

MITSUBISHI MICROCOMPUTERS M35060-XXXSP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

DESCRIPTION

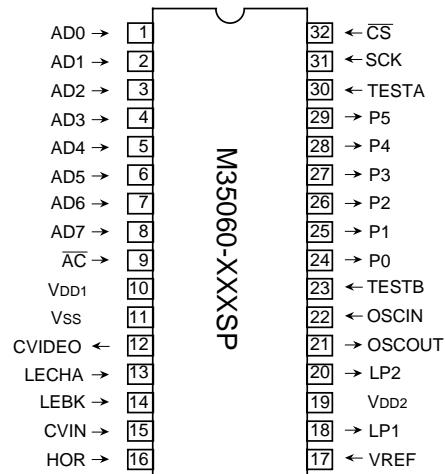
M35060-XXXSP is CATV screen display control IC which can display 40 (horizontal) X 16 (vertical). It has built-in SYRAM which can be used with character ROM.

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 versions of M35060-XXXSP, the character patterns are also mentioned.

FEATURES

- Screen composition 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

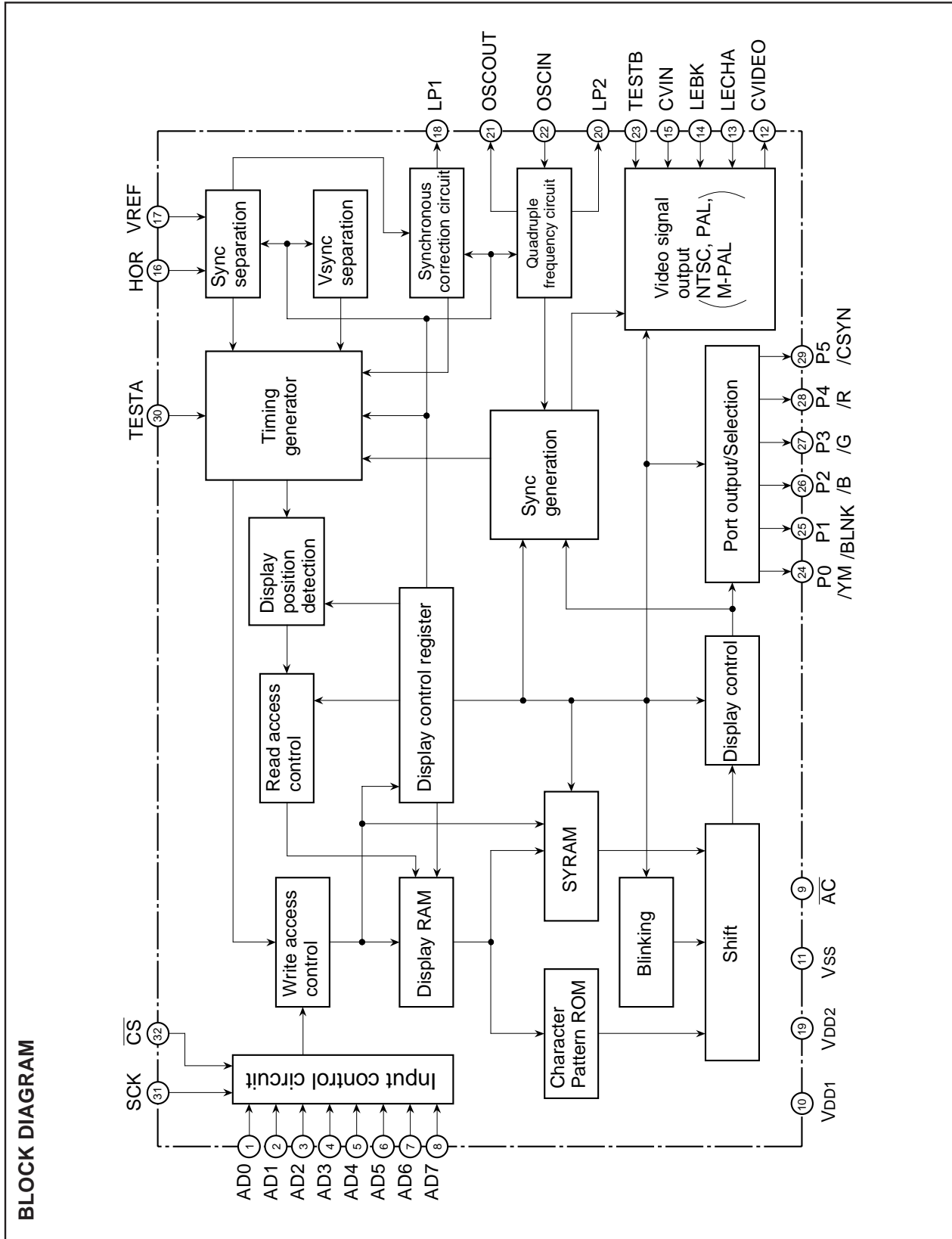
PIN CONFIGURATION (TOP VIEW)



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 \overline{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.
\overline{CS}	Chip select input	Input	This is chip selection input pin. When this pin is "L", transmission is enabled. This pin is hysteresis input.



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 6E_{C16} 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

address	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
⋮	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	SEP _{V1}	SEP _{V0}	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

address	DA17 ~ DAD	DAC	DAB	DAA	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0	SYRAM code
300 ₁₆	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	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	
⋮	⋮	⋮	⋮											⋮	
6D0 ₁₆	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	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	

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

SCREEN CONSTITUTION

The screen lines and rows are determined from each address of the display RAM.

The screen constitution is shown in Figure 1.

Line 0	000	001	002	003	004	005	006	007	008	009	00A	00B	00C	00D	00E	00F	010	011	012	013	014	015	016	017	018	019	01A	01B	01C	01D	01E	01F	020	021	022	023	024	025	026	027
Line 1	028	029	02A	02B	02C	02D	02E	02F	030	031	032	033	034	035	036	037	038	039	03A	03B	03C	03D	03E	03F	040	041	042	043	044	045	046	047	048	049	04A	04B	04C	04D	04E	04F
	050	051	052	053	054	055	056	057	058	059	05A	05B	05C	05D	05E	05F	060	061	062	063	064	065	066	067	068	069	06A	06B	06C	06D	06E	06F	070	071	072	073	074	075	076	077
	078	079	07A	07B	07C	07D	07E	07F	080	081	082	083	084	085	086	087	088	089	08A	08B	08C	08D	08E	08F	090	091	092	093	094	095	096	097	098	099	09A	09B	09C	09D	09E	09F
	0A0	0A1	0A2	0A3	0A4	0A5	0A6	0A7	0A8	0A9	0AA	0AB	0AC	0AD	0AE	0AF	0B0	0B1	0B2	0B3	0B4	0B5	0B6	0B7	0B8	0B9	0BA	0BB	0BC	0BD	0BE	0BF	0C0	0C1	0C2	0C3	0C4	0C5	0C6	0C7
	0C8	0C9	0CA	0CB	0CC	0CD	0CE	0CF	0D0	0D1	0D2	0D3	0D4	0D5	0D6	0D7	0D8	0D9	0DA	0DB	0DC	0DD	0DE	0DF	0E0	0E1	0E2	0E3	0E4	0E5	0E6	0E7	0E8	0E9	0EA	0EB	0EC	0ED	0EE	0EF
	0F0	0F1	0F2	0F3	0F4	0F5	0F6	0F7	0F8	0F9	0FA	0FB	0FC	0FD	0FE	0FF	100	101	102	103	104	105	106	107	108	109	10A	10B	10C	10D	10E	10F	110	111	112	113	114	115	116	117
	118	119	11A	11B	11C	11D	11E	11F	120	121	122	123	124	125	126	127	128	129	12A	12B	12C	12D	12E	12F	130	131	132	133	134	135	136	137	138	139	13A	13B	13C	13D	13E	13F
	140	141	142	143	144	145	146	147	148	149	14A	14B	14C	14D	14E	14F	150	151	152	153	154	155	156	157	158	159	15A	15B	15C	15D	15E	15F	160	161	162	163	164	165	166	167
	168	169	16A	16B	16C	16D	16E	16F	170	171	172	173	174	175	176	177	178	179	17A	17B	17C	17D	17E	17F	180	181	182	183	184	185	186	187	188	189	18A	18B	18C	18D	18E	18F
	190	191	192	193	194	195	196	197	198	199	19A	19B	19C	19D	19E	19F	1A0	1A1	1A2	1A3	1A4	1A5	1A6	1A7	1A8	1A9	1AA	1AB	1AC	1AD	1AE	1AF	1B0	1B1	1B2	1B3	1B4	1B5	1B6	1B7
	1B8	1B9	1BA	1BB	1BC	1BD	1BE	1BF	1C0	1C1	1C2	1C3	1C4	1C5	1C6	1C7	1C8	1C9	1CA	1CB	1CC	1CD	1CE	1CF	1D0	1D1	1D2	1D3	1D4	1D5	1D6	1D7	1D8	1D9	1DA	1DB	1DC	1DD	1DE	1DF
	1E0	1E1	1E2	1E3	1E4	1E5	1E6	1E7	1E8	1E9	1EA	1EB	1EC	1ED	1EE	1EF	1F0	1F1	1F2	1F3	1F4	1F5	1F6	1F7	1F8	1F9	1FA	1FB	1FC	1FD	1FE	1FF	200	201	202	203	204	205	206	207
	208	209	20A	20B	20C	20D	20E	20F	210	211	212	213	214	215	216	217	218	219	21A	21B	21C	21D	21E	21F	220	221	222	223	224	225	226	227	228	229	22A	22B	22C	22D	22E	22F
	230	231	232	233	234	235	236	237	238	239	23A	23B	23C	23D	23E	23F	240	241	242	243	244	245	246	247	248	249	24A	24B	24C	24D	24E	24F	250	251	252	253	254	255	256	257
	258	259	25A	25B	25C	25D	25E	25F	260	261	262	263	264	265	266	267	268	269	26A	26B	26C	26D	26E	26F	270	271	272	273	274	275	276	277	278	279	27A	27B	27C	27D	27E	27F
	280	281	282	283	284	285	286	287	288	289	28A	28B	28C	28D	28E	28F	290	291	292	293	294	295	296	297	298	299	29A	29B	29C	29D	29E	29F	2A0	2A1	2A2	2A3	2A4	2A5	2A6	2A7

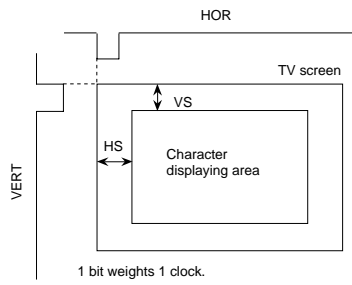
The hexadecimal numbers in the boxes show the display RAM address

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				
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.		
		1				
9	HP1	0				
		1				
A	HP2	0				
		1				
B	HP3	0				
		1				
C	HP4	0				
		1				
D	HP5	0				
		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 ○ around the status value means the reset status by the "L" level is input to \overline{AC} pin.

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(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			T: Display clock		Set to line 4 of display RAM																								
		1																													
5	HSZ5	0					T: Display clock		Set to line 5 of display RAM																						
		1																													
6	HSZ6	0							T: Display clock		Set to line 6 of display RAM																				
		1																													
7	HSZ7	0									T: Display clock		Set to line 7 of display RAM																		
		1																													
8	HSZ8	0											T: Display clock		Set to line 8 of display RAM																
		1																													
9	HSZ9	0													T: Display clock		Set to line 9 of display RAM														
		1																													
A	HSZ10	0															T: Display clock		Set to line 10 of display RAM												
		1																													
B	HSZ11	0	T: Display clock																Set to line 11 of display RAM												
		1																													
C	HSZ12	0			T: Display clock														Set to line 12 of display RAM												
		1																													
D	HSZ13	0					T: Display clock												Set to line 13 of display RAM												
		1																													
E	HSZ14	0							T: Display clock										Set to line 14 of display RAM												
		1																													
F	HSZ15	0									T: Display clock								Set to line 15 of display RAM												
		1																													
10	HSZ16	0											T: Display clock						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>BLINK1</td> <td>0</td> <td>Blinking OFF</td> <td>Duty 25%</td> </tr> <tr> <td></td> <td>1</td> <td>Duty 50%</td> <td>Duty 75%</td> </tr> </table>					BLINK0	0	1	BLINK1	0	Blinking OFF	Duty 25%		1	Duty 50%	Duty 75%	Blinking duty ratio can be altered.
															BLINK0	0			1												
BLINK1	0	Blinking OFF													Duty 25%																
	1	Duty 50%													Duty 75%																
1																															
12	BLINK1	0	<table border="1"> <tr> <td></td> <td>BLINK0</td> <td>0</td> <td>1</td> </tr> <tr> <td>BLINK1</td> <td>0</td> <td>Blinking OFF</td> <td>Duty 25%</td> </tr> <tr> <td></td> <td>1</td> <td>Duty 50%</td> <td>Duty 75%</td> </tr> </table>													BLINK0	0	1	BLINK1	0	Blinking OFF	Duty 25%		1	Duty 50%	Duty 75%	Blinking cycle can be altered.				
					BLINK0	0									1																
BLINK1	0	Blinking OFF	Duty 25%																												
	1	Duty 50%	Duty 75%																												
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																													

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(3) Address 2AA16

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																	
		1																	
17	—	0																	
		1																	

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(4) Address 2AB16

DA	Register	Contents				Remarks	
		Status	Function				
0	DSP0 00	0	DSP0XX	0	1	Set to line 0 of display RAM	
		1					
1	DSP0 01	0	DSP1XX	0	1	Set to line 1 of display RAM	
		1					
2	DSP0 02	0	0	Character	Border	Set to line 2 of display RAM	
		1					
3	DSP0 03	0	1	Matrix-outline	Halftone (Note)	Set to line 3 of display RAM	
		1					
4	DSP0 04	0	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.			Set to line 4 of display RAM	
		1					
5	DSP0 05	0	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.			Set to line 5 of display RAM	
		1					
6	DSP0 06	0	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.			Set to line 6 of display RAM	
		1					
7	DSP0 07	0	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.			Set to line 7 of display RAM	
		1					
8	DSP0 08	0	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.			Set to line 8 of display RAM	
		1					
9	DSP0 09	0	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.			Set to line 9 of display RAM	
		1					
A	DSP0 10	0	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.			Set to line 10 of display RAM	
		1					
B	DSP0 11	0	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.			Set to line 11 of display RAM	
		1					
C	DSP0 12	0	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.			Set to line 12 of display RAM	
		1					
D	DSP0 13	0	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.			Set to line 13 of display RAM	
		1					
E	DSP0 14	0	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.			Set to line 14 of display RAM	
		1					
F	DSP0 15	0	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.			Set to line 15 of display RAM	
		1					
10	DSP0 16	0	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.			Set to line 16 of display RAM	
		1					
11	PHASE 0	0	PHASE	PHASE	PHASE	Color	
		1					
12	PHASE 1	0	2	1	0	SELCOR=0	SELCOR=1
		1					
13	PHASE 2	0	0	0	0	Black	Black
		1					
14	TEST25	0	0	0	1	Red	Red-2
		1					
15	TEST26	0	0	1	0	Green	Green-2
		1					
16	—	0	0	1	1	Yellow	Yellow
		1					
17	—	0	1	0	0	Blue	Gray
		1					
18	—	0	1	0	1	Magenta	Yellow-2
		1					
19	—	0	1	1	0	Cyan	Cyan
		1					
20	—	0	1	1	1	White	White
		1					
21	—	0	Test mode (Must be cleared to 0.)			Raster color setting.	
		1					
22	—	0	Must be cleared to 0.			Refer Fig 3, 4 about phase angle.	
		1					
23	—	0	Must be cleared to 0.			Refer Fig 3, 4 about phase angle.	
		1					

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(5) Address 2AC16

DA	Register	Status	Contents			Remarks																																													
			Function																																																
0	DSP1 00	0	DSP0XX	0	1	Set to line 0 of display RAM																																													
		1																																																	
1	DSP1 01	0	DSP1XX	0	1	Set to line 1 of display RAM																																													
		1																																																	
2	DSP1 02	0	0	Character	Border	Set to line 2 of display RAM																																													
		1		Matrix-outline	Half-tone (Note)																																														
3	DSP1 03	0	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.			Set to line 3 of display RAM																																													
4	DSP1 04	0				Set to line 4 of display RAM																																													
		1																																																	
5	DSP1 05	0				Set to line 5 of display RAM																																													
		1																																																	
6	DSP1 06	0				Set to line 6 of display RAM																																													
		1																																																	
7	DSP1 07	0				Set to line 7 of display RAM																																													
		1																																																	
8	DSP1 08	0				Set to line 8 of display RAM																																													
		1																																																	
9	DSP1 09	0				Set to line 9 of display RAM																																													
		1																																																	
A	DSP1 10	0				Set to line 10 of display RAM																																													
		1																																																	
B	DSP1 11	0				Set to line 11 of display RAM																																													
		1																																																	
C	DSP1 12	0	Set to line 12 of display RAM																																																
		1																																																	
D	DSP1 13	0	Set to line 13 of display RAM																																																
		1																																																	
E	DSP1 14	0	Set to line 14 of display RAM																																																
		1																																																	
F	DSP1 15	0	Set to line 15 of display RAM																																																
		1																																																	
10	DSP1 16	0	Set to line 16 of display RAM																																																
		1																																																	
11	LINER	0	<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																																															
1	Refer Fig. 3, 4 about phase angle.																																																		
14	TEST21	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																																																	

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(6) Address 2AD₁₆

DA	Register	Contents		Remarks						
		Status	Function							
0	ERS0	0	Erase display RAM	Set to line 0 of display RAM						
		1								
1	ERS1	0	<table border="1"> <tr> <th>ERSx</th> <th>RAM erase</th> </tr> <tr> <td>0</td> <td>do erase</td> </tr> <tr> <td>1</td> <td>do not erase</td> </tr> </table>	ERSx	RAM erase	0	do erase	1	do not erase	Set to line 1 of display RAM
		ERSx	RAM erase							
0	do erase									
1	do not erase									
1										
2	ERS2	0	It is unnecessary to reset these registers to "0". Multiple settings of ERS _n is not allowed.	Set to line 2 of display RAM						
		1								
3	ERS3	0		Set to line 3 of display RAM						
		1								
4	ERS4	0		Set to line 4 of display RAM						
		1								
5	ERS5	0		Set to line 5 of display RAM						
		1								
6	ERS6	0		Set to line 6 of display RAM						
		1								
7	ERS7	0		Set to line 7 of display RAM						
		1								
8	ERS8	0		Set to line 8 of display RAM						
		1								
9	ERS9	0		Set to line 9 of display RAM						
		1								
A	ERS10	0		Set to line 10 of display RAM						
		1								
B	ERS11	0		Set to line 11 of display RAM						
		1								
C	ERS12	0		Set to line 12 of display RAM						
		1								
D	ERS13	0		Set to line 13 of display RAM						
		1								
E	ERS14	0		Set to line 14 of display RAM						
		1								
F	ERS15	0		Set to line 15 of display RAM						
		1								
10	ERS16	0		Set to line 16 of display RAM						
		1								
11	SERS0	0	Erase SYRAM	Set to SYRAM code 00 ₁₆ to 0F ₁₆						
		1								
12	SERS1	0	<table border="1"> <tr> <th>SERSx</th> <th>SYRAM erase</th> </tr> <tr> <td>0</td> <td>do erase</td> </tr> <tr> <td>1</td> <td>do not erase</td> </tr> </table>	SERSx	SYRAM erase	0	do erase	1	do not erase	Set to SYRAM code 10 ₁₆ to 1F ₁₆
		SERSx	SYRAM erase							
0	do erase									
1	do not erase									
1										
13	SERS2	0	It is unnecessary to reset these registers to "0". Multiple settings of SERS _n is not allowed.	Set to SYRAM code 20 ₁₆ to 2F ₁₆						
		1								
14	SERS3	0		Set to SYRAM code 30 ₁₆ to 3E ₁₆						
		1								
15	TEST22	0	Test mode (Must be cleared to 0.)							
		1								
16	TEST23	0								
		1								
17	—	0	Must be cleared to 0.							
		1								

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(7) Address 2AE16

DA	Register	Contents		Remarks		
		Status	Function			
0	SBIT0	0	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				
1	SBIT1	0				
		1				
2	SBIT2	0				
		1				
3	SBIT3	0				
		1				
4	SLIN0	0			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
		1				
5	SLIN1	0				
		1				
6	SLIN2	0				
		1				
7	SLIN3	0				
		1				
8	SLIN4	0				
		1				
9	SST0	0	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		
		1				
A	0					
	1					
B	0					
	1					
C	0					
	1					
D	0					
	1					
E	SEND0	0			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
		1				
F	SEND1	0				
		1				
10	SEND2	0				
		1				
11	SEND3	0				
		1				
12	SEND4	0				
		1				
13	—	0	Must be cleared to 0.			
		1				
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.

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(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 ft control $ft = fh \times \left\{ \sum_{n=0}^7 (2^n PC_n) + 512 \right\}$	PC7 to PC0 < 3616, PC7 to PC0 > C616 is not available.																								
		1																										
11	PC1	0																										
		1																										
12	PC2	0																										
		1																										
13	PC3	0																										
		1																										
14	PC4	0																										
		1																										
15	PC5	0																										
		1																										
16	PC6	0																										
		1																										
17	PC7	0																										
		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.

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(9) Address 2B0₁₆

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>
		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	<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>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																			
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> </tbody> </table>	PAL/NTSC	MPAL	Format	0	0	NTSC	0	1	M-PAL							
		PAL/NTSC	MPAL	Format															
0	0	NTSC																	
0	1	M-PAL																	
1	<table border="1"> <thead> <tr> <th>PAL/NTSC</th> <th>MPAL</th> <th>Format</th> </tr> </thead> <tbody> <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	1	0	PAL	1	1	unavailable									
PAL/NTSC	MPAL	Format																	
1	0	PAL																	
1	1	unavailable																	
E	PAL/NTSC	0	<table border="1"> <thead> <tr> <th>PAL/NTSC</th> <th>MPAL</th> <th>Format</th> </tr> </thead> <tbody> <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	1	0	PAL	1	1	unavailable							
		PAL/NTSC	MPAL	Format															
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1	<table border="1"> <thead> <tr> <th>PAL/NTSC</th> <th>MPAL</th> <th>Format</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>unavailable</td> </tr> </tbody> </table>	PAL/NTSC	MPAL	Format	1	1	unavailable												
PAL/NTSC	MPAL	Format																	
1	1	unavailable																	
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
Mazenta	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	—	—	—

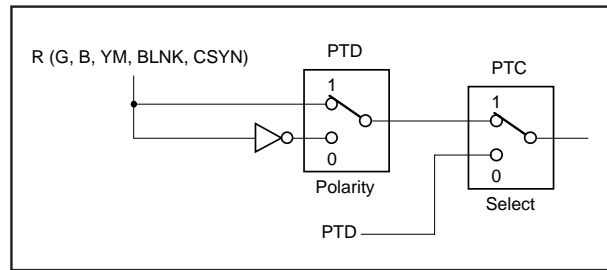


Fig. 2 Switching port output with R, G and B output

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

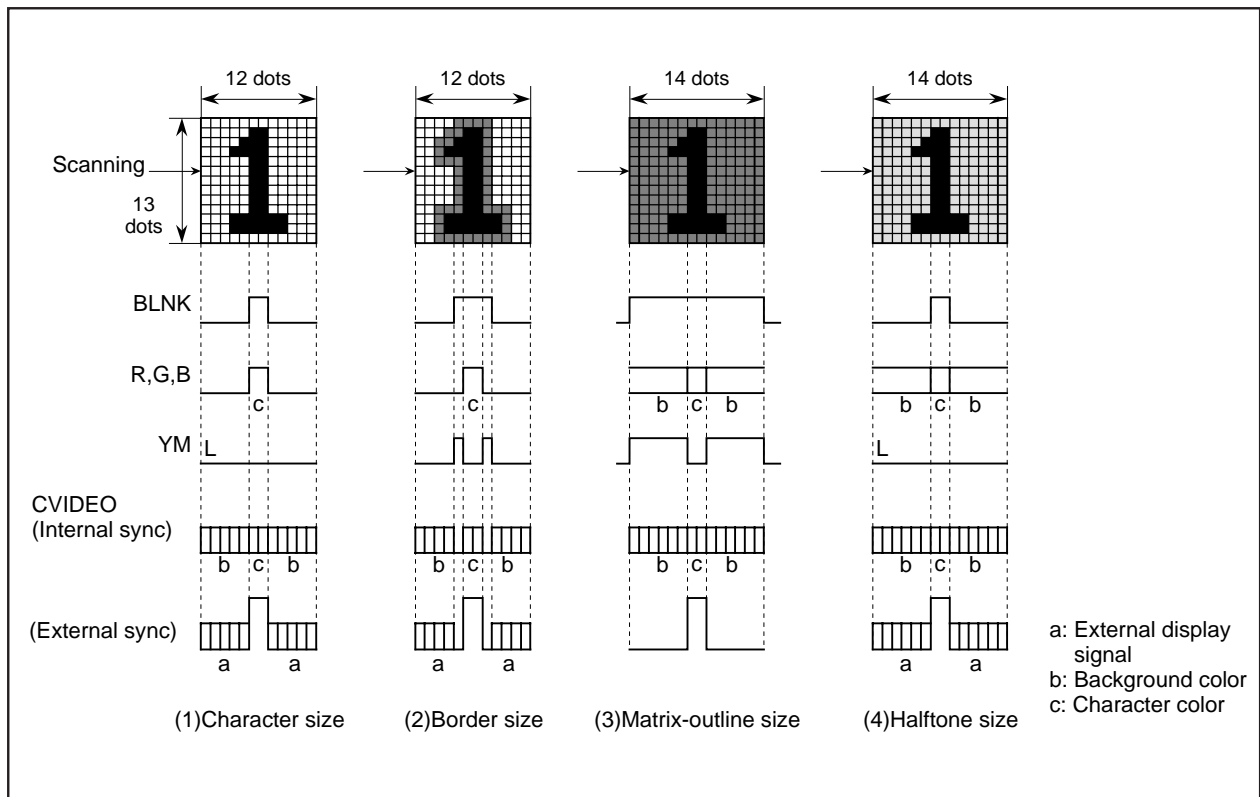


Fig. 3 Display forms at each display mode

For matrix and half-tone, 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.

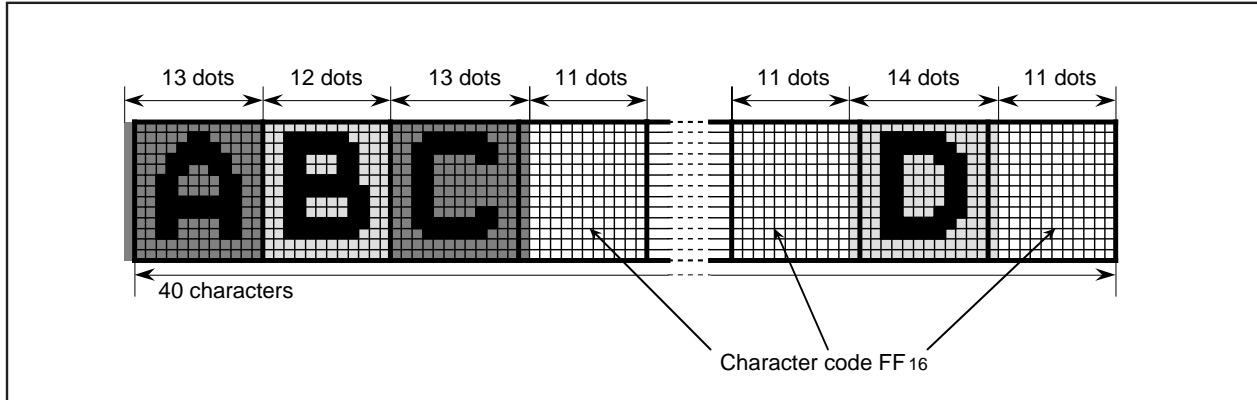


Fig. 4 Number of dots in the horizontal direction at matrix-outline or half-tone

2. Border mode

In border mode, characters are displayed with borders. (Refer to Table 9.) In matrix and half-tone 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		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 outline. 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.

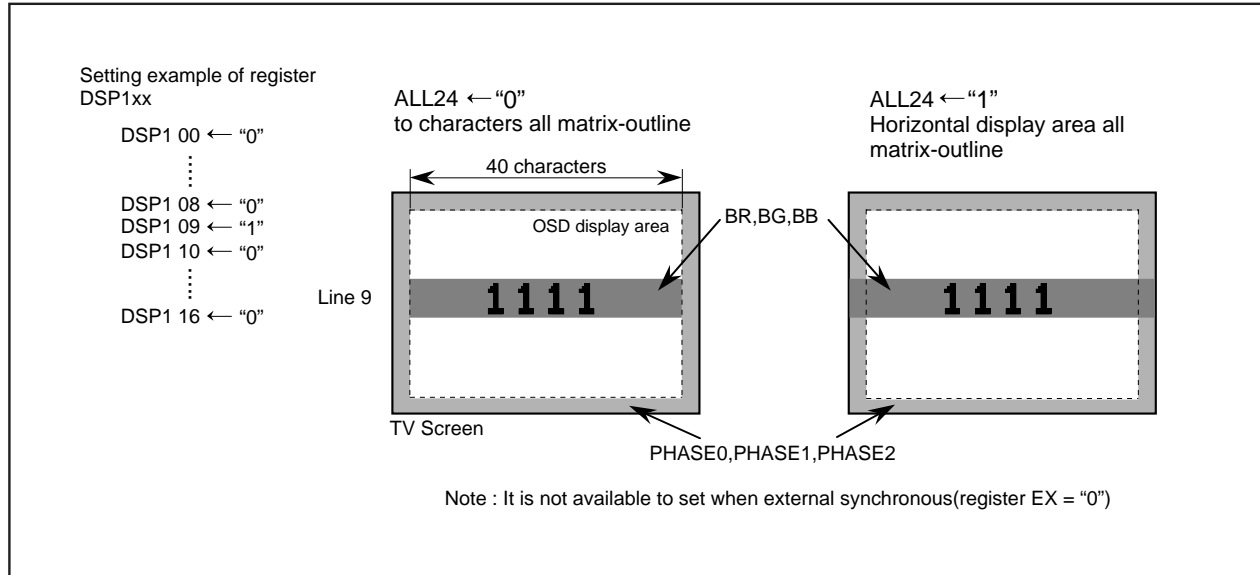


Fig. 5 Setting example all matrix-outline area

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

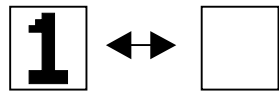

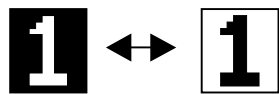

BLINK3	Blinking mode	at blinking OFF
0	Blinking 	Normal 
1	Normal character, reversed character alternation display 	Reverse 

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.

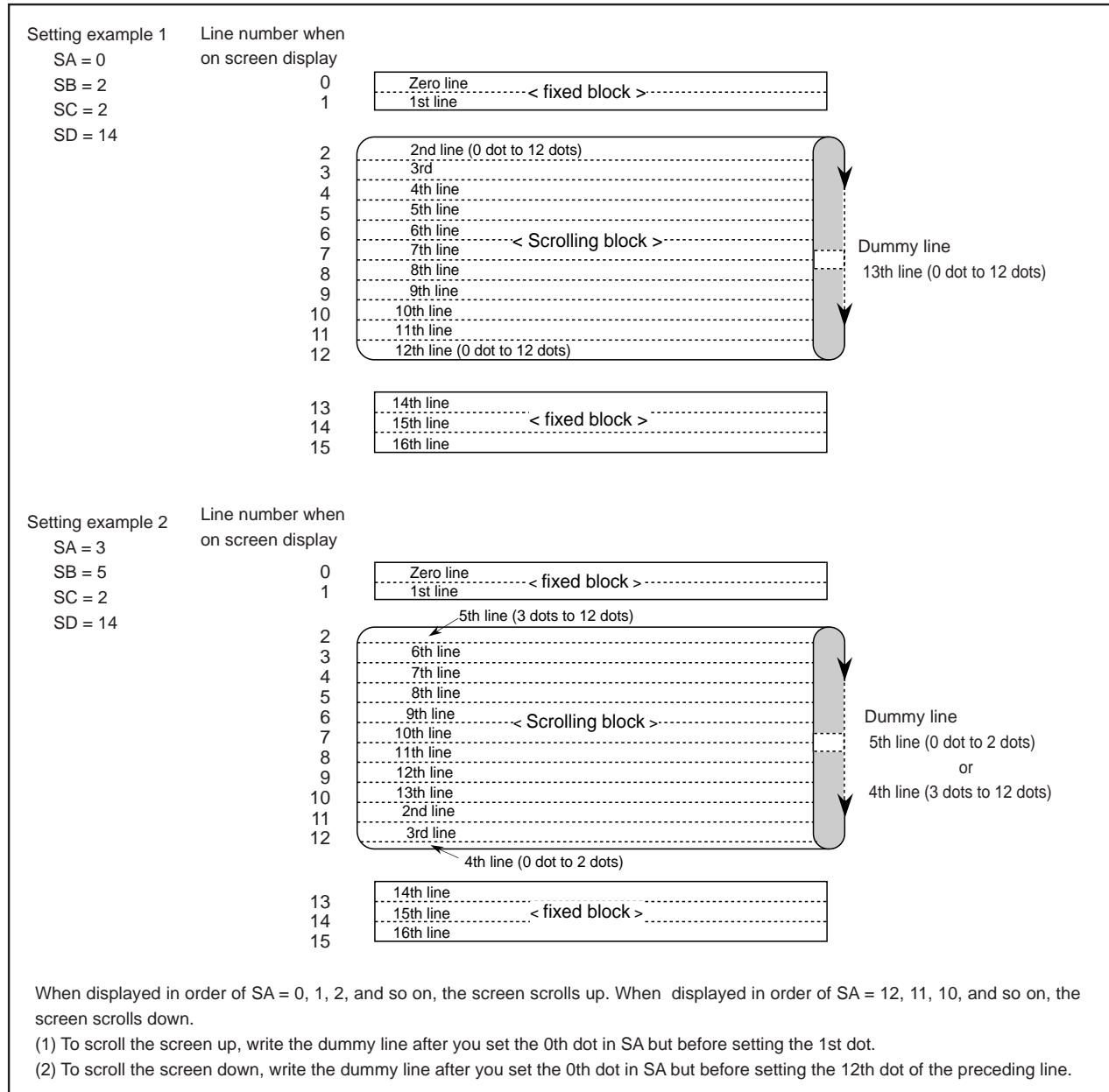


Fig. 6 Scrolling example

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.

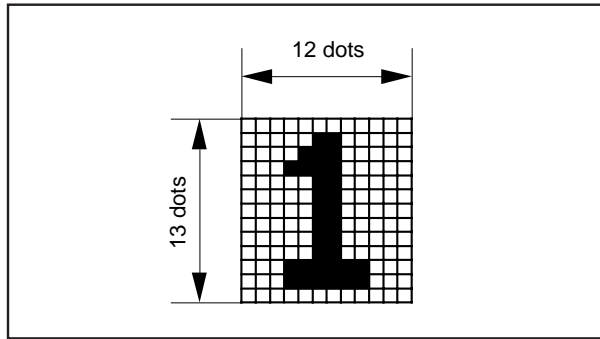


Fig. 7 Character construction

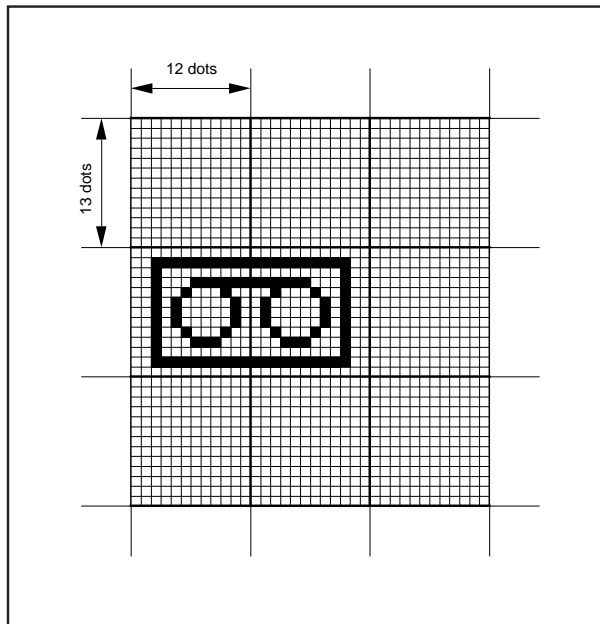


Fig. 8 Example for displaying a continuous pattern

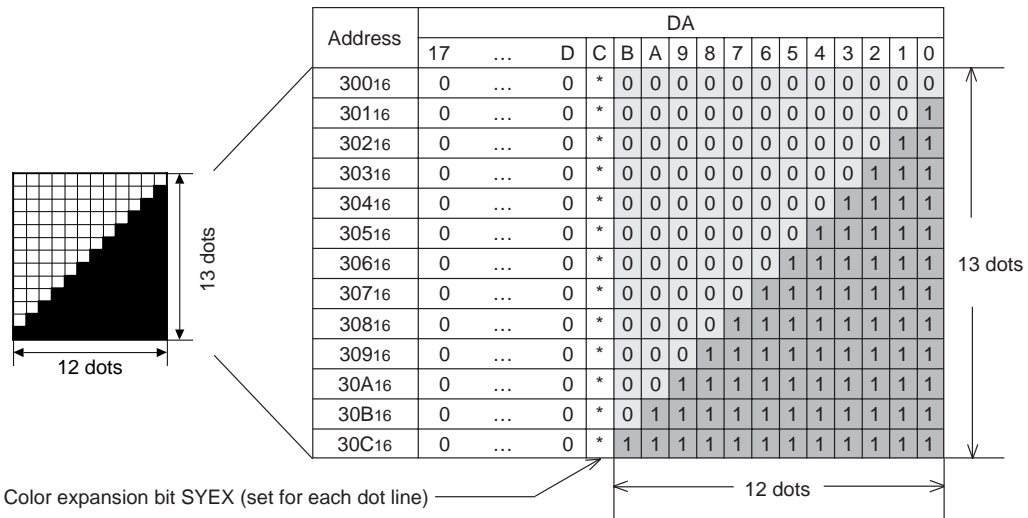
(2) SYRAM

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.

(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

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

(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.

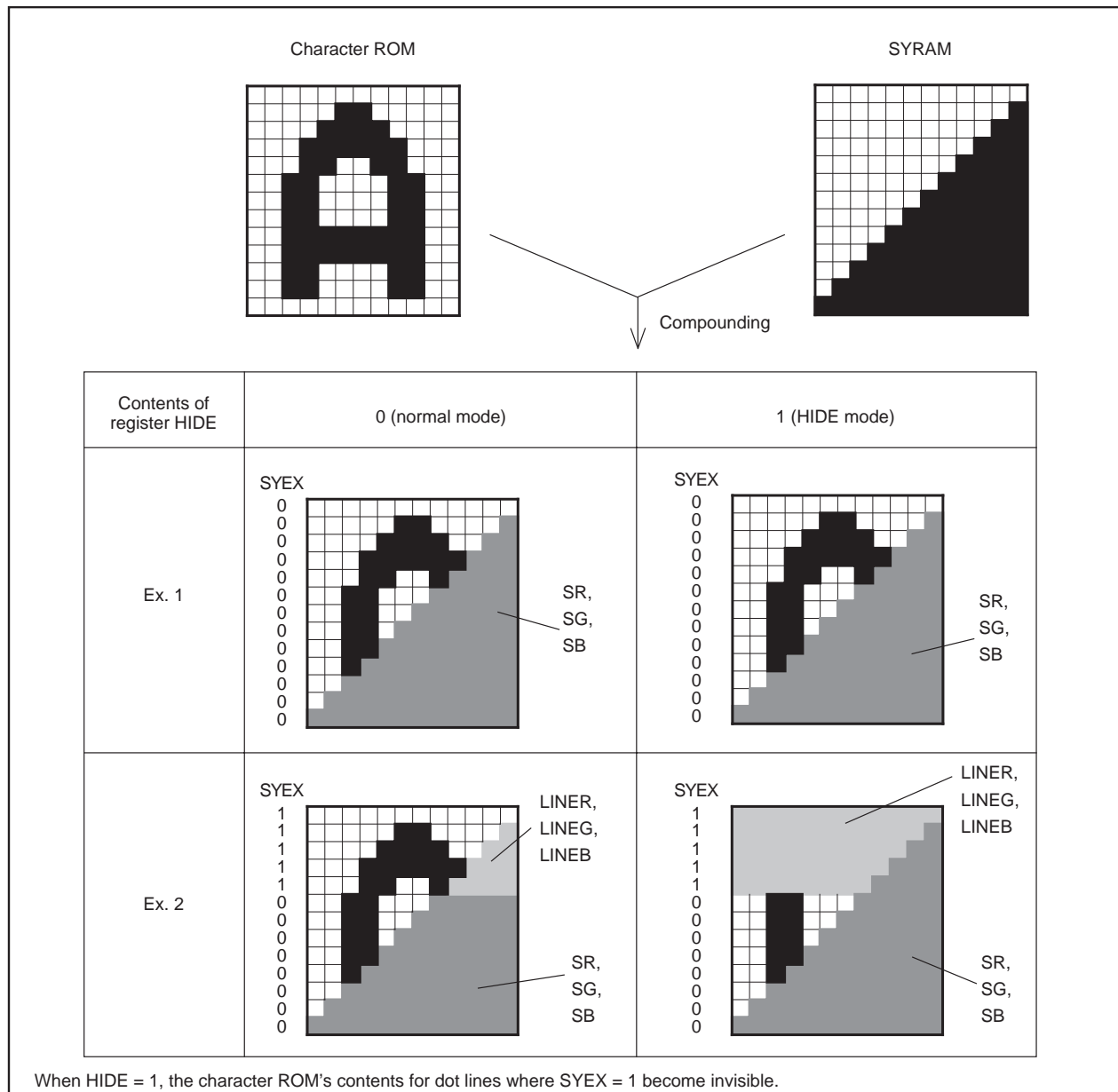


Fig. 10 Compounding example

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.

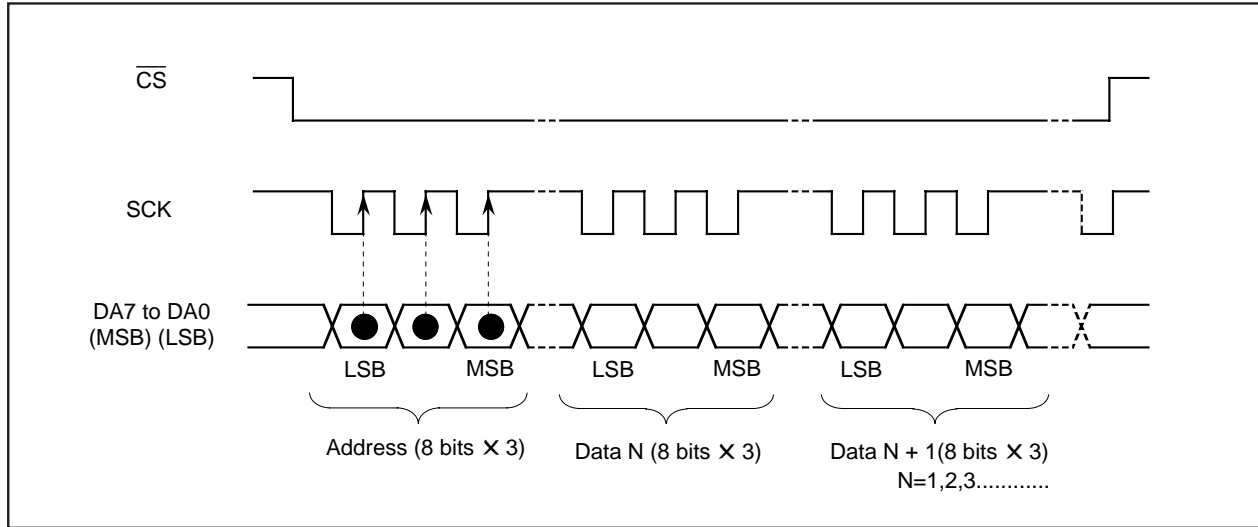


Fig. 11 Serial input timing

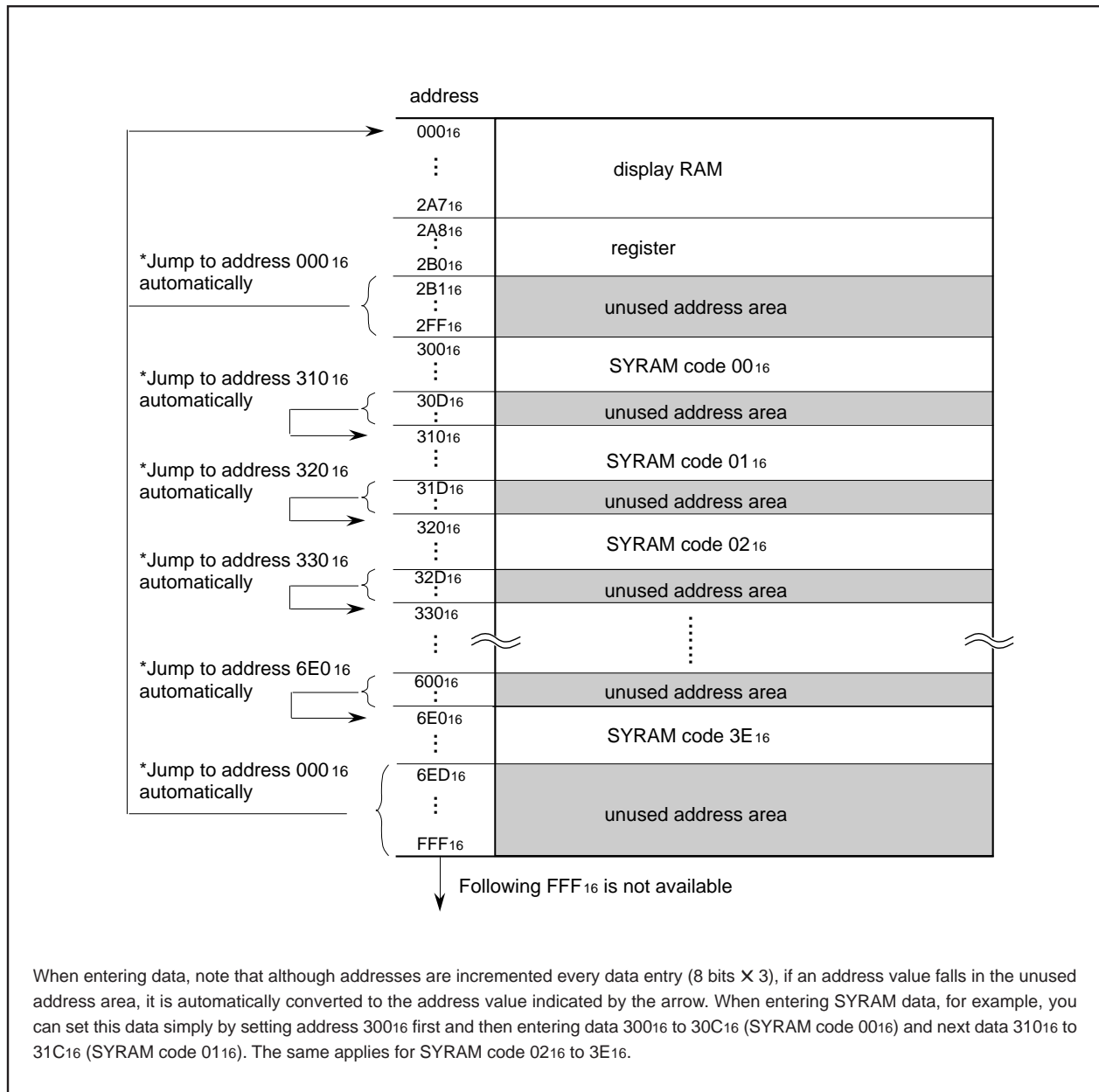


Fig. 12 Address construction

M35060-XXXSP PERIPHERAL CIRCUIT

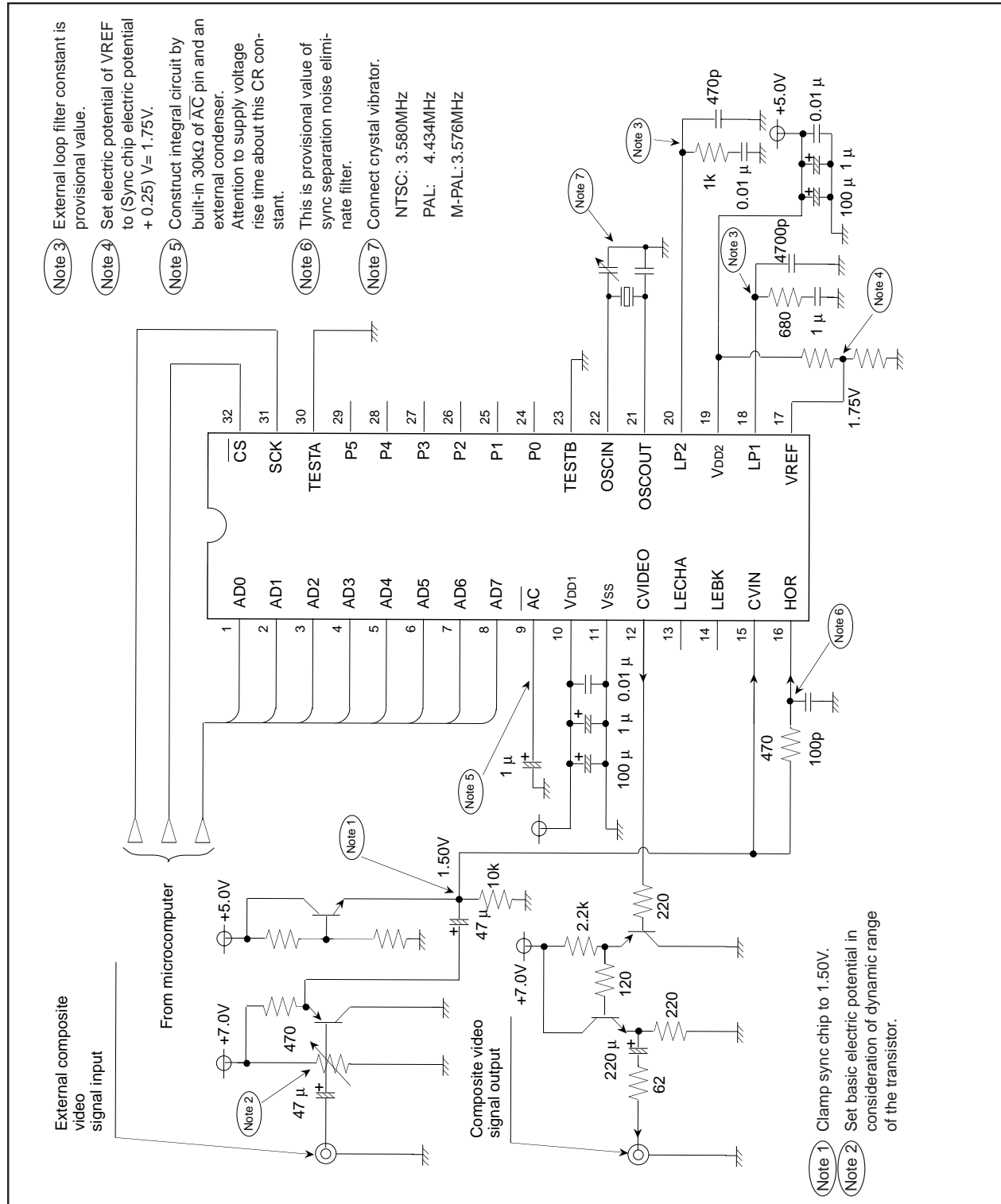


Fig.13 M35060-XXXSP example of peripheral circuit

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.	
$t_w(\text{SCK})$	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

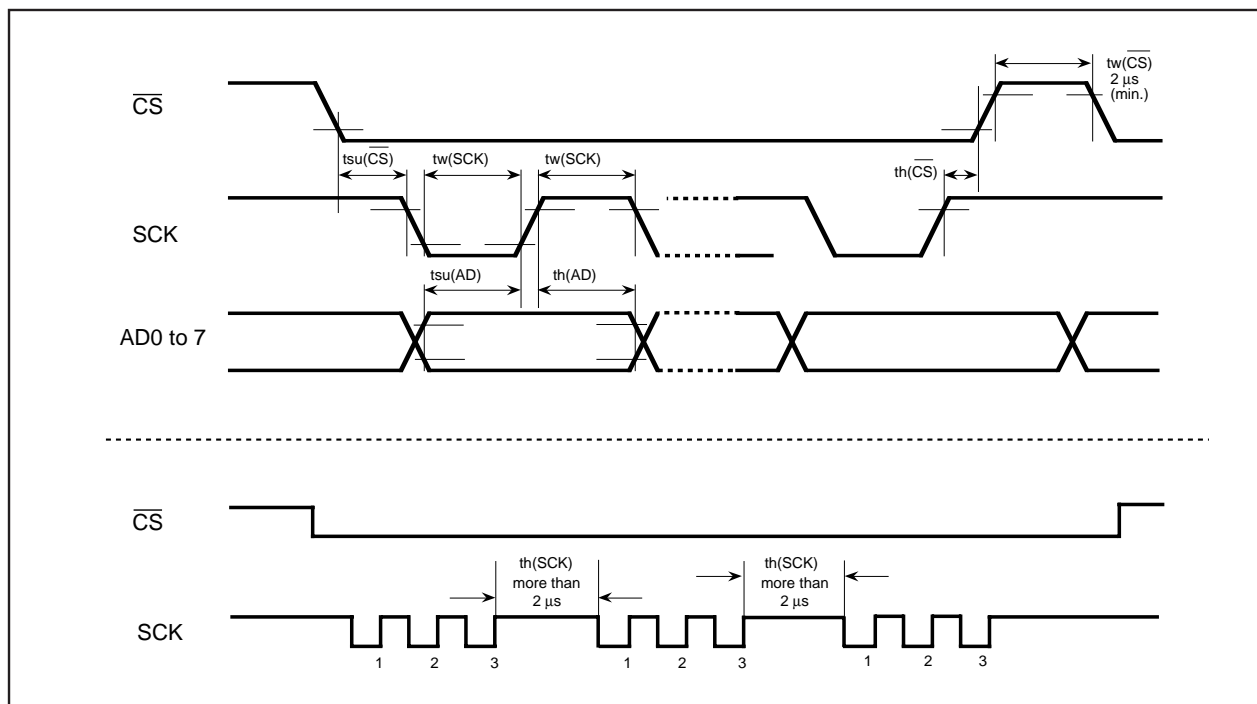


Fig. 14 Serial input timing requirements

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/ \overline{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.)

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

ABSOLUTE MAXIMUM RATINGS ($V_{DD} = 5.00V$, $T_a = -20^{\circ}C$ to $+70^{\circ}C$ 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	$T_a = 25^{\circ}C$	300	mW
T_{opr}	Operating temperature		- 20 to 70	$^{\circ}C$
T_{stg}	Storage temperature		- 40 to 125	$^{\circ}C$

RECOMMENDED OPERATIONAL CONDITIONS ($V_{DD} = 5.00V$, $T_a = -20^{\circ}C$ to $+70^{\circ}C$ 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	$0.8 \times V_{DD}$	V_{DD}	V_{DD}	V
V_{IL}	"L" level input voltage \overline{AC} , \overline{CS} , SCK, AD0 to AD7	0	0	$0.2 \times V_{DD}$	V
V_{CVIN}	Composite video input supply voltage CVIN	—	2Vp-p	—	V
fOSCIN	Oscillation frequency for synchronous signal	—	3.580 4.434 3.576	—	MHz

ELECTRICAL CHARACTERISTICS ($V_{DD} = 5.00V$, $T_a = +25^{\circ}C$ unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{DD}	Supply voltage	$T_a = -20^{\circ}C$ to $+70^{\circ}C$	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	k Ω

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

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_{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.

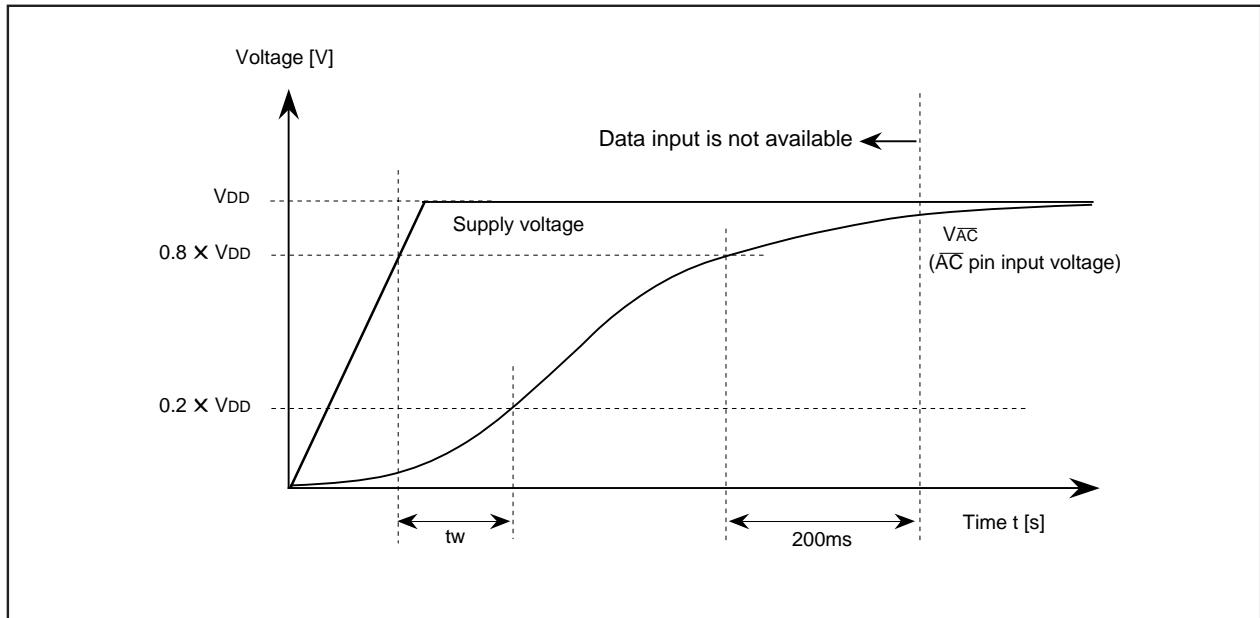


Fig. 15 Timing of power supplying to \overline{AC} pin

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.

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.

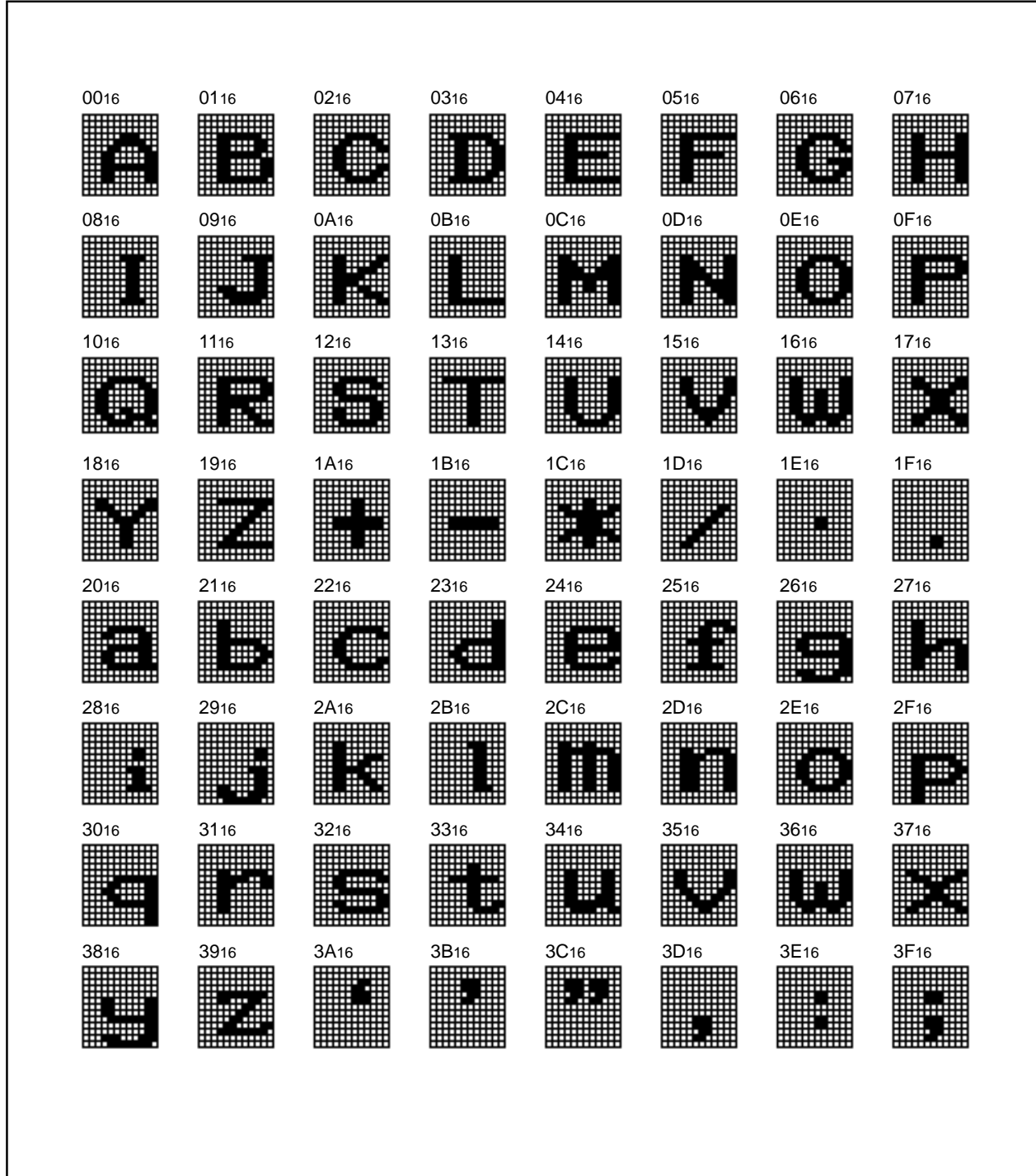


Fig. 16 M35060-001SP character patterns (1)

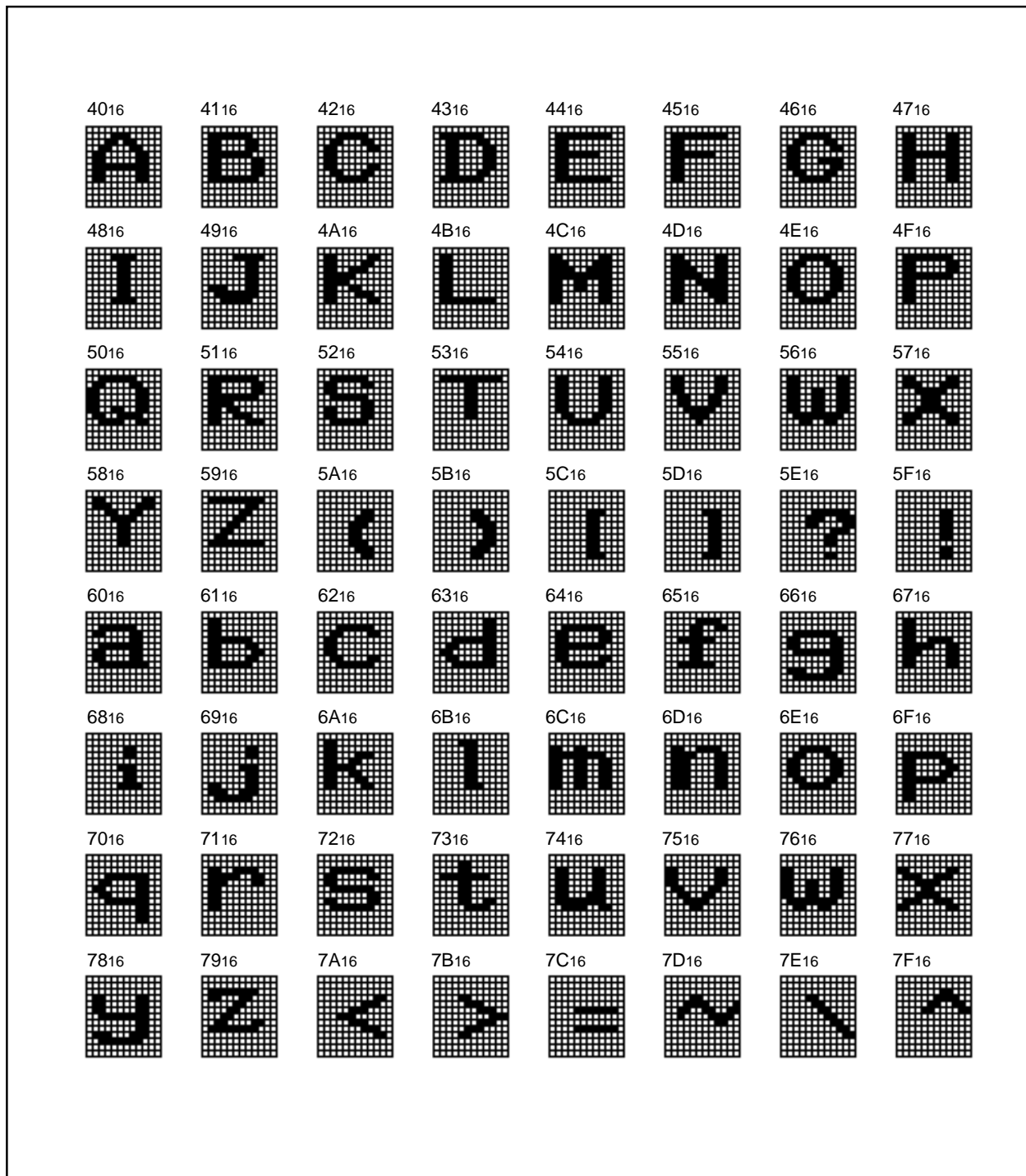


Fig. 17 M35060-001SP character patterns (2)

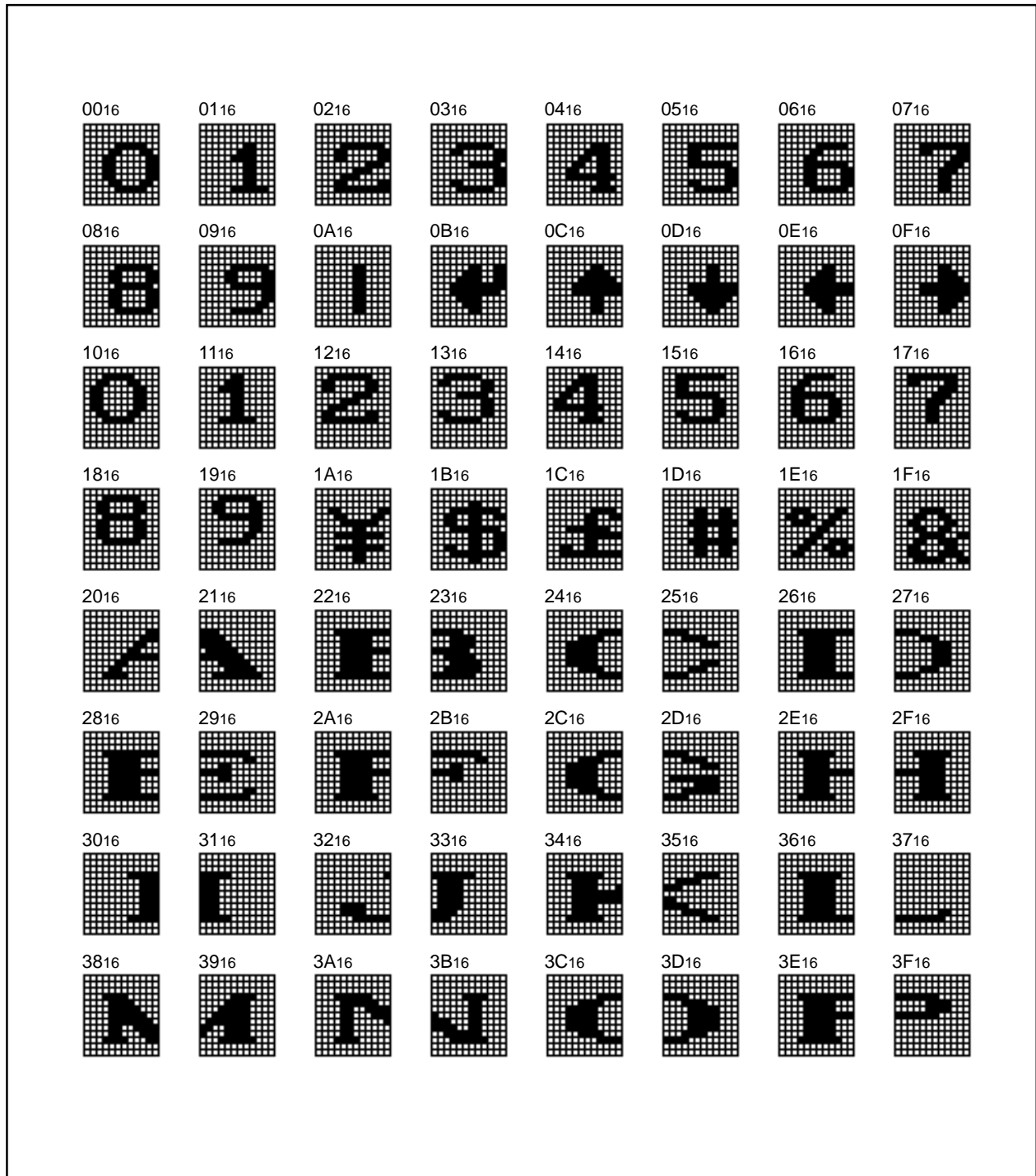


Fig. 18 M35060-001SP character patterns (3)

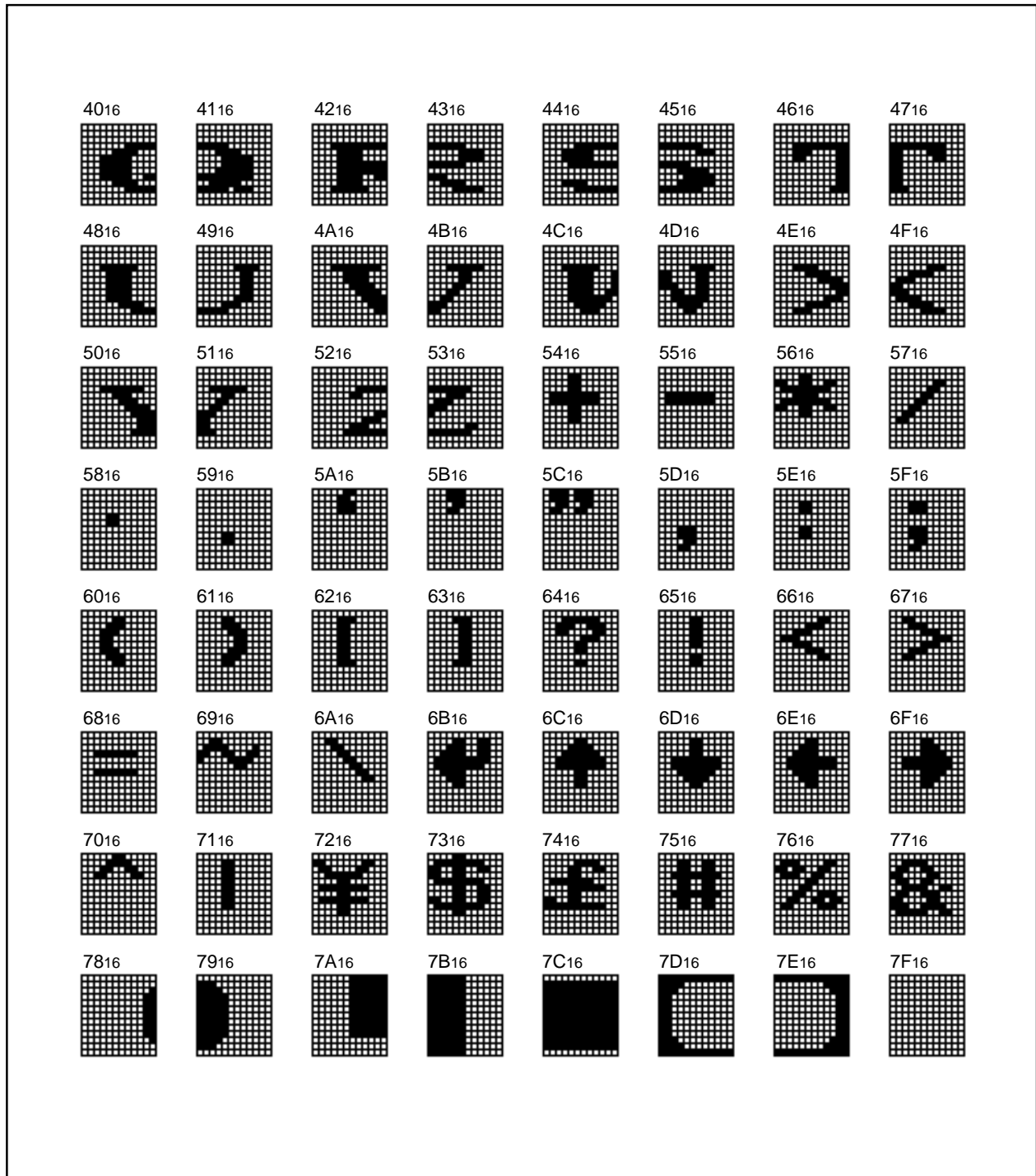


Fig. 19 M35060-001SP character patterns (4)

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.

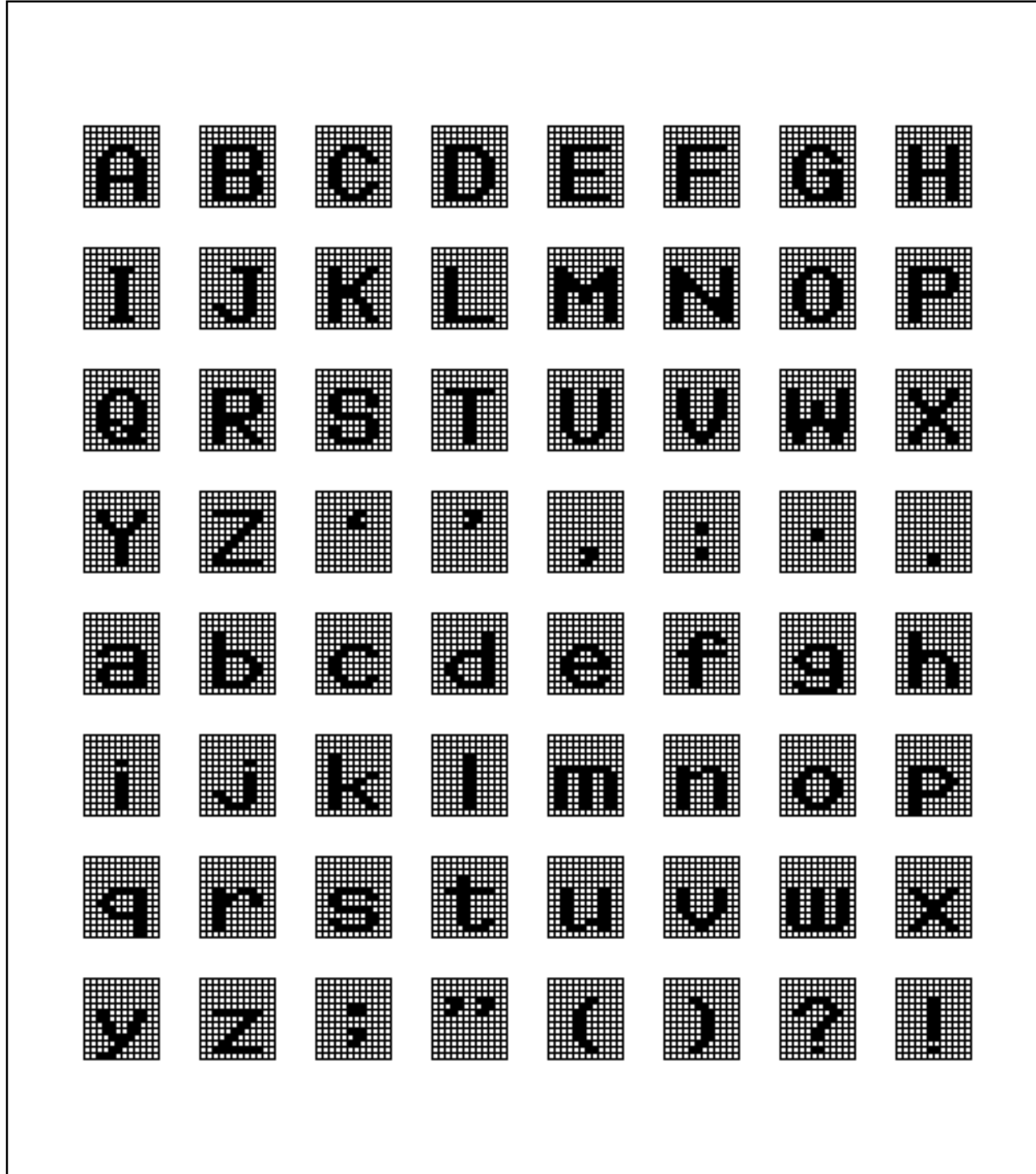


Fig. 20 M35060-002SP character patterns (1)

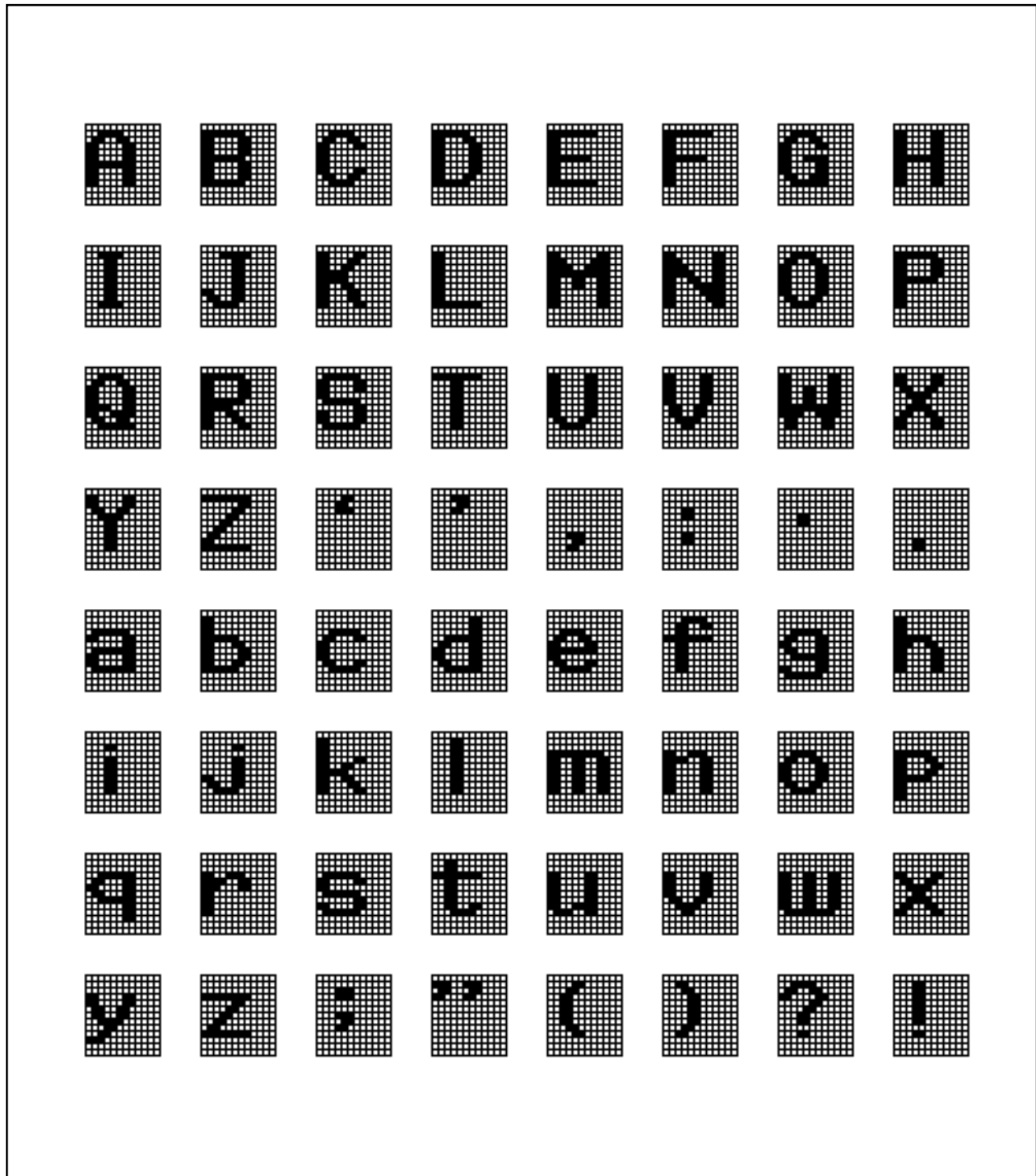


Fig. 21 M35060-002SP character patterns (2)

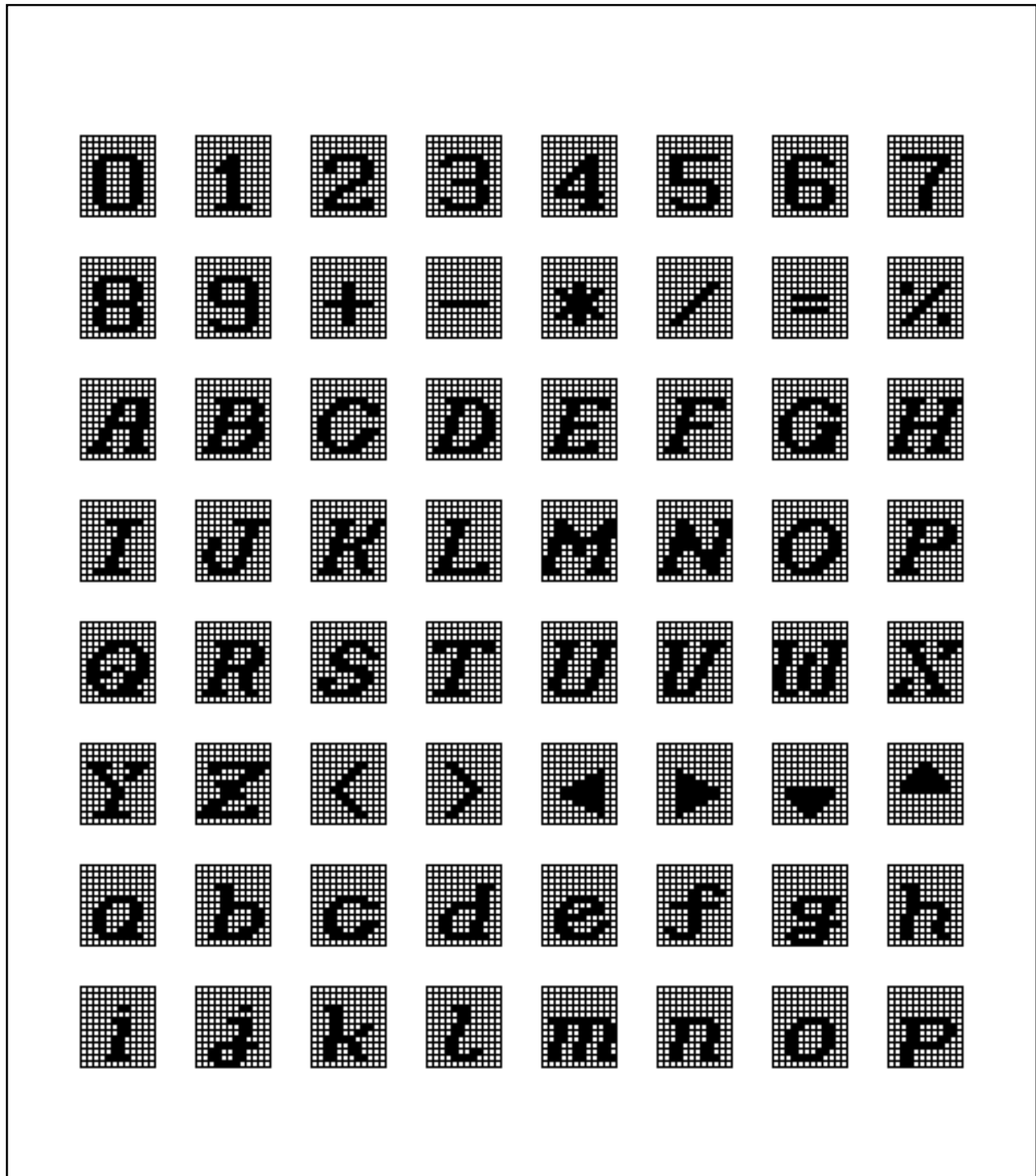


Fig. 22 M35060-002SP character patterns (3)

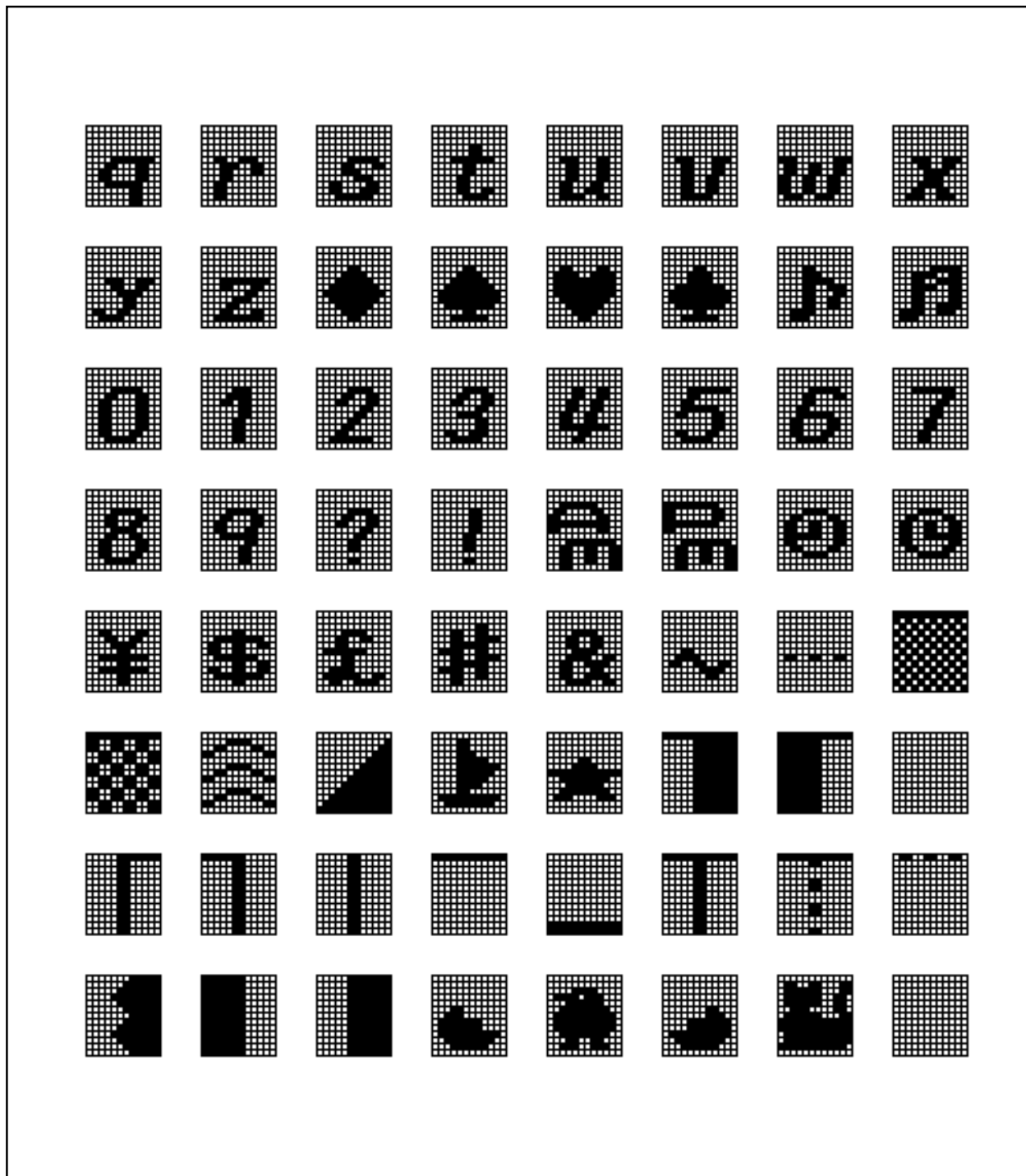


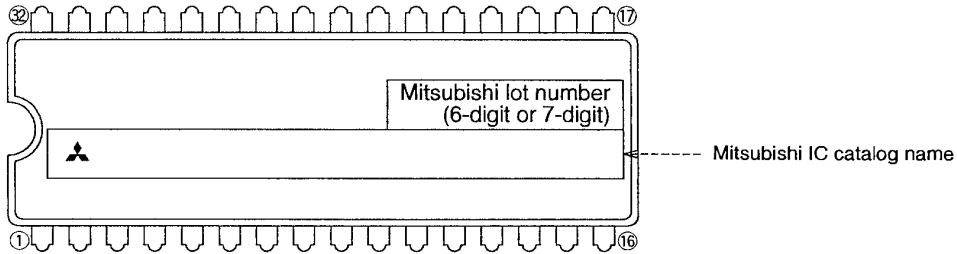
Fig. 23 M35060-002SP character patterns (4)

32P4B (32-PIN SHRINK DIP) MARK SPECIFICATION FORM

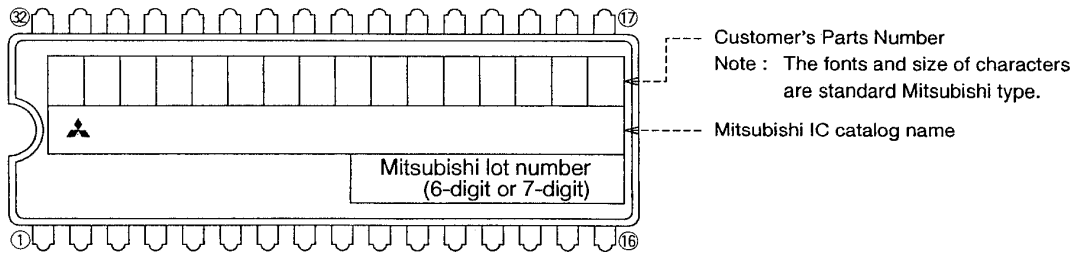
Mitsubishi IC catalog name

Please choose one of the marking types below (A, B, C), and enter the Mitsubishi catalog name and the special mark (if needed).

A. Standard Mitsubishi Mark



B. Customer's Parts Number + Mitsubishi catalog name



Note 1 : The mark field should be written right aligned.

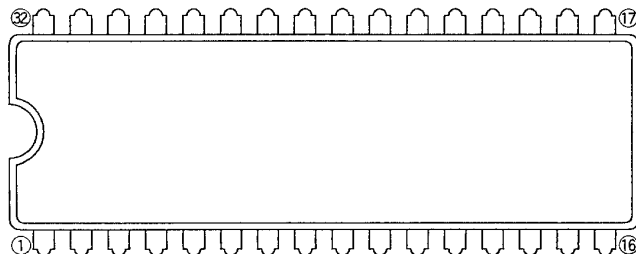
2 : The fonts and size of characters are standard Mitsubishi type.

3 : Customer's Parts Number can be up to 16 characters : Only 0 ~ 9, A ~ Z, +, -, /, (,), &, ©, • (periods), , (commas) are usable.

4 : If the Mitsubishi logo is not required, check the box on the right.

Mitsubishi logo is not required

C. Special Mark Required



Note 1 : If the Special Mark is to be Printed, indicate the desired layout of the mark in the upper figure. The layout will be duplicated as close as possible. Mitsubishi lot number (6-digit or 7-digit) and Mask ROM number (3-digit) are always marked.

2 : If the customer's trade mark logo must be used in the Special Mark, check the box on the right. Please submit a clean original of the logo. For the new special character fonts a clean font original (ideally logo drawing) must be submitted.

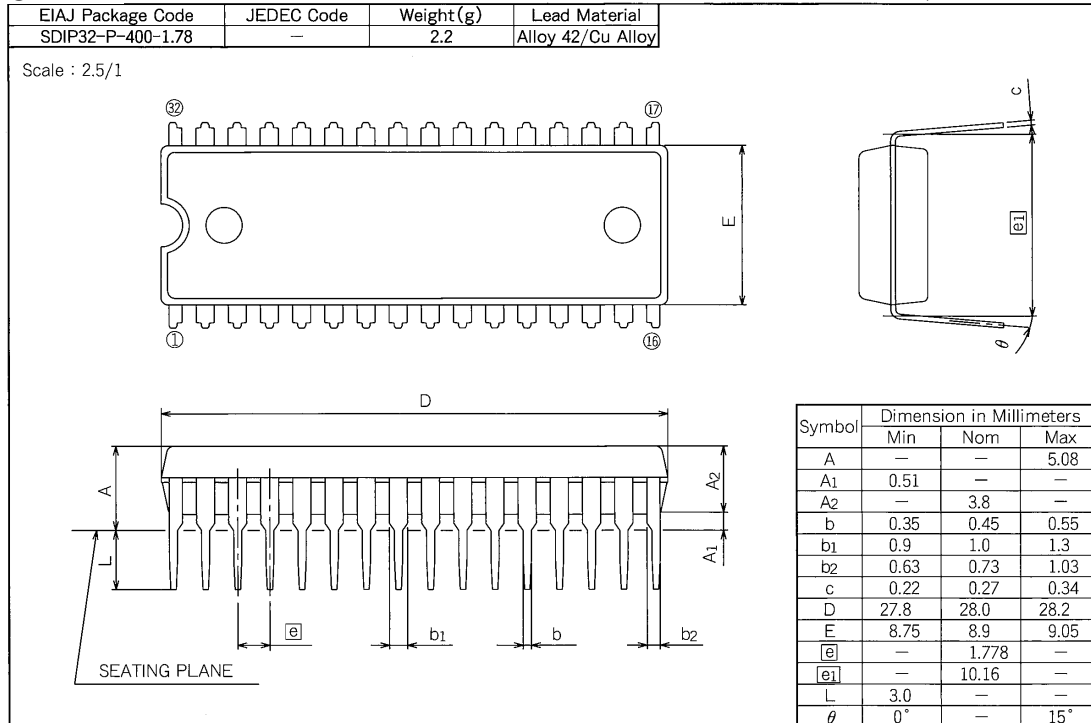
Special logo required

3 : The standard Mitsubishi font is used for all characters except for a logo.

PACKAGE OUTLINE

32P4B

Plastic 32pin 400mil SDIP





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.

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REVISION DESCRIPTION LIST

M35060-XXXSP DATA SHEET

Rev. No.	Revision Description	Rev. date
1.0	First Edition	980402
1.1	<ul style="list-style-type: none">• Deletes some Japanese font and create pdf file (some pages)• P39 and P40 MARK SPECIFICATION FORM and PACKAGE OUTLINE are added	000725