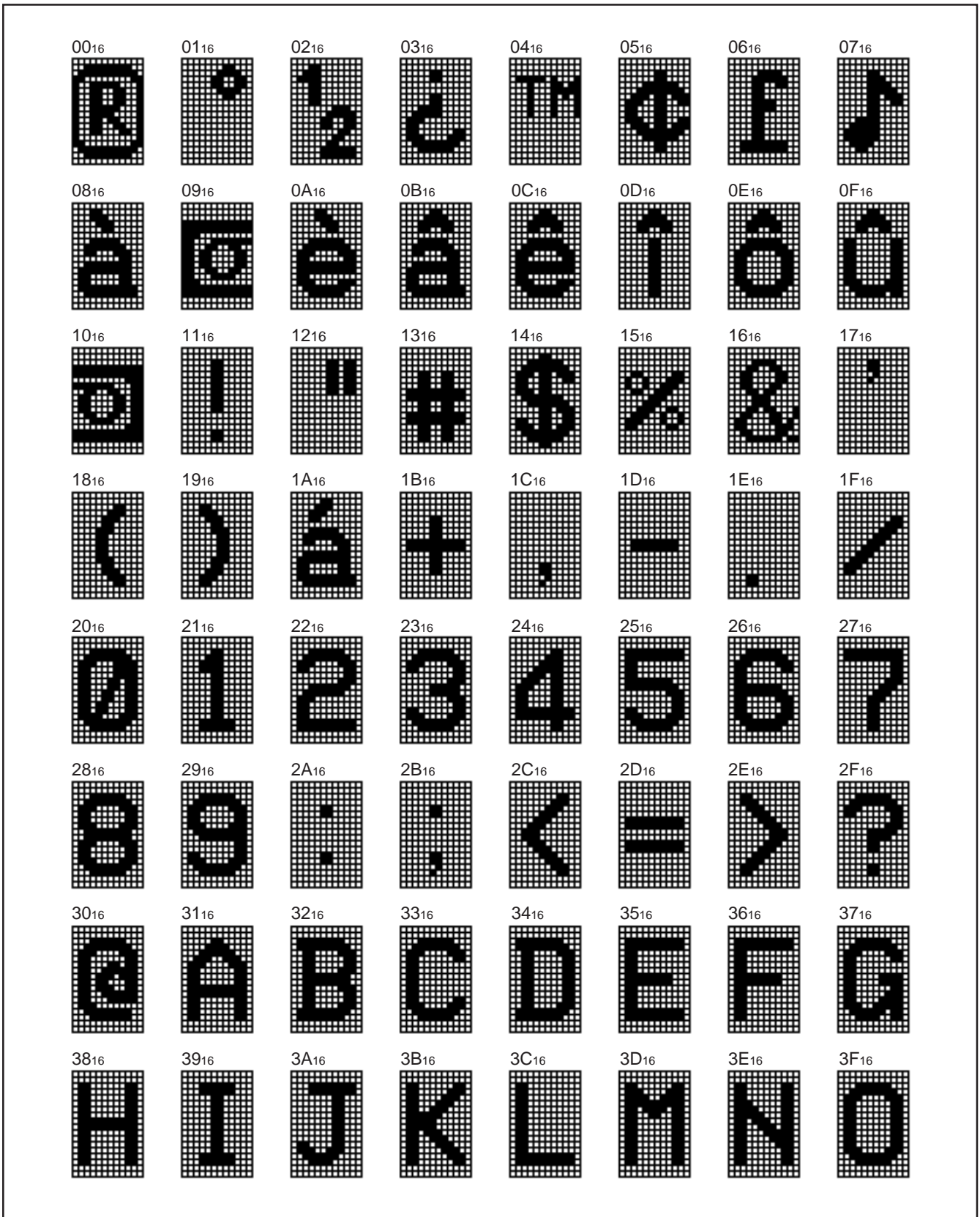


Fig. 21 M35053-001SP/FP character pattern (1)

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS



Fig. 22 M35053-001SP/FP character pattern (2)

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS



Fig. 23 M35053-001SP/FP character pattern (3)

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

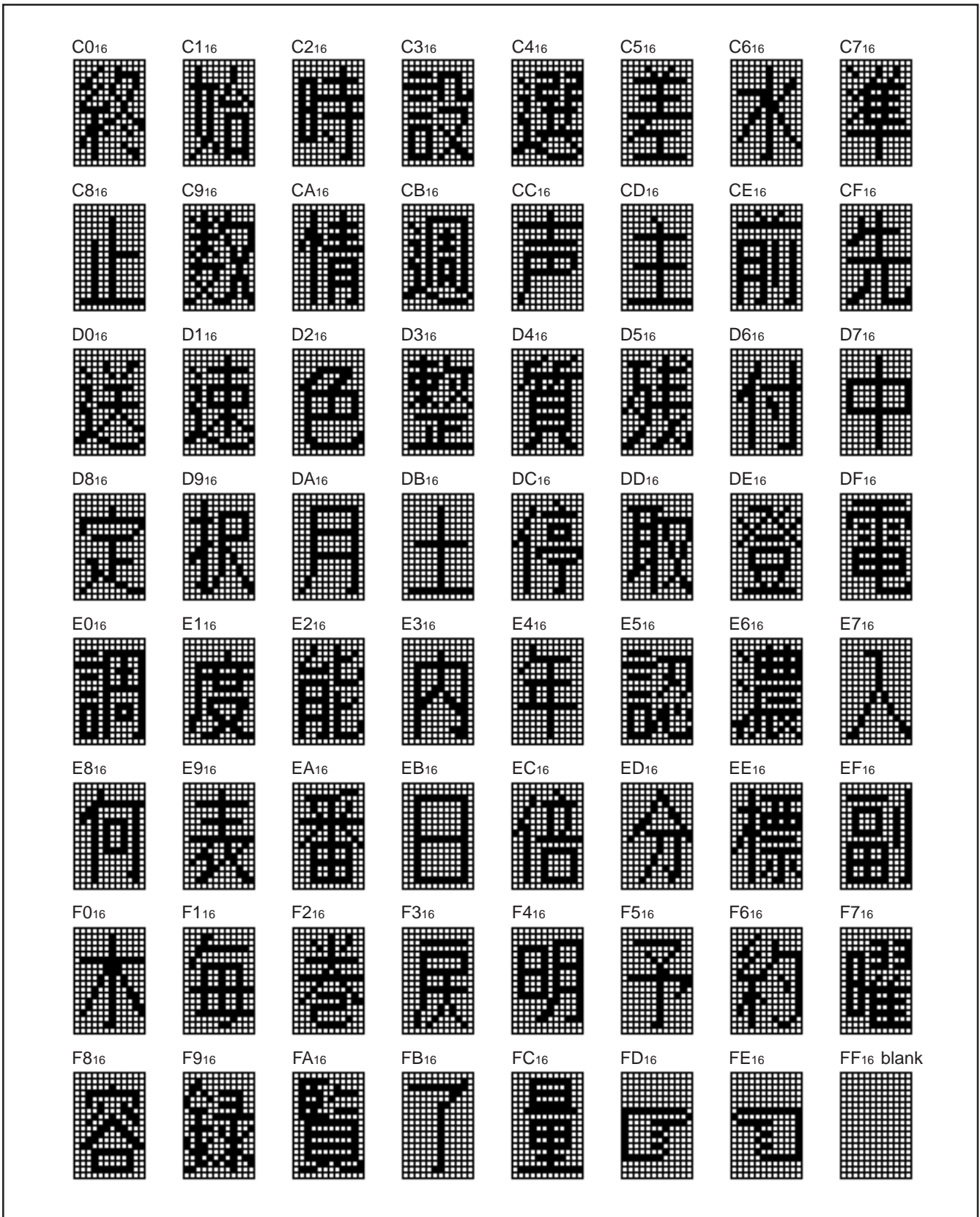
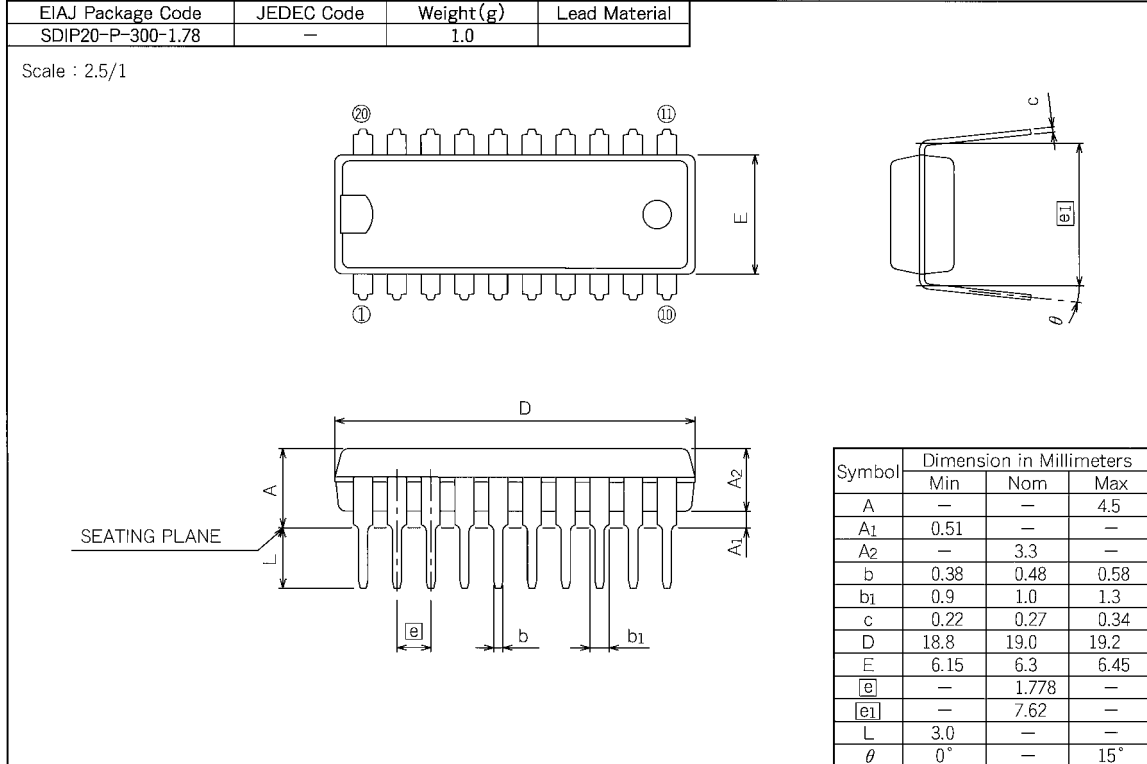


Fig. 24 M35053-001SP/FP character pattern (4)

PACKAGE OUTLINE

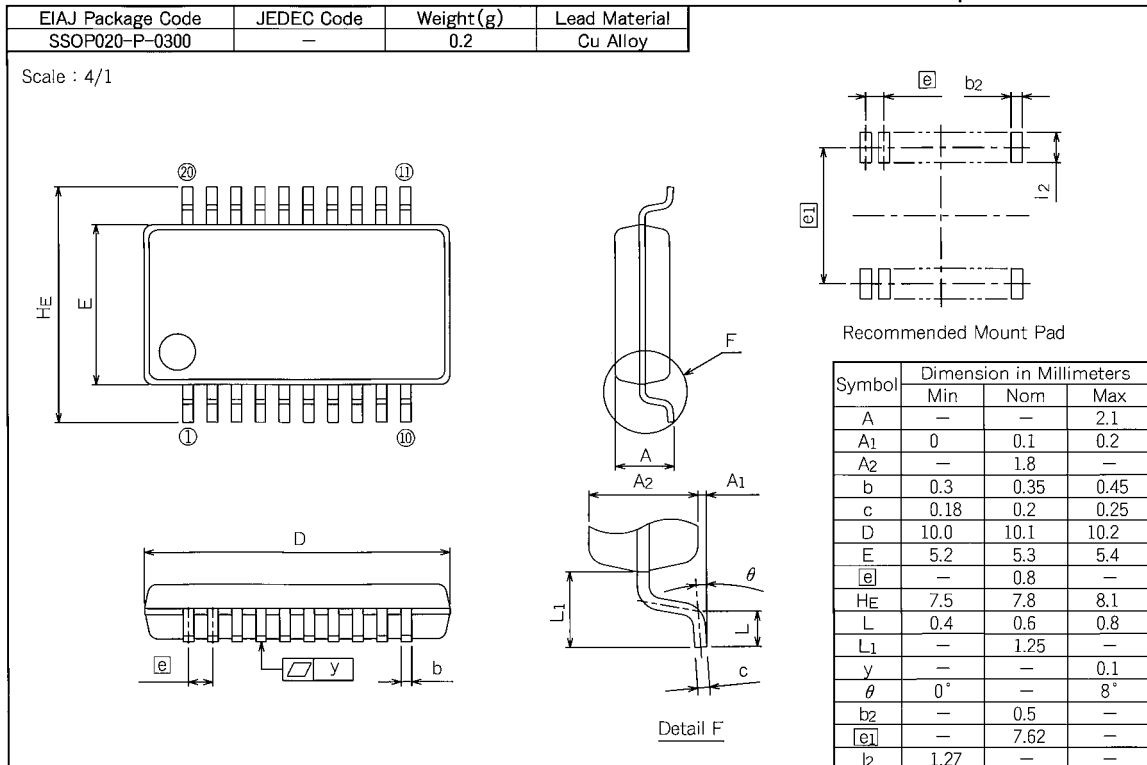
20P4B

Plastic 20pin 300mil SDIP



20P2Q-A

Plastic 20pin 300mil SSOP



Renesas Technology Corp.

Nippon Bldg.,6-2,Otemachi 2-chome,Chiyoda-ku,Tokyo,100-0004 Japan

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REVISION DESCRIPTION LIST

M35053-XXXSP/FP DATA SHEET

Rev. No.	Revision Description	Rev. date
1.0	First Edition	980402
1.1	P44 20P2Q-A (20-PIN SSOP) MARK SPECIFICATION FORM B: Note 4 added	000707
1.2	Delete Mask ROM ORDER CONFIRMATION FORM and MASK SPECIFICATION FORM	000829