

MITSUBISHI MICROCOMPUTERS  
**M35060-XXXSP**

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

**DESCRIPTION**

M35060-XXXSP is CATV screen display control IC which can display 40 (horizontal) X 16 (vertical). It has built-in SYRAM which can be used with character ROM.

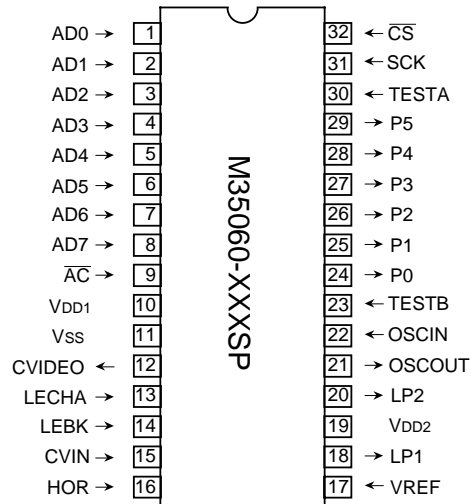
It uses a silicon gate CMOS process and it housed in a small 32-pin shrink DIP package. For M35060-001SP and M35060-002SP that are standard ROM version of M35060-XXXSP, the character patterns are also mentioned.

**FEATURES**

- Screen composition ..... 40 characters X 17 lines  
(at scrolling ..... 40 characters X 16 lines)
- Number of characters displayed ..... 680 (Max.)
- Character composition ..... 12 X 13 dot matrix
- Characters available character ROM ..... 256 characters  
SYRAM ..... 63 characters
- Character sizes available horizontal ..... 2 (once, twice)  
vertical ..... 2 (once, twice)  
setting by every line
- Display locations available  
Horizontal direction ..... 480 locations  
Vertical direction ..... 235 locations
- Blinking ..... character units  
Cycle ... approximately 1 second, or approximately 0.5 seconds  
Duty ..... 25%, 50% or 75%
- Data input ..... 8-bit parallel X 3
- Coloring Character coloring ..... 8 colors choices per character  
Background coloring .... 8 colors choices per character  
Raster coloring ..... 8 colors choices per screen
- Blanking Character size blanking  
Border size blanking  
Matrix-outline  
Halftone blanking  
Can be set by every line
- General-purpose output ports Combined port output ..... 6  
(switching to RGB output)
- RAM erase ..... Display RAM erasing by every line  
SYRAM erasing separately
- Scrolling ..... Bit by bit smooth scroll implemented by software
- Composite synchronizing signal generation ..... Built-in  
(PAL, NTSC, M-PAL)
- Display oscillation circuit ..... Built-in
- Synchronous separation circuit ..... Built-in
- Synchronous correction circuit ..... Built-in

**Note:** Superimpose black and white display. (NTSC, PAL, M-PAL)

**PIN CONFIGURATION (TOP VIEW)**



**Outline 32P4B**

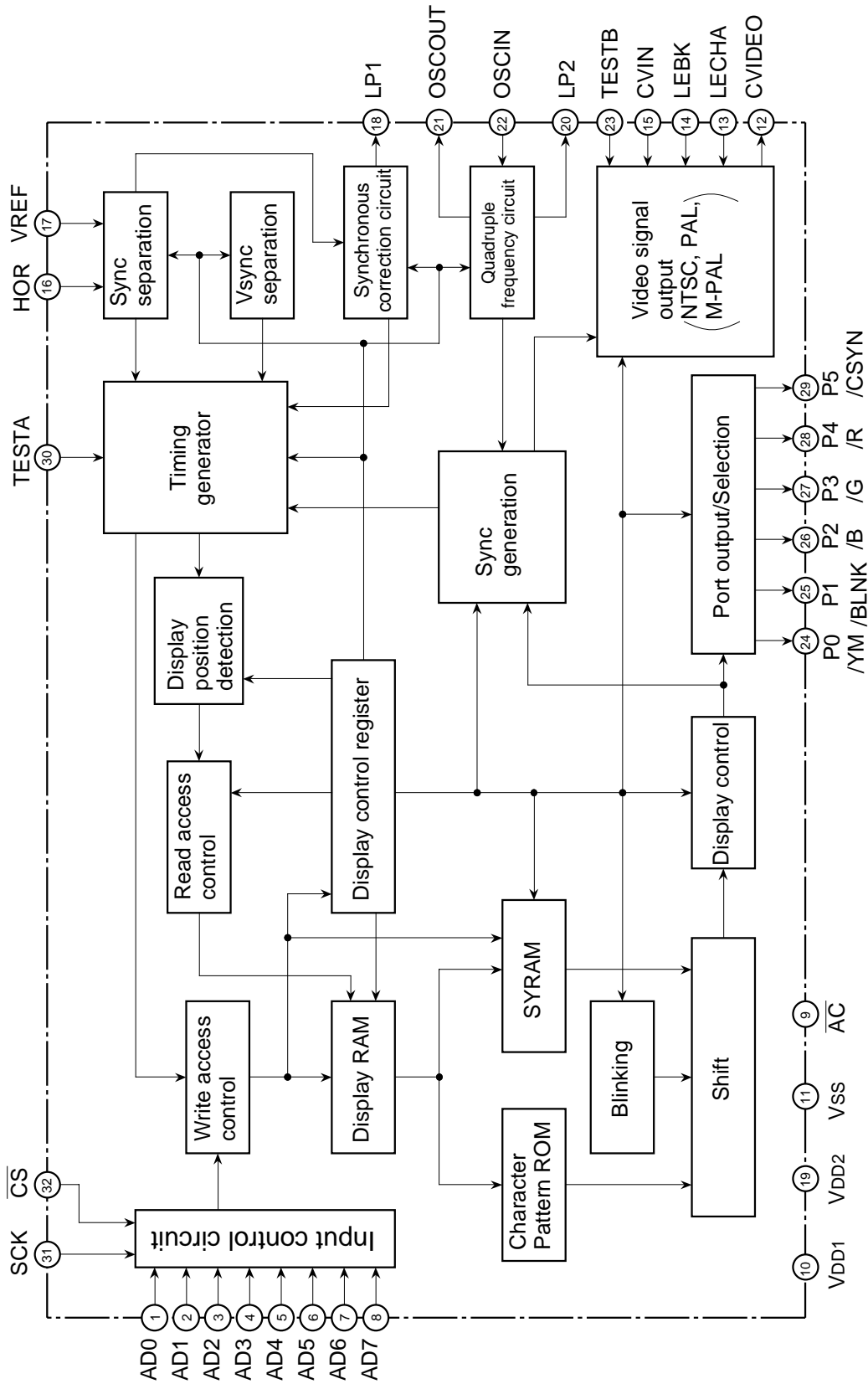
**PIN DESCRIPTION**

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
00016	SB	SG	SR	SYC5	SYC4	SYC3	SYC2	SYC1	SYC0	BB	BG	BR	BLINK	CB	CG	CR	C7	C6	C5	C4	C3	C2	C1	C0
}	SY color setting			SYRAM setting						Raster color setting			BLINK	Character color setting			Character setting							
	2A716	SB	SG	SR	SYC5	SYC4	SYC3	SYC2	SYC1	SYC0	BB	BG	BR	BLINK	CB	CG	CR	C7	C6	C5	C4	C3	C2	C1
2A816	—	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
2A916	—	—	—	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
2AA16	—	—	—	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
2AB16	—	—	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
2AC16	—	—	—	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
2AD16	—	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
2AE16	—	—	—	—	—	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
2AF16	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
2B016	—	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

TESTn (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
30016	0	SYEX	S00B	S00A	S009	S008	S007	S006	S005	S004	S003	S002	S001	S000	0016
30C16		SYEX	S00B	S00A	S009	S008	S007	S006	S005	S004	S003	S002	S001	S000	
31016	0	SYEX	S01B	S01A	S019	S018	S017	S016	S015	S014	S013	S012	S011	S010	0116
31C16		SYEX	S01B	S01A	S019	S018	S017	S016	S015	S014	S013	S012	S011	S010	
}	∴	∴	}											}	
6D016	0	SYEX	S3DB	S3DA	S3D9	S3D8	S3D7	S3D6	S3D5	S3D4	S3D3	S3D2	S3D1	S3D0	3D16
6DC16		SYEX	S3DB	S3DA	S3D9	S3D8	S3D7	S3D6	S3D5	S3D4	S3D3	S3D2	S3D1	S3D0	
6E016	0	SYEX	S3EB	S3EA	S3E9	S3E8	S3E7	S3E6	S3E5	S3E4	S3E3	S3E2	S3E1	S3E0	3E16
6EC16		SYEX	S3EB	S3EA	S3E9	S3E8	S3E7	S3E6	S3E5	S3E4	S3E3	S3E2	S3E1	S3E0	

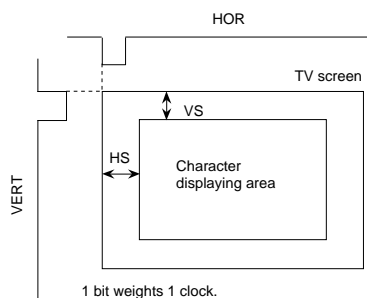
∴ : Name or value changes by definite ratio.  
 ∴ : The same name or value continues.



**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		
		0		
		1		
		0		
		1		
		0		
		1		
1	VP1	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
2	VP2	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
3	VP3	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
4	VP4	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
5	VP5	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
6	VP6	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
7	VP7	0		
		1		
		0		
		1		
		0		
		1		
		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.
		1		
		0		
		1		
		0		
		1		
		0		
		1		
9	HP1	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
A	HP2	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
B	HP3	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
C	HP4	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
D	HP5	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
E	HP6	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
F	HP7	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
10	HP8	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
11	TEST10	0	Test mode (Must be cleared to 0.)	
		1		
		0		
		1		
		0		
		1		
		0		
		1		
12	TEST11	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
13	TEST0	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
14	TEST1	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
15	TEST2	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
16	TEST3	0		
		1		
		0		
		1		
		0		
		1		
		0		
		1		
17	—	0	Must be cleared to 0.	
		1		



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

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(3) Address 2AA<sub>16</sub>

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



# M35060-XXXSP

## SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(4) Address 2AB<sub>16</sub>

DA	Register	Status	Contents			Remarks																																																	
			Function																																																				
0	DSP0 00	① 1	<table border="1"> <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>	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 by combination of DSP0xx (address 2AB <sub>16</sub> and DSP1xx) and DSP1xx (address 2AC <sub>16</sub> ).			Set to line 3 of display RAM																																																	
4	DSP0 04	① 1	At internal synchronous mode (EX = 1), display monitor signal area is all blanking signal (BLNK output) area.			Set to line 4 of display RAM																																																	
5	DSP0 05	① 1				Set to line 5 of display RAM																																																	
6	DSP0 06	① 1	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.			Set to line 6 of display RAM																																																	
7	DSP0 07	① 1	However, the halftone display is possible only with superimposed displays.			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 border="1"> <thead> <tr> <th>PHASE</th> <th>PHASE</th> <th>PHASE</th> <th colspan="2">Color</th> </tr> <tr> <td>2</td> <td>1</td> <td>0</td> <th>SELCOR=0</th> <th>SELCOR=1</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>Black</td> <td>Black</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>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> </tbody> </table>		PHASE	PHASE	PHASE	Color		2	1	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	PHASE	PHASE	Color																																																				
2	1	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																																																					
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 2AC<sub>16</sub>

DA	Register	Status	Contents			Remarks																																																	
			Function																																																				
0	DSP1 00	0 1	<table border="1"> <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>			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	0 1				Set to line 1 of display RAM																																																	
2	DSP1 02	0 1				Set to line 2 of display RAM																																																	
3	DSP1 03	0 1	<p>Set by combination of DSP0xx (address 2AB<sub>16</sub> and DSP1xx) and DSP1xx (address 2AC<sub>16</sub>). At internal synchronous mode (EX = 1), display monitor signal area is all blanking signal (BLNK output) area.</p> <p>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.</p>			Set to line 3 of display RAM																																																	
4	DSP1 04	0 1				Set to line 4 of display RAM																																																	
5	DSP1 05	0 1				Set to line 5 of display RAM																																																	
6	DSP1 06	0 1				Set to line 6 of display RAM																																																	
7	DSP1 07	0 1				Set to line 7 of display RAM																																																	
8	DSP1 08	0 1				Set to line 8 of display RAM																																																	
9	DSP1 09	0 1				Set to line 9 of display RAM																																																	
A	DSP1 10	0 1				Set to line 10 of display RAM																																																	
B	DSP1 11	0 1				Set to line 11 of display RAM																																																	
C	DSP1 12	0 1				Set to line 12 of display RAM																																																	
D	DSP1 13	0 1				Set to line 13 of display RAM																																																	
E	DSP1 14	0 1				Set to line 14 of display RAM																																																	
F	DSP1 15	0 1				Set to line 15 of display RAM																																																	
10	DSP1 16	0 1				Set to line 16 of display RAM																																																	
11	LINER	0 1				<table border="1"> <thead> <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> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>Black</td> <td>Black</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>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> </tbody> </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.
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	0 1			Refer Fig. 3, 4 about phase angle.																																																		
13	LINEB	0 1																																																					
14	TEST21	0 1	Test mode (Must be cleared to 0.)																																																				
15	—	0 1																																																					
16	—	0 1	Must be cleared to 0.																																																				
17	—	0 1																																																					

(6) Address 2AD<sub>16</sub>

DA	Register	Contents		Remarks							
		Status	Function								
0	ERS0	0	Erase display RAM	Set to line 0 of display RAM							
		1									
1	ERS1	0	ERSx      RAM erase	Set to line 1 of display RAM							
		1	0      do erase								
2	ERS2	0	It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.	Set to line 2 of display RAM							
		1			1      do not erase						
3	ERS3	0	It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.	Set to line 3 of display RAM							
		1									
4	ERS4	0		It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.	Set to line 4 of display RAM						
		1									
5	ERS5	0			It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.	Set to line 5 of display RAM					
		1									
6	ERS6	0				It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.	Set to line 6 of display RAM				
		1									
7	ERS7	0					It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.	Set to line 7 of display RAM			
		1									
8	ERS8	0						It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.	Set to line 8 of display RAM		
		1									
9	ERS9	0							It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.	Set to line 9 of display RAM	
		1									
A	ERS10	0								It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.	Set to line 10 of display RAM
		1									
B	ERS11	0	It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.								Set to line 11 of display RAM
		1									
C	ERS12	0		It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.							Set to line 12 of display RAM
		1									
D	ERS13	0			It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.						Set to line 13 of display RAM
		1									
E	ERS14	0				It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.					Set to line 14 of display RAM
		1									
F	ERS15	0					It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.				Set to line 15 of display RAM
		1									
10	ERS16	0						It is unnecessary to reset these registers to "0". Multiple settings of ERS <sub>n</sub> is not allowed.			Set to line 16 of display RAM
		1									
11	SERS0	0							Erase SYRAM		Set to SYRAM code 00 <sub>16</sub> to 0F <sub>16</sub>
		1									
12	SERS1	0							SERSx      SYRAM erase	Set to SYRAM code 10 <sub>16</sub> to 1F <sub>16</sub>	
		1							0      do erase		
13	SERS2	0	It is unnecessary to reset these registers to "0". Multiple settings of SERS <sub>n</sub> is not allowed.						Set to SYRAM code 20 <sub>16</sub> to 2F <sub>16</sub>		
		1								1      do not erase	
14	SERS3	0	It is unnecessary to reset these registers to "0". Multiple settings of SERS <sub>n</sub> is not allowed.	Set to SYRAM code 30 <sub>16</sub> to 3E <sub>16</sub>							
		1									
15	TEST22	0	Test mode (Must be cleared to 0.)								
		1									
16	TEST23	0									
		1									
17	—	0	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: $SA = \sum_{n=0}^3 2^n (SBIT_n)$	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: $SB = \sum_{n=0}^4 2^n (SLIN_n)$	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): $SC = \sum_{n=0}^4 2^n (SST_n)$	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): $SD = \sum_{n=0}^4 2^n (SEND_n)$	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	0	Port P0 output	Select P0 pin																								
		1	YM output																									
1	PTC1	0	Port P1 output	Select P1 pin																								
		1	BLNK output																									
2	PTC2	0	Port P2 output	Select P2 pin																								
		1	B output																									
3	PTC3	0	Port P3 output	Select P3 pin																								
		1	G output																									
4	PTC4	0	Port P4 output	Select P4 pin																								
		1	R output																									
5	PTC5	0	Port P5 output	Select P5 pin																								
		1	CSYN output																									
6	PTD0	0	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	0	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	0	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	0	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	0	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	0	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	0	<table border="1"> <thead> <tr> <th>SRAND</th> <th>SRAND</th> <th colspan="2">SRAND2</th> </tr> <tr> <th>1</th> <th>0</th> <th>0</th> <th>1</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Complete border = 1 dot</td> <td>Right and dot border = 1 dot</td> </tr> <tr> <td>0</td> <td>1</td> <td>Complete border = 2 dot</td> <td>Right and dot border = 2 dot</td> </tr> <tr> <td>1</td> <td>0</td> <td>Complete border = 3 dot</td> <td>Right and dot border = 3 dot</td> </tr> <tr> <td>1</td> <td>1</td> <td>Complete border = 4 dot</td> <td>Right and dot border = 4 dot</td> </tr> </tbody> </table>	SRAND	SRAND	SRAND2		1	0	0	1	0	0	Complete border = 1 dot	Right and dot border = 1 dot	0	1	Complete border = 2 dot	Right and dot border = 2 dot	1	0	Complete border = 3 dot	Right and dot border = 3 dot	1	1	Complete border = 4 dot	Right and dot border = 4 dot	Condition of border display is changeable.
		SRAND		SRAND	SRAND2																							
1	0	0	1																									
0	0	Complete border = 1 dot	Right and dot border = 1 dot																									
0	1	Complete border = 2 dot	Right and dot border = 2 dot																									
1	0	Complete border = 3 dot	Right and dot border = 3 dot																									
1	1	Complete border = 4 dot	Right and dot border = 4 dot																									
1	Vertical direction is 1 dot only.																											
F	ALL24	0	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	0	Display frequency $f_T$ control  $f_T = f_H \times \left\{ \sum_{n=0}^7 (2^n PC_n) + 512 \right\}$	PC7 to PC0 < 3616, PC7 to PC0 > C616 is not available.																								
11	PC1	1																										
12	PC2	0																										
13	PC3	1																										
14	PC4	0																										
15	PC5	1																										
16	PC6	0																										
17	PC7	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.

# M35060-XXXSP

## SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(9) Address 2B0<sub>16</sub>

DA	Register	Contents		Remarks															
		Status	Function																
0	EX	0	External synchronization	(Note)															
		1	Internal synchronization																
1	—	0	Set to "0".																
		1																	
2	SELCOR	0	Normal	Refer to Table 3, 4, 7 and 8.															
		1	Mode of expansion																
3	—	0	Must be cleared to 0.																
		1																	
4	DSPON	0	Digital output display OFF																
		1	Digital output display ON																
5	DSPONV	0	Composite video output display OFF																
		1	Composite video output display ON																
6	—	0	Must be cleared to 0.																
		1																	
7	BLK	0	Matrix outline	Only at register "DSP1xx" = 1 (xx = 00 to 16) is available.															
		1	Matrix outline + border																
8	SEPV0	0	<table border="1"> <thead> <tr> <th>SEPV1</th> <th>SEPV0</th> <th>Composite Sync Separation Function</th> </tr> </thead> <tbody> <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> </tbody> </table>	SEPV1	SEPV0	Composite Sync Separation 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	<p>Method of sync separation from composite video.</p> <p>Case (1) condition: vertical sync must repeat 2X within (2) or (3); indicates this area.</p>
		SEPV1		SEPV0	Composite Sync Separation 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																			
9	SEPV1	0																	
		1																	
A	TEST15	0	Test mode (Must be cleared to 0.)																
		1																	
B	TEST16	0																	
		1																	
C	PALH	0	Interlace/noninterlace normal mode	Only at PAL and MPAL mode are available.															
		1	Interlace/noninterlace expansion mode																
D	MPAL	0	<table border="1"> <thead> <tr> <th>PAL/NTSC</th> <th>MPAL</th> <th>Format</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>unavailable</td> </tr> </tbody> </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	0																	
		1																	
F	INT/NON	0	Interlace																
		1	Noninterlace																
10	LEVEL0	0	Composite video generation is off.	Refer to Table 5 and 6.															
		1	Composite video generation is on.																
11	LEVEL1	0	Display clock is on (oscillating).																
		1	Display clock is off (not oscillating).																
12	LEVEL2	0	Sync separation is disabled.																
		1	Sync separation is enabled.																
13	TEST24	0	Test mode (Must be cleared to 0.)																
		1																	
14	TEST17	0																	
		1																	
15	TEST18	0																	
		1																	
16	TEST19	0																	
		1																	
17	—	0	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	± 7 /16	Red
0	1	0	27 /16	∓ 5 /16	Green
0	1	1	/16	± /16	Yellow
1	0	0	17 /16	∓ 15 /16	Blue
1	0	1	11 /16	± 11 /16	Magenta
1	1	0	23 /16	∓ 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	± 7 /16	Red-2
0	1	0	27 /16	∓ 5 /16	Green-2
0	1	1	/16	± /16	Yellow
1	0	0	—	—	Gray
1	0	1	/16	± /16	Yellow-2
1	1	0	23 /16	∓ 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	±4 /16	1.9	2.1	2.3	—	1.0	—
Black	—	—	2.1	2.3	2.5	—	—	—
Red	7 /16 ± 2 /16	± 7 /16 ± 2 /16	2.3	2.5	2.7	1.5	3.0	4.5
Green	27 /16 ± 2 /16	∓ 5 /16 ± 2 /16	2.7	2.9	3.1	1.4	2.8	4.2
Yellow	/16 ± 2 /16	± /16 ± 2 /16	3.1	3.3	3.5	1.0	2.0	3.0
Blue	17 /16 ± 2 /16	∓ 15 /16 ± 2 /16	2.0	2.2	2.4	1.0	2.0	3.0
Magenta	11 /16 ± 2 /16	± 11 /16 ± 2 /16	2.5	2.7	2.9	1.4	2.8	4.2
Cyan	23 /16 ± 2 /16	∓ 9 /16 ± 2 /16	2.9	3.1	3.3	1.5	3.0	4.5
White	—	—	3.1	3.3	3.5	—	—	—

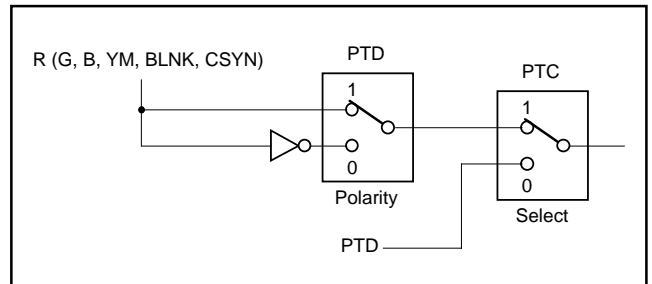


Fig. 2 Switching port output with R, G and B output

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

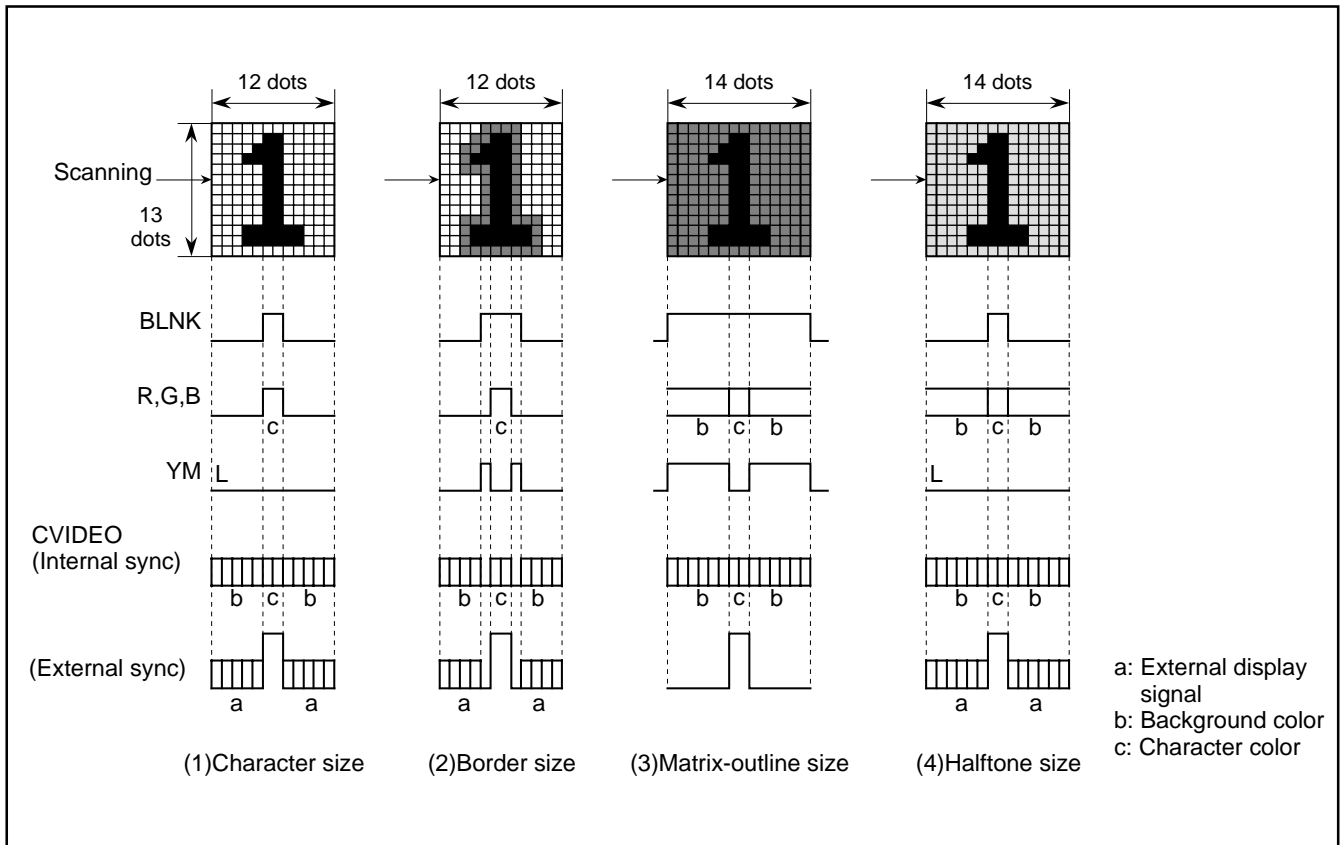


Fig. 3 Display forms at each display mode



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 FF<sub>16</sub>.

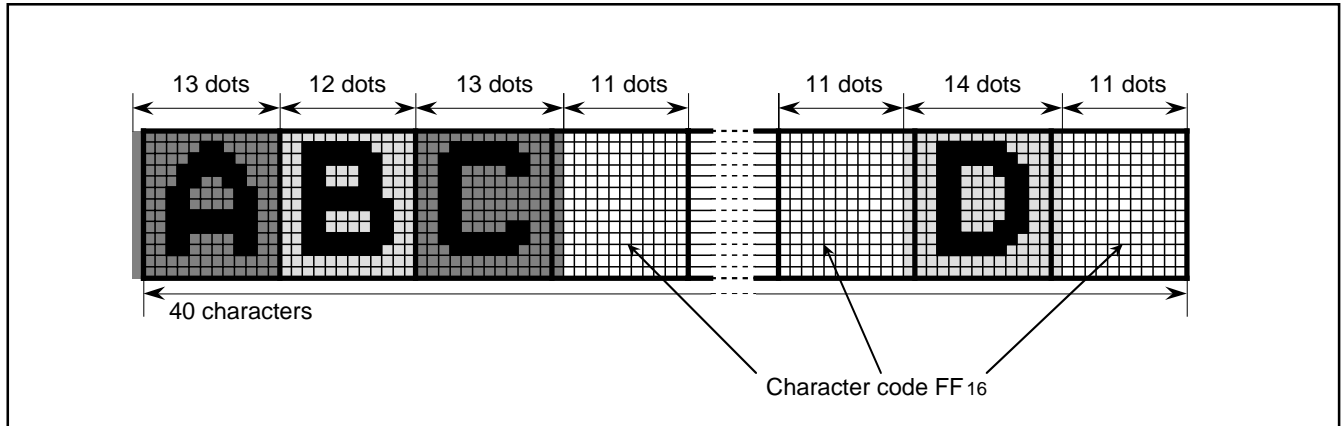


Fig. 4 Number of dots in the horizontal direction at matrix-outline or halftone

**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 2B0<sub>16</sub>) is set to 1. Table 10 lists the types of borders.

Table 10 Bordering

SRAND2 (Address 2AF <sub>16</sub> )	SRAND1, 0	00	01	10	11
0	The zero dot →				
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.

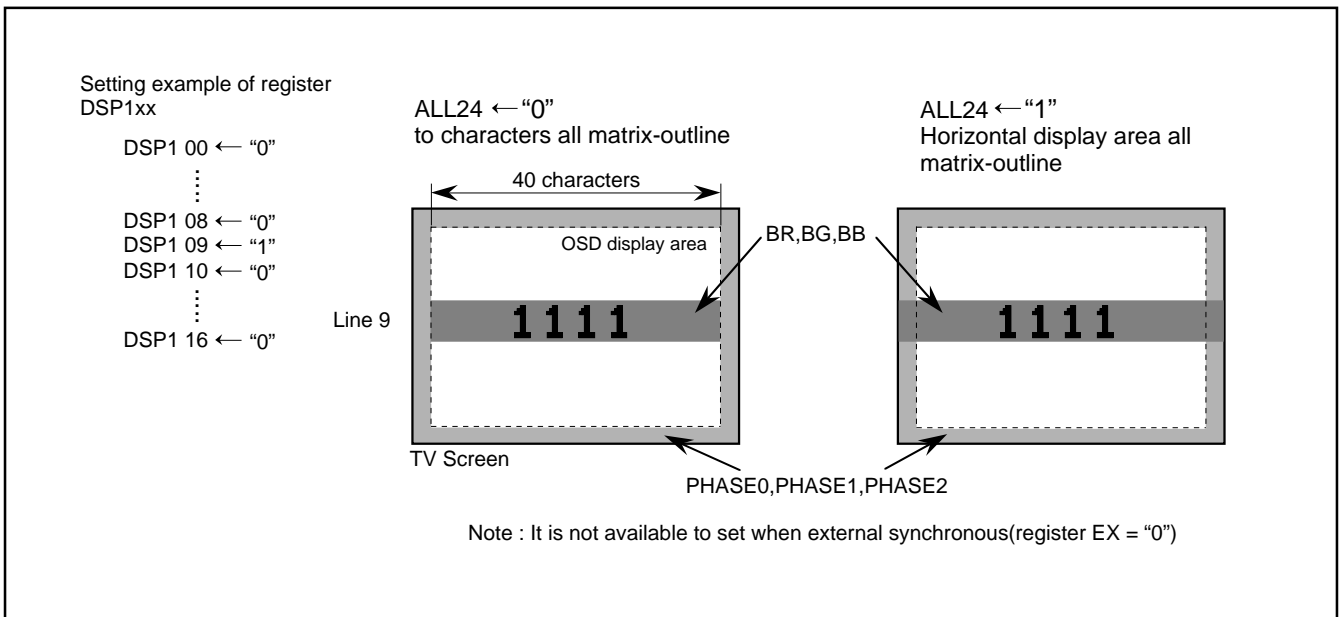


Fig. 5 Setting example all matrix-outline area

**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.

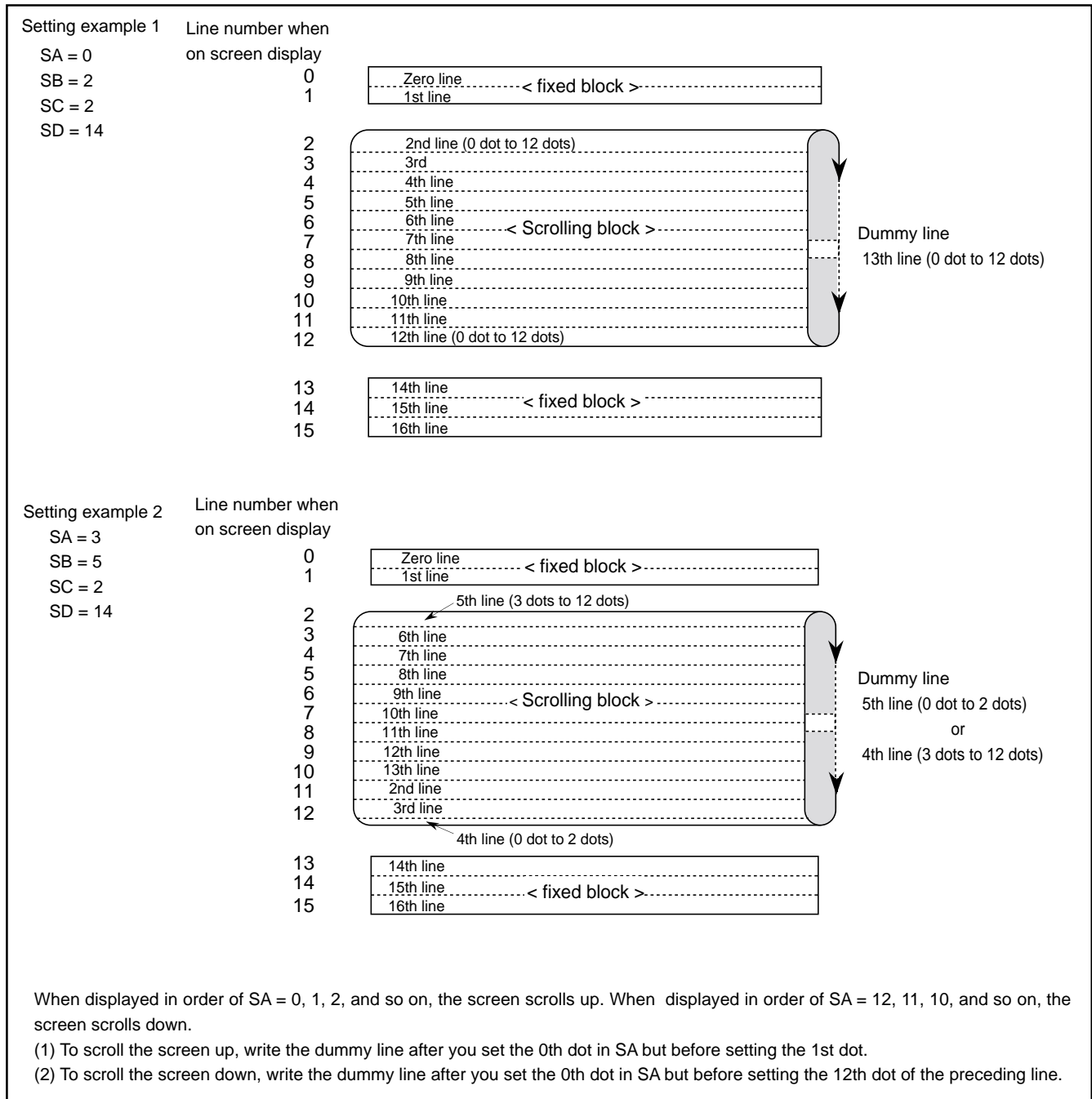


Fig. 6 Scrolling example

**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.

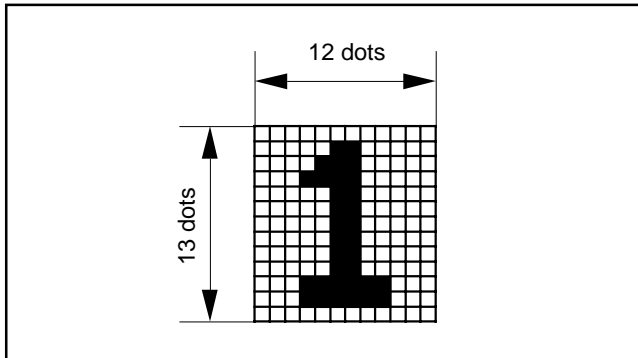


Fig. 7 Character construction

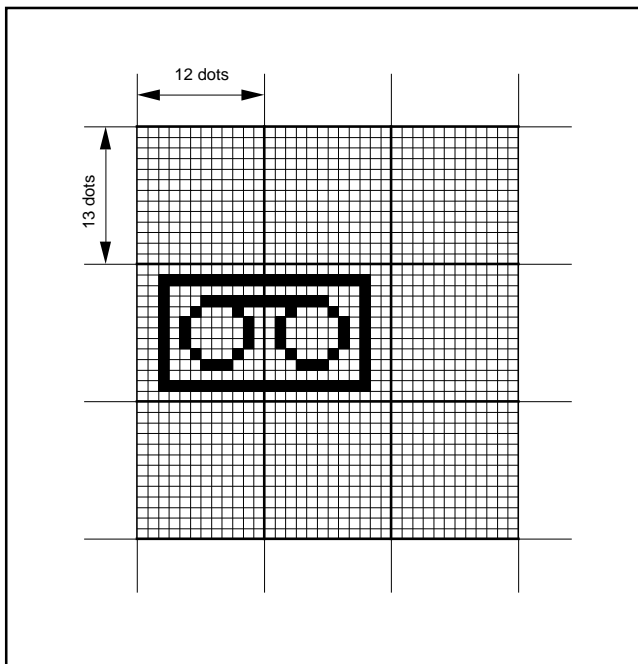
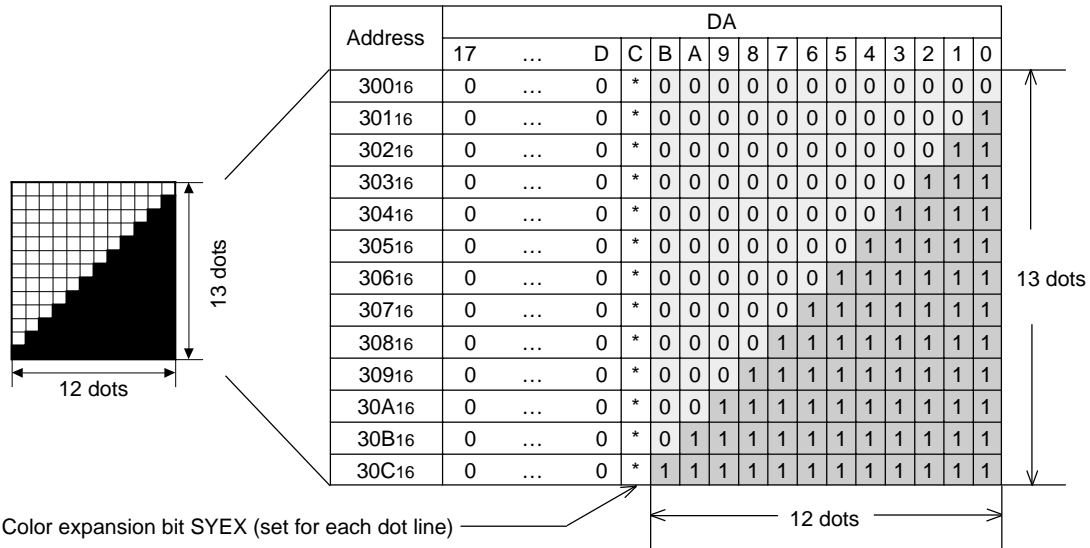


Fig. 8 Example for displaying a continuous pattern

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



Color expansion bit SYEX (set for each dot line)  
 The HIDE register (address 2AA16) becomes valid for only the dot line where \* = 1.  
 For details, refer to the next section, "(3) Compounding character ROM and SYRAM."

1 bit: 1 dot of character

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.

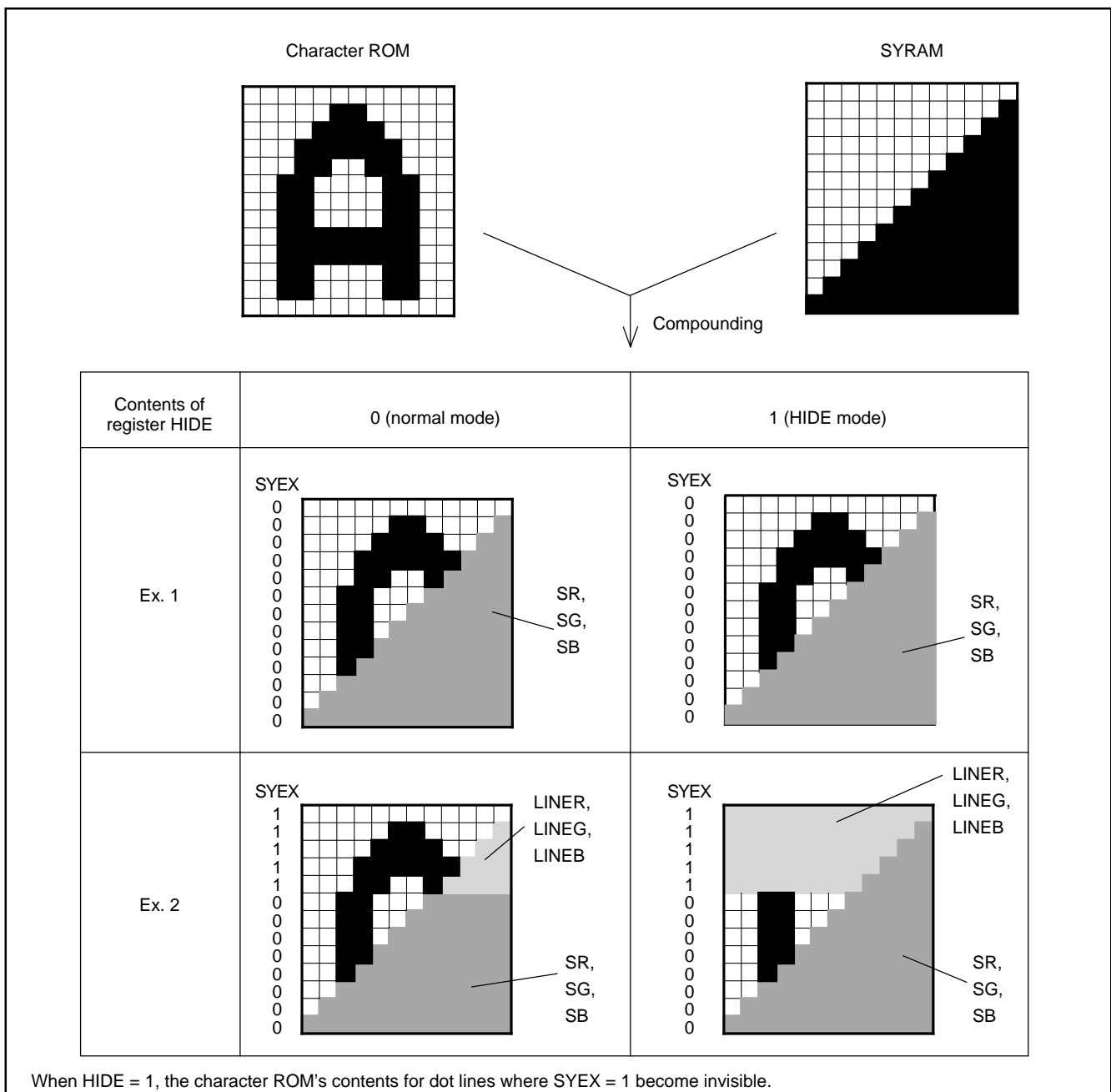


Fig. 10 Compounding example

# M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

## EXAMPLE FOR DATA INPUT

Use an 8-bit parallel X 3 serial input to set data in the display RAM, display control register, and SYRAM. Table 14 lists an example of how data is set.

**Table 14 Data setting**

No.	Contents		DA																			
	Address/data	Remarks	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
1	Address (2B016)	Address setting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
2	Data (2B016)	Display OFF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
3	Data (30016)	Set addresses SYRAM 30016 to 6EC16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
4	Data (30116)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮			
822	Data (6EC16)	Set address	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
823	Address (00016)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
824	Data (00016)	Set registers address display RAM 00016 to 2A716	SB	SG	SR	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC		
825	Data (00116)		SB	SG	SR	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮		
1503	Data (2A716)	Set registers address 2A816 to 2AF16	SB	SG	SR	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	SYC	
1504	Data (2A816)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1505	Data (2A916)		0	0	0	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK	BLINK
1506	Data (2AA16)		0	0	0	0	EQP	0	0	HIDE	0	0	0	0	0	0	0	0	0	0	0	0
1507	Data (2AB16)		0	0	0	0	0	0	0	PHASE	PHASE	PHASE	PHASE	PHASE	PHASE	PHASE	PHASE	PHASE	PHASE	PHASE	PHASE	PHASE
1508	Data (2AC16)		0	0	0	0	0	0	0	LINE	LINE	LINE	LINE	LINE	LINE	LINE	LINE	LINE	LINE	LINE	LINE	LINE
1509	Data (2AD16)		0	0	0	0	0	0	0	SERS	SERS	SERS	SERS	SERS	SERS	SERS	SERS	SERS	SERS	SERS	SERS	SERS
1510	Data (2AE16)		0	0	0	0	0	0	0	SEND	SEND	SEND	SEND	SEND	SEND	SEND	SEND	SEND	SEND	SEND	SEND	SEND
1511	Data (2AF16)		PC7	PC6	PC5	PC4	PC3	PC2	PC1	PC0	ALL24	SRAND	SRAND	SRAND	SRAND	SRAND	SRAND	SRAND	SRAND	SRAND	SRAND	SRAND
1512	Data (2B016)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

**SERIAL DATA INPUT TIMING**

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

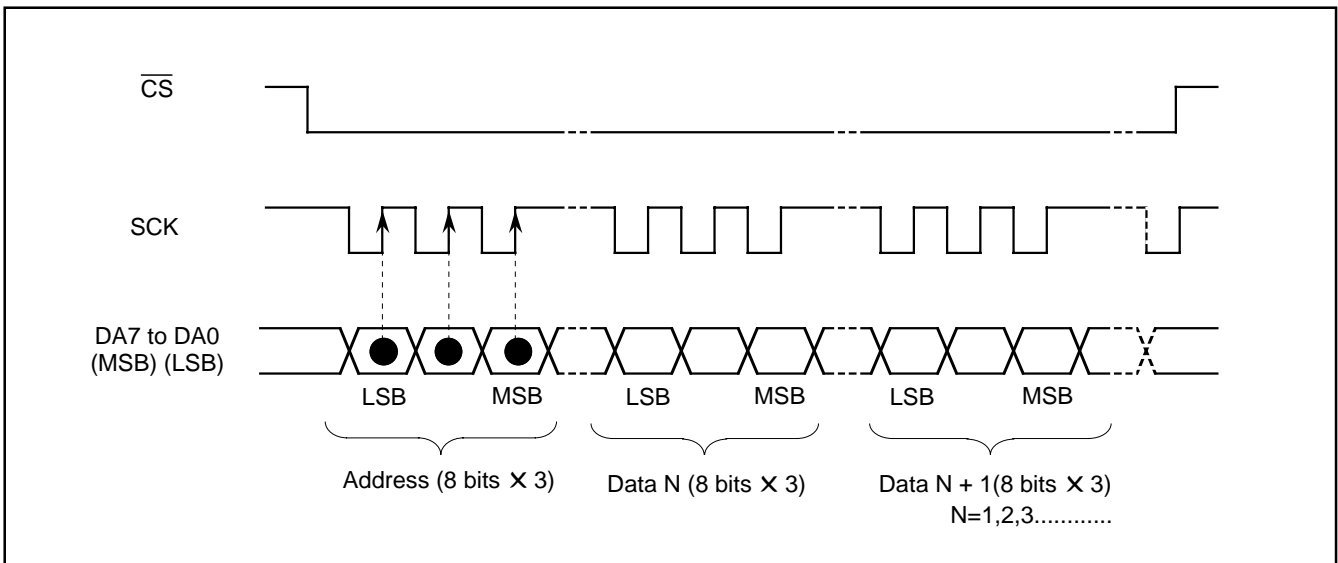


Fig. 11 Serial input timing



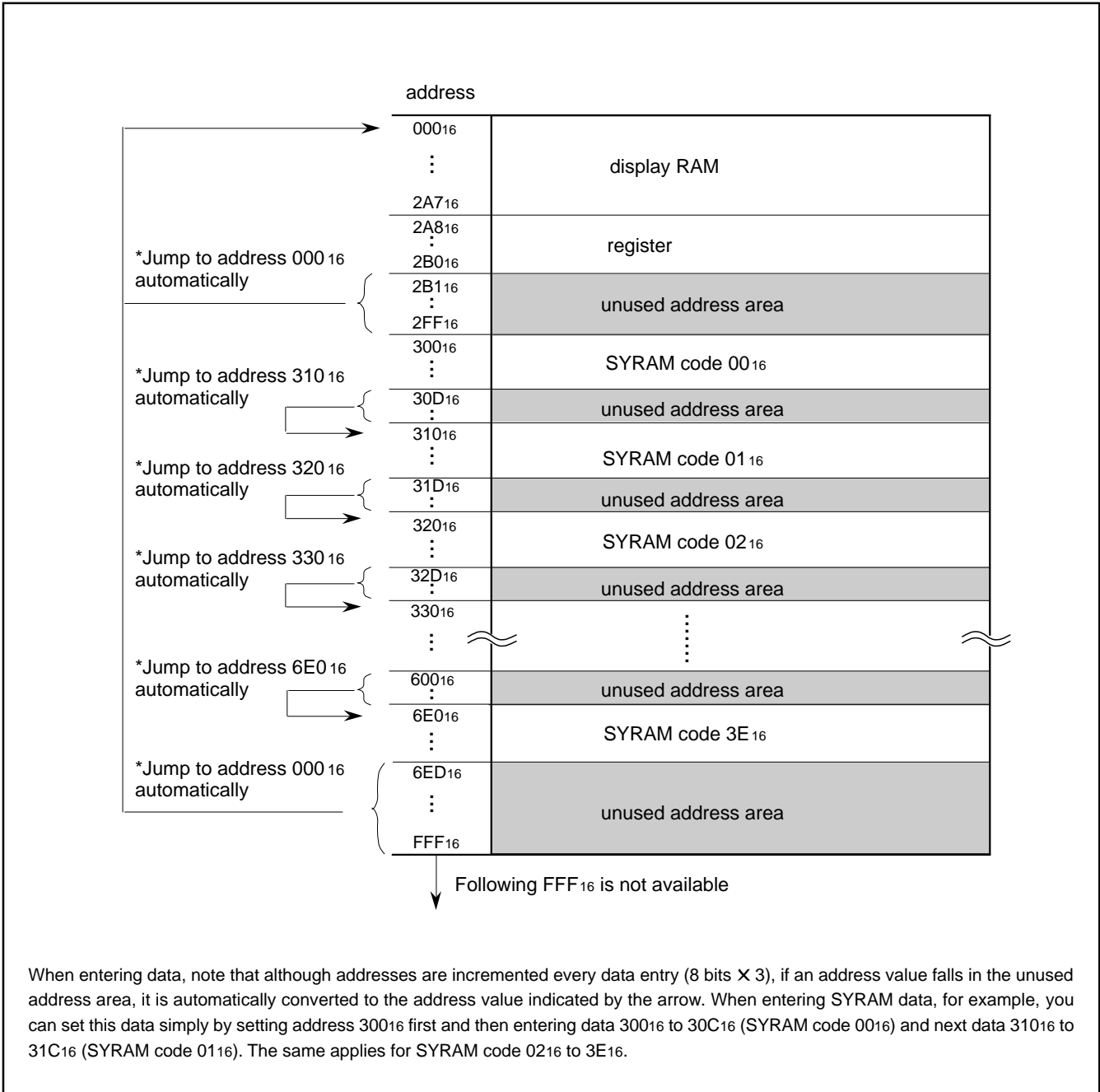


Fig. 12 Address construction

M35060-XXXSP PERIPHERAL CIRCUIT

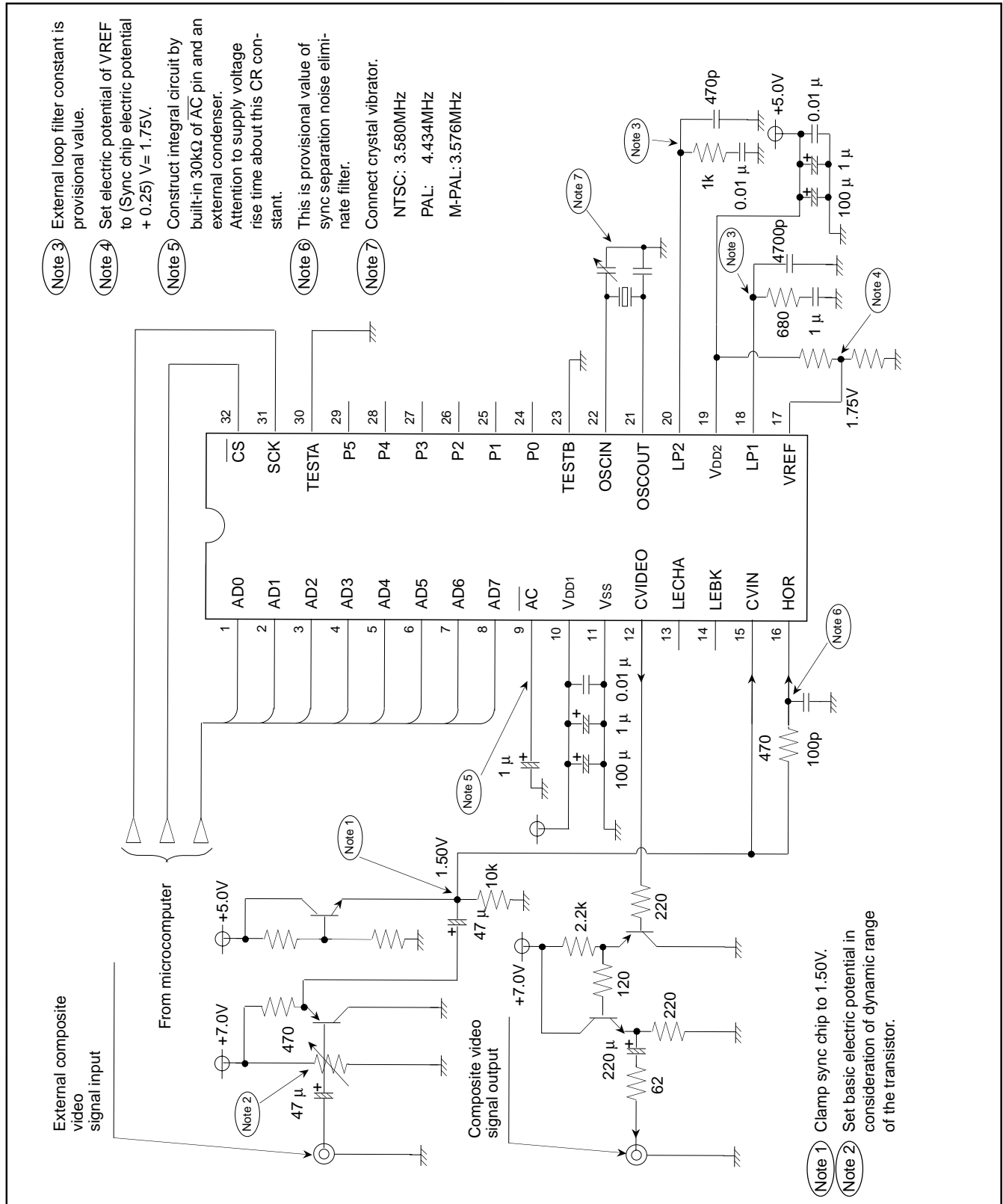


Fig.13 M35060-XXXSP example of peripheral circuit

**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.	
$t_w$ (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
$t_{su}$ (AD)	AD setup time	200	—	—	ns
$t_h$ (AD)	AD hold time	200	—	—	ns
$t_h$ (SCK)	1 word hold time	2	—	—	ms

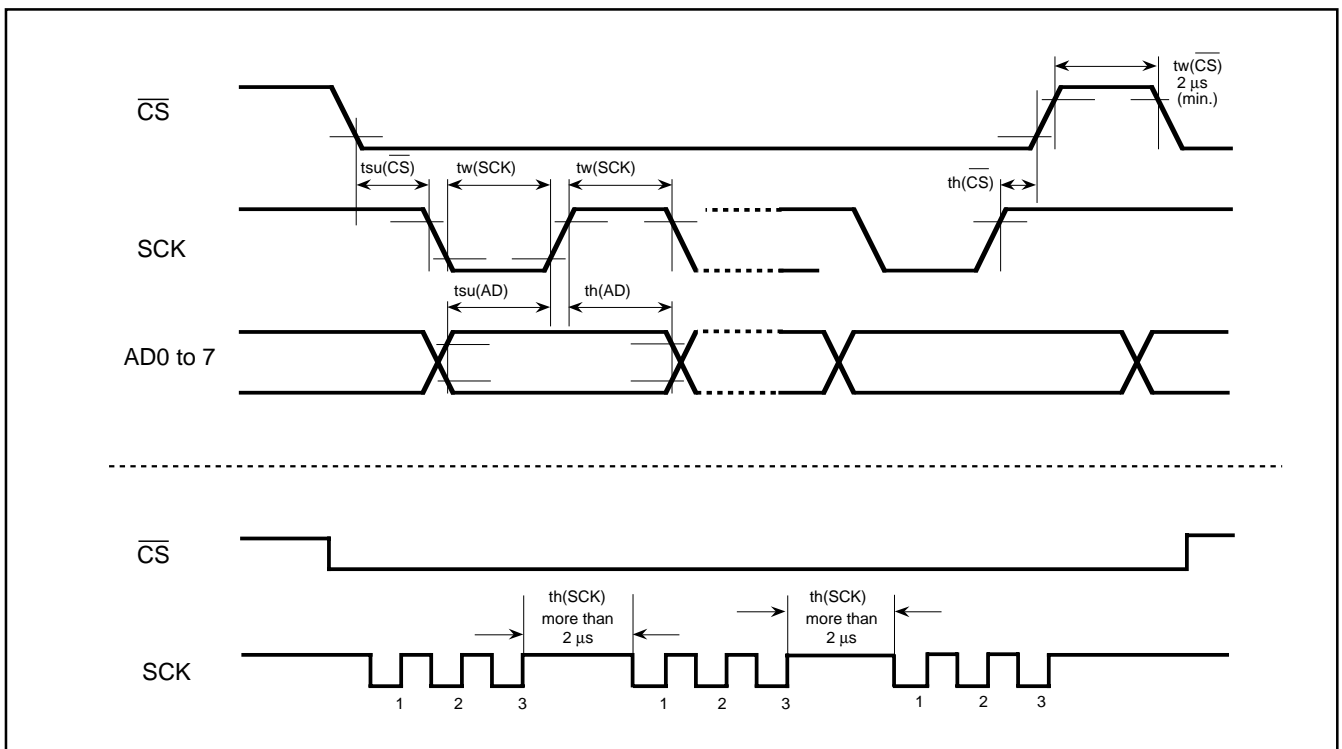


Fig. 14 Serial input timing requirements

**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<sub>DD</sub> = 5.00V, T<sub>a</sub> = - 20°C to +70°C unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V <sub>DD</sub>	Supply voltage	With respect to V <sub>SS</sub> .	- 0.3 to 6.0	V
V <sub>I</sub>	Input voltage		V <sub>SS</sub> - 0.3 < V <sub>I</sub> < V <sub>DD</sub> +0.3	V
V <sub>O</sub>	Output voltage		V <sub>SS</sub> < V <sub>O</sub> < V <sub>DD</sub>	V
P <sub>d</sub>	Power dissipation	T <sub>a</sub> = 25°C	300	mW
T <sub>opr</sub>	Operating temperature		- 20 to 70	°C
T <sub>stg</sub>	Storage temperature		- 40 to 125	°C

### RECOMMENDED OPERATIONAL CONDITIONS (V<sub>DD</sub> = 5.00V, T<sub>a</sub> = - 20°C to +70°C unless otherwise noted)

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

### ELECTRICAL CHARACTERISTICS (V<sub>DD</sub> = 5.00V, T<sub>a</sub> = +25°C unless otherwise noted)

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

### VIDEO SIGNAL INPUT CONDITIONS (V<sub>DD</sub> = 5V, T<sub>a</sub> = - 20°C to +70°C)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
V <sub>IN-CU</sub>	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.

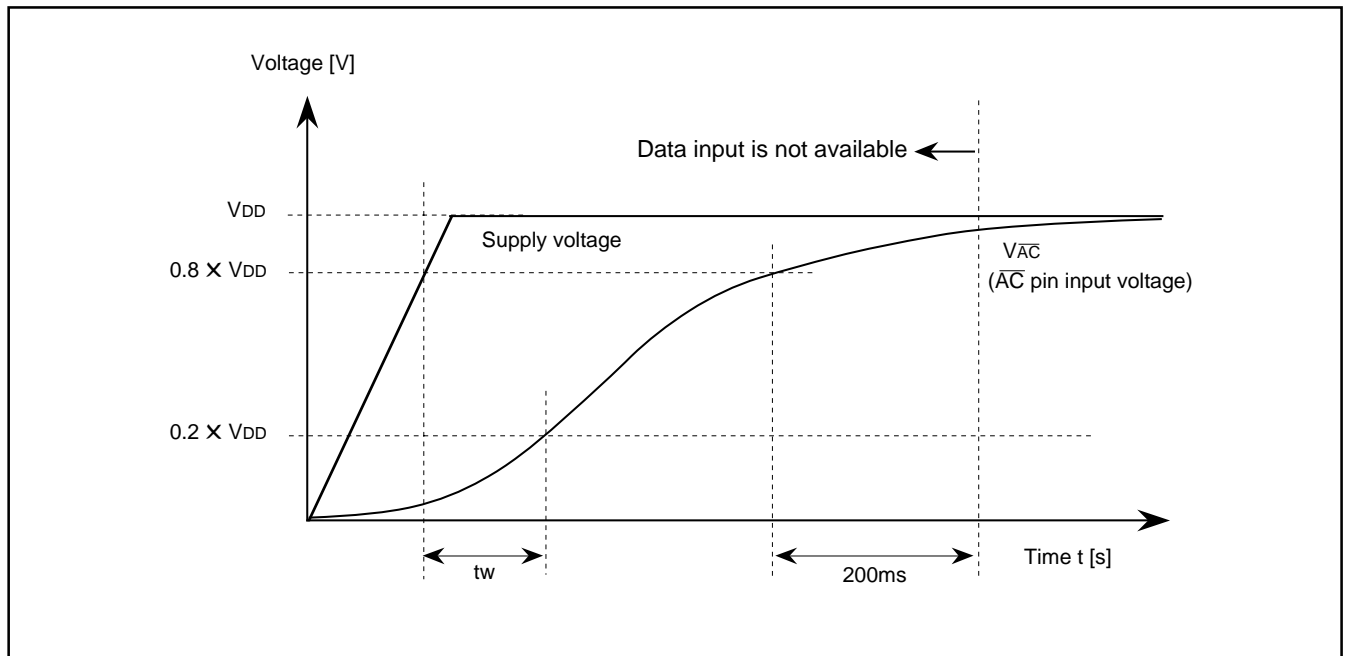


Fig. 15 Timing of power supplying to  $\overline{AC}$  pin

**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.

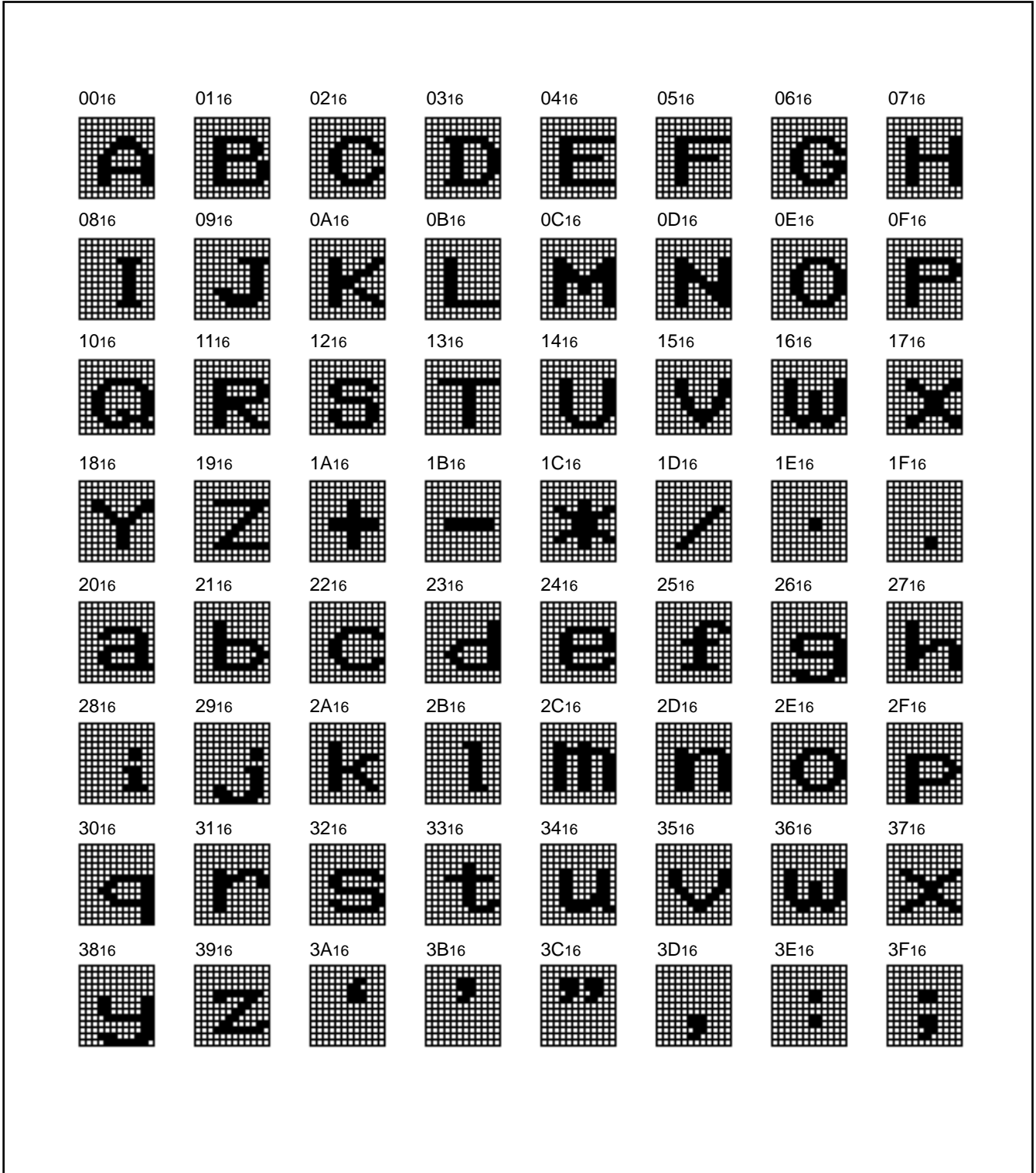


Fig. 16 M35060-001SP character patterns (1)

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

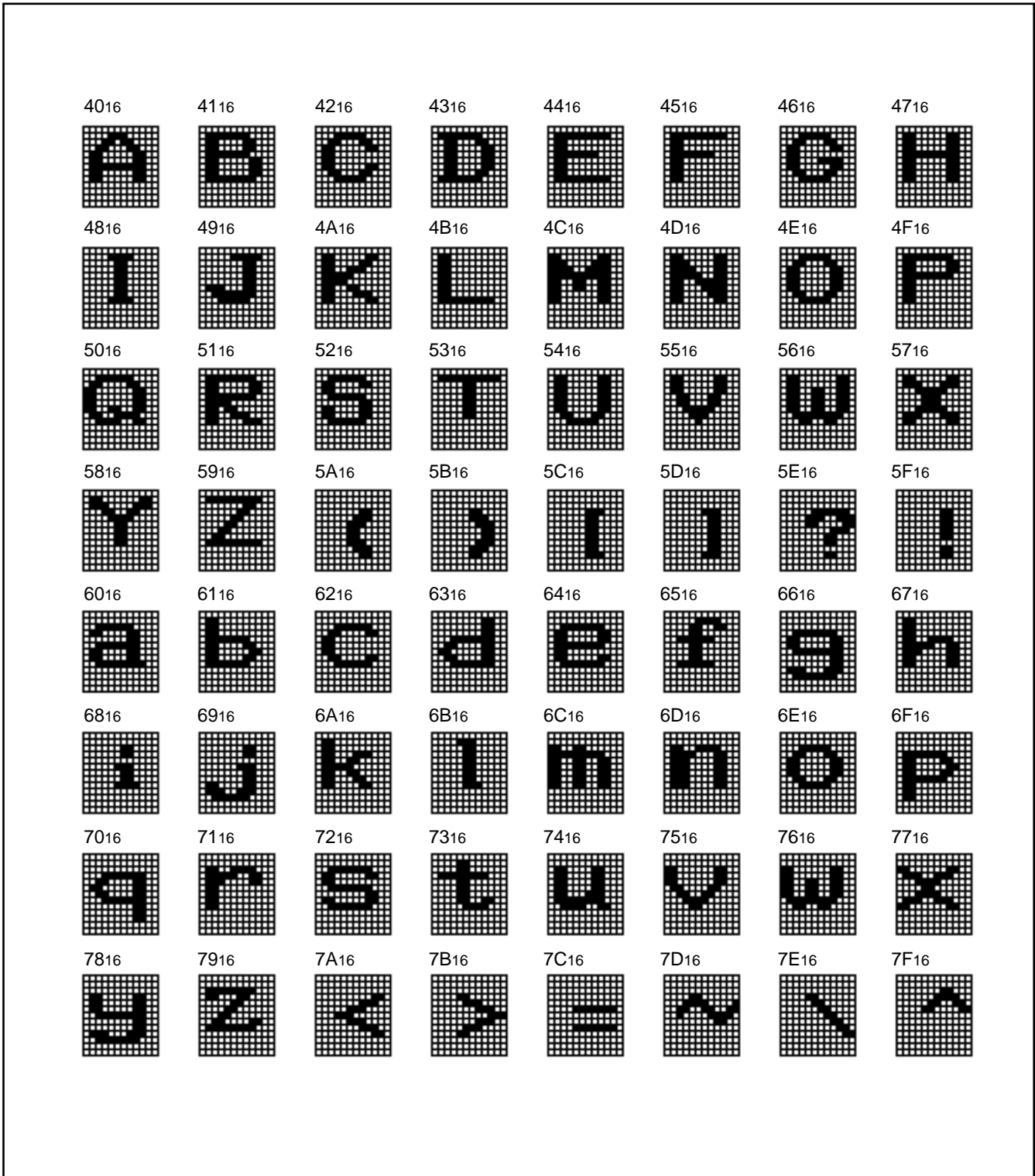


Fig. 17 M35060-001SP character patterns (2)



# M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

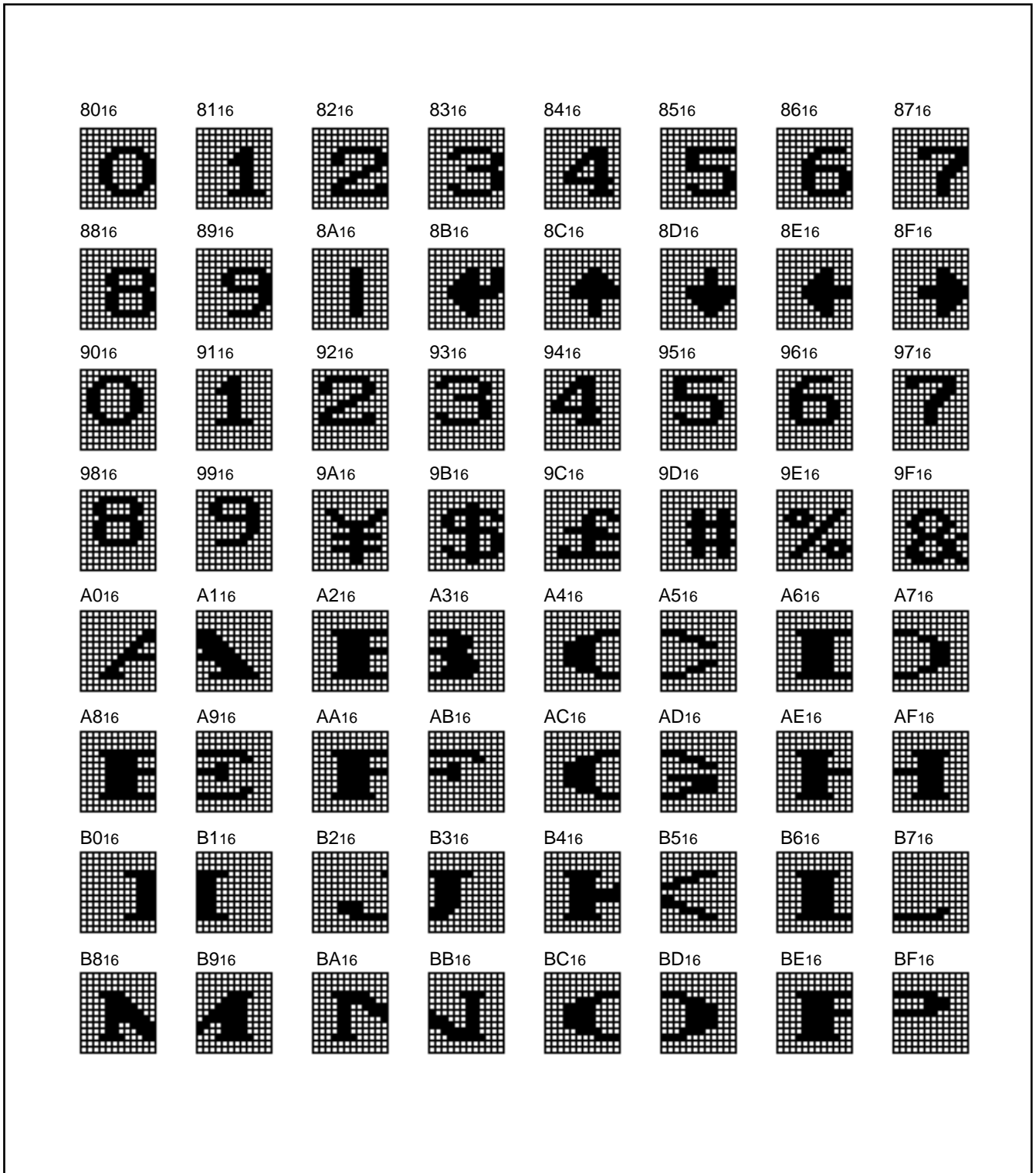


Fig. 18 M35060-001SP character patterns (3)

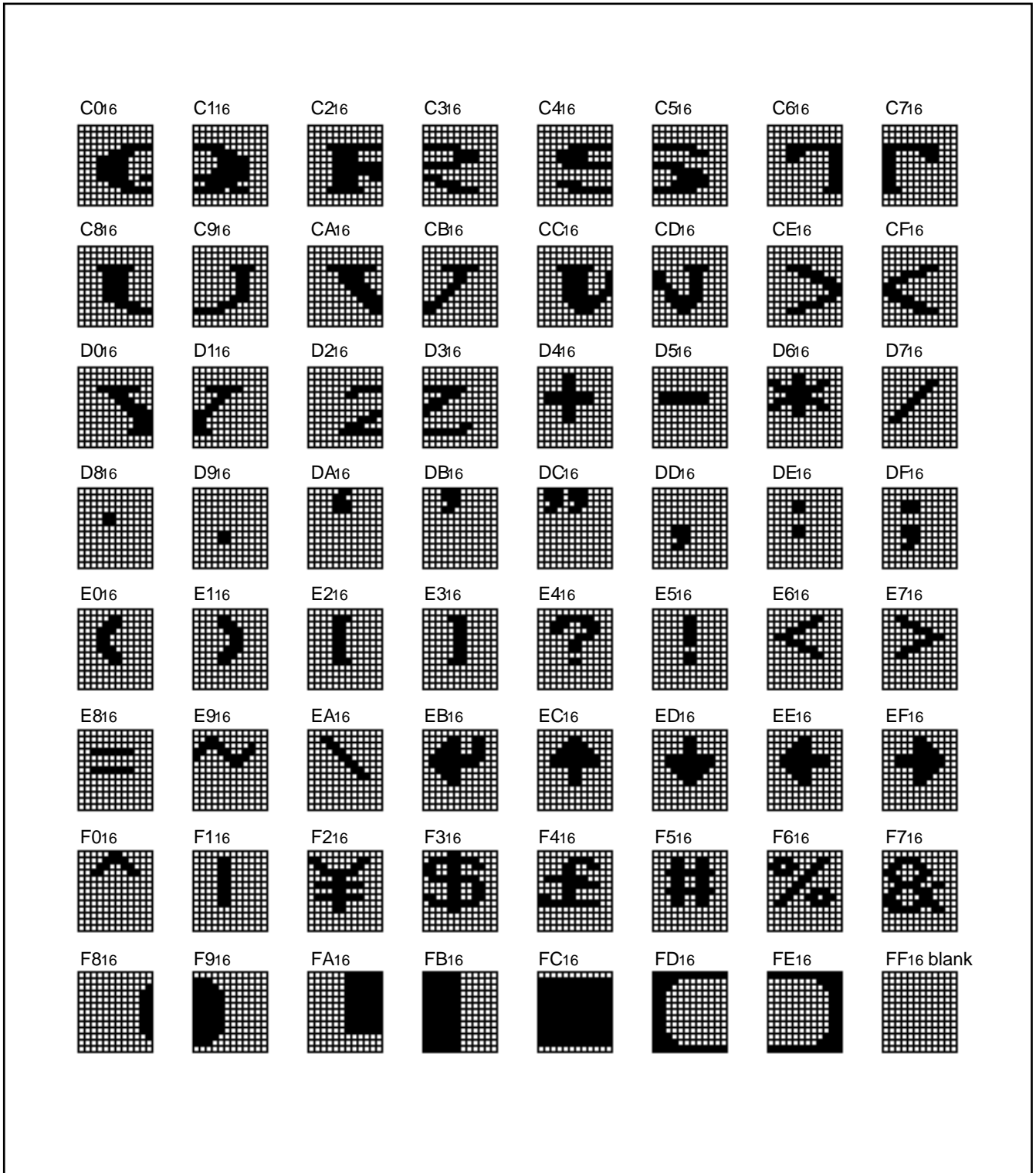


Fig. 19 M35060-001SP character patterns (4)

# M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

## 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.

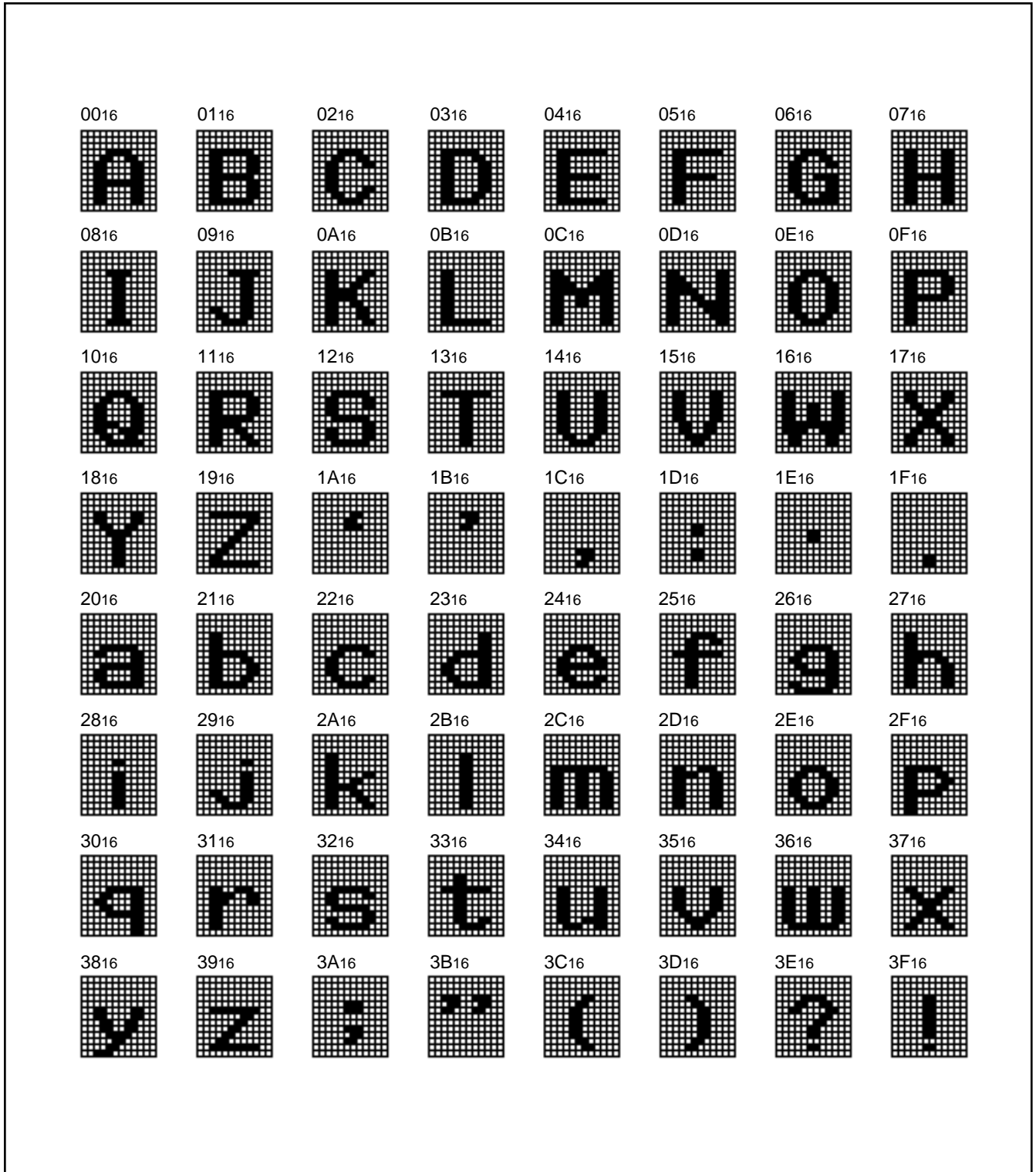


Fig. 20 M35060-002SP character patterns (1)

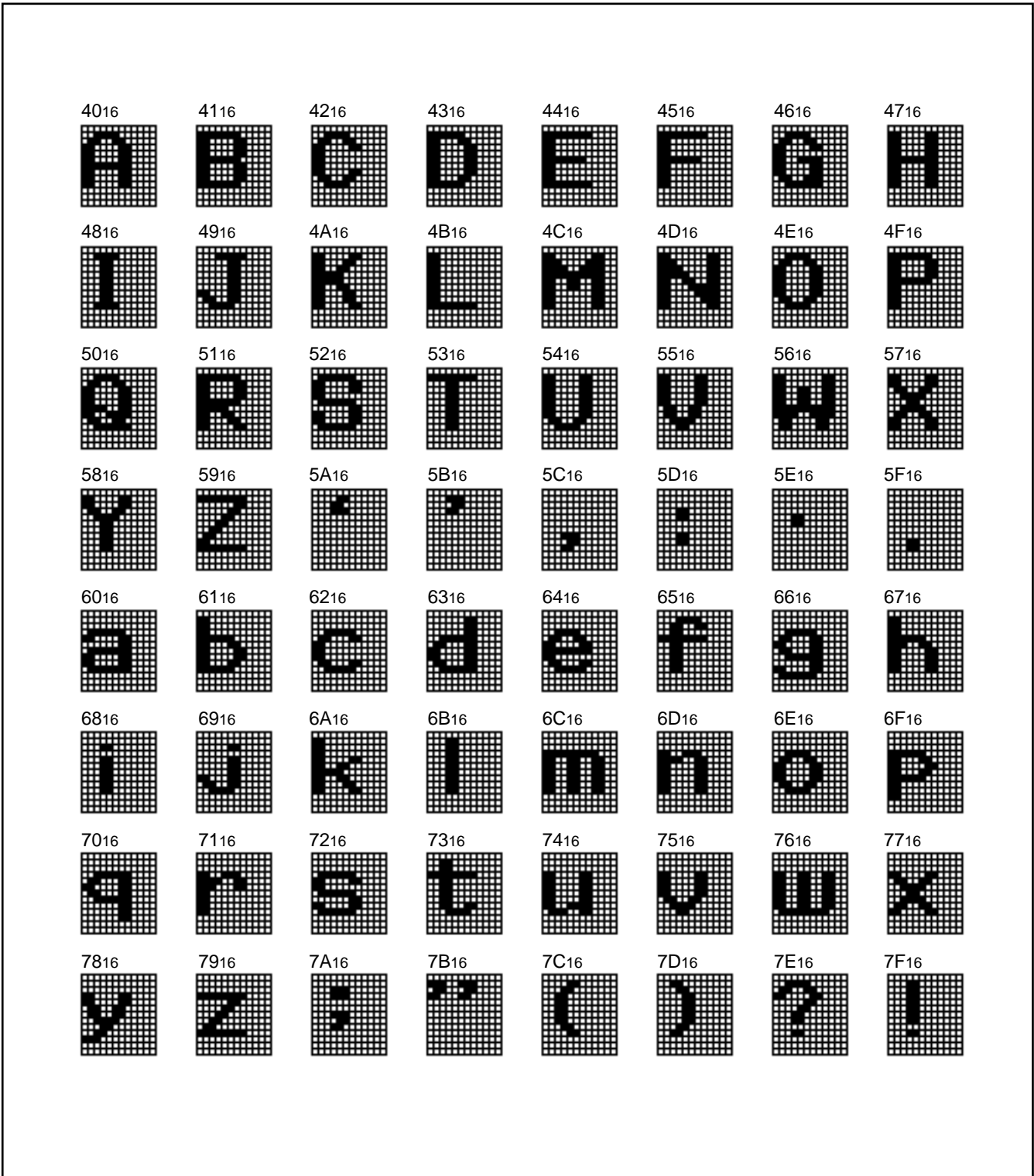


Fig. 21 M35060-002SP character patterns (2)

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

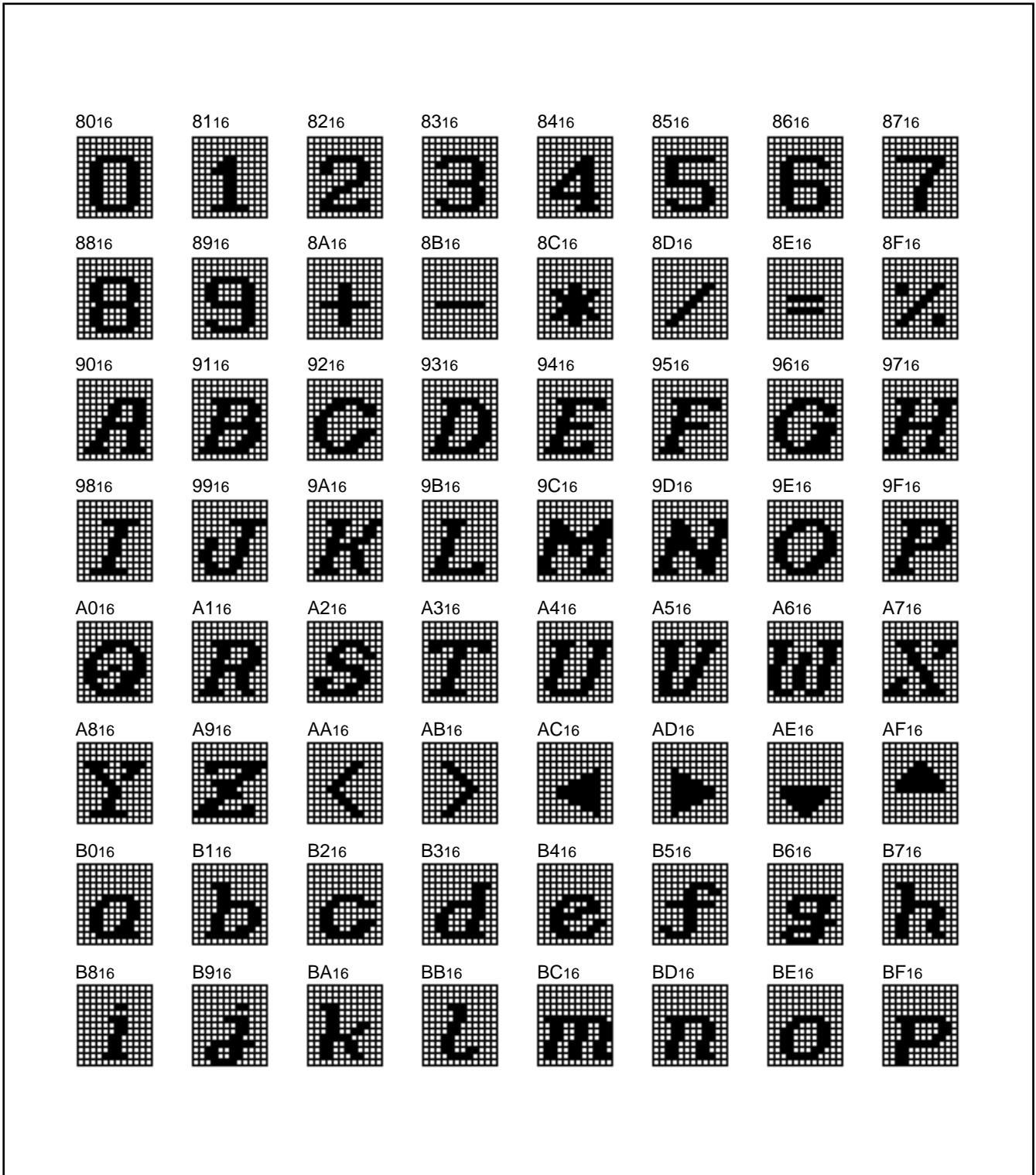


Fig. 22 M35060-002SP character patterns (3)

M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

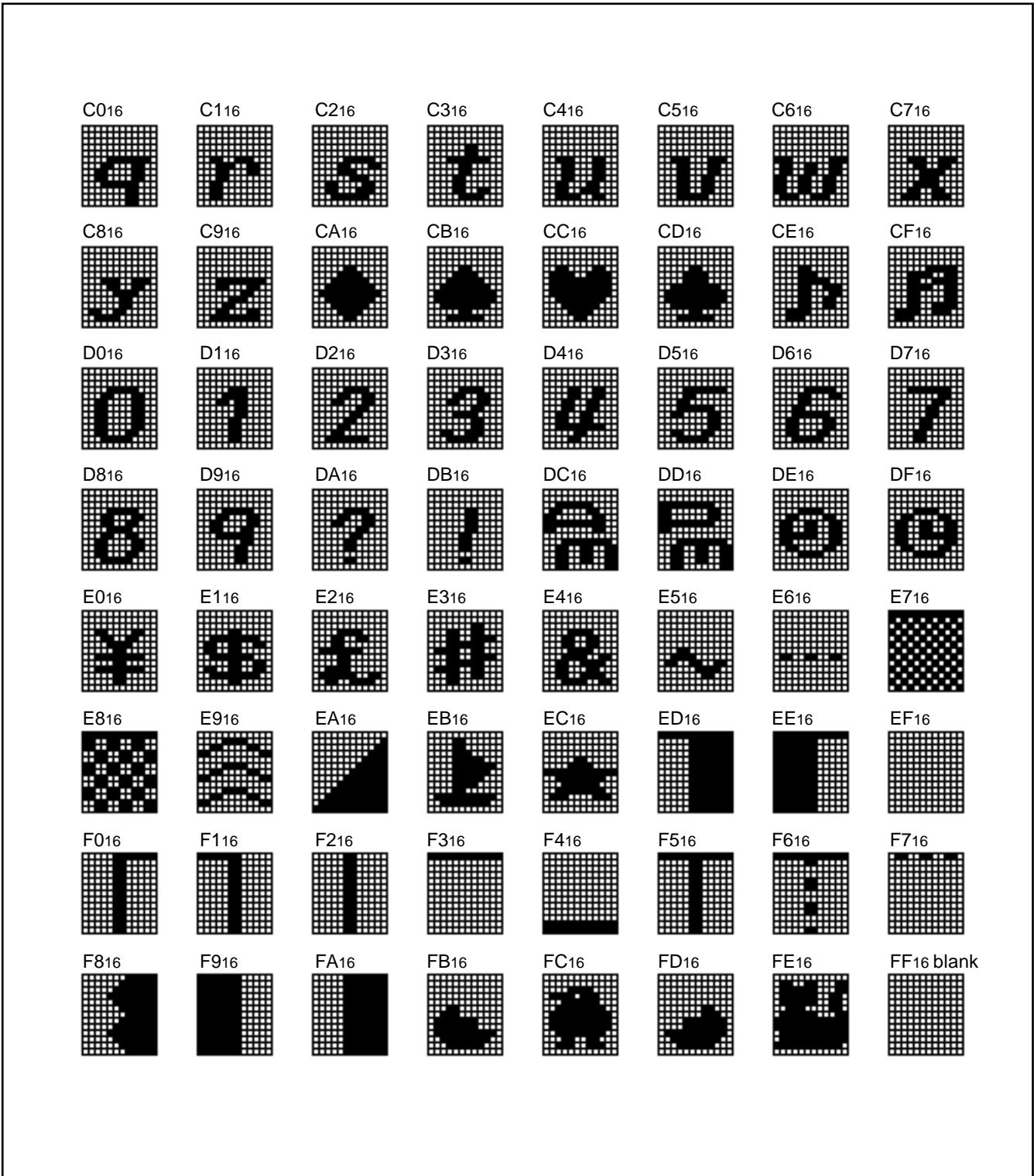


Fig. 23 M35060-002SP character patterns (4)

# M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

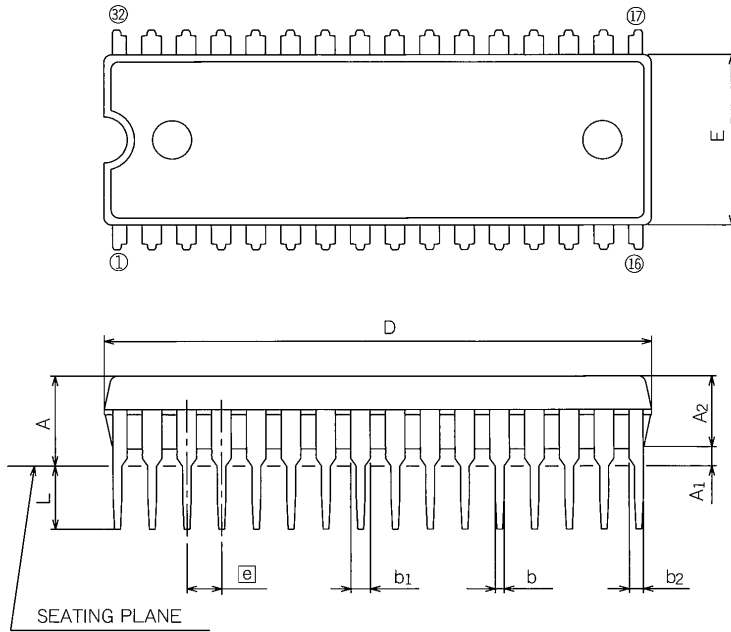
## PACKAGE OUTLINE

### 32P4B

Plastic 32pin 400mil SDIP

EIAJ Package Code	JEDEC Code	Weight (g)	Lead Material
SDIP32-P-400-1.78	—	2.2	Alloy 42/Cu Alloy

Scale : 2.5/1



Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	—	—	5.08
A1	0.51	—	—
A2	—	3.8	—
b	0.35	0.45	0.55
b1	0.9	1.0	1.3
b2	0.63	0.73	1.03
c	0.22	0.27	0.34
D	27.8	28.0	28.2
E	8.75	8.9	9.05
e	—	1.778	—
e1	—	10.16	—
L	3.0	—	—
θ	0°	—	15°

# Renesas Technology Corp.

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REVISION DESCRIPTION LIST

M35060-XXXSP DATA SHEET

Rev. No.	Revision Description	Rev. date				
1.0	First Edition	9804				
1.1	<ul style="list-style-type: none"> <li>• Deletes some Japanese font and create pdf file (some pages)</li> <li>• P39 and P40 MARK SPECIFICATION FORM and PACKAGE OUTLINE are added</li> </ul>	0007				
1.2	<p>Delete MARK SPECIFICATION FORM</p> <ul style="list-style-type: none"> <li>• 1 FEATURES</li> </ul> <table border="1" style="margin-left: 40px;"> <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	<p>P1 The following note is added                      Note: Superimpose black and white display. (NTSC, PAL, M-PAL)</p> <p>P35 Fig 20 M35060-002SP character patterns(1)                      Address 00<sub>16</sub>, 01<sub>16</sub> ..... 3E<sub>16</sub>, 3F<sub>16</sub> are added</p> <p>P36 Fig 21 M35060-002SP character patterns(2)                      Address 40<sub>16</sub>, 41<sub>16</sub> ..... 7E<sub>16</sub>, 7F<sub>16</sub> are added</p> <p>P37 Fig 22 M35060-002SP character patterns(3)                      Address 80<sub>16</sub>, 81<sub>16</sub> ..... BE<sub>16</sub>, BF<sub>16</sub> are added</p> <p>P38 Fig 23 M35060-002SP character patterns(4)                      Address C0<sub>16</sub>, C1<sub>16</sub> ..... FE<sub>16</sub>, FF<sub>16</sub> are added</p>	0110				