

To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: <http://www.renesas.com>

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

Send any inquiries to <http://www.renesas.com/inquiry>.

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: “Standard”, “High Quality”, and “Specific”. The recommended applications for each Renesas Electronics product depends on the product’s quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as “Specific” without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as “Specific” or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is “Standard” unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.
 - “Standard”: Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.
 - “High Quality”: Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.
 - “Specific”: Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) “Renesas Electronics” as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) “Renesas Electronics product(s)” means any product developed or manufactured by or for Renesas Electronics.

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

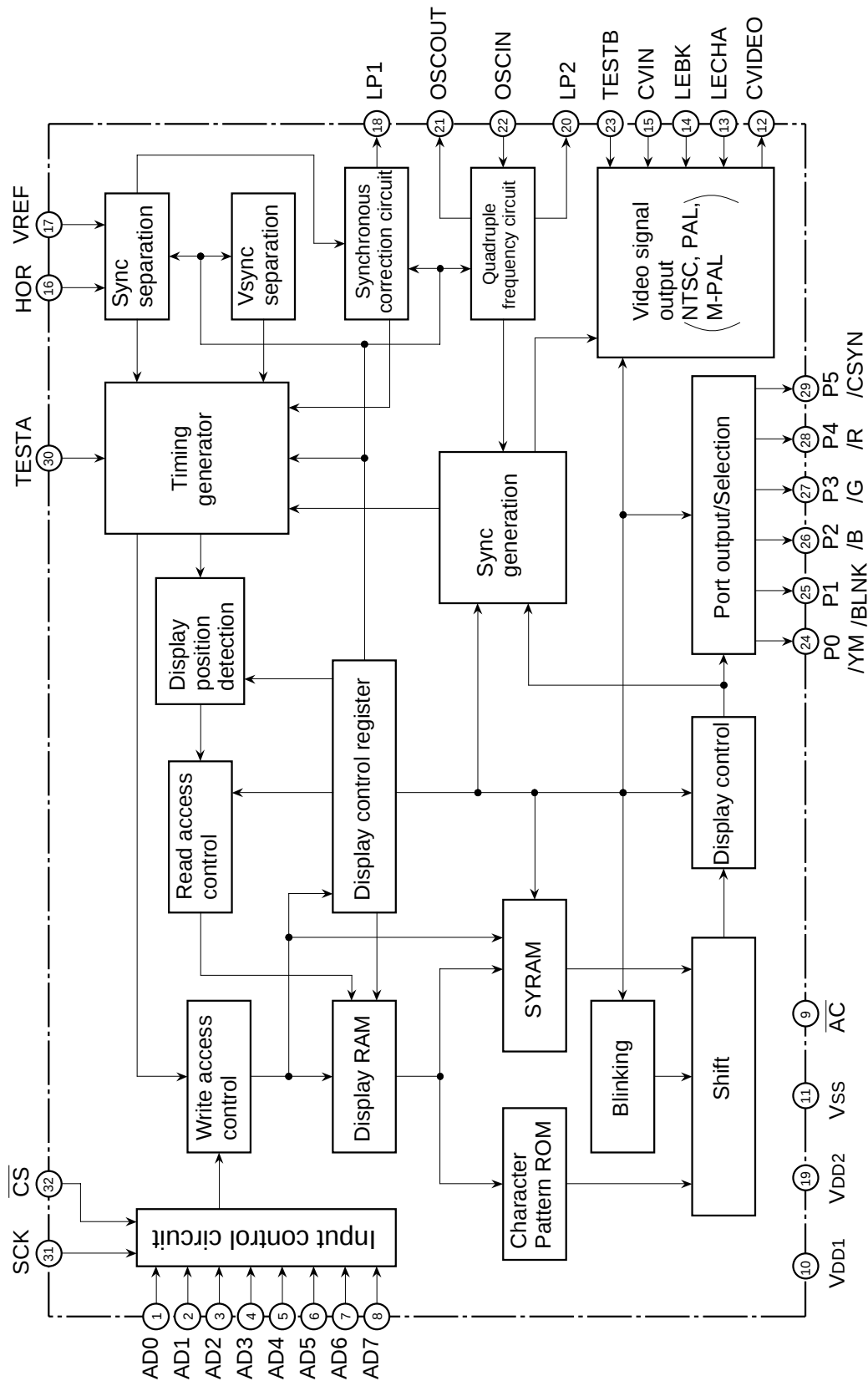
PIN DESCRIPTION

Symbol	Pin name	Input/Output	Function
AD0~AD7	Parallel data input	Input	These input pins determine address and data of the Display RAM, Control RAM, and Overlay RAM (SYRAM) by 8-bit parallel. Hysteresis input is required.
AC	Auto-clear input	Input	When this input pin transitions from "H" to "L", the device is reset. Built-in a pull-up resistor. Hysteresis input is required.
VDD1	Power pin	—	Digital power supply pin. This pin must be connected to + 5V.
VSS	Earthing pin	—	Ground pin. This pin must be connected to 0V.
CVIDEO	Composite video signal output	Output	This pin outputs the composite video signal. The output signal is 2Vp-p. In superimpose mode, this pin's signal consists of the OSD signal combined with the input composite signal CVIN.
LECHA	Character level input	Input	This input pin is used for controlling the "white" character color level of the OSD signal.
LEBK	Black level input	Input	This input pin is used for controlling the "black" character color level of the OSD signal.
CVIN	Composite video signal input	Input	This input pin is used for the superimpose mode. An external composite signal may be input through this pin and mixed with the internally generated OSD signal.
HOR	Synchronous signal input	Input	This input pin is used to input the same signal as CVIN. The horizontal and vertical sync signals are then extracted internally within the device.
VREF	Slice level input	Input	This input pin is used to determine the slice voltage for extracting the sync signals from the video composite signal.
LP1	Filter output 1	Output	This is filter output pin 1.
VDD2	Power pin	—	Analog power supply pin. This pin must be connected to +5V.
LP2	Filter output 2	Output	This is filter output pin 2.
OSCOUT	The pins for attaching an external oscillator circuit for generating the synchronization signal.	Output	These are the pins for attaching an external oscillator circuit for generating the synchronization signal: NTSC (3.580MHz), PAL (4.434MHz), M-PAL (3.576MHz).
OSCIN		Input	
TESTB	Test input	Input	Factory test pin. The pin must be connected to GND.
P0	Port output	Output	This output pin can be configured to port P0 or YM output.
P1	Port output	Output	This output pin can be configured to port P1 or BLNK output.
P2	Port output	Output	This output pin can be configured to port P2 or B output.
P3	Port output	Output	This output pin can be configured to port P3 or G output.
P4	Port output	Output	This output pin can be configured to port P4 or R output.
P5	Port output	Output	This output pin can be configured to port P5 or CSYN output.
TESTA	Test input	Input	Factory test pin. The pin must be connected to GND.
SCK	Clock input for data input	Input	This pin is enabled when the CS pin is "L". Data input to pins AD0 to AD7 is latched at the rising edge of this signal. This pin is hysteresis input.
CS	Chip select input	Input	This is chip selection input pin. When this pin is "L", transmission is enabled. This pin is hysteresis input.

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

BLOCK DIAGRAM



M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

MEMORY CONSTRUCTION

Address 000₁₆ to 2A7₁₆ are assigned to the display RAM, 2A8₁₆ to 2B0₁₆ are assigned to the display control registers and 300₁₆ to 6EC₁₆ are assigned to SYRAM.

The internal circuit is reset and all display control registers (address 2A8₁₆ to 2B0₁₆) are set to "0". The memory constitution of display RAM and register is shown in Figure 1 and the memory constitution of SYRAM is shown in Figure 2.

Table 1 The memory constitution of display RAM and register

add- ress	DA17	DA16	DA15	DA14	DA13	DA12	DA11	DA10	DAF	DAE	DAD	DAC	DAB	DAA	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
000 ₁₆	SB	SG	SR	SYC5	SYC4	SYC3	SYC2	SYC1	SYC0	BB	BG	BR	BLINK	CB	CG	CR	C7	C6	C5	C4	C3	C2	C1	C0
l	SY color setting			SYRAM setting						Raster color setting			BLINK	Character color setting			Character setting							
2A7 ₁₆	SB	SG	SR	SYC5	SYC4	SYC3	SYC2	SYC1	SYC0	BB	BG	BR	BLINK	CB	CG	CR	C7	C6	C5	C4	C3	C2	C1	C0
2A8 ₁₆	—	TEST 3	TEST 2	TEST 1	TEST 0	TEST 11	TEST 10	HP8	HP7	HP6	HP5	HP4	HP3	HP2	HP1	HP0	VP7	VP6	VP5	VP4	VP3	VP2	VP1	VP0
2A9 ₁₆	—	—	—	BLINK 3	BLINK 2	BLINK 1	BLINK 0	HSZ 16	HSZ 15	HSZ 14	HSZ 13	HSZ 12	HSZ 11	HSZ 10	HSZ 9	HSZ 8	HSZ 7	HSZ 6	HSZ 5	HSZ 4	HSZ 3	HSZ 2	HSZ 1	HSZ 0
2AA ₁₆	—	—	—	TEST 12	EQP	TEST 20	HIDE	VSZ 16	VSZ 15	VSZ 14	VSZ 13	VSZ 12	VSZ 11	VSZ 10	VSZ 9	VSZ 8	VSZ 7	VSZ 6	VSZ 5	VSZ 4	VSZ 3	VSZ 2	VSZ 1	VSZ 0
2AB ₁₆	—	—	TEST 26	TEST 25	PHASE 2	PHASE 1	PHASE 0	DSP0 16	DSP0 15	DSP0 14	DSP0 13	DSP0 12	DSP0 11	DSP0 10	DSP0 09	DSP0 08	DSP0 07	DSP0 06	DSP0 05	DSP0 04	DSP0 03	DSP0 02	DSP0 01	DSP0 00
2AC ₁₆	—	—	—	TEST 21	LINE B	LINE G	LINE R	DSP1 16	DSP1 15	DSP1 14	DSP1 13	DSP1 12	DSP1 11	DSP1 10	DSP1 09	DSP1 08	DSP1 07	DSP1 06	DSP1 05	DSP1 04	DSP1 03	DSP1 02	DSP1 01	DSP1 00
2AD ₁₆	—	TEST 23	TEST 22	SERS 3	SERS 2	SERS 1	SERS 0	ERS 16	ERS 15	ERS 14	ERS 13	ERS 12	ERS 11	ERS 10	ERS 9	ERS 8	ERS 7	ERS 6	ERS 5	ERS 4	ERS 3	ERS 2	ERS 1	ERS 0
2AE ₁₆	—	—	—	—	—	SEND 4	SEND 3	SEND 2	SEND 1	SEND 0	SST 4	SST 3	SST 2	SST 1	SST 0	SLIN 4	SLIN 3	SLIN 2	SLIN 1	SLIN 0	SBIT 3	SBIT 2	SBIT 1	SBIT 0
2AF ₁₆	PC7	PC6	PC5	PC4	PC3	PC2	PC1	PC0	ALL24	SRAND 2	SRAND 1	SRAND 0	PTD 5	PTD 4	PTD 3	PTD 2	PTD 1	PTD 0	PTC 5	PTC 4	PTC 3	PTC 2	PTC 1	PTC 0
2B0 ₁₆	—	TEST 19	TEST 18	TEST 17	TEST 24	LEVEL 2	LEVEL 1	LEVEL 0	INT NON	PAL NTSC	MPAL	PALH	TEST 16	TEST 15	SEPV1	SEPV0	BLK	—	DSP ONV	DSP ON	—	SEL COR	—	EX

TEST_n (n = number) is MITSUBISHI test memory. Set 0 to all bits.

Table 2 The memory constitution of SYRAM

add- ress	DA17 ~ DAD	DAC	DAB	DAA	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0	SYRAM code
300 ₁₆ l	0	SYEX	S00B	S00A	S009	S008	S007	S006	S005	S004	S003	S002	S001	S000	00 ₁₆
30C ₁₆		SYEX	S00B	S00A	S009	S008	S007	S006	S005	S004	S003	S002	S001	S000	
310 ₁₆ l	0	SYEX	S01B	S01A	S019	S018	S017	S016	S015	S014	S013	S012	S011	S010	01 ₁₆
31C ₁₆		SYEX	S01B	S01A	S019	S018	S017	S016	S015	S014	S013	S012	S011	S010	
l	⋮	⋮	l												l
6D0 ₁₆ l	0	SYEX	S3DB	S3DA	S3D9	S3D8	S3D7	S3D6	S3D5	S3D4	S3D3	S3D2	S3D1	S3D0	3D ₁₆
6DC ₁₆		SYEX	S3DB	S3DA	S3D9	S3D8	S3D7	S3D6	S3D5	S3D4	S3D3	S3D2	S3D1	S3D0	
6E0 ₁₆ l	0	SYEX	S3EB	S3EA	S3E9	S3E8	S3E7	S3E6	S3E5	S3E4	S3E3	S3E2	S3E1	S3E0	3E ₁₆
6EC ₁₆		SYEX	S3EB	S3EA	S3E9	S3E8	S3E7	S3E6	S3E5	S3E4	S3E3	S3E2	S3E1	S3E0	

l : Name or value changes by definite ratio.

⋮ : The same name or value continues.

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

SCREEN CONSTITUTION

The screen lines and rows are determined from each address of the display RAM.
The screen constitution is shown in Figure 1.

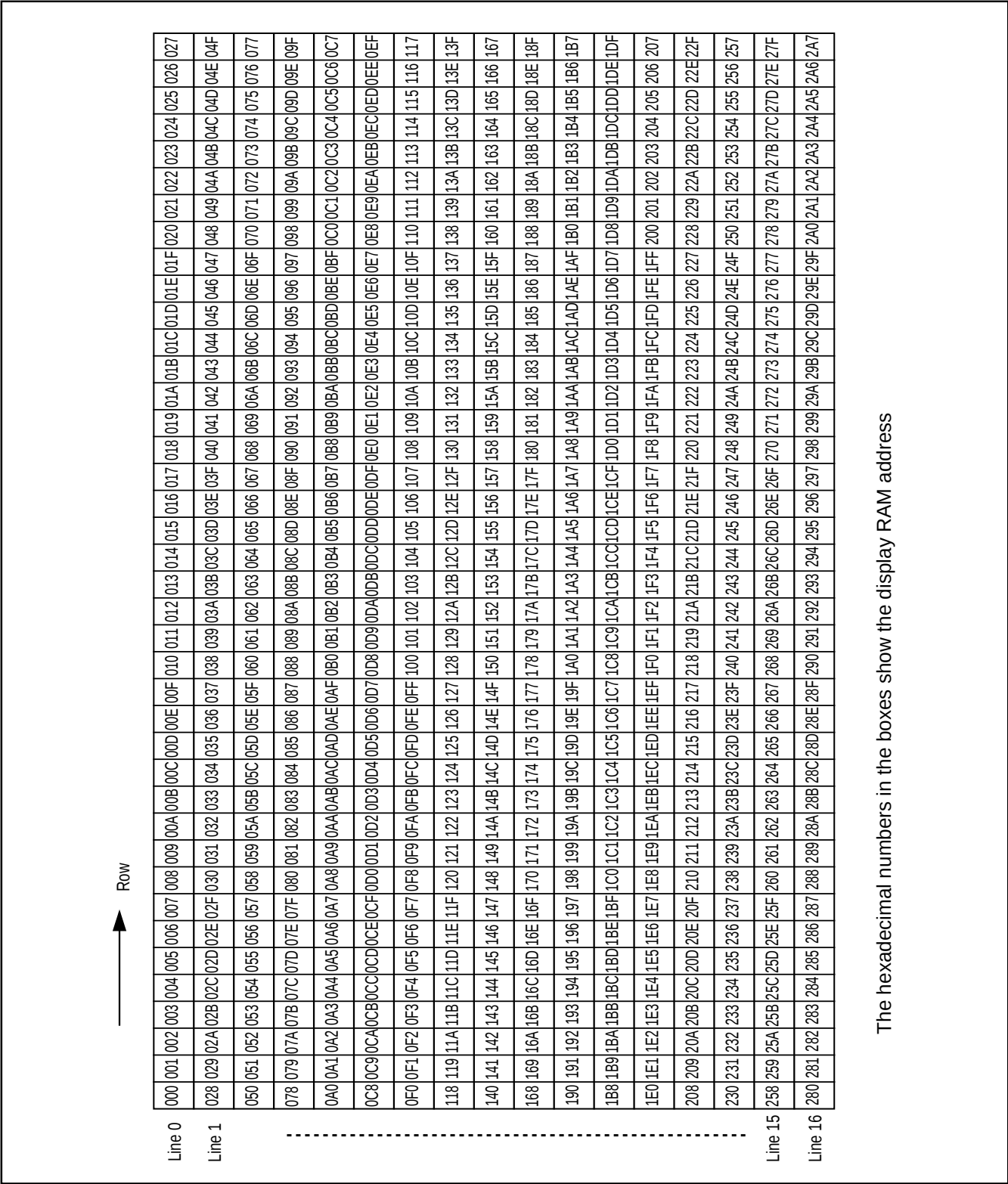
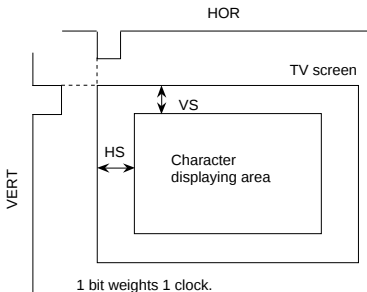


Fig. 1 Screen constitution

REGISTERS DESCRIPTION

(1) Address 2A816

DA	Register	Contents		Remarks
		Status	Function	
0	VP0	0	If VS is the vertical display start location, $VS = H \times \left(\sum_{n=0}^7 2^n VP_n \right)$ H: Cycle with the horizontal synchronizing pulse	The vertical start location is specified using the 8 bits from VP7 to VP0. VP7 to VP0 < 1416 are not available.
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	0		
		1		
8	HP0	0	If HS is the horizontal display start location, $HS = T \times \left(\sum_{n=0}^8 2^n HP_n + 9 \right)$ T: Cycle with the display clock	The horizontal start location is specified using the 9 bits from HP8 to HP0. HP8 to HP0 < 1916 are not available.
9	HP1	0		
		1		
A	HP2	0		
		1		
B	HP3	0		
		1		
C	HP4	0		
		1		
D	HP5	0	 1 bit weights 1 clock.	
		1		
E	HP6	0		
		1		
F	HP7	0		
		1		
10	HP8	0		
		1		
11	TEST10	0	Test mode (Must be cleared to 0.)	
		1		
12	TEST11	0		
		1		
13	TEST0	0		
		1		
14	TEST1	0		
		1		
15	TEST2	0		
		1		
16	TEST3	0		
		1		
17	—	0	Must be cleared to 0.	
		1		

Note: The mark 0 around the status value means the reset status by the "L" level is input to $\overline{AC}$ pin.

(2) Address 2A916

DA	Register	Contents			Remarks					
		Status	Function							
0	HSZ0	0	T: Display clock	HSZxHorizontal direction character size	Set to line 0 of display RAM					
		1			Set to line 1 of display RAM					
1	HSZ1	0			1T/dot	Set to line 2 of display RAM				
		1		2T/dot	Set to line 3 of display RAM					
2	HSZ2	0		T: Display clock	Set to line 4 of display RAM					
		1			Set to line 5 of display RAM					
3	HSZ3	0			Set to line 6 of display RAM					
		1			Set to line 7 of display RAM					
4	HSZ4	0			Set to line 8 of display RAM					
		1			Set to line 9 of display RAM					
5	HSZ5	0			Set to line 10 of display RAM					
		1			Set to line 11 of display RAM					
6	HSZ6	0			Set to line 12 of display RAM					
		1			Set to line 13 of display RAM					
7	HSZ7	0			Set to line 14 of display RAM					
		1			Set to line 15 of display RAM					
8	HSZ8	0			Set to line 16 of display RAM					
		1								
9	HSZ9	0								
		1								
A	HSZ10	0								
		1								
B	HSZ11	0								
		1								
C	HSZ12	0								
		1								
D	HSZ13	0								
		1								
E	HSZ14	0								
		1								
F	HSZ15	0								
		1								
10	HSZ16	0								
		1								
11	BLINK0	0	BLINK1 \ BLINK0 <table><tr><td>0</td><td>Blinking OFF</td><td>Duty 25%</td></tr><tr><td>1</td><td>Duty 50%</td><td>Duty 75%</td></tr></table>	0	Blinking OFF	Duty 25%	1	Duty 50%	Duty 75%	Blinking duty ratio can be altered.
		0		Blinking OFF	Duty 25%					
1	Duty 50%	Duty 75%								
1										
12	BLINK1	0			Blinking cycle can be altered.					
		1								
13	BLINK2	0	Cycle approximately 1 second.	Character is in flashing state.						
		1	Cycle approximately 0.5 second.							
14	BLINK3	0	Normal blinking	Character is always displayed (normal character, reversed character).						
		1	Normal character, reversed character alternation display.							
15	—	0	Must be cleared to 0.							
		1								
16	—	0								
		1								
17	—	0								
		1								

(3) Address 2AA₁₆

DA	Register	Contents		Remarks						
		Status	Function							
0	VSZ0	① 1	<table><tr><td>VSZx</td><td>Vertical direction character size</td></tr><tr><td>0</td><td>1H/dot</td></tr><tr><td>1</td><td>2H/dot</td></tr></table> H: Horizontal synchronous pulse	VSZx	Vertical direction character size	0	1H/dot	1	2H/dot	Set to line 0 of display RAM
VSZx	Vertical direction character size									
0	1H/dot									
1	2H/dot									
1	VSZ1	① 1		Set to line 1 of display RAM						
2	VSZ2	① 1		Set to line 2 of display RAM						
3	VSZ3	① 1		Set to line 3 of display RAM						
4	VSZ4	① 1		Set to line 4 of display RAM						
5	VSZ5	① 1		Set to line 5 of display RAM						
6	VSZ6	① 1		Set to line 6 of display RAM						
7	VSZ7	① 1		Set to line 7 of display RAM						
8	VSZ8	① 1		Set to line 8 of display RAM						
9	VSZ9	① 1		Set to line 9 of display RAM						
A	VSZ10	① 1		Set to line 10 of display RAM						
B	VSZ11	① 1		Set to line 11 of display RAM						
C	VSZ12	① 1		Set to line 12 of display RAM						
D	VSZ13	① 1		Set to line 13 of display RAM						
E	VSZ14	① 1	Set to line 14 of display RAM							
F	VSZ15	① 1	Set to line 15 of display RAM							
10	VSZ16	① 1	Set to line 16 of display RAM							
11	HIDE	① 1	SYRAM writting over	Decided by register LINER, G and B or DAC bit of SYRAM.						
			SYRAM writting over or character erasing							
12	TEST20	① 1	Test mode (Must be cleared to 0.)							
13	EQP	① 1	It does not include equivalent pulse.							
			It includes equivalent pulse.							
14	TEST12	① 1	Test mode (Must be cleared to 0.)							
15	—	① 1	Must be cleared to 0.							
16	—	① 1								
17	—	① 1								

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(4) Address 2AB16

DA	Register	Contents				Remarks																																																		
		Status	Function																																																					
0	DSP0 00	① 1	<table><tr><td>DSP0XX \ DSP1XX</td><td>0</td><td>1</td></tr><tr><td>0</td><td>Character</td><td>Border</td></tr><tr><td>1</td><td>Matrix-outline</td><td>Halftone (Note)</td></tr></table> Set by combination of DSP0xx (address 2AB16 and DSP1xx) and DSP1xx (address 2AC16). At internal synchronous mode (EX = 1), display monitor signal area is all blanking signal (BLNK output) area. Note: For halftone display, it is necessary to input the external composite video signal to the CVIN terminal, and externally connect a 100 to 200 resistor in series. However, the halftone display is possible only with superimposed displays.			DSP0XX \ DSP1XX	0	1	0	Character	Border	1	Matrix-outline	Halftone (Note)	Set to line 0 of display RAM																																									
DSP0XX \ DSP1XX	0	1																																																						
0	Character	Border																																																						
1	Matrix-outline	Halftone (Note)																																																						
1	DSP0 01	① 1				Set to line 1 of display RAM																																																		
2	DSP0 02	① 1				Set to line 2 of display RAM																																																		
3	DSP0 03	① 1				Set to line 3 of display RAM																																																		
4	DSP0 04	① 1				Set to line 4 of display RAM																																																		
5	DSP0 05	① 1				Set to line 5 of display RAM																																																		
6	DSP0 06	① 1				Set to line 6 of display RAM																																																		
7	DSP0 07	① 1				Set to line 7 of display RAM																																																		
8	DSP0 08	① 1				Set to line 8 of display RAM																																																		
9	DSP0 09	① 1				Set to line 9 of display RAM																																																		
A	DSP0 10	① 1				Set to line 10 of display RAM																																																		
B	DSP0 11	① 1				Set to line 11 of display RAM																																																		
C	DSP0 12	① 1				Set to line 12 of display RAM																																																		
D	DSP0 13	① 1	Set to line 13 of display RAM																																																					
E	DSP0 14	① 1	Set to line 14 of display RAM																																																					
F	DSP0 15	① 1	Set to line 15 of display RAM																																																					
10	DSP0 16	① 1	Set to line 16 of display RAM																																																					
11	PHASE 0	① 1	<table><tr><td>PHASE 2</td><td>PHASE 1</td><td>PHASE 0</td><td colspan="2">Color</td></tr><tr><td>0</td><td>0</td><td>0</td><td>SELCOR=0</td><td>SELCOR=1</td></tr><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>Red</td><td>Red-2</td></tr><tr><td>0</td><td>1</td><td>0</td><td>Green</td><td>Green-2</td></tr><tr><td>0</td><td>1</td><td>1</td><td>Yellow</td><td>Yellow</td></tr><tr><td>1</td><td>0</td><td>0</td><td>Blue</td><td>Gray</td></tr><tr><td>1</td><td>0</td><td>1</td><td>Magenta</td><td>Yellow-2</td></tr><tr><td>1</td><td>1</td><td>0</td><td>Cyan</td><td>Cyan</td></tr><tr><td>1</td><td>1</td><td>1</td><td>White</td><td>White</td></tr></table>			PHASE 2	PHASE 1	PHASE 0	Color		0	0	0	SELCOR=0	SELCOR=1	0	0	0	Black	Black	0	0	1	Red	Red-2	0	1	0	Green	Green-2	0	1	1	Yellow	Yellow	1	0	0	Blue	Gray	1	0	1	Magenta	Yellow-2	1	1	0	Cyan	Cyan	1	1	1	White	White	Raster color setting.
PHASE 2	PHASE 1	PHASE 0	Color																																																					
0	0	0	SELCOR=0	SELCOR=1																																																				
0	0	0	Black	Black																																																				
0	0	1	Red	Red-2																																																				
0	1	0	Green	Green-2																																																				
0	1	1	Yellow	Yellow																																																				
1	0	0	Blue	Gray																																																				
1	0	1	Magenta	Yellow-2																																																				
1	1	0	Cyan	Cyan																																																				
1	1	1	White	White																																																				
12	PHASE 1	① 1																																																						
13	PHASE 2	① 1				Refer Fig 3, 4 about phase angle.																																																		
14	TEST25	① 1	Test mode (Must be cleared to 0.)																																																					
15	TEST26	① 1																																																						
16	—	① 1	Must be cleared to 0.																																																					
17	—	① 1																																																						

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(5) Address 2AC16

DA	Register	Contents				Remarks																																														
		Status	Function																																																	
0	DSP1 00	① 1	<table><tr><td>DSP0XX \ DSP1XX</td><td>0</td><td>1</td></tr><tr><td>0</td><td>Character</td><td>Border</td></tr><tr><td>1</td><td>Matrix-outline</td><td>Halftone (Note)</td></tr></table> Set by combination of DSP0xx (address 2AB16 and DSP1xx) and DSP1xx (address 2AC16). At internal synchronous mode (EX = 1), display monitor signal area is all blanking signal (BLNK output) area. Note: For halftone display, it is necessary to input the external composite video signal to the CVIN terminal, and externally connect a 100 to 200 resistor in series. However, the halftone display is possible only with superimposed displays.			DSP0XX \ DSP1XX	0	1	0	Character	Border	1	Matrix-outline	Halftone (Note)	Set to line 0 of display RAM																																					
DSP0XX \ DSP1XX	0	1																																																		
0	Character	Border																																																		
1	Matrix-outline	Halftone (Note)																																																		
1	DSP1 01	① 1				Set to line 1 of display RAM																																														
2	DSP1 02	① 1				Set to line 2 of display RAM																																														
3	DSP1 03	① 1				Set to line 3 of display RAM																																														
4	DSP1 04	① 1				Set to line 4 of display RAM																																														
5	DSP1 05	① 1				Set to line 5 of display RAM																																														
6	DSP1 06	① 1				Set to line 6 of display RAM																																														
7	DSP1 07	① 1				Set to line 7 of display RAM																																														
8	DSP1 08	① 1				Set to line 8 of display RAM																																														
9	DSP1 09	① 1				Set to line 9 of display RAM																																														
A	DSP1 10	① 1				Set to line 10 of display RAM																																														
B	DSP1 11	① 1				Set to line 11 of display RAM																																														
C	DSP1 12	① 1				Set to line 12 of display RAM																																														
D	DSP1 13	① 1	Set to line 13 of display RAM																																																	
E	DSP1 14	① 1	Set to line 14 of display RAM																																																	
F	DSP1 15	① 1	Set to line 15 of display RAM																																																	
10	DSP1 16	① 1	Set to line 16 of display RAM																																																	
11	LINER	① 1	<table><tr><th rowspan="2">LINE B</th><th rowspan="2">LINE G</th><th rowspan="2">LINE R</th><th colspan="2">Color</th></tr><tr><th>SELCOR=0</th><th>SELCOR=1</th></tr><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>Red</td><td>Red-2</td></tr><tr><td>0</td><td>1</td><td>0</td><td>Green</td><td>Green-2</td></tr><tr><td>0</td><td>1</td><td>1</td><td>Yellow</td><td>Yellow</td></tr><tr><td>1</td><td>0</td><td>0</td><td>Blue</td><td>Gray</td></tr><tr><td>1</td><td>0</td><td>1</td><td>Magenta</td><td>Yellow-2</td></tr><tr><td>1</td><td>1</td><td>0</td><td>Cyan</td><td>Cyan</td></tr><tr><td>1</td><td>1</td><td>1</td><td>White</td><td>White</td></tr></table>		LINE B	LINE G	LINE R	Color		SELCOR=0	SELCOR=1	0	0	0	Black	Black	0	0	1	Red	Red-2	0	1	0	Green	Green-2	0	1	1	Yellow	Yellow	1	0	0	Blue	Gray	1	0	1	Magenta	Yellow-2	1	1	0	Cyan	Cyan	1	1	1	White	White	SYRAM color setting. Color is decided by DAC bit (SYEX) of SYRAM or HIDE register. Refer Fig. 3, 4 about phase angle.
LINE B	LINE G	LINE R	Color																																																	
			SELCOR=0	SELCOR=1																																																
0	0	0	Black	Black																																																
0	0	1	Red	Red-2																																																
0	1	0	Green	Green-2																																																
0	1	1	Yellow	Yellow																																																
1	0	0	Blue	Gray																																																
1	0	1	Magenta	Yellow-2																																																
1	1	0	Cyan	Cyan																																																
1	1	1	White	White																																																
12	LINEG	① 1																																																		
13	LINEB	① 1																																																		
14	TEST21	① 1	Test mode (Must be cleared to 0.)																																																	
15	—	① 1																																																		
16	—	① 1	Must be cleared to 0.																																																	
17	—	① 1																																																		

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(6) Address 2AD₁₆

DA	Register	Contents		Remarks						
		Status	Function							
0	ERS0	①	Erase display RAM <table><tr><td>ERSx</td><td>RAM erase</td></tr><tr><td>0</td><td>do erase</td></tr><tr><td>1</td><td>do not erase</td></tr></table> It is unnecessary to reset these registers to “0”. Multiple settings of ERS _n is not allowed.	ERSx	RAM erase	0	do erase	1	do not erase	Set to line 0 of display RAM
		ERSx		RAM erase						
0	do erase									
1	do not erase									
1	1	Set to line 1 of display RAM								
2	ERS2	①		Set to line 2 of display RAM						
		1								
3	ERS3	①		Set to line 3 of display RAM						
		1								
4	ERS4	①		Set to line 4 of display RAM						
		1								
5	ERS5	①		Set to line 5 of display RAM						
		1								
6	ERS6	①		Set to line 6 of display RAM						
		1								
7	ERS7	①		Set to line 7 of display RAM						
		1								
8	ERS8	①	Set to line 8 of display RAM							
		1								
9	ERS9	①	Set to line 9 of display RAM							
		1								
A	ERS10	①	Set to line 10 of display RAM							
		1								
B	ERS11	①	Set to line 11 of display RAM							
		1								
C	ERS12	①	Set to line 12 of display RAM							
		1								
D	ERS13	①	Set to line 13 of display RAM							
		1								
E	ERS14	①	Set to line 14 of display RAM							
		1								
F	ERS15	①	Set to line 15 of display RAM							
		1								
10	ERS16	①	Set to line 16 of display RAM							
		1								
11	SERS0	①	Erase SYRAM <table><tr><td>SERSx</td><td>SYRAM erase</td></tr><tr><td>0</td><td>do erase</td></tr><tr><td>1</td><td>do not erase</td></tr></table> It is unnecessary to reset these registers to “0”. Multiple settings of SERS _n is not allowed.	SERSx	SYRAM erase	0	do erase	1	do not erase	Set to SYRAM code 00 ₁₆ to 0F ₁₆
		SERSx		SYRAM erase						
0	do erase									
1	do not erase									
1										
12	SERS1	①	Set to SYRAM code 10 ₁₆ to 1F ₁₆							
		1								
13	SERS2	①	Set to SYRAM code 20 ₁₆ to 2F ₁₆							
		1								
14	SERS3	①	Set to SYRAM code 30 ₁₆ to 3E ₁₆							
		1								
15	TEST22	①	Test mode (Must be cleared to 0.)							
		1								
16	TEST23	①								
		1								
17	—	①	Must be cleared to 0.							
		1								

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(7) Address 2AE₁₆

DA	Register	Contents		Remarks
		Status	Function	
0	SBIT0	0 1	Set display start bit of scroll block: $SA = \sum_{n=0}^3 2^n (SBITn)$	Setting valid SA = 0 to 12 invalid SA = 13 to 15
1	SBIT1	0 1		
2	SBIT2	0 1		
3	SBIT3	0 1		
4	SLIN0	0 1	Set display start line of scroll block: $SB = \sum_{n=0}^4 2^n (SLINn)$	Setting valid SB = 0 to 16 invalid SB = 17 to 31
5	SLIN1	0 1		
6	SLIN2	0 1		
7	SLIN3	0 1		
8	SLIN4	0 1		
9	SST0	0 1	Set start line of scroll block (last line number of the fixed block 1): $SC = \sum_{n=0}^4 2^n (SSTn)$	Setting valid SC = 0 to 15 invalid SC = 16 to 31
A	SST1	0 1		
B	SST2	0 1		
C	SST3	0 1		
D	SST4	0 1		
E	SEND0	0 1	Set start line of fixed block 2 (last line number of the scroll block): $SD = \sum_{n=0}^4 2^n (SENDn)$	When the scrolling on setting valid SD = 2 to 17 invalid SD = 18 to 31 When the scrolling off set SD = 0 SD > SC + 2
F	SEND1	0 1		
10	SEND2	0 1		
11	SEND3	0 1		
12	SEND4	0 1		
13	—	0 1	Must be cleared to 0.	
14	—	0 1		
15	—	0 1		
16	—	0 1		
17	—	0 1		

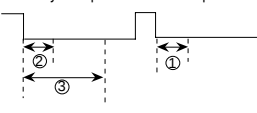
Note: When the scrolling on, set the ratio which will be SC < SB < SD.

(8) Address 2AF16

DA	Register	Contents				Remarks		
		Status	Function					
0	PTC0	①	Port P0 output			Select P0 pin		
		1	YM output					
1	PTC1	①	Port P1 output			Select P1 pin		
		1	BLNK output					
2	PTC2	①	Port P2 output			Select P2 pin		
		1	B output					
3	PTC3	①	Port P3 output			Select P3 pin		
		1	G output					
4	PTC4	①	Port P4 output			Select P4 pin		
		1	R output					
5	PTC5	①	Port P5 output			Select P5 pin		
		1	CSYN output					
6	PTD0	①	When port output: 0 output, when YM output: negative polarity.			Select data of P0 pin		
		1	When port output: 1 output, when YM output: polarity.					
7	PTD1	①	When port output: 0 output, when BLNK output: negative polarity.			Select data of P1 pin		
		1	When port output: 1 output, when BLNK output: polarity.					
8	PTD2	①	When port output: 0 output, when B output: negative polarity.			Select data of P2 pin		
		1	When port output: 1 output, when B output: polarity.					
9	PTD3	①	When port output: 0 output, when G output: negative polarity.			Select data of P3 pin		
		1	When port output: 1 output, when G output: polarity.					
A	PTD4	①	When port output: 0 output, when R output: negative polarity.			Select data of P4 pin		
		1	When port output: 1 output, when R output: polarity.					
B	PTD5	①	When port output: 0 output, when CSYN output: negative polarity.			Select data of P5 pin		
		1	When port output: 1 output, when CSYN output: polarity.					
C	SRAND0	①	SRAND	SRAND	SRAND2		Condition of border display is changeable.	
		1	1	0	0			1
D	SRAND1	①	0	0	Complete border = 1 dot			Right and dot border = 1 dot
		1	0	1	Complete border = 2 dot			Right and dot border = 2 dot
E	SRAND2	①	1	0	Complete border = 3 dot			Right and dot border = 3 dot
		1	1	1	Complete border = 4 dot			Right and dot border = 4 dot
F	ALL24	①	Blanking with all 40 characters in matrix-outline mode				Horizontal display range can be altered when all characters are in matrix-outline size. At external synchronous, set to 0. Operation of character code FF16 becomes ineffective.	
		1	Horizontal display period fully blanked with all characters in matrix-outline size.					
10	PC0	①	Display frequency fr control $fr = fh \times \left\{ \sum_{n=0}^7 (2^n PC_n) + 512 \right\}$					PC7 to PC0 < 3616, PC7 to PC0 > C616 is not available.
11	PC1	①						
		1						
12	PC2	①						
		1						
13	PC3	①						
		1						
14	PC4	①						
		1						
15	PC5	①						
		1						
16	PC6	①						
		1						
17	PC7	①						
		1						

Note: At EX (address 2B016) = "0" (external synchronous), setting "1" of ALL24 register is not available.
Refer Fig. 2 about PTC0 to 5, PTD0 to 5.

(9) Address 2B016

DA	Register	Contents		Remarks															
		Status	Function																
0	EX	①	External synchronization	(Note)															
		1	Internal synchronization																
1	—	①	Set to “0”.																
		1																	
2	SELCOR	①	Normal	Refer to Table 3, 4, 7 and 8.															
		1	Mode of expansion																
3	—	①	Must be cleared to 0.																
		1																	
4	DSPON	①	Digital output display OFF																
		1	Digital output display ON																
5	DSPONV	①	Composite video output display OFF																
		1	Composite video output display ON																
6	—	①	Must be cleared to 0.																
		1																	
7	BLK	①	Matrix outline	Only at register “DSP1xx” = 1 (xx = 00 to 16) is available.															
		1	Matrix outline + border																
8	SEPV0	①	<table><tr><th>SEPV1</th><th>SEPV0</th><th>Composite Sync Spearation Function</th></tr><tr><td>0</td><td>0</td><td>Separation is performed during (1) in vertical blanking period</td></tr><tr><td>0</td><td>1</td><td>Separation is performed during (2) in vertical blanking period 1</td></tr><tr><td>1</td><td>0</td><td>Separation is performed during (3) in vertical blanking period</td></tr><tr><td>1</td><td>1</td><td>Unavailable</td></tr></table>	SEPV1	SEPV0	Composite Sync Spearation Function	0	0	Separation is performed during (1) in vertical blanking period	0	1	Separation is performed during (2) in vertical blanking period 1	1	0	Separation is performed during (3) in vertical blanking period	1	1	Unavailable	Method of sync separation from composite video.  Case (1) condition: vertical sync must repeat 2X within (2) or (3); indicates this area.
		SEPV1		SEPV0	Composite Sync Spearation Function														
0	0	Separation is performed during (1) in vertical blanking period																	
0	1	Separation is performed during (2) in vertical blanking period 1																	
1	0	Separation is performed during (3) in vertical blanking period																	
1	1	Unavailable																	
1																			
A	TEST15	①	Test mode (Must be cleared to 0.)																
		1																	
B	TEST16	①																	
		1																	
C	PALH	①	Interlace/noninterlace normal mode	Only at PAL and MPAL mode are available.															
		1	Interlace/noninterlace expansion mode																
D	MPAL	①	<table><tr><th>PAL/NTSC</th><th>MPAL</th><th>Format</th></tr><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>unavailable</td></tr></table>	PAL/NTSC	MPAL	Format	0	0	NTSC	0	1	M-PAL	1	0	PAL	1	1	unavailable	
		PAL/NTSC	MPAL	Format															
0	0	NTSC																	
0	1	M-PAL																	
1	0	PAL																	
1	1	unavailable																	
1																			
E	PAL/NTSC	①																	
		1																	
F	INT/NON	①	Interlace																
		1	Noninterlace																
10	LEVEL0	①	Composite video generation is off.	Refer to Table 5 and 6.															
		1	Composite video generation is on.																
11	LEVEL1	①	Display clock is on (oscillating).																
		1	Display clock is off (not oscillating).																
12	LEVEL2	①	Sync separation is disabled.																
		1	Sync separation is enabled.																
13	TEST24	①	Test mode (Must be cleared to 0.)																
		1																	
14	TEST17	①																	
		1																	
15	TEST18	①																	
		1																	
16	TEST19	①																	
		1																	
17	—	①	Must be cleared to 0.																
		1																	

Note: For internal synchronization, shut out (mute) the external video signal input to the CVIN terminal, outside the IC. This avoids external video signal leaks inside the IC.

REGISTER CONSTRUCTION COMPOSITION

Table 3 Color and phase of NTSC, PAL (SELCOR = 0)

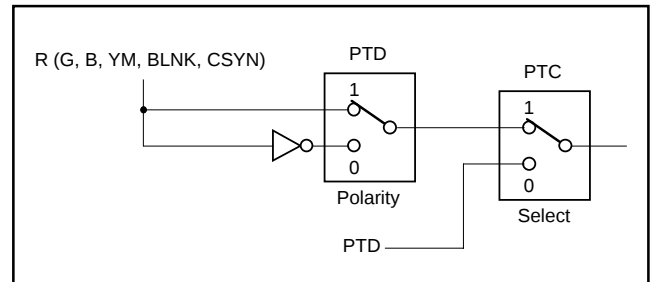
PHASE2 / LINEB	PHASE1 / LINEG	PHASE0 / LINER	Phase (rad)		Color
			NTSC	PAL	
0	0	0	—	—	Black
0	0	1	7 /16	$\pm 7 /16$	Red
0	1	0	27 /16	$\mp 5 /16$	Green
0	1	1	/16	$\pm /16$	Yellow
1	0	0	17 /16	$\mp 15 /16$	Blue
1	0	1	11 /16	$\pm 11 /16$	Magenta
1	1	0	23 /16	$\mp 9 /16$	Cyan
1	1	1	—	—	White

Table 4 Color and phase of NTSC, PAL (SELCOR = 1)

PHASE2 / LINEB	PHASE1 / LINEG	PHASE0 / LINER	Phase (rad)		Color
			NTSC	PAL	
0	0	0	—	—	Black
0	0	1	7 /16	$\pm 7 /16$	Red-2
0	1	0	27 /16	$\mp 5 /16$	Green-2
0	1	1	/16	$\pm /16$	Yellow
1	0	0	—	—	Gray
1	0	1	/16	$\pm /16$	Yellow-2
1	1	0	23 /16	$\mp 9 /16$	Cyan
1	1	1	—	—	White

Table 7 Video signal level (SELCOR = 0)

Color name	Phase (rad)		Luminance level (V)			Chroma amplitude (vs. color burst)		
	NTSC	PAL	Min.	Typ.	Max.	Min.	Typ.	Max.
Sync	—	—	1.3	1.5	1.7	—	—	—
Pedestal	—	—	1.9	2.1	2.3	—	—	—
Color Burst	0	$\pm 4 /16$	1.9	2.1	2.3	—	1.0	—
Black	—	—	2.1	2.3	2.5	—	—	—
Red	$7 /16 \pm 2 /16$	$\pm 7 /16 \pm 2 /16$	2.3	2.5	2.7	1.5	3.0	4.5
Green	$27 /16 \pm 2 /16$	$\mp 5 /16 \pm 2 /16$	2.7	2.9	3.1	1.4	2.8	4.2
Yellow	$/16 \pm 2 /16$	$\pm /16 \pm 2 /16$	3.1	3.3	3.5	1.0	2.0	3.0
Blue	$17 /16 \pm 2 /16$	$\mp 15 /16 \pm 2 /16$	2.0	2.2	2.4	1.0	2.0	3.0
Magenta	$11 /16 \pm 2 /16$	$\pm 11 /16 \pm 2 /16$	2.5	2.7	2.9	1.4	2.8	4.2
Cyan	$23 /16 \pm 2 /16$	$\mp 9 /16 \pm 2 /16$	2.9	3.1	3.3	1.5	3.0	4.5
White	—	—	3.1	3.3	3.5	—	—	—


Fig. 2 Switching port output with R, G and B output
Table 5 Setting condition at LEVEL 0, 1 and 2

	At display clock operates	At display clock stops
LEVEL1	0	1
DSPON	1	0
DSPONV	1	0
CS pin	L	H

No character display at display clock

Table 6 Setting condition at LEVEL 0, 1 and 2 (at operation)

	Operation state	Stop state
LEVEL0	1	0
LEVEL1	0	1
LEVEL2	1	0

Table 8 Video signal level (SELCOR = 1)

Color name	Phase (rad)		Luminance level (V)			Chroma amplitude (vs. color burst)		
	NTSC	PAL	Min.	Typ.	Max.	Min.	Typ.	Max.
Sync	—	—	1.3	1.5	1.7	—	—	—
Pedestal	—	—	1.9	2.1	2.3	—	—	—
Color Burst	0	$\pm 4 / 16$	1.9	2.1	2.3	—	1.0	—
Black	—	—	2.1	2.3	2.5	—	—	—
Red-2	$7 / 16 \pm 2 / 16$	$\pm 7 / 16 \pm 2 / 16$	2.6	2.8	3.0	1.5	2.0	3.0
Green-2	$27 / 16 \pm 2 / 16$	$\mp 5 / 16 \pm 2 / 16$	3.1	3.3	3.5	0.5	1.0	1.5
Yellow	$/ 16 \pm 2 / 16$	$\pm / 16 \pm 2 / 16$	3.1	3.3	3.5	1.0	2.0	3.0
Gray	—	—	2.8	3.0	3.2	—	—	—
Yellow-2	$/ 16 \pm 2 / 16$	$\pm / 16 \pm 2 / 16$	3.2	3.4	3.6	0.4	0.8	1.2
Cyan	$23 / 16 \pm 2 / 16$	$\mp 9 / 16 \pm 2 / 16$	2.9	3.1	3.3	1.5	3.0	4.5
White	—	—	3.1	3.3	3.5	—	—	—

DISPLAY FORMS

1. Blanking mode

Display forms are shown in Table 9, display forms at each display mode are shown in Fig. 3.

Table 9 Display forms

Display mode	DSP1 xx (Address 2AC16)	DSP0 xx (Address 2AB16)	BLNK output
Character	0	0	Character size
Border	0	1	Border size
Matrix-outline	1	0	All blanking
Halftone	1	1	Blanking OFF

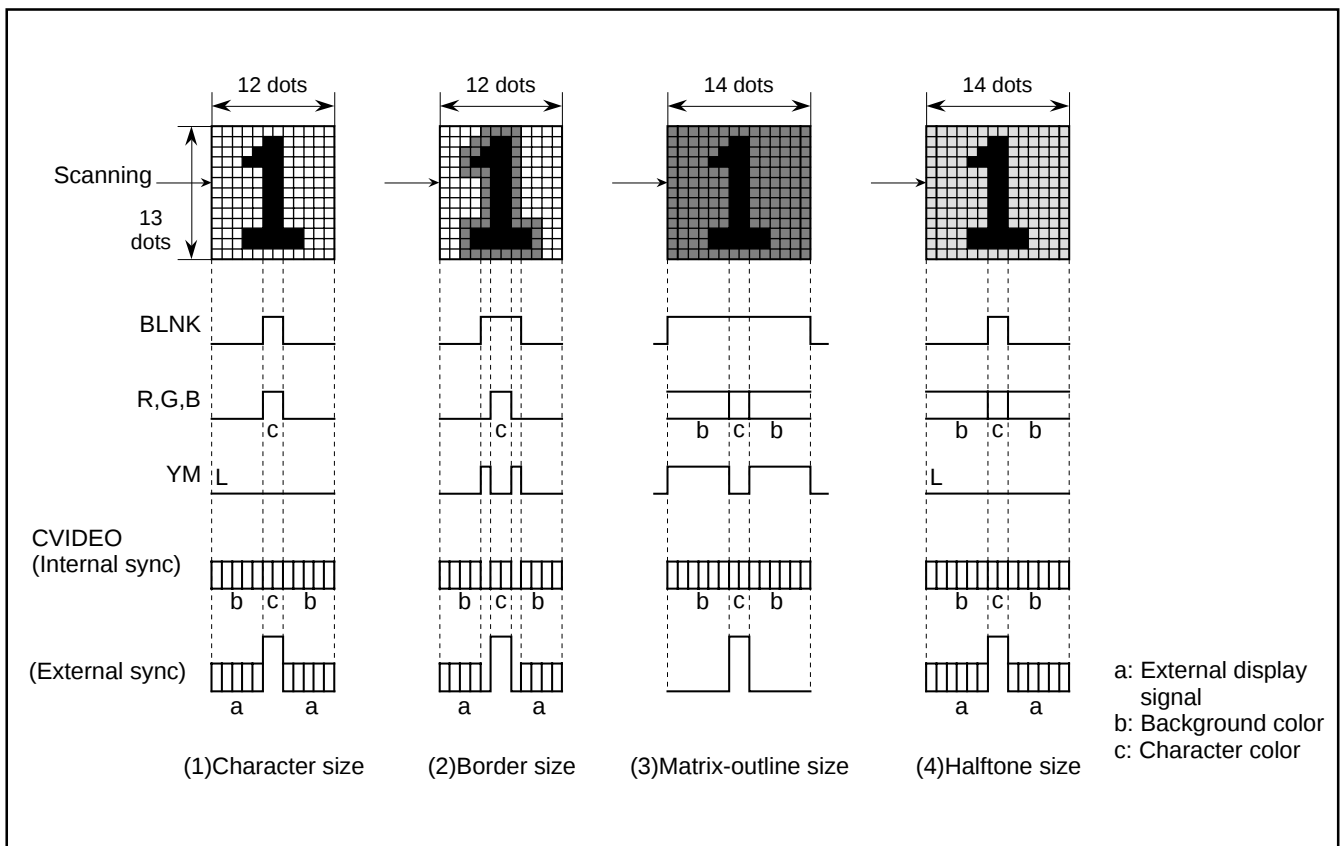


Fig. 3 Display forms at each display mode

For matrix and halftone, a character's number of dots in the horizontal direction increases to 14.

Figure 4 shows a display example for a case where adjacent characters have different background colors and for character code FF₁₆.

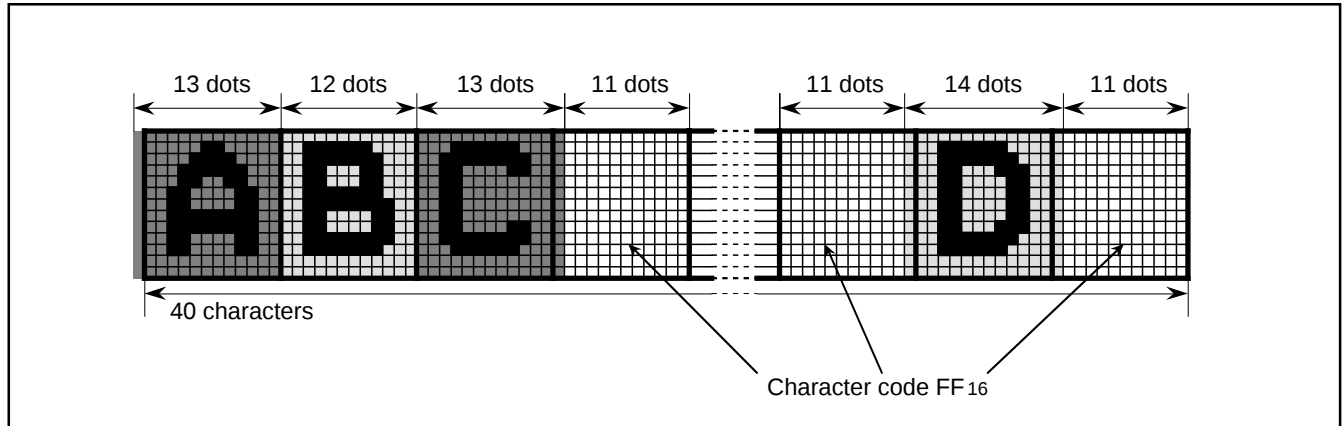


Fig. 4 Number of dots in the horizontal direction at matrix-outline or halftone

2. Border mode

In border mode, characters are displayed with borders. (Refer to Table 9.) In matrix and halftone modes also, characters are displayed with borders if the BLK register (address 2B0₁₆) is set to 1. Table 10 lists the types of borders.

Table 10 Bordering

SRAND2 (Address 2AF ₁₆)	SRAND1, 0	00	01	10	11
0	The zero dot →	 1 dot in horizontal direction	 2 dots in horizontal direction	 3 dots in horizontal direction	 4 dots in horizontal direction
1		 1 dot in horizontal direction	 2 dots in horizontal direction	 3 dots in horizontal direction	 4 dots in horizontal direction

Horizontal direction bordering is only 1 dot. When the character extends to the top line of the matrix, no border is left at the top, and when the character extends to the bottom (12th) line of the matrix, no border is left at the bottom.

3. Setting matrix outline

The ALL24 register (address 2AF16) allows you to set a matrix out-line. A matrix outline can be set for each line by using the DSP1XX register (address 2AC16) .
However, this setting is inhibited if the EX register (address 2B016) is 0 (external sync). An example of how you set a matrix outline is shown in Figure 5.

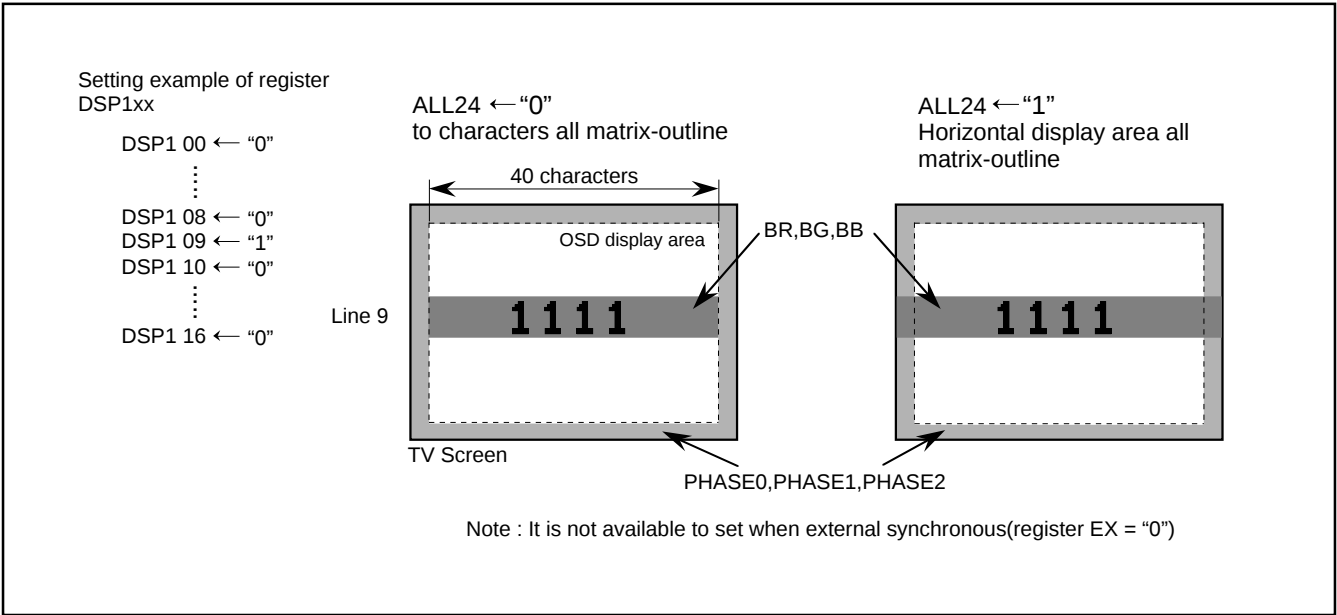


Fig. 5 Setting example all matrix-outline area

4. Blinking mode

Two patterns blinking by register BLINK3 (address 2A916) or BLINK bit of display RAM.
Blinking mode is shown in Table 11 (SYRAM do not blink).

Use registers BLINK0, 1, and 2 (address 2A916) to set the duty ratio and period that determines the blinking time. Tables 12 and 13 list the relationship between the register settings and the duty ratio and period.

Table 11 Blinking mode

BLINK3	Blinking mode	at blinking OFF
0	Blinking 	Normal
1	Normal character, reversed character alternation display 	Reverse

Table 12 Setting of duty ratio

BLINK1	BLINK0	0	1
0		Blink OFF	Duty 25%
1		Duty 50%	Duty 75%

Table 13 Setting of cycle

BLINK2	Cycle
0	Approximately 1 second (Vertical sync divided into 1/64)
1	Approximately 0.5 second (Vertical sync divided into 1/32)

5. Scroll display mode

The scroll display mode is entered by setting registers SBIT0 to 3 (SA), SLIN0 to 4 (SB), SST0 to 4 (SC), and SEND0 to 4 (SD) (all at address 2AE16). (Scroll is turned off when SD = 0.)

The screen is scrolled in the range from the (SC)'th line to the (SD-1)'th line, and sections above and below this range are fixed. The beginning line and beginning dot of scroll are the (SA)'th dot

on the (SB)'th line.

The screen can be scrolled up or down by successively incrementing or decrementing SA and SB.

Figure 6 shows examples of how the display is scrolled. The scroll range in these examples contains 12 lines (second to the 13th lines). However, the screen can display only 11 lines at a time, and the remaining one line is handled as a dummy line and not displayed.

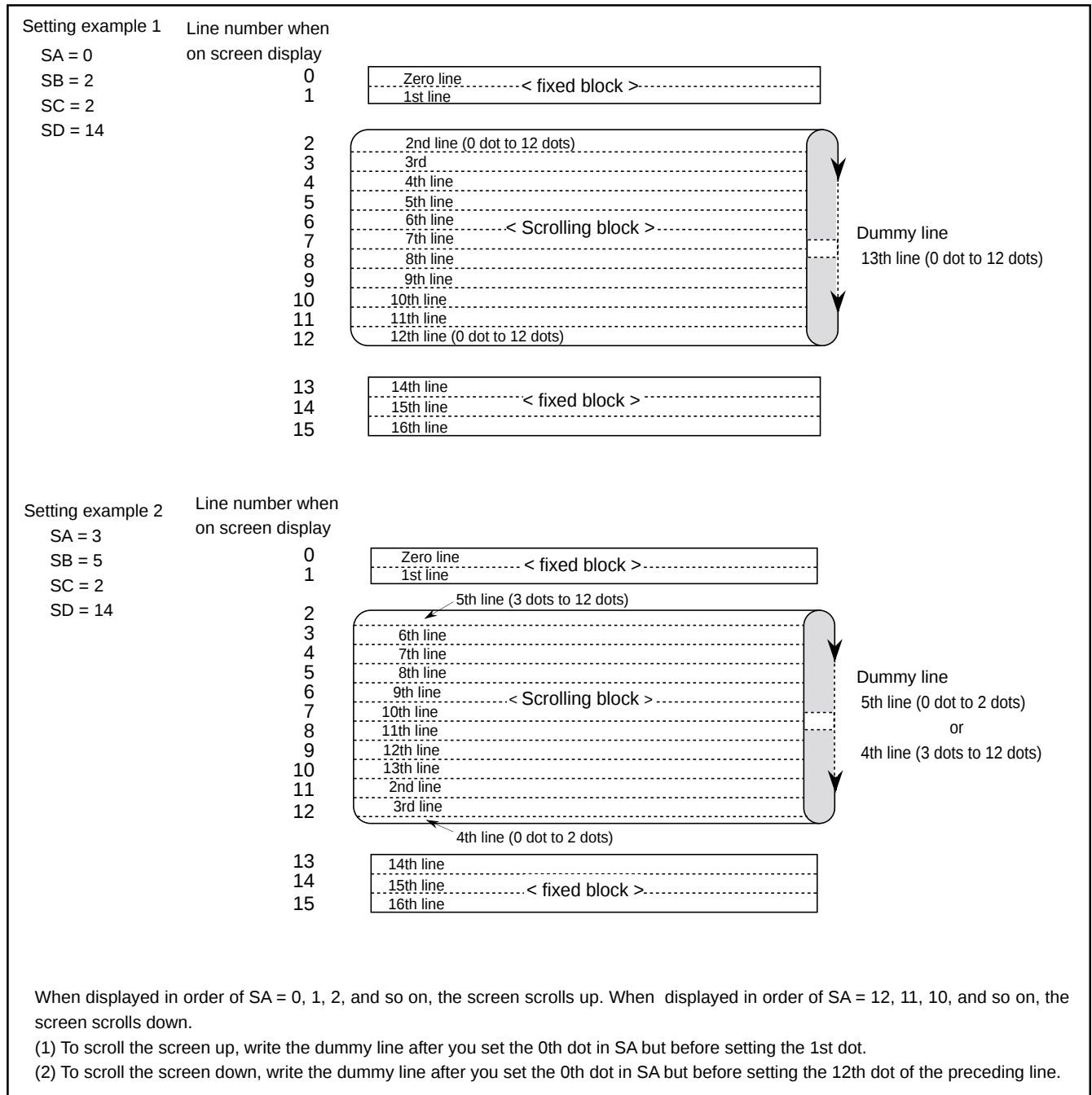


Fig. 6 Scrolling example

6. Character font

(1) Character ROM

Images are composed on a 12 X 13 dot matrix, and characters can be linked vertically and horizontally with other characters to allow the display the continuous symbols.

Character code FF16 is fixed as blank, without a background.

(2) SYRAM

You can set characters for 63 letters per screen (SYRAM code 0016 to 3E16). Figure 9 shows an example of how to set.

Use display RAM's SYC5 to 0 (0016 to 3E16) to specify SYRAM. Note that SYRAM code 3F16 is fixed to a blank, so you cannot set a character font to this code.

If you do not put SYRAM and a character together, use code 3F16.

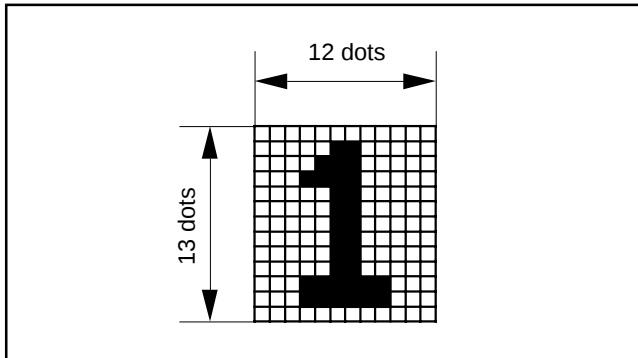


Fig. 7 Character construction

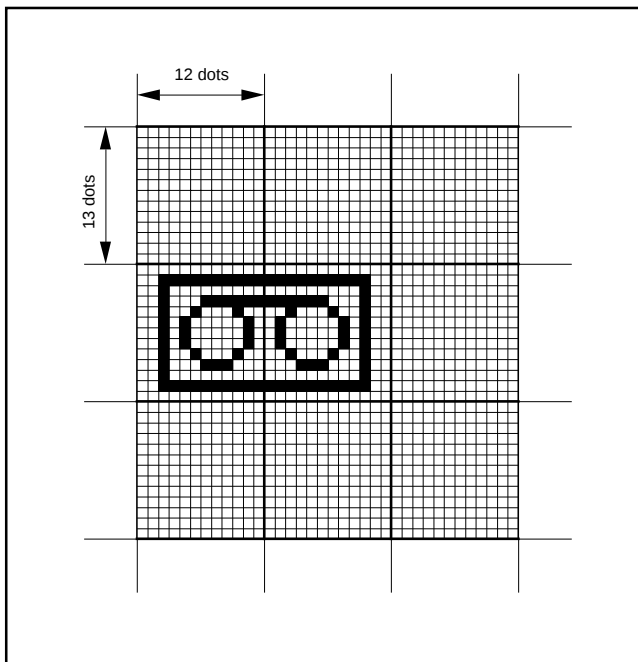


Fig. 8 Example for displaying a continuous pattern

(ex) SYRAM code 0016 Set character by setting data to address 30016 to 30C16

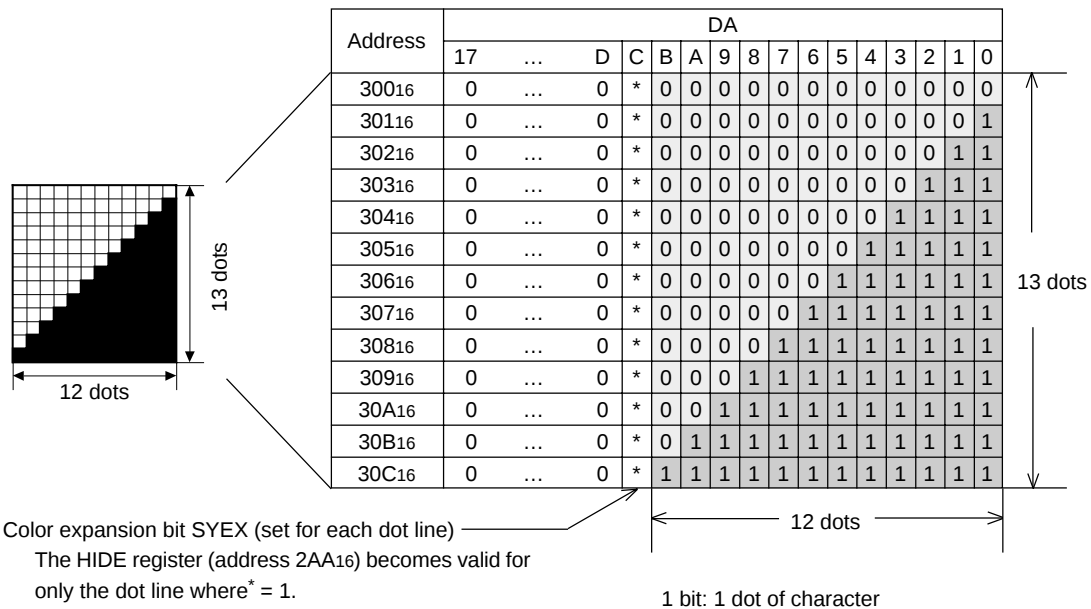


Fig. 9 Setting example of SYRAM

(3) Compounding character ROM and SYRAM

You can compound characters in character ROM with SYRAM.
The compounding method is determined by the SYEX color expansion bit and the HIDE register (address 2AA16).
For dot lines where SYEX = 0, the SYRAM color is set by the display RAM's SR, SG, and SB irrespective of the HIDE register's content.
If the HIDE register's content is 0, the SYRAM color for dot lines where SYEX = 1 is set by the LINER, LINEG, and LINEB registers (address 2AC16).

If the HIDE register's content is 1, the character ROM part of the dot lines where SYEX = 1 is overwritten in HIDE mode with colors set by the LINER, LINEG, and LINEB registers irrespective of the ROM's content and color. The color of the SYRAM part is set by the display RAM's SR, SG, and SB as in the case of dot lines where SYEX = 0.

Figure 10 shows an example for each instance of compounding.

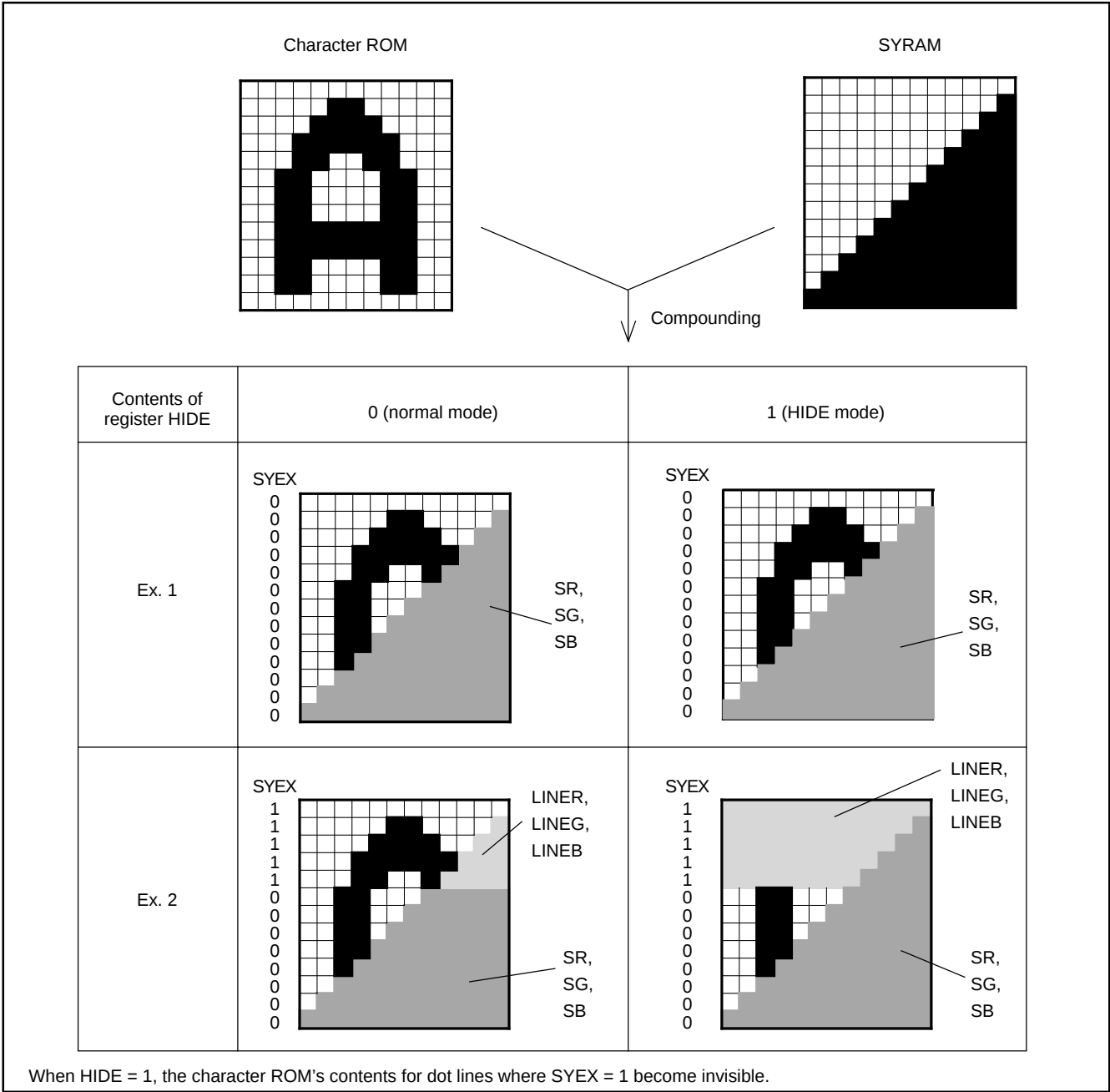


Fig. 10 Compounding example

Table 14 Data setting

No.	Contents	
	Address/data	Remarks
1	Address (2B0 ₁₆)	Address setting
2	Data (2B0 ₁₆)	Display OFF
3	Data (300 ₁₆)	Set addresses SYRAM
4	Data (301 ₁₆)	300 ₁₆ to 6EC ₁₆
⋮	⋮	⋮
822	Data (6EC ₁₆)	
823	Address (000 ₁₆)	Set address
824	Data (000 ₁₆)	Set registers address
825	Data (001 ₁₆)	display RAM
⋮	⋮	000 ₁₆ to 2A7 ₁₆
1503	Data (2A7 ₁₆)	
1504	Data (2A8 ₁₆)	Set registers address
1505	Data (2A9 ₁₆)	2A8 ₁₆ to 2AF ₁₆
1506	Data (2AA ₁₆)	
1507	Data (2AB ₁₆)	
1508	Data (2AC ₁₆)	
1509	Data (2AD ₁₆)	
1510	Data (2AE ₁₆)	
1511	Data (2AF ₁₆)	
1512	Data (2B0 ₁₆)	Display ON

- (1) The address consists of 8 bits $\times$ 3.
- (2) The data consists of 8 bits $\times$ 3.
- (3) The 8 bits $\times$ 3 in the SCK after the $\overline{\text{CS}}$ signal has fallen are the address, and for succeeding input data, the address is incremented every 24 bits (8 bits $\times$ 3). Refer to Fig.12 about detail for address increment.

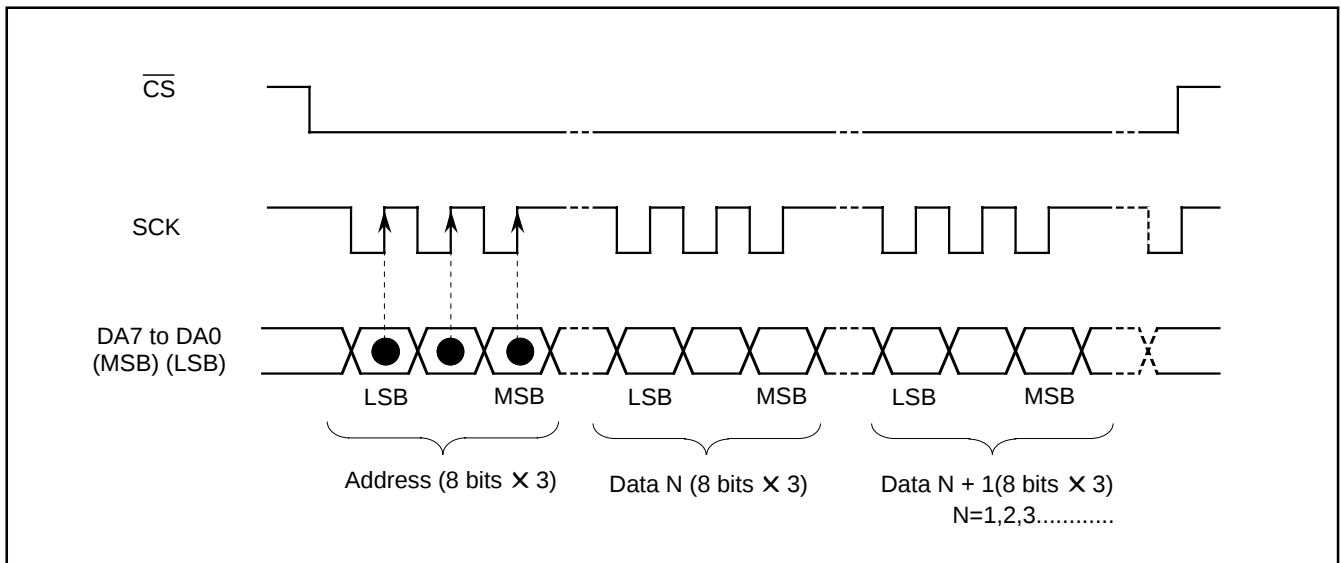
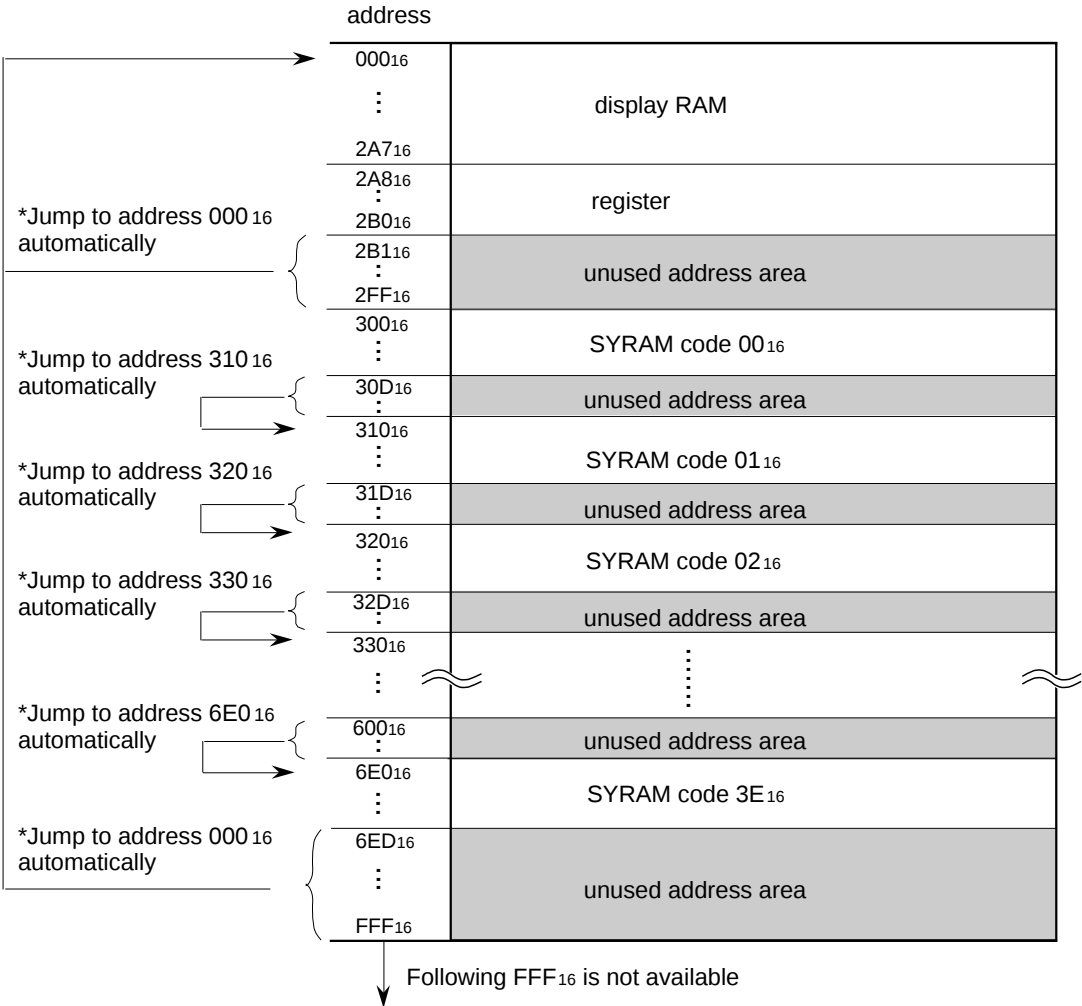


Fig. 11 Serial input timing

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS



When entering data, note that although addresses are incremented every data entry (8 bits X 3), if an address value falls in the unused address area, it is automatically converted to the address value indicated by the arrow. When entering SYRAM data, for example, you can set this data simply by setting address 300₁₆ first and then entering data 300₁₆ to 30C₁₆ (SYRAM code 00₁₆) and next data 310₁₆ to 31C₁₆ (SYRAM code 01₁₆). The same applies for SYRAM code 02₁₆ to 3E₁₆.

Fig. 12 Address construction

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

M35060-XXXSP PERIPHERAL CIRCUIT

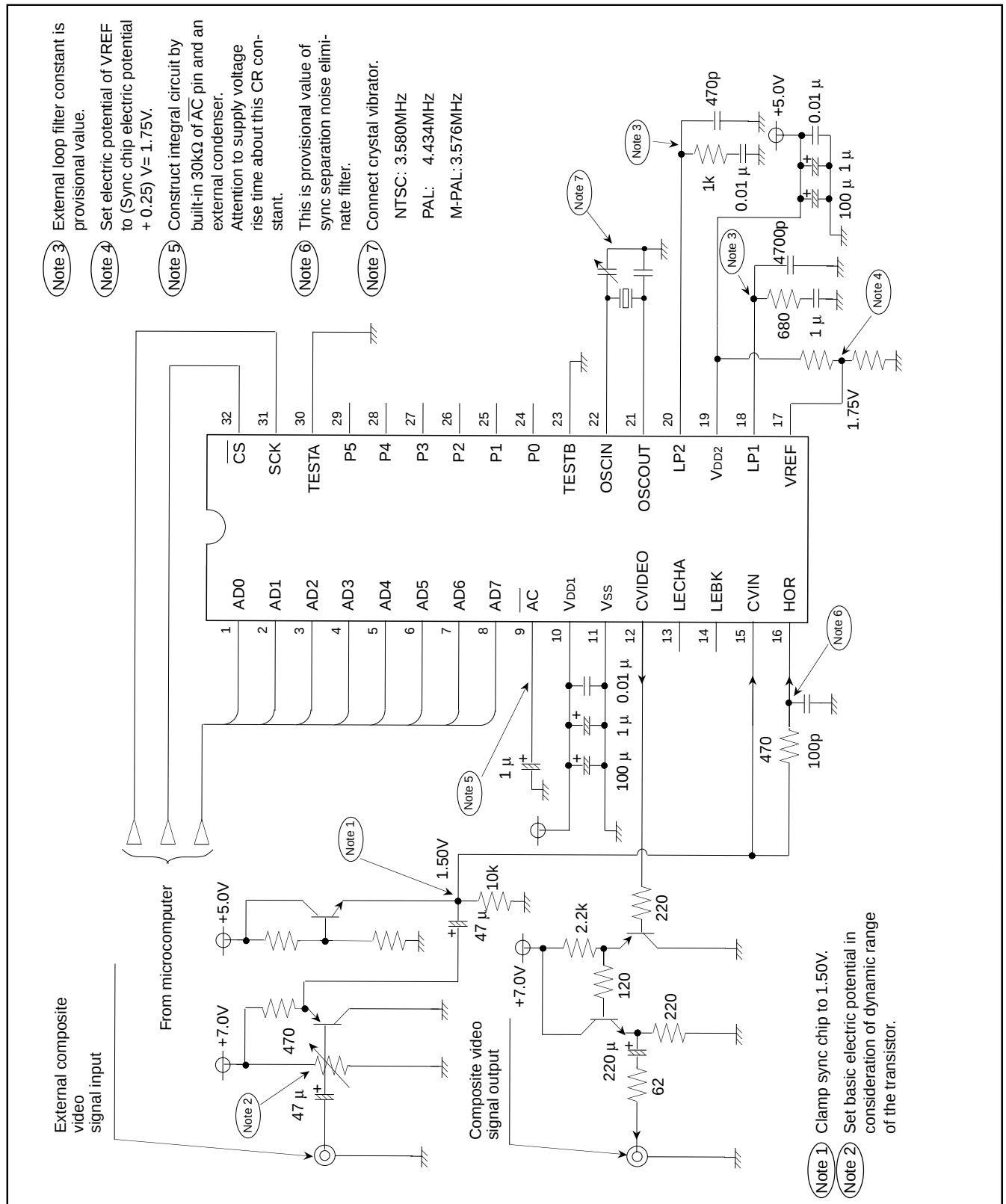
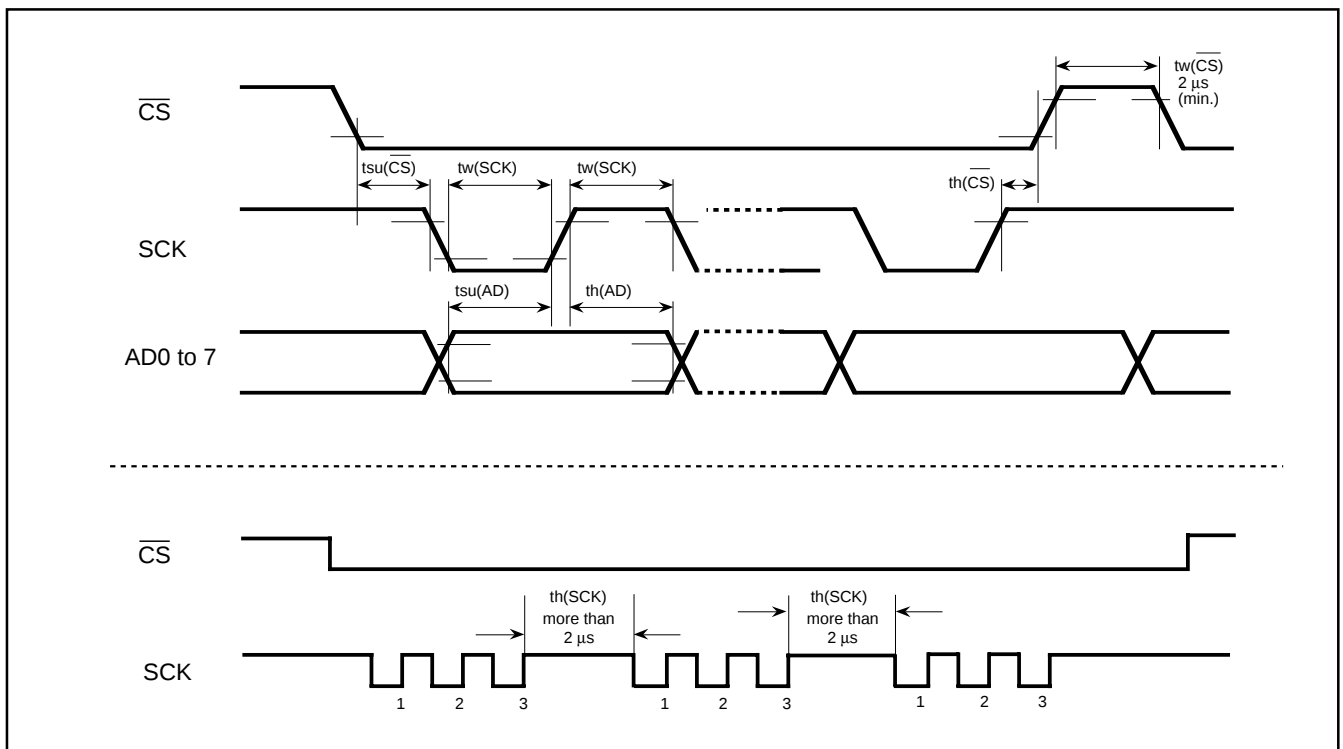


Fig.13 M35060-XXXSP example of peripheral circuit

TIMING REQUIREMENTS ($T_a = -20^{\circ}\text{C}$ to $+70^{\circ}\text{C}$, $V_{DD} = 5.00 \pm 0.25\text{V}$ unless otherwise noted)

DATA INPUT

Symbol	Parameter	Limits			Unit
		Min.	Typ.	Max.	
$t_w(\text{SCK})$	SCK width	200	—	—	ns
$t_{su}(\overline{\text{CS}})$	$\overline{\text{CS}}$ setup time	200	—	—	ns
$t_h(\overline{\text{CS}})$	$\overline{\text{CS}}$ hold time	2	—	—	ms
$t_{su}(\text{AD})$	AD setup time	200	—	—	ns
$t_h(\text{AD})$	AD hold time	200	—	—	ns
$t_h(\text{SCK})$	1 word hold time	2	—	—	ms


Fig. 14 Serial input timing requirements

PRECAUTIONS

1. Note for when starting of system
Before setting registers at the starting of system, be sure to re-set the M35060-XXXSP by applying "L" level to the $\overline{AC}$ pin.
2. 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.
3. Note for when throwing power supply into the M35060-XXXSP
When power to the M35060-XXXSP is activated, characters are sometimes output without defining the internal display RAM, composite RAM and register. Also, immediately after power is turned ON, up until the oscillator circuit stabilizes, data is sometimes not set correctly in the register. Therefore, use the following start-up procedure.
 - (a) Throwing power supply into the M35060-XXXSP ($\overline{AC}$ pin = "L")
 - (b) Auto-clear releasing ($\overline{AC}$ pin = "H")
 - (c) 200 ms waiting state (stabilization period of internal oscillation circuit) Data input is forbidden.
 - (d) Set register LEVELn
 - (e) Set register PAL/NTSC
 - (f) Set register PCn
 - (g) 20 ms waiting state (stabilization period of internal oscillation circuit)
Data input is forbidden.
 - (h) Set other registers
 - (i) Set SYRAM
 - (j) Set display RAM
 - (k) Set register DSPON and register DSPONV to display ON
4. Precautions when resuming internal oscillation from the OFF state.
The internal oscillator circuit stops oscillating when register LEVEL = 1, DSPON = 0, DSPONV = 0 and CS terminal = H. When resuming internal oscillation from the OFF state, up until the oscillator circuit stabilizes, data is sometimes not set correctly in the register. Therefore, start oscillation as follows.
 - (a) $\overline{CS}$ pin = "H" (oscillation stop)
 - (b) $\overline{CS}$ pin = "L" (oscillation start)
 - (c) 20 ms waiting state (stabilization period of internal oscillation circuit)
 - (d) Set register LEVEL 1 = 0
 - (e) Set other registers: SYRAM, display RAM
 - (f) Set register DSPON and register DSPONV to display ON
5. Note for oscillation
Make note of the fact that the internal oscillator circuit cannot stabilize in the below situations.
 - (a) When the external composite video signal is discontinuous (changing channels etc.)
 - (b) When change the setting of register PCn
 - (c) When change the setting of register LEVELn
 When (a)~(c), set the display to OFF by registers DSPON and DSPONV before change the setting. Other registers' settings are forbidden during 20ms after the setting.
6. When no external composite video signal is input (Without a signal, characters cannot be displayed by external synchronization. Therefore, switch to internal synchronization.)
7. When signal level of the external composite video signal is extremely poor (With a weak electric field, character display is uncontrollable by external synchronization. Therefore, switch to internal synchronization.)
8. When a crystal oscillator is connected to OSCIN (22-pin) or OSCOUT (21-pin) (Talk with the manufacturer of the crystal oscillator you are using about matching it to this IC.)

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

ABSOLUTE MAXIMUM RATINGS (V_{DD} = 5.00V, T_a = – 20°C to +70°C unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V _{DD}	Supply voltage	With respect to V _{SS} .	– 0.3 to 6.0	V
V _I	Input voltage		V _{SS} – 0.3 < V _I < V _{DD} +0.3	V
V _O	Output voltage		V _{SS} < V _O < V _{DD}	V
P _d	Power dissipation	T _a = 25°C	300	mW
T _{opr}	Operating temperature		– 20 to 70	°C
T _{stg}	Storage temperature		– 40 to 125	°C

RECOMMENDED OPERATIONAL CONDITIONS (V_{DD} = 5.00V, T_a = – 20°C to +70°C unless otherwise noted)

Symbol	Parameter	Limits			Unit
		Min.	Typ.	Max.	
V _{DD}	Supply voltage	4.75	5.00	5.25	V
V _{IH}	“H” level input voltage $\overline{AC}$, $\overline{CS}$, SCK, AD0 to AD7	0.8 × V _{DD}	V _{DD}	V _{DD}	V
V _{IL}	“L” level input voltage $\overline{AC}$, $\overline{CS}$, SCK, AD0 to AD7	0	0	0.2 × V _{DD}	V
V _{CVIN}	Composite video input supply voltage CVIN	—	2Vp-p	—	V
f _{OSCIN}	Oscillation frequency for synchronous signal	—	3.580 4.434 3.576	—	MHz

ELECTRICAL CHARACTERISTICS (V_{DD} = 5.00V, T_a = +25°C unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
V _{DD}	Supply voltage	T _a = – 20°C to +70°C	4.75	5.00	5.25	V
I _{DD}	Supply current	V _{DD} = 5.00V	—	30	60	mV
V _{OH}	“H” level output voltage P0 to P5	V _{DD} = 4.75, I _{OH} = – 0.2mA	3.75	—	—	V
V _{OL}	“L” level output voltage P0 to P5	V _{DD} = 4.75, I _{OL} = 0.2mA	—	—	0.4	V
R _I	Pull-up resistance $\overline{AC}$	V _{DD} = 5.00V	10	30	100	kΩ

VIDEO SIGNAL INPUT CONDITIONS (V_{DD} = 5V, T_a = – 20°C to +70°C)

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

NOTE FOR SUPPLYING POWER

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

The internal circuit of M35060-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 15.

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 M35060-XXXSP, the t_w time must be reserved for 1 ms or more.

Before starting input from the microcomputer, the waiting time (t_s) must be reserved for 200 ms 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.

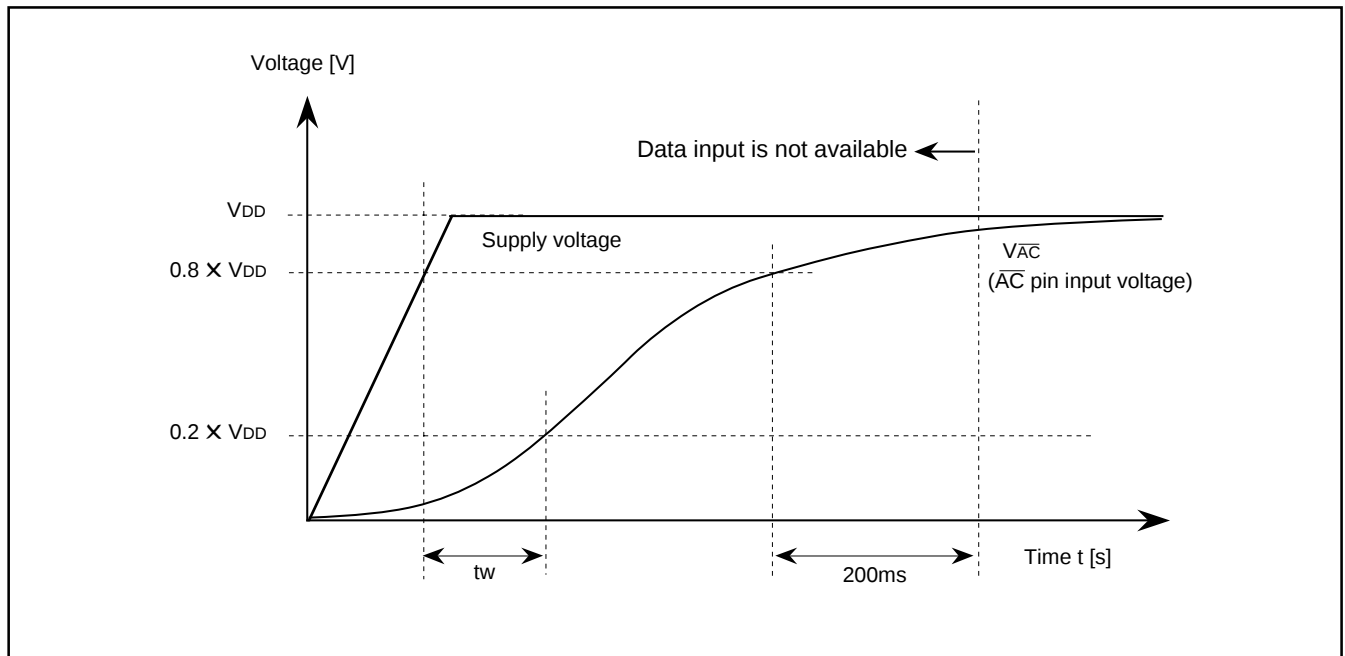


Fig. 15 Timing of power supplying to $\overline{AC}$ pin

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.

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

STANDARD ROM TYPE: M35060-001SP

M35060-001SP is a standard ROM type of M35060-XXXSP.

Character patterns are fixed to the contents of Figure 16 to 19.

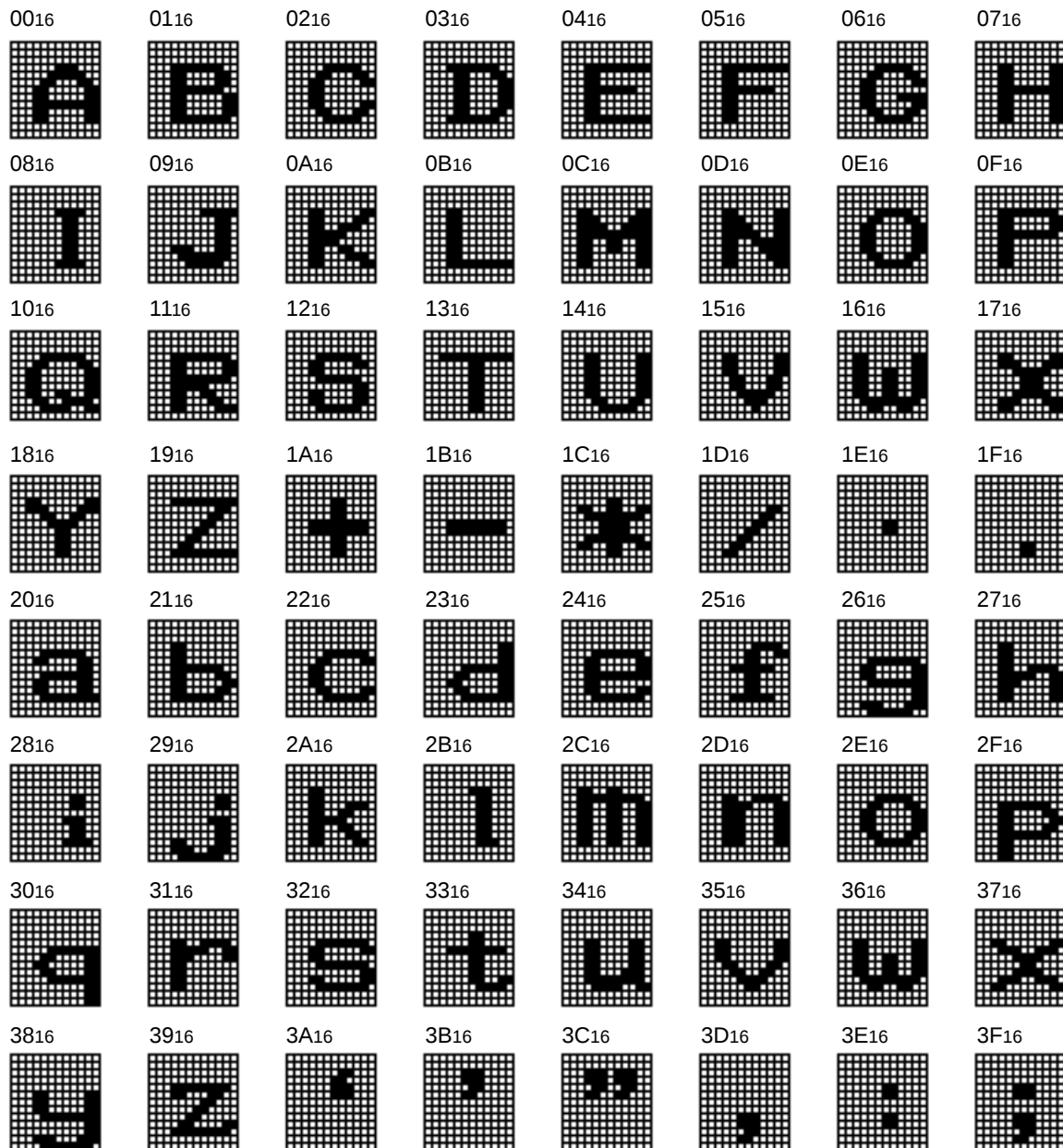


Fig. 16 M35060-001SP character patterns (1)

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

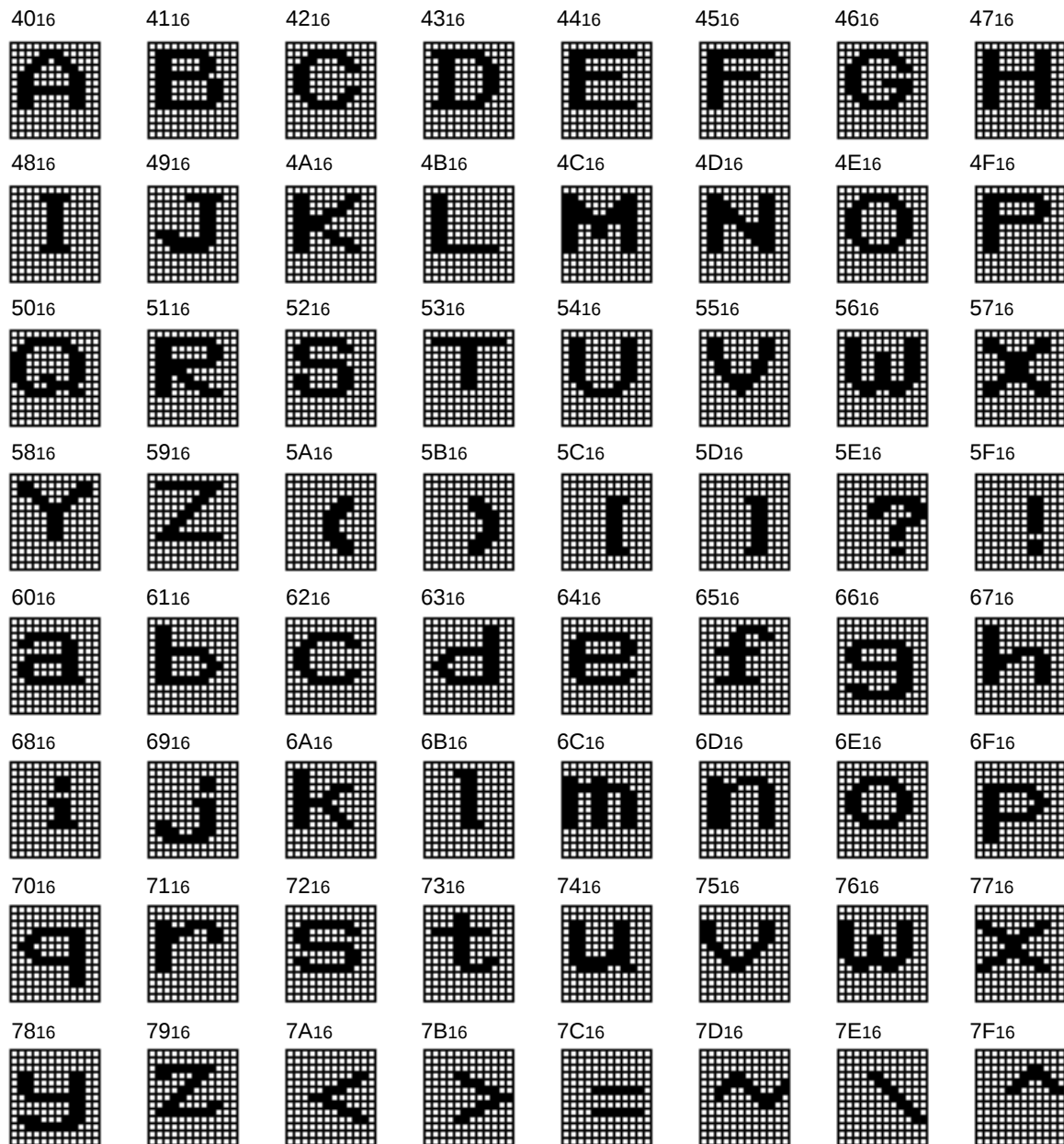


Fig. 17 M35060-001SP character patterns (2)

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

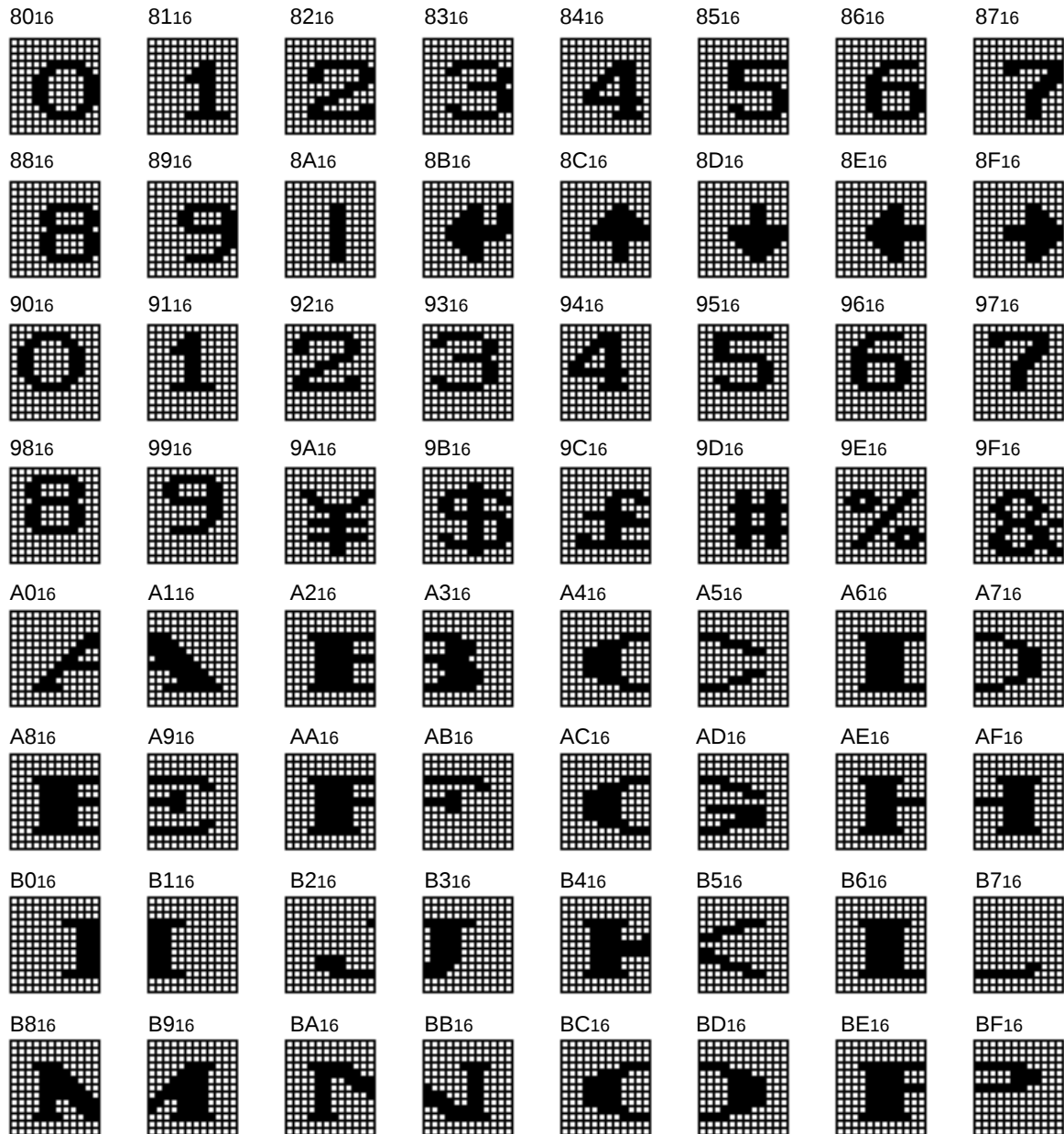


Fig. 18 M35060-001SP character patterns (3)

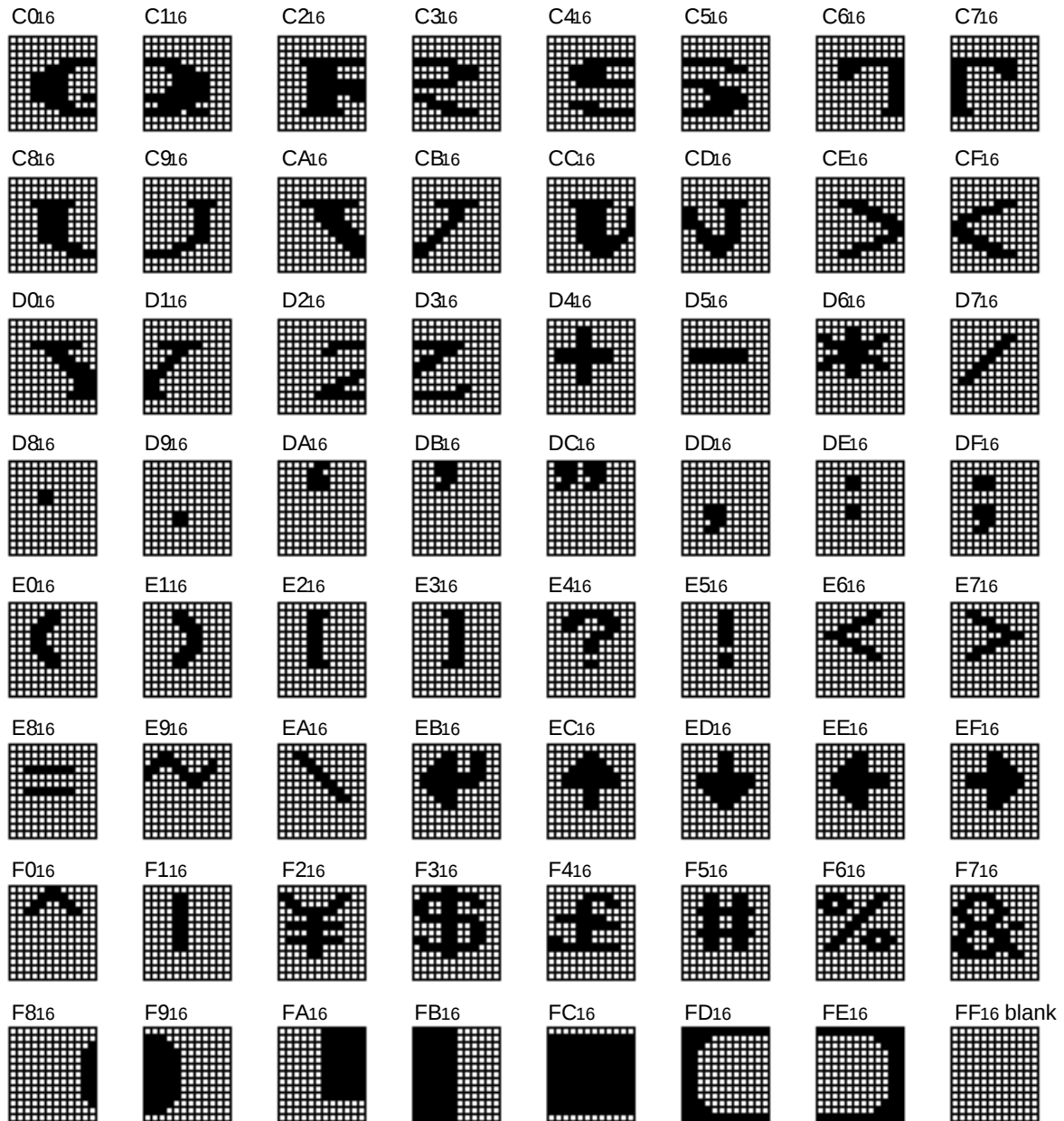


Fig. 19 M35060-001SP character patterns (4)

STANDARD ROM TYPE: M35060-002SP

M35060-002SP is a standard ROM type of M35060-XXXSP.

Character patterns are fixed to the contents of Figure 20 to 23.

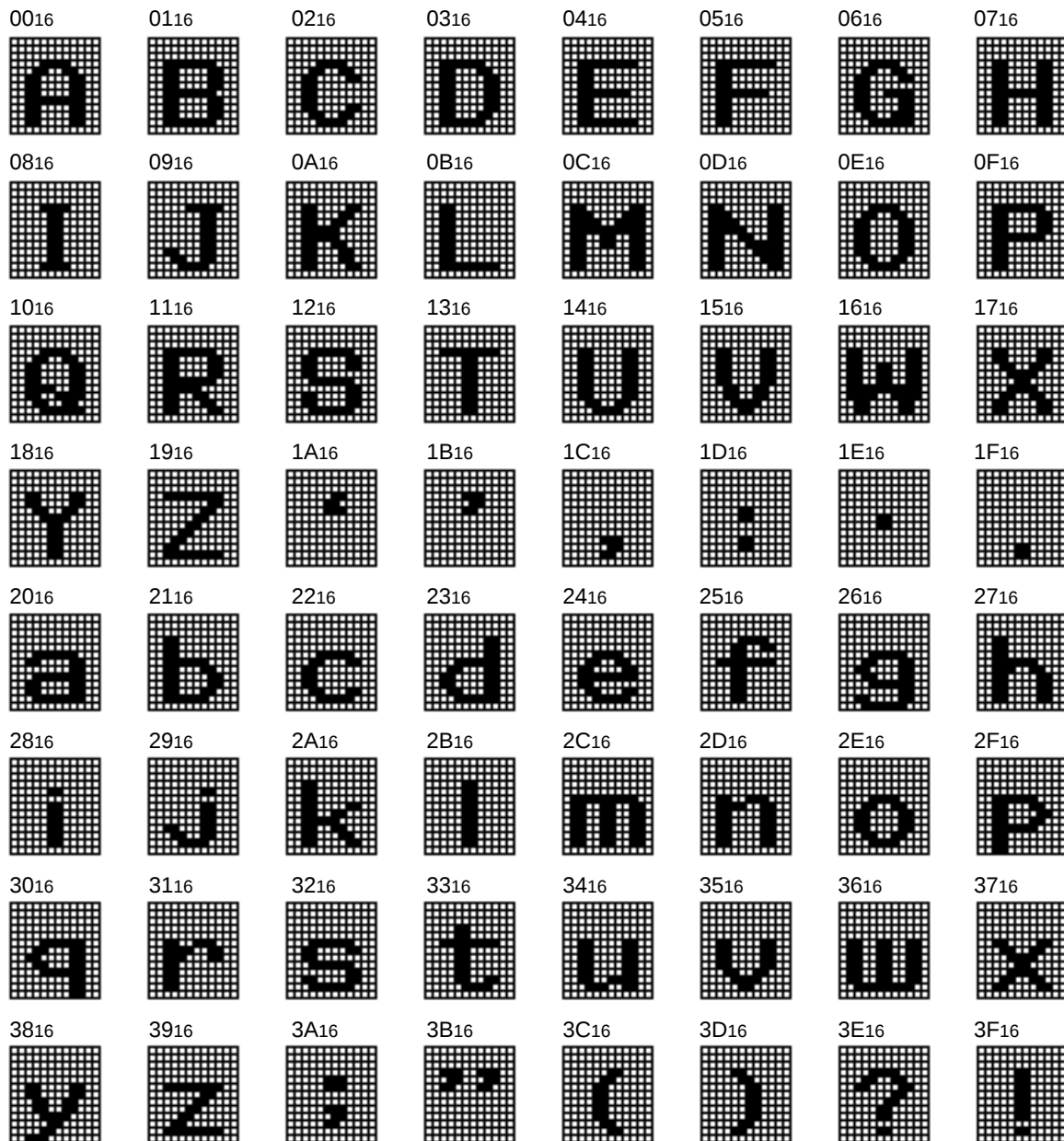


Fig. 20 M35060-002SP character patterns (1)

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS



Fig. 21 M35060-002SP character patterns (2)

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

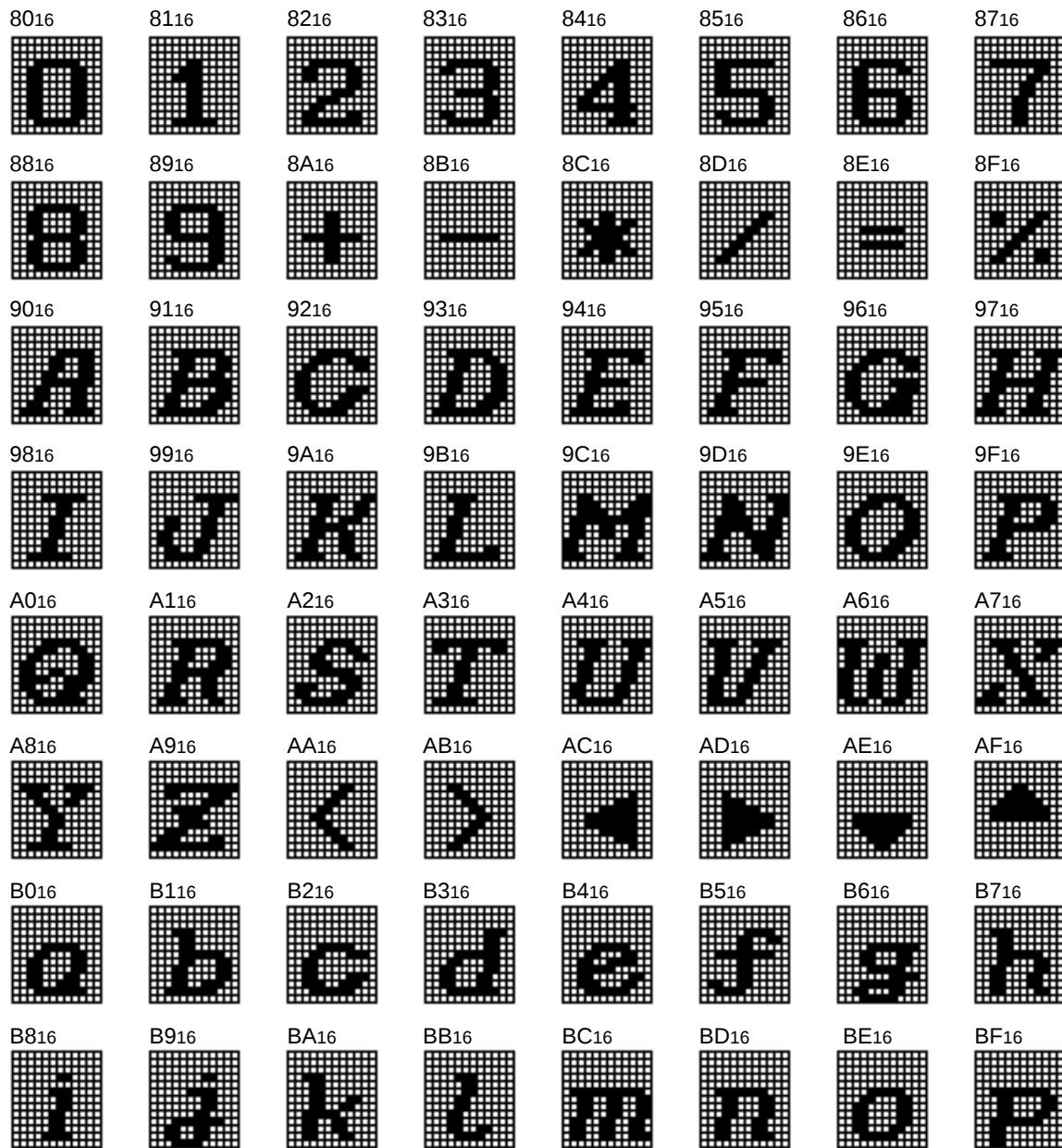


Fig. 22 M35060-002SP character patterns (3)

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

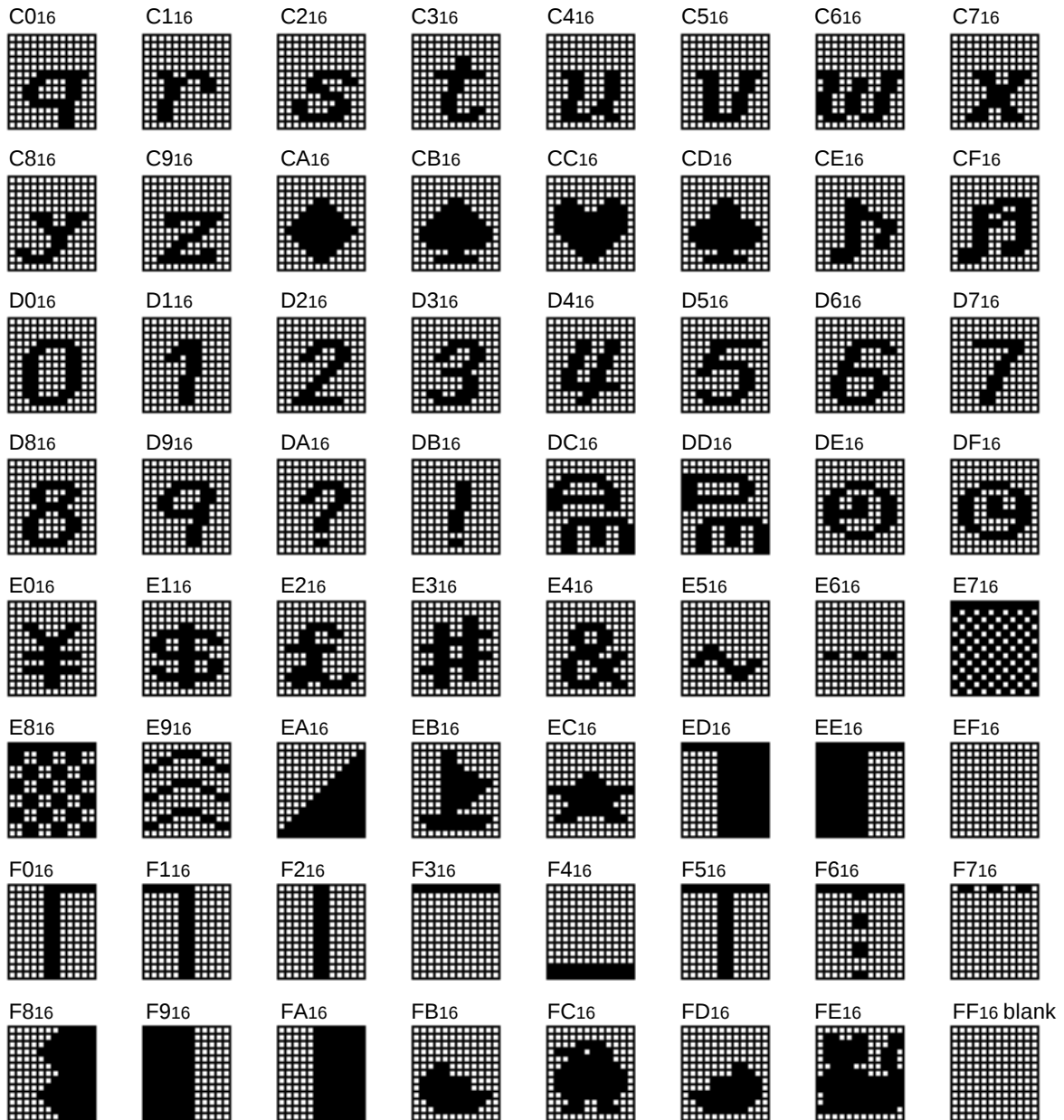


Fig. 23 M35060-002SP character patterns (4)

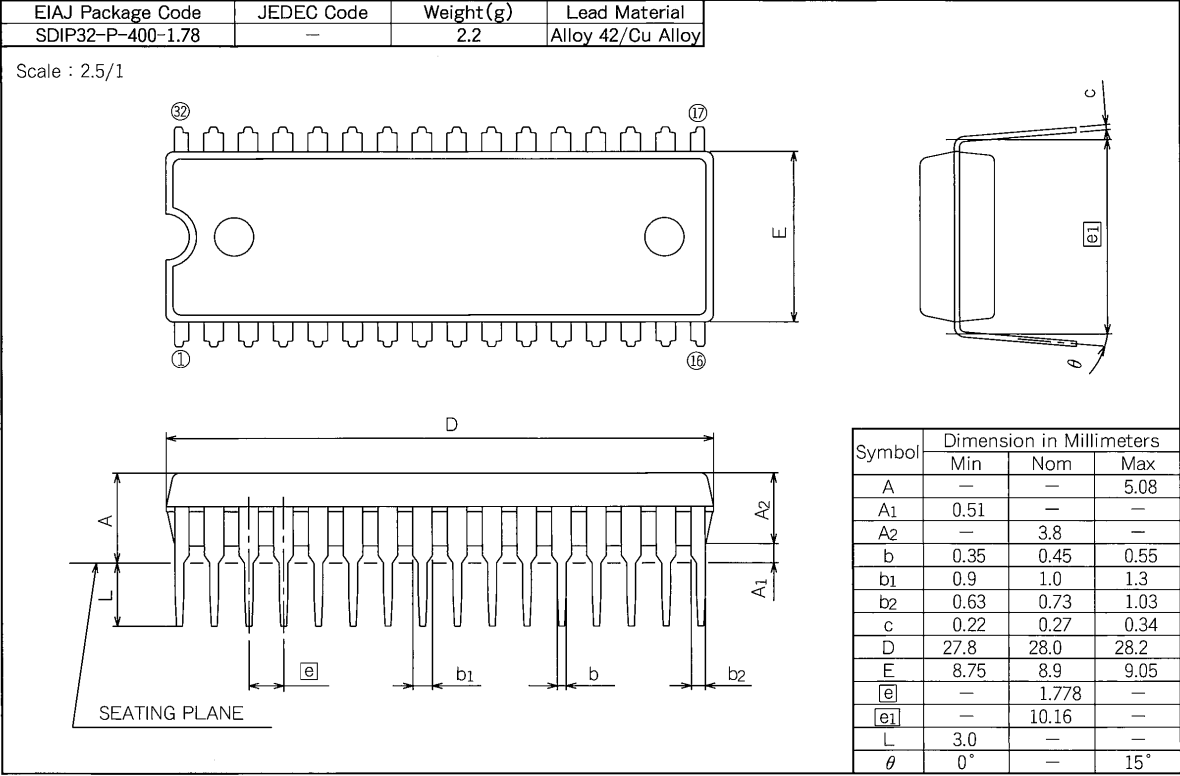
M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

PACKAGE OUTLINE

32P4B

Plastic 32pin 400mil SDIP



Renesas Technology Corp.

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

Keep safety first in your circuit designs!

- Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

- These materials are intended as a reference to assist our customers in the selection of the Mitsubishi semiconductor product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Mitsubishi Electric Corporation or a third party.
- Mitsubishi Electric Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
- All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Mitsubishi Electric Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for the latest product information before purchasing a product listed herein.
- The information described here may contain technical inaccuracies or typographical errors. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors. Please also pay attention to information published by Mitsubishi Electric Corporation by various means, including the Mitsubishi Semiconductor home page (<http://www.mitsubishichips.com>).
- When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
- Mitsubishi Electric Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
- The prior written approval of Mitsubishi Electric Corporation is necessary to reprint or reproduce in whole or in part these materials.
- If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
- Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
- Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for further details on these materials or the products contained therein.

REVISION DESCRIPTION LIST

M35060-XXXSP DATA SHEET

Rev. No.	Revision Description	Rev. date				
1.0	First Edition	9804				
1.1	- Deletes some Japanese font and create pdf file (some pages) - P39 and P40 MARK SPECIFICATION FORM and PACKAGE OUTLINE are added	0007				
1.2	Delete MARK SPECIFICATION FORM 1 FEATURES <table><thead><tr><th>Error</th><th>Correct</th></tr></thead><tbody><tr><td>Screen composition 40 characters 16 lines</td><td>Screen composition 40 characters 17 lines (At scrolling) 40 characters 16 lines</td></tr></tbody></table>	Error	Correct	Screen composition 40 characters 16 lines	Screen composition 40 characters 17 lines (At scrolling) 40 characters 16 lines	0008
Error	Correct					
Screen composition 40 characters 16 lines	Screen composition 40 characters 17 lines (At scrolling) 40 characters 16 lines					
1.3	P1 The following note is added Note: Superimpose black and white display. (NTSC, PAL, M-PAL) P35 Fig 20 M35060-002SP character patterns(1) Address 00₁₆, 01₁₆ 3E₁₆, 3F₁₆ are added P36 Fig 21 M35060-002SP character patterns(2) Address 40₁₆, 41₁₆ 7E₁₆, 7F₁₆ are added P37 Fig 22 M35060-002SP character patterns(3) Address 80₁₆, 81₁₆ BE₁₆, BF₁₆ are added P38 Fig 23 M35060-002SP character patterns(4) Address C0₁₆, C1₁₆ FE₁₆, FF₁₆ are added	0110				