To all our customers

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

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

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

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

M35049-XXXFP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

DESCRIPTION

The M35049-XXXFP is a character pattern display control IC can display on the TV display. It can display 2 pages (24 characters × 12 lines per 1 page) at the same time. It uses a silicon gate CMOS process and it housed in a 20-pin shrink SOP package.
For M35049-001FP that is a standard ROM version of M35049-XXXFP respectively, the character pattern is also mentioned.

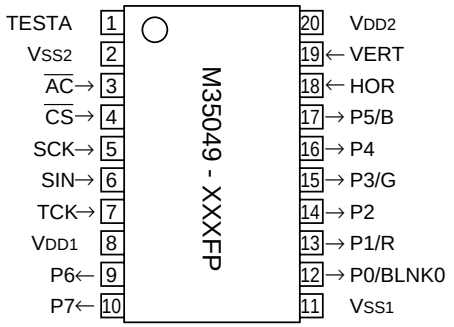
FEATURES

- Screen composition ..... 24 characters × 12 lines × 2 pages
- Number of characters displayed ..... 288 (Max.) × 2 pages
- Character composition ..... 12 × 18 dot matrix
- Characters available ..... page 0 : 256 characters
  page 1 : 256 characters
- Character sizes available ..... 4 (vertical) × 2 (horizontal)
- Display locations available
  Horizontal direction ..... 472 locations
  Vertical direction ..... 255 locations
- Blinking ..... Character units
  Cycle : division of vertical synchronization signal into 32 or 64
  Duty : 25%, 50%, or 75%
- Data input ..... By the 16-bit serial input function
- Coloring
  Character color ..... Character unit
  Background coloring ..... Character unit
  Border (shadow) coloring ..... 8 colors (RGB output)
  Specified by register
  Raster coloring ..... 8 colors (RGB output)
  Specified by register
- Blanking — Character size blanking
  Border size blanking
  Matrix-outline blanking
  All blanking (all raster area)
- Output ports
  4 shared output ports (toggled between RGB output)
  4 dedicated output ports
- Display RAM erase function
- Display input frequency range ..... F_{OSC} = 6.3 MHz to 16.0 MHz
  (External input clock)
- Horizontal synchronous input frequency
  ..... H.sync = 15 .0 kHz to 32.0 kHz
- Display oscillation stop function

APPLICATION

Movie, Digital steel camera

PIN CONFIGURATION (TOP VIEW)

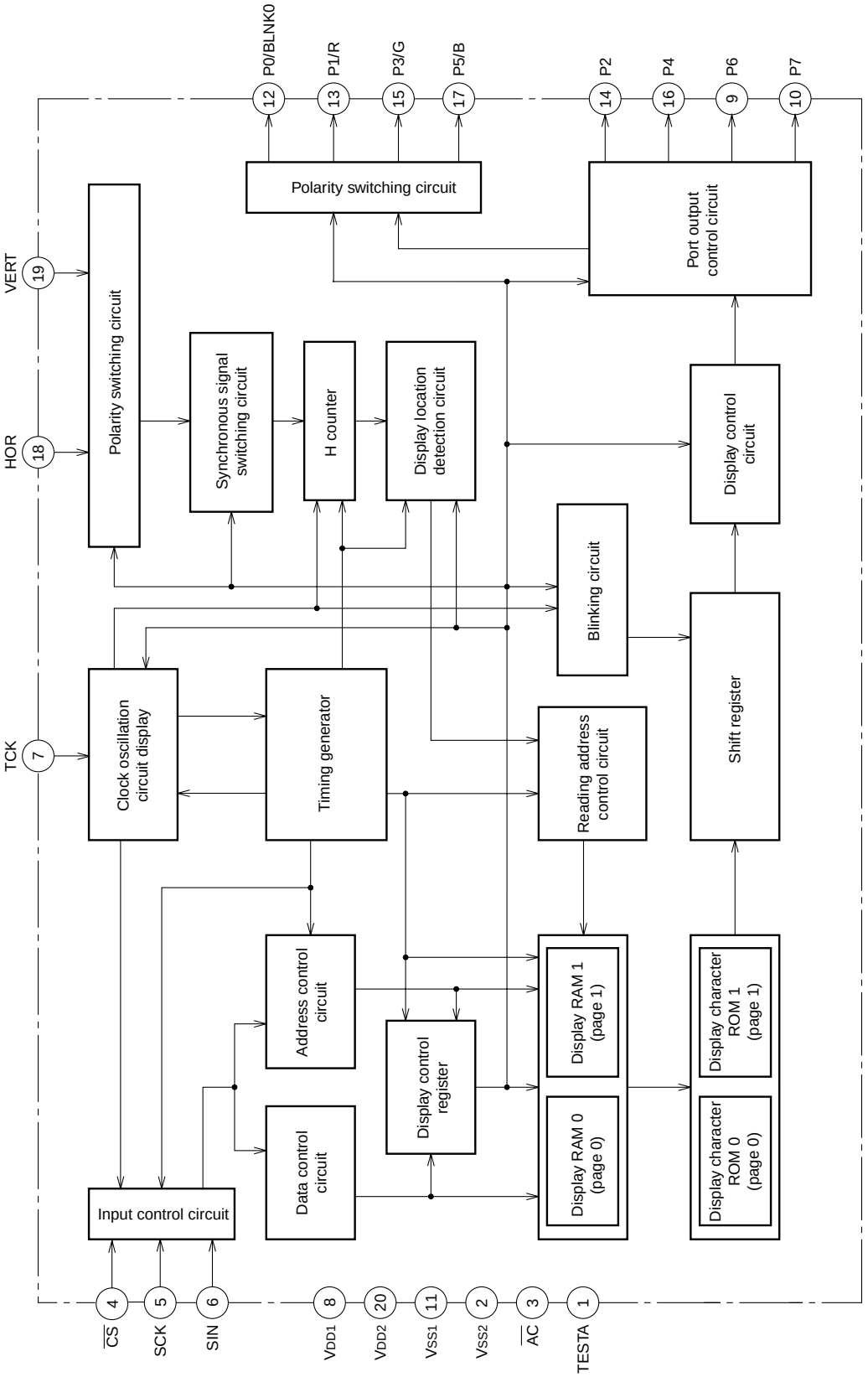


Outline 20P2Q-A

PIN DESCRIPTION

Pin Number	Symbol	Pin name	Input/ Output	Function
1	TESTA	TEST pin	–	Test pin. Open this pin.
2	V_{SS2}	Earthing pin	–	Connect to GND.
3	$\overline{AC}$	Auto-clear input	Input	When “L”, this pin resets the internal IC circuit. Hysteresis input. Built-in pull-up resistor.
4	$\overline{CS}$	Chip select input	Input	Chip select pin. Set this pin to "L" level at serial data transfer. Hysteresis input. Built-in pull-up resistor.
5	SCK	Serial data input	Input	SIN pin serial data is taken in when SCK rises at $\overline{CS}$ pin "L" level. Hysteresis input. Built-in pull-up resistor.
6	SIN	Serial data input	Input	This is the pin for serial input of display control register and display RAM data. Hysteresis input. Built-in pull-up resistor.
7	TCK	External clock	Input	This is the pin for external clock input.
8	V_{DD1}	Power pin	–	Please connect to +3V with the power pin.
9	P6	Port P6 output	Output	This is the output port.
10	P7	Port P7 output	Output	This is the output port.
11	V_{SS1}	Earthing pin	–	Please connect to GND using circuit earthing pin.
12	P0/BLNK0	Port P0 output	Output	This pin can be toggled between port pin output and BLNK0 signal output.
13	P1/R	Port P1 output	Output	This pin can be toggled between port pin output and R signal output.
14	P2	Port P2 output	Output	This is the output port.
15	P3/G	Port P3 output	Output	This pin can be toggled between port pin output and G signal output.
16	P4	Port P4 output	Output	This is the output port.
17	P5/B	Port P5 output	Output	This pin can be toggled between port pin output and B signal output.
18	HOR	Horizontal synchro-nous signal input	Input	This pin inputs the horizontal synchronous signal. Hysteresis input.
19	VERT	Vertical synchro-nous signal input	Input	This pin inputs the vertical synchronous signal. Hysteresis input.
20	V_{DD2}	Power pin	–	Please connect to + 3V with the power pin.

BLOCK DIAGRAM



MEMORY CONSTITUTION

Address 000_{16} to $11F_{16}$ are assigned to the display RAM, address 120_{16} to 128_{16} are assigned to the display control registers. The internal circuit is reset and all display control registers (address 120_{16} to 128_{16}) are set to "0" when the $\overline{AC}$ pin level is "L". And then, RAM is not erased and be undefinited. This memory is consisted of 2 pages : page 0 memory and page 1 memory (their addresses are common), page controlled by DAF bit of each address when writing data. For detail, see "DATA INPUT EXAMPLE". Memory constitution is shown in Figure 1 and 2.

Addresses	DAF	DAE	DAD	DAC	DAB	DAA	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
000_{16}	0	BB	BG	BR	BLINK	B	G	R	C7	C6	C5	C4	C3	C2	C1	C0
001_{16}	0	BB	BG	BR	BLINK	B	G	R	C7	C6	C5	C4	C3	C2	C1	C0
⋮	⋮	Background coloring			Blink-ing	Character color			Character code							
$11E_{16}$	0	BB	BG	BR	BLINK	B	G	R	C7	C6	C5	C4	C3	C2	C1	C0
$11F_{16}$	0	BB	BG	BR	BLINK	B	G	R	C7	C6	C5	C4	C3	C2	C1	C0
120_{16}	0	TEST27	VJT	TEST26	TEST25	TEST24	TEST23	TEST22	TEST21	TEST20	TEST19	TEST18	TEST17	TEST16	TEST15	TEST14
121_{16}	0	TEST28	PTD7	PTD6	PTD5	PTD4	PTD3	PTD2	PTD1	PTD0	PTC5	PTC4	PTC3	PTC2	PTC1	PTC0
122_{16}	0	TEST31	SPACE2	SPACE1	SPACE0	TEST30	TEST29	HP8	HP7	HP6	HP5	HP4	HP3	HP2	HP1	HP0
123_{16}	0	TEST34	TEST3	TEST2	TEST1	TEST0	TEST33	TEST32	VP7	VP6	VP5	VP4	VP3	VP2	VP1	VP0
124_{16}	0	TEST9	TEST5	TEST4	DSP11	DSP10	DSP9	DSP8	DSP7	DSP6	DSP5	DSP4	DSP3	DSP2	DSP1	DSP0
125_{16}	0	TEST10	VSZ1H1	VSZ1H0	VSZ1L1	VSZ1L0	V1SZ1	V1SZ0	LIN9	LIN8	LIN7	LIN6	LIN5	LIN4	LIN3	LIN2
126_{16}	0	POPUP	VSZ2H1	VSZ2H0	VSZ2L1	VSZ2L0	V18SZ1	V18SZ0	LIN17	LIN16	LIN15	LIN14	LIN13	LIN12	LIN11	LIN10
127_{16}	0	MODE0	TEST12	HSZ20	TEST11	HSZ10	BETA14	TEST8	TEST7	TEST6	FB	FG	FR	RB	RG	RR
128_{16}	0	MODE1	BLINK2	BLINK1	BLINK0	DSPON	TEST35	RAMERS	SYAD	BLK1	BLK0	POLH	POLV	VMASK	B/$\overline{F}$	BCOL

Fig. 1 Memory constitution (page 0 memory)

Addresses	DAF	DAE	DAD	DAC	DAB	DAA	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0
000_{16}	1	BB	BG	BR	BLINK	B	G	R	C7	C6	C5	C4	C3	C2	C1	C0
001_{16}	1	BB	BG	BR	BLINK	B	G	R	C7	C6	C5	C4	C3	C2	C1	C0
⋮	⋮	Background coloring			Blink-ing	Character color			Character code							
$11E_{16}$	1	BB	BG	BR	BLINK	B	G	R	C7	C6	C5	C4	C3	C2	C1	C0
$11F_{16}$	1	BB	BG	BR	BLINK	B	G	R	C7	C6	C5	C4	C3	C2	C1	C0
120_{16}	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
121_{16}	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
122_{16}	1	—	SPACE2	SPACE1	SPACE0	TEST30	TEST29	HP8	HP7	HP6	HP5	HP4	HP3	HP2	HP1	HP0
123_{16}	1	—	TEST3	TEST2	TEST1	TEST0	TEST33	TEST32	VP7	VP6	VP5	VP4	VP3	VP2	VP1	VP0
124_{16}	1	—	—	TEST4	DSP11	DSP10	DSP9	DSP8	DSP7	DSP6	DSP5	DSP4	DSP3	DSP2	DSP1	DSP0
125_{16}	1	—	VSZ1H1	VSZ1H0	VSZ1L1	VSZ1L0	V1SZ1	V1SZ0	LIN9	LIN8	LIN7	LIN6	LIN5	LIN4	LIN3	LIN2
126_{16}	1	—	VSZ2H1	VSZ2H0	VSZ2L1	VSZ2L0	V18SZ1	V18SZ0	LIN17	LIN16	LIN15	LIN14	LIN13	LIN12	LIN11	LIN10
127_{16}	1	—	TEST12	HSZ20	TEST11	HSZ10	BETA14	TEST8	TEST7	TEST6	FB	FG	FR	RB	RG	RR
128_{16}	1	—	BLINK2	BLINK1	BLINK0	DSPON	TEST13	RAMERS	SYAD	BLK1	BLK0	—	—	—	—	BCOL

Fig. 2 Memory constitution (page 1 memory)

Note: Page 0 and page 1 registers are found in their respective pages. For example, HP8 to HP0 of the page 0 memory sets the horizontal display start position of page 0, whereas HP8 to HP0 (same register name) of the page 1 memory sets the horizontal display start position of page 1. Also, registers common to both page 0 and page 1 are found only in the page 0 memory. For example, PTC0 is the control register of the P0 pin and is found only in the page 0 memory.

SCREEN CONSTITUTION

The screen lines and rows are determined from each address of the display RAM (page 0 and page 1 are common). The screen constitution is shown in Figure 3.

Row / Line	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	000_{16}	001_{16}	002_{16}	003_{16}	004_{16}	005_{16}	006_{16}	007_{16}	008_{16}	009_{16}	$00A_{16}$	$00B_{16}$	$00C_{16}$	$00D_{16}$	$00E_{16}$	$00F_{16}$	010_{16}	011_{16}	012_{16}	013_{16}	014_{16}	015_{16}	016_{16}	017_{16}
2	018_{16}	019_{16}	$01A_{16}$	$01B_{16}$	$01C_{16}$	$01D_{16}$	$01E_{16}$	$01F_{16}$	020_{16}	021_{16}	022_{16}	023_{16}	024_{16}	025_{16}	026_{16}	027_{16}	028_{16}	029_{16}	$02A_{16}$	$02B_{16}$	$02C_{16}$	$02D_{16}$	$02E_{16}$	$02F_{16}$
3	030_{16}	031_{16}	032_{16}	033_{16}	034_{16}	035_{16}	036_{16}	037_{16}	038_{16}	039_{16}	$03A_{16}$	$03B_{16}$	$03C_{16}$	$03D_{16}$	$03E_{16}$	$03F_{16}$	040_{16}	041_{16}	042_{16}	043_{16}	044_{16}	045_{16}	046_{16}	047_{16}
4	048_{16}	049_{16}	$04A_{16}$	$04B_{16}$	$04C_{16}$	$04D_{16}$	$04E_{16}$	$04F_{16}$	050_{16}	051_{16}	052_{16}	053_{16}	054_{16}	055_{16}	056_{16}	057_{16}	058_{16}	059_{16}	$05A_{16}$	$05B_{16}$	$05C_{16}$	$05D_{16}$	$05E_{16}$	$05F_{16}$
5	060_{16}	061_{16}	062_{16}	063_{16}	064_{16}	065_{16}	066_{16}	067_{16}	068_{16}	069_{16}	$06A_{16}$	$06B_{16}$	$06C_{16}$	$06D_{16}$	$06E_{16}$	$06F_{16}$	070_{16}	071_{16}	072_{16}	073_{16}	074_{16}	075_{16}	076_{16}	077_{16}
6	078_{16}	079_{16}	$07A_{16}$	$07B_{16}$	$07C_{16}$	$07D_{16}$	$07E_{16}$	$07F_{16}$	080_{16}	081_{16}	082_{16}	083_{16}	084_{16}	085_{16}	086_{16}	087_{16}	088_{16}	089_{16}	$08A_{16}$	$08B_{16}$	$08C_{16}$	$08D_{16}$	$08E_{16}$	$08F_{16}$
7	090_{16}	091_{16}	092_{16}	093_{16}	094_{16}	095_{16}	096_{16}	097_{16}	098_{16}	099_{16}	$09A_{16}$	$09B_{16}$	$09C_{16}$	$09D_{16}$	$09E_{16}$	$09F_{16}$	$0A0_{16}$	$0A1_{16}$	$0A2_{16}$	$0A3_{16}$	$0A4_{16}$	$0A5_{16}$	$0A6_{16}$	$0A7_{16}$
8	$0A8_{16}$	$0A9_{16}$	$0AA_{16}$	$0AB_{16}$	$0AC_{16}$	$0AD_{16}$	$0AE_{16}$	$0AF_{16}$	$0B0_{16}$	$0B1_{16}$	$0B2_{16}$	$0B3_{16}$	$0B4_{16}$	$0B5_{16}$	$0B6_{16}$	$0B7_{16}$	$0B8_{16}$	$0B9_{16}$	$0BA_{16}$	$0BB_{16}$	$0BC_{16}$	$0BD_{16}$	$0BE_{16}$	$0BF_{16}$
9	$0C0_{16}$	$0C1_{16}$	$0C2_{16}$	$0C3_{16}$	$0C4_{16}$	$0C5_{16}$	$0C6_{16}$	$0C7_{16}$	$0C8_{16}$	$0C9_{16}$	$0CA_{16}$	$0CB_{16}$	$0CC_{16}$	$0CD_{16}$	$0CE_{16}$	$0CF_{16}$	$0D0_{16}$	$0D1_{16}$	$0D2_{16}$	$0D3_{16}$	$0D4_{16}$	$0D5_{16}$	$0D6_{16}$	$0D7_{16}$
10	$0D8_{16}$	$0D9_{16}$	$0DA_{16}$	$0DB_{16}$	$0DC_{16}$	$0DD_{16}$	$0DE_{16}$	$0DF_{16}$	$0E0_{16}$	$0E1_{16}$	$0E2_{16}$	$0E3_{16}$	$0E4_{16}$	$0E5_{16}$	$0E6_{16}$	$0E7_{16}$	$0E8_{16}$	$0E9_{16}$	$0EA_{16}$	$0EB_{16}$	$0EC_{16}$	$0ED_{16}$	$0EE_{16}$	$0EF_{16}$
11	$0F0_{16}$	$0F1_{16}$	$0F2_{16}$	$0F3_{16}$	$0F4_{16}$	$0F5_{16}$	$0F6_{16}$	$0F7_{16}$	$0F8_{16}$	$0F9_{16}$	$0FA_{16}$	$0FB_{16}$	$0FC_{16}$	$0FD_{16}$	$0FE_{16}$	$0FF_{16}$	100_{16}	101_{16}	102_{16}	103_{16}	104_{16}	105_{16}	106_{16}	107_{16}
12	108_{16}	109_{16}	$10A_{16}$	$10B_{16}$	$10C_{16}$	$10D_{16}$	$10E_{16}$	$10F_{16}$	110_{16}	111_{16}	112_{16}	113_{16}	114_{16}	115_{16}	116_{16}	117_{16}	118_{16}	119_{16}	$11A_{16}$	$11B_{16}$	$11C_{16}$	$11D_{16}$	$11E_{16}$	$11F_{16}$

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

Fig. 3 Screen constitution

DISPLAY RAM

Address 000_{16} to $11F_{16}$

<table>
<tr><th rowspan="2">DA</th><th rowspan="2">Register</th><th colspan="2">Contents</th><th rowspan="2">Remarks</th></tr>
<tr><th>Status</th><th>Function</th></tr>
<tr><td>0</td><td>C0</td><td>0
1</td><td rowspan="8">Set the displayed ROM character code.

To write data into page 0 (Note 2), select the data from the ROM characters (256 types) for page 0 and set the character code. To write data into page 1, do the same from the ROM characters (256 types) for page 1.</td><td rowspan="8">Set display character</td></tr>
<tr><td>1</td><td>C1</td><td>0
1</td></tr>
<tr><td>2</td><td>C2</td><td>0
1</td></tr>
<tr><td>3</td><td>C3</td><td>0
1</td></tr>
<tr><td>4</td><td>C4</td><td>0
1</td></tr>
<tr><td>5</td><td>C5</td><td>0
1</td></tr>
<tr><td>6</td><td>C6</td><td>0
1</td></tr>
<tr><td>7</td><td>C7</td><td>0
1</td></tr>
<tr><td>8</td><td>R</td><td>0
1</td><td rowspan="3"><table><tr><th>B</th><th>G</th><th>R</th><th>Color</th></tr><tr><td>0</td><td>0</td><td>0</td><td>Black</td></tr><tr><td>0</td><td>0</td><td>1</td><td>Red</td></tr><tr><td>0</td><td>1</td><td>0</td><td>Green</td></tr><tr><td>0</td><td>1</td><td>1</td><td>Yellow</td></tr><tr><td>1</td><td>0</td><td>0</td><td>Blue</td></tr><tr><td>1</td><td>0</td><td>1</td><td>Magenta</td></tr><tr><td>1</td><td>1</td><td>0</td><td>Cyan</td></tr><tr><td>1</td><td>1</td><td>1</td><td>White</td></tr></table></td><td rowspan="3">Set character color (character unit)</td></tr>
<tr><td>9</td><td>G</td><td>0
1</td></tr>
<tr><td>A</td><td>B</td><td>0
1</td></tr>
<tr><td>B</td><td>BLINK</td><td>0</td><td>Do not blink.</td><td rowspan="2">Set blinking
See register BLINK2 to BLINK0 (address128_{16})</td></tr>
<tr><td></td><td></td><td>1</td><td>Blinking</td></tr>
<tr><td>C</td><td>BR</td><td>0
1</td><td rowspan="3"><table><tr><th>BB</th><th>BG</th><th>BR</th><th>Color</th></tr><tr><td>0</td><td>0</td><td>0</td><td>Black</td></tr><tr><td>0</td><td>0</td><td>1</td><td>Red</td></tr><tr><td>0</td><td>1</td><td>0</td><td>Green</td></tr><tr><td>0</td><td>1</td><td>1</td><td>Yellow</td></tr><tr><td>1</td><td>0</td><td>0</td><td>Blue</td></tr><tr><td>1</td><td>0</td><td>1</td><td>Magenta</td></tr><tr><td>1</td><td>1</td><td>0</td><td>Cyan</td></tr><tr><td>1</td><td>1</td><td>1</td><td>White</td></tr></table></td><td rowspan="3">Set character background
(character unit)</td></tr>
<tr><td>D</td><td>BG</td><td>0
1</td></tr>
<tr><td>E</td><td>BB</td><td>0
1</td></tr>
</table>

Notes 1. The display RAM is undefined state at the $\overline{AC}$ pin.

2. The display RAM consists of 2 pages, page 0 and page 1 (common address). The page in which data is written is controlled by the DAF bit. When set to "0", data is written into page 0, whereas when set to "1", data is written into page 1.

REGISTERS DESCRIPTION

(1) Address 120_{16}

DA	Register	Contents		Remarks
		Status	Function	
0	TEST14 (Note 3)	⓪	It should be fixed to “0”.	
		1	Can not be used.	
1	TEST15 (Note 3)	⓪	It should be fixed to “0”.	
		1	Can not be used.	
2	TEST16 (Note 3)	⓪	It should be fixed to “0”.	
		1	Can not be used.	
3	TEST17 (Note 3)	⓪	It should be fixed to “0”.	
		1	Can not be used.	
4	TEST18 (Note 3)	⓪	It should be fixed to “0”.	
		1	Can not be used.	
5	TEST19 (Note 3)	⓪	It should be fixed to “0”.	
		1	Can not be used.	
6	TEST20 (Note 3)	⓪	It should be fixed to “0”.	
		1	Can not be used.	
7	TEST21 (Note 3)	⓪	It should be fixed to “0”.	
		1	Can not be used.It should be fixed to “0”.	
8	TEST22 (Note 3)	⓪	Can not be used.	
		1	It should be fixed to “0”.	
9	TEST23 (Note 3)	⓪	Can not be used.	
		1	It should be fixed to “0”.	
A	TEST24 (Note 3)	⓪	Can not be used.	
		1	It should be fixed to “0”.	
B	TEST25 (Note 3)	⓪	Can not be used.	
		1	It should be fixed to “0”.	
C	TEST26 (Note 3)	⓪	Can not be used.	
		1	It should be fixed to “0”.	
D	VJT	⓪	It is used to "0", normally.	
		1	Alleviates continuous vertical jitters.	
E	TEST27 (Note 3)	⓪	Can not be used.	
		1	It should be fixed to “0”.	

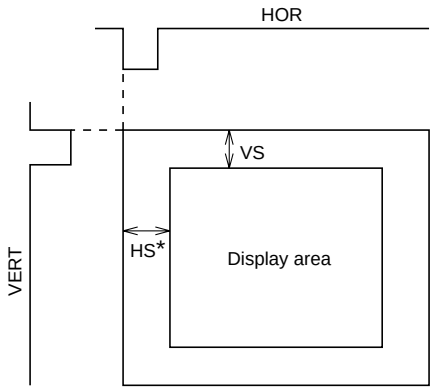
Notes 1. The mark ◯ around the status value means the reset status by the "L" level is input to $\overline{AC}$ pin.
2. The page in which data is written is controlled by the DAF bit. When set to "0", data is written into page 0, whereas when set to "1", data is written into page 1.
3. Registers marked with (Note 3) are found only in page 0, therefore the register value does not change when the DAF bit is set to "1".

(2) Address 121_{16}

DA	Register	Contents		Remarks
		Status	Function	
0	PTC0 (Note 3)	⓪	P0 output (port P0).	P0 pin output control.
		1	BLNK0 output.	
1	PTC1 (Note 3)	⓪	P1 output (port P1).	P1 pin output control.
		1	R signal output.	
2	PTC2 (Note 3)	⓪	P2 output (port P2).	P2 pin output control.
		1	Can not be used.	
3	PTC3 (Note 3)	⓪	P3 output (port P3).	P3 pin output control.
		1	G signal output.	
4	PTC4 (Note 3)	⓪	P4 output (port P4).	P4 pin output control.
		1	Can not be used.	
5	PTC5 (Note 3)	⓪	P5 output (port P5).	P5 pin output control.
		1	B signal output.	
6	PTD0 (Note 3)	⓪	“L” output or negative polarity output (BLNK0 output).	P0 pin data control.
		1	“H” output or positive polarity output (BLNK0 output).	
7	PTD1 (Note 3)	⓪	“L” output or negative polarity output (R signal output).	P1 pin data control.
		1	“H” output or positive polarity output (R signal output).	
8	PTD2 (Note 3)	⓪	“L” output.	P2 pin data control.
		1	“H” output.	
9	PTD3 (Note 3)	⓪	“L” output or negative polarity output (G signal output).	P3 pin data control.
		1	“H” output or positive polarity output (G signal output).	
A	PTD4 (Note 3)	⓪	“L” output.	P4 pin data control.
		1	“H” output.	
B	PTD5 (Note 3)	⓪	“L” output or negative polarity output (B signal output).	P5 pin data control.
		1	“H” output or positive polarity output (B signal output).	
C	PTD6 (Note 3)	⓪	“L” output.	P6 pin data control.
		1	“H” output.	
D	PTD7 (Note 3)	⓪	“L” output.	P7 pin data control.
		1	“H” output.	
E	TEST28 (Note 3)	⓪	Can not be used.	
		1	It should be fixed to “0”.	

Notes 1. The mark ◯ around the status value means the reset status by the "L" level is input to $\overline{AC}$ pin.
2. The page in which data is written is controlled by the DAF bit. When set to "0", data is written into page 0, whereas when set to "1", data is written into page 1.
3. Registers marked with (Note 3) are found only in page 0, therefore the register value does not change when the DAF bit is set to "1".

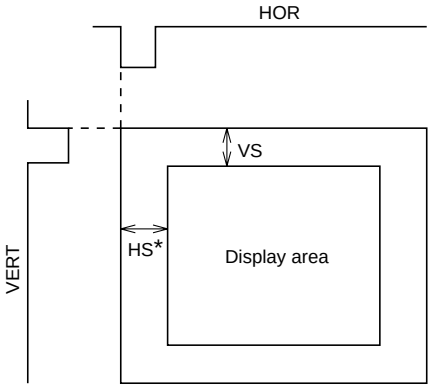
(3) Address 122_{16}

<table>
<tr><th rowspan="2">DA</th><th rowspan="2">Register</th><th colspan="2">Contents</th><th rowspan="2">Remarks</th></tr>
<tr><th>Status</th><th>Function</th></tr>
<tr><td>0</td><td>HP0</td><td>⓪
1</td><td rowspan="9">If HS is the horizontal display start location,
$HS = T \times (\sum_{n=0}^{8} 2^n HP_n + 6)$
T : Period of display frequency
472 settings are possible.
 
</td><td rowspan="9">Horizontal display start location is specified using the 11 bits from HP8 to HP0.
HP8 to HP0 = (00000000000_2) and (00000100111_2) setting is forbidden.

HS* (shown left) shows horizontal display start location that is register B/$\overline{F}$ (address 128_{16}) = 0 is set.</td></tr>
<tr><td>1</td><td>HP1</td><td>⓪
1</td></tr>
<tr><td>2</td><td>HP2</td><td>⓪
1</td></tr>
<tr><td>3</td><td>HP3</td><td>⓪
1</td></tr>
<tr><td>4</td><td>HP4</td><td>⓪
1</td></tr>
<tr><td>5</td><td>HP5</td><td>⓪
1</td></tr>
<tr><td>6</td><td>HP6</td><td>⓪
1</td></tr>
<tr><td>7</td><td>HP7</td><td>⓪
1</td></tr>
<tr><td>8</td><td>HP8</td><td>⓪
1</td></tr>
<tr><td>9</td><td>TEST29</td><td>⓪
1</td><td>Can not be used.
It should be fixed to “0”.</td><td></td></tr>
<tr><td>A</td><td>TEST30</td><td>⓪
1</td><td>Can not be used.
It should be fixed to “0”.</td><td></td></tr>
<tr><td>B</td><td>SPACE0</td><td>⓪
1</td><td rowspan="2">
<table>
<tr><th colspan="3">SPACE</th><th rowspan="2">Number of Lines and Space
<(S) represents space></th></tr>
<tr><th>2</th><th>1</th><th>0</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>12</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1 (S) 10 (S) 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>2 (S) 8 (S) 2</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>3 (S) 6 (S) 3</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>4 (S) 4 (S) 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>5 (S) 2 (S) 5</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>6 (S) 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>6 (S)(S) 6</td></tr>
</table>
(S) represents one line worth of spac</td><td rowspan="2">Leave one line worth of space in the vertical direction.
For example, 6 (S) 6 indicates two sets of 6 lines with a line of spaces between lines 6 and 7.
A line is 18 × N horizontal scan lines.
N is determined by the character size in the vertical direction</td></tr>
<tr><td>C</td><td>SPACE1</td><td>⓪
1</td></tr>
<tr><td>D</td><td>SPACE2</td><td>⓪
1</td></tr>
<tr><td>E</td><td>TEST31
(Note 3)</td><td>⓪
1</td><td>Can not be used.
It should be fixed to “0”.</td><td></td></tr>
</table>

Notes 1. The mark ⓪ around the status value means the reset status by the "L" level is input to $\overline{AC}$ pin.
2. The page in which data is written is controlled by the DAF bit. When set to "0", data is written into page 0, whereas when set to "1", data is written into page 1.
3. Registers marked with (Note 3) are found only in page 0, therefore the register value does not change when the DAF bit is set to "1".

(4) Address 123_{16}

DA	Register	Contents		Remarks
		Status	Function	
0	VP0	⓪	If VS is the vertical display start location, $VS = H \times \sum_{n=0}^{7} 2^n VP_n$ H: Cycle with the horizontal synchronizing pulse 255 settings are possible.  	The vertical start location is specified using the 10 bits from VP7 to VP0. VP7 to VP0 = (0000000000_2) setting is forbidden. HS* (shown left) shows horizontal display start location that is register B/$\overline{F}$ (address 128_{16}) = 0 is set.
		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	TEST32	⓪	It should be fixed to “0”.	
		1	Can not be used.	
9	TEST33	⓪	It should be fixed to “0”.	
		1	Can not be used.	
A	TEST0	⓪	It should be fixed to “0”.	
		1	Can not be used.	
B	TEST1	⓪	It should be fixed to “0”.	
		1	Can not be used.	
C	TEST2	⓪	It should be fixed to “0”.	
		1	Can not be used.	
D	TEST3	⓪	It should be fixed to “0”.	
		1	Can not be used.	
E	TEST34 (Note 3)	⓪	It should be fixed to “0”.	
		1	Can not be used.	

Notes 1. The mark ◯ around the status value means the reset status by the "L" level is input to $\overline{AC}$ pin.
2. The page in which data is written is controlled by the DAF bit. When set to "0", data is written into page 0, whereas when set to "1", data is written into page 1.
3. Registers marked with (Note 3) are found only in page 0, therefore the register value does not change when the DAF bit is set to "1".

(5) Address 124_{16}

<table>
<tr><th rowspan="2">DA</th><th rowspan="2">Register</th><th colspan="2">Contents</th><th rowspan="2">Remarks</th></tr>
<tr><th>Status</th><th>Function</th></tr>
<tr><td>0</td><td>DSP0</td><td>⓪</td><td rowspan="13">The display mode (blanking mode) for line n on the display screen is set line-by-line, using DSPn (n = 0 to 11).

The display mode is determined by the combination of registers BLK1 and BLK0 (address 128_{16}). Settings are given below.

<table><tr><th>BLK1</th><th>BLK0</th><th>DSPn= “0”</th><th>DSPn= “1”</th></tr><tr><td>0</td><td>0</td><td>Matrix-outline border</td><td>Matrix-outline</td></tr><tr><td>0</td><td>1</td><td>Character</td><td>Border</td></tr><tr><td>1</td><td>0</td><td>Border</td><td>Matrix-outline</td></tr><tr><td>1</td><td>1</td><td>Matrix-outline</td><td>Character</td></tr></table>(At register BCOL = “0”)

For detail, see DISPLAY FORM1(1).</td><td>Sets the display mode of line 1.</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>1</td><td>DSP1</td><td>⓪</td><td></td><td>Sets the display mode of line 2.</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>2</td><td>DSP2</td><td>⓪</td><td></td><td>Sets the display mode of line 3.</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>3</td><td>DSP3</td><td>⓪</td><td></td><td>Sets the display mode of line 4.</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>4</td><td>DSP4</td><td>⓪</td><td></td><td>Sets the display mode of line 5.</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>5</td><td>DSP5</td><td>⓪</td><td></td><td>Sets the display mode of line 6.</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>6</td><td>DSP6</td><td>⓪</td><td></td><td>Sets the display mode of line 7.</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>7</td><td>DSP7</td><td>⓪</td><td></td><td>Sets the display mode of line 8.</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>8</td><td>DSP8</td><td>⓪</td><td></td><td>Sets the display mode of line 9.</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>9</td><td>DSP9</td><td>⓪</td><td></td><td>Sets the display mode of line 10.</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>A</td><td>DSP10</td><td>⓪</td><td></td><td>Sets the display mode of line 11.</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>B</td><td>DSP11</td><td>⓪</td><td></td><td>Sets the display mode of line 12.</td></tr>
<tr><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td>C</td><td>TEST4</td><td>⓪</td><td>It should be fixed to “0”.</td><td></td></tr>
<tr><td></td><td></td><td>1</td><td>Can not be used.</td><td></td></tr>
<tr><td>D</td><td>TEST5
(Note 3)</td><td>⓪</td><td>It should be fixed to “0”.</td><td></td></tr>
<tr><td></td><td></td><td>1</td><td>Can not be used.</td><td></td></tr>
<tr><td>E</td><td>TEST9
(Note 3)</td><td>⓪</td><td>Can not be used.</td><td></td></tr>
<tr><td></td><td></td><td>1</td><td>It should be fixed to “1”.</td><td></td></tr>
</table>

Notes 1. The mark ⓪ around the status value means the reset status by the "L" level is input to $\overline{AC}$ pin.
2. The page in which data is written is controlled by the DAF bit. When set to "0", data is written into page 0, whereas when set to "1", data is written into page 1.
3. Registers marked with (Note 3) are found only in page 0, therefore the register value does not change when the DAF bit is set to "1".

(6) Address 125_{16}

<table>
<tr><th rowspan="2">DA</th><th rowspan="2">Register</th><th colspan="2">Contents</th><th rowspan="2">Remarks</th></tr>
<tr><th>Status</th><th>Function</th></tr>
<tr><td>0</td><td>LIN2</td><td>⓪</td><td rowspan="10">The vertical dot size for line n in the character dot lines (18 vertical lines) is set using LINn (n = 2 to 17).

Dot size can be selected between 2 types for each dot line.

For dot size, see the below registers. Line 1 and lines 2 to 12 can be set independent of one another.

<table><tr><th></th><th>LINn = “0”</th><th>LINn = “1”</th></tr><tr><td>1st line</td><td>Refer to VSZ1L0 and VSZ1L1</td><td>Refer to VSZ1H0 and VSZ1H1</td></tr><tr><td>2nd to 12th line</td><td>Refer to VSZ2L0 and VSZ2L1</td><td>Refer to VSZ2H0 and VSZ2H1</td></tr></table></td><td>Vertical direction dot size setting for the 2nd line.</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>1</td><td>LIN3</td><td>⓪</td><td>Vertical direction dot size setting for the 3rd line.</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>2</td><td>LIN4</td><td>⓪</td><td>Vertical direction dot size setting for the 4th line.</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>3</td><td>LIN5</td><td>⓪</td><td>Vertical direction dot size setting for the 5th line.</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>4</td><td>LIN6</td><td>⓪</td><td>Vertical direction dot size setting for the 6th line.</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>5</td><td>LIN7</td><td>⓪</td><td>Vertical direction dot size setting for the 7th line.</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>6</td><td>LIN8</td><td>⓪</td><td>Vertical direction dot size setting for the 8th line.</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>7</td><td>LIN9</td><td>⓪</td><td>Vertical direction dot size setting for the 9th line.</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>8</td><td>V1SZ0</td><td>⓪</td><td rowspan="2">H: Cycle with the horizontal synchronizing pulse
<table><tr><th>V1SZ1</th><th>V1SZ0</th><th>Vertical direction size</th></tr><tr><td>0</td><td>0</td><td>1H/dot</td></tr><tr><td>0</td><td>1</td><td>2H/dot</td></tr><tr><td>1</td><td>0</td><td>3H/dot</td></tr><tr><td>1</td><td>1</td><td>4H/dot</td></tr></table></td><td rowspan="2">Vertical direction dot size setting for the 1st line.
(all lines are common)</td></tr>
<tr><td></td><td></td><td>1</td></tr>
<tr><td>9</td><td>V1SZ1</td><td>⓪</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>A</td><td>VSZ1L0</td><td>⓪</td><td rowspan="2">H: Cycle with the horizontal synchronizing pulse
<table><tr><th>VSZ1L1</th><th>VSZ1L0</th><th>Vertical direction size</th></tr><tr><td>0</td><td>0</td><td>1H/dot</td></tr><tr><td>0</td><td>1</td><td>2H/dot</td></tr><tr><td>1</td><td>0</td><td>3H/dot</td></tr><tr><td>1</td><td>1</td><td>4H/dot</td></tr></table></td><td rowspan="2">Character dot line vertical direction dot size setting for the 1st line (LINn = 0).</td></tr>
<tr><td></td><td></td><td>1</td></tr>
<tr><td>B</td><td>VSZ1L1</td><td>⓪</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>C</td><td>VSZ1H0</td><td>⓪</td><td rowspan="2">H: Cycle with the horizontal synchronizing pulse
<table><tr><th>VSZ1H1</th><th>VSZ1H0</th><th>Vertical direction size</th></tr><tr><td>0</td><td>0</td><td>1H/dot</td></tr><tr><td>0</td><td>1</td><td>2H/dot</td></tr><tr><td>1</td><td>0</td><td>3H/dot</td></tr><tr><td>1</td><td>1</td><td>4H/dot</td></tr></table></td><td rowspan="2">Character dot line vertical direction dot size setting for the 1st line (LINn = 1).</td></tr>
<tr><td></td><td></td><td>1</td></tr>
<tr><td>D</td><td>VSZ1H1</td><td>⓪</td></tr>
<tr><td></td><td></td><td>1</td><td></td></tr>
<tr><td>E</td><td>TEST10
(Note 3)</td><td>⓪</td><td>It should be fixed to “0”.</td><td></td></tr>
<tr><td></td><td></td><td>1</td><td>Can not be used.</td><td></td></tr>
</table>

Notes 1. The mark ◯ around the status value means the reset status by the "L" level is input to $\overline{AC}$ pin.
2. The page in which data is written is controlled by the DAF bit. When set to "0", data is written into page 0, whereas when set to "1", data is written into page 1.
3. Registers marked with (Note 3) are found only in page 0, therefore the register value does not change when the DAF bit is set to "1".

(7) Address 126_{16}

<table>
<tr><th rowspan="2">DA</th><th rowspan="2">Register</th><th colspan="2">Contents</th><th rowspan="2">Remarks</th></tr>
<tr><th>Status</th><th>Function</th></tr>
<tr><td>0</td><td>LIN10</td><td>⓪
1</td><td rowspan="8">The vertical dot size for line n in the character dot lines (18 vertical lines) is set using LINn (n = 2 to 17).

Dot size can be selected between 2 types for each dot line.

For dot size, see the below registers. Line 1 and lines 2 to 12 can be set independent of one another.

<table><tr><th></th><th>LINn = “0”</th><th>LINn = “1”</th></tr><tr><td>1st line</td><td>Refer to VSZ1L0 and VSZ1L1</td><td>Refer to VSZ1H0 and VSZ1H1</td></tr><tr><td>2nd to 12th line</td><td>Refer to VSZ2L0 and VSZ2L1</td><td>Refer to VSZ2H0 and VSZ2H1</td></tr></table></td><td>Vertical direction dot size setting for the 11th line.</td></tr>
<tr><td>1</td><td>LIN11</td><td>⓪
1</td><td>Vertical direction dot size setting for the 11th line.</td></tr>
<tr><td>2</td><td>LIN12</td><td>⓪
1</td><td>Vertical direction dot size setting for the 12th line.</td></tr>
<tr><td>3</td><td>LIN13</td><td>⓪
1</td><td>Vertical direction dot size setting for the 13th line.</td></tr>
<tr><td>4</td><td>LIN14</td><td>⓪
1</td><td>Vertical direction dot size setting for the 14th line.</td></tr>
<tr><td>5</td><td>LIN15</td><td>⓪
1</td><td>Vertical direction dot size setting for the 15th line.</td></tr>
<tr><td>6</td><td>LIN16</td><td>⓪
1</td><td>Vertical direction dot size setting for the 16th line.</td></tr>
<tr><td>7</td><td>LIN17</td><td>⓪
1</td><td>Vertical direction dot size setting for the 17th line.</td></tr>
<tr><td>8</td><td>V18SZ0</td><td>⓪
1</td><td rowspan="2">H: Cycle with the horizontal synchronizing pulse
<table><tr><th>V18SZ1</th><th>V18SZ0</th><th>Vertical direction size</th></tr><tr><td>0</td><td>0</td><td>1H/dot</td></tr><tr><td>0</td><td>1</td><td>2H/dot</td></tr><tr><td>1</td><td>0</td><td>3H/dot</td></tr><tr><td>1</td><td>1</td><td>4H/dot</td></tr></table></td><td rowspan="2">Vertical direction dot size setting for the 18th line.
(all lines are common)</td></tr>
<tr><td>9</td><td>V18SZ1</td><td>⓪
1</td></tr>
<tr><td>A</td><td>VSZ2L0</td><td>⓪
1</td><td rowspan="2">H: Cycle with the horizontal synchronizing pulse
<table><tr><th>VSZ2L1</th><th>VSZ2L0</th><th>Vertical direction size</th></tr><tr><td>0</td><td>0</td><td>1H/dot</td></tr><tr><td>0</td><td>1</td><td>2H/dot</td></tr><tr><td>1</td><td>0</td><td>3H/dot</td></tr><tr><td>1</td><td>1</td><td>4H/dot</td></tr></table></td><td rowspan="2">Character dot line vertical direction dot size setting for the 2nd line to 12th line (LINn = 0).</td></tr>
<tr><td>B</td><td>VSZ2L1</td><td>⓪
1</td></tr>
<tr><td>C</td><td>VSZ2H0</td><td>⓪
1</td><td rowspan="2">H: Cycle with the horizontal synchronizing pulse
<table><tr><th>VSZ2H1</th><th>VSZ2H0</th><th>Vertical direction size</th></tr><tr><td>0</td><td>0</td><td>1H/dot</td></tr><tr><td>0</td><td>1</td><td>2H/dot</td></tr><tr><td>1</td><td>0</td><td>3H/dot</td></tr><tr><td>1</td><td>1</td><td>4H/dot</td></tr></table></td><td rowspan="2">Character dot line vertical direction dot size setting for the 2nd line to 12th line (LINn = 1).</td></tr>
<tr><td>D</td><td>VSZ2H1</td><td>⓪
1</td></tr>
<tr><td>E</td><td>POPUP
(Note 3)</td><td>⓪
1</td><td>Page 1 priority display
Page 0 priority display</td><td>Sets the priority page for when 2 pages are displayed at the same time. The setting is effective only when the standard display mode is set as MODE0 = "0" , MODE1 = "0". See "DISPLAY FORM 2" .</td></tr>
</table>

Notes 1. The mark ◯ around the status value means the reset status by the "L" level is input to $\overline{AC}$ pin.
2. The page in which data is written is controlled by the DAF bit. When set to "0", data is written into page 0, whereas when set to "1", data is written into page 1.
3. Registers marked with (Note 3) are found only in page 0, therefore the register value does not change when the DAF bit is set to "1".

(8) Address 127_{16}

<table>
<tr><th rowspan="2">DA</th><th rowspan="2">Register</th><th colspan="2">Contents</th><th rowspan="2">Remarks</th></tr>
<tr><th>Status</th><th>Function</th></tr>
<tr><td>0</td><td>RR</td><td>⓪
1</td><td>
<table>
<tr><th>RB</th><th>RG</th><th>RR</th><th>Color</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Black</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Red</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Green</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Yellow</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Blue</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Magenta</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Cyan</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>White</td></tr>
</table>
</td><td rowspan="3">Sets the raster color of all blankings.</td></tr>
<tr><td>1</td><td>RG</td><td>⓪
1</td></tr>
<tr><td>2</td><td>RB</td><td>⓪
1</td></tr>
<tr><td>3</td><td>FR</td><td>⓪
1</td><td>
<table>
<tr><th>FB</th><th>FG</th><th>FR</th><th>Color</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Black</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Red</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Green</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Yellow</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Blue</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Magenta</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Cyan</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>White</td></tr>
</table>
</td><td rowspan="3">Sets the blanking color of the Border size, or the shadow size.</td></tr>
<tr><td>4</td><td>FG</td><td>⓪
1</td></tr>
<tr><td>5</td><td>FB</td><td>⓪
1</td></tr>
<tr><td>6</td><td>TEST6</td><td>⓪</td><td>It should be fixed to “0”.</td><td rowspan="2"></td></tr>
<tr><td></td><td>1</td><td>Can not be used.</td></tr>
<tr><td>7</td><td>TEST7</td><td>⓪</td><td>It should be fixed to “0”.</td><td rowspan="2"></td></tr>
<tr><td></td><td>1</td><td>Can not be used.</td></tr>
<tr><td>8</td><td>TEST8</td><td>⓪</td><td>It should be fixed to “0”.</td><td rowspan="2"></td></tr>
<tr><td></td><td>1</td><td>Can not be used.</td></tr>
<tr><td>9</td><td>BETA14</td><td>⓪</td><td>Matrix-outline display (12 × 18 dot)</td><td rowspan="2"></td></tr>
<tr><td></td><td>1</td><td>Matrix-outline display (14 × 18 dot)</td></tr>
<tr><td>A</td><td>HSZ10</td><td>⓪
1</td><td>
<table>
<tr><th>HSZ10</th><th>Horizontal direction size</th></tr>
<tr><td>0</td><td>1T/dot</td></tr>
<tr><td>1</td><td>2T/dot</td></tr>
</table>
</td><td>Character size setting in the horizontal direction for the first line.
T : Display frequency cycle</td></tr>
<tr><td>B</td><td>TEST11</td><td>⓪</td><td>It should be fixed to “0”.</td><td rowspan="2"></td></tr>
<tr><td></td><td>1</td><td>Can not be used.</td></tr>
<tr><td>C</td><td>HSZ20</td><td>⓪
1</td><td>
<table>
<tr><th>HSZ20</th><th>Horizontal direction size</th></tr>
<tr><td>0</td><td>1T/dot</td></tr>
<tr><td>1</td><td>2T/dot</td></tr>
</table>
</td><td>Character size setting in the horizontal direction for the 2nd line to 12th line.
T : Display frequency cycle</td></tr>
<tr><td>D</td><td>TEST12</td><td>⓪</td><td>It should be fixed to “0”.</td><td rowspan="2"></td></tr>
<tr><td></td><td>1</td><td>Can not be used.</td></tr>
<tr><td>E</td><td>MODE0
(Note 3)</td><td>⓪
1</td><td>
<table>
<tr><th>MODE1</th><th>MODE0</th><th>Display mode</th></tr>
<tr><td>0</td><td>0</td><td>Standard (Note4)</td></tr>
<tr><td>0</td><td>1</td><td>AND</td></tr>
<tr><td>1</td><td>0</td><td>EXOR</td></tr>
<tr><td>1</td><td>1</td><td>OR</td></tr>
</table>
</td><td>Sets the display mode for when 2 pages are displayed at the same time.
See “DISPLAY FORM 2”.
MODE1(address128_{16}) .</td></tr>
</table>

Notes 1. The mark ◯ around the status value means the reset status by the "L" level is input to $\overline{AC}$ pin.
2. The page in which data is written is controlled by the DAF bit. When set to "0", data is written into page 0, whereas when set to "1", data is written into page 1.
3. Registers marked with (Note 3) are found only in page 0, therefore the register value does not change when the DAF bit is set to "1".
4. 2 way settings are available by POPUP (address 126_{16}).

(9) Address 128_{16}

<table>
<tr><th rowspan="2">DA</th><th rowspan="2">Register</th><th colspan="2">Contents</th><th rowspan="2">Remarks</th></tr>
<tr><th>Status</th><th>Function</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">BCOL</td><td>⓪</td><td>Blanking of BLK0, BLK1</td><td rowspan="2">Sets all raster blanking</td></tr>
<tr><td>1</td><td>All raster blanking</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">B/$\overline{F}$
(Note 3)</td><td>⓪</td><td>Synchronize with the leading edge of horizontal synchronization.</td><td rowspan="2">Synchronize with the front porch or back porch of the horizontal synchronazation signal.</td></tr>
<tr><td>1</td><td>Synchronize with the trailing edge of horizontal synchronization.</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">VMASK
(Note 3)</td><td>⓪</td><td>Do not mask by VERT input signal</td><td rowspan="2">Set mask at phase comparison operating.</td></tr>
<tr><td>1</td><td>Mask by VERT input signal</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">POLV
(Note 3)</td><td>⓪</td><td>VERT pin is negative polarity</td><td rowspan="2">Set VERT pin polarity.</td></tr>
<tr><td>1</td><td>VERT pin is positive polarity</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">POLH
(Note 3)</td><td>⓪</td><td>HOR pin is negative polarity</td><td rowspan="2">Set HOR pin polarity.</td></tr>
<tr><td>1</td><td>HOR pin is positive polarity</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">BLK0</td><td>⓪</td><td rowspan="3"><table><tr><th>BLINK1</th><th>BLINK0</th><th>Blanking mode</th></tr><tr><td>0</td><td>0</td><td>Matrix-outline size</td></tr><tr><td>0</td><td>1</td><td>Character size</td></tr><tr><td>1</td><td>0</td><td>Border size</td></tr><tr><td>1</td><td>1</td><td>Matrix-outline size</td></tr></table>(When DSPn (address 124_{16}) = “0”)</td><td rowspan="3">Set blanking mode.
See “DISPLAY SHAPE 2”.</td></tr>
<tr><td>1</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">BLK1</td><td>⓪</td></tr>
<tr><td>1</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">SYAD</td><td>⓪</td><td>Border display of character</td><td rowspan="2">See “DISPLAY FORM1 (2)”.</td></tr>
<tr><td>1</td><td>Shadow display of character</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">RAMERS</td><td>⓪</td><td>RAM not erased</td><td rowspan="2">There is no need to reset because there is no register for this bit.</td></tr>
<tr><td>1</td><td>RAM erased</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">TEST35</td><td>⓪</td><td>It should be fixed to “0”.</td><td rowspan="2">Fix the page 1 memory (TEST13) to “0”.</td></tr>
<tr><td>1</td><td>Can not be used.</td></tr>
<tr><td rowspan="2">A</td><td rowspan="2">DSPON</td><td>⓪</td><td>Display OFF</td><td rowspan="2"></td></tr>
<tr><td>1</td><td>Display ON</td></tr>
<tr><td rowspan="2">B</td><td rowspan="2">BLINK0</td><td>⓪</td><td rowspan="3"><table><tr><th colspan="2">BLINK</th><th rowspan="2">Duty</th></tr><tr><th>1</th><th>0</th></tr><tr><td>0</td><td>0</td><td>Blinking OFF</td></tr><tr><td>0</td><td>1</td><td>25%</td></tr><tr><td>1</td><td>0</td><td>50%</td></tr><tr><td>1</td><td>1</td><td>75%</td></tr></table></td><td rowspan="3">Set blinking duty ratio.</td></tr>
<tr><td>1</td></tr>
<tr><td rowspan="2">C</td><td rowspan="2">BLINK1</td><td>⓪</td></tr>
<tr><td>1</td></tr>
<tr><td rowspan="2">D</td><td rowspan="2">BLINK2</td><td>⓪</td><td>Divided into 64 of vertical synchronous signal</td><td rowspan="2">Set blinking frequency.</td></tr>
<tr><td>1</td><td>Divided into 32 of vertical synchronous signal</td></tr>
<tr><td rowspan="2">E</td><td rowspan="2">MODE1
(Note 3)</td><td>⓪</td><td rowspan="2">For setting, see MODE0 (address 127_{16}).</td><td rowspan="2">Sets the display mode for when 2 pages are displayed at the same time.</td></tr>
<tr><td>1</td></tr>
</table>

Notes 1. The mark ◯ around the status value means the reset status by the "L" level is input to $\overline{AC}$ pin.
2. The page in which data is written is controlled by the DAF bit. When set to "0", data is written into page 0, whereas when set to "1", data is written into page 1.
3. Registers marked with (Note 3) are found only in page 0, therefore the register value does not change when the DAF bit is set to "1".

DISPLAY FORM 1

M35049-XXXFP has the following four display forms.

(1) Blanking mode

Character size
: Blanking same as the character size.

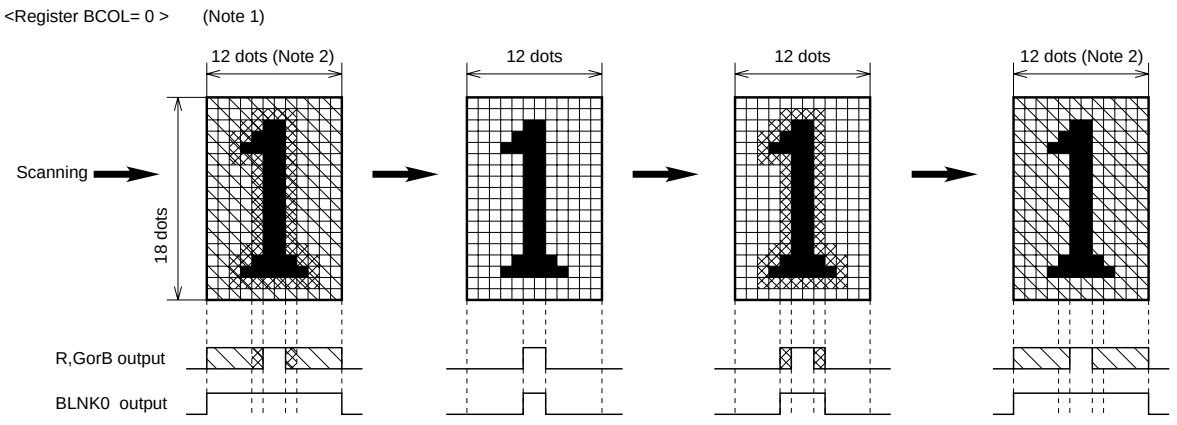
Border size
: Blanking the background as a size from character.

Matrix-outline size
: Blanking the background 12 ×18 dot.

All blanking size
: When set register BCOL to “1”, all raster area is blanking.

The display mode and blanking mode can be set line-by-line, as follows, from registers BCOL, BLK1, BLK0 (address 128_{16}), DSP0 to DSP11 (address 124_{16}).

BCOL	BLK1	BLK0	Line of DSPn = “0”		Line of DSPn = “1”	
			Display mode	Blanking mode	Display mode	Blanking mode
0	0	0	All matrix-outline border display	All matrix-outline size	All matrix-outline display	All matrix-outline size
	0	1	Character display	Character size	Border display	Border size
	1	0	Border display	Border size	All matrix-outline display	All matrix-outlinesize
	1	1	All matrix-outline display	All matrix-outline size	Character display	Character size
1	0	0	All matrix-outline border display	All blanking size	All matrix-outline display	All blanking size
	0	1	Character display		Border display	
	1	0	Border display		All matrix-outline display	
	1	1	All matrix-outline display		Character display	



Note 1. When register BCOL is set to 1 , the raster range of the display modes set respectively by BLK1 and BLK0 are colored by registers RR, RG, and RB (address 127_{16}). And the blanking mode is set all blanking size (all raster size) regardless of the BLK1 and BLK0 settings.
Note 2. The horizontal size of the full matrix-outline size can be set to 14 dots by register BETA14 (address 127_{16}). BLNK0 can also be output at 14 dots.

Fig. 4 Display form

(2) Shadow display

When border display mode, if set SYAD (address 128_{16}) = “0” to “1”, it change to shadow display mode.
Border and shadow display are shown below.
Set shadow display color by BR, BG or BB of display RAM or by register FR, FG and FB (address 127_{16}).

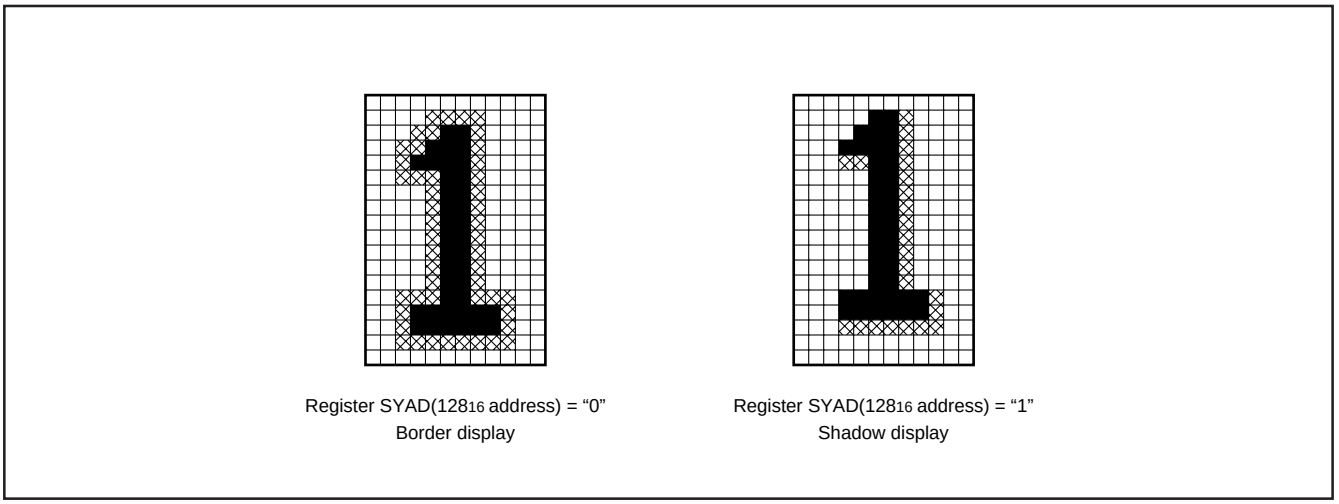


Fig. 5 Border and shadow display

DISPLAY FORM 2

This IC can display both page 0 and page 1 at the same time.
Page 0: Set the DAF bit in each addresses to "0".
Page 1: Set the DAF bit in each addresses to "1".

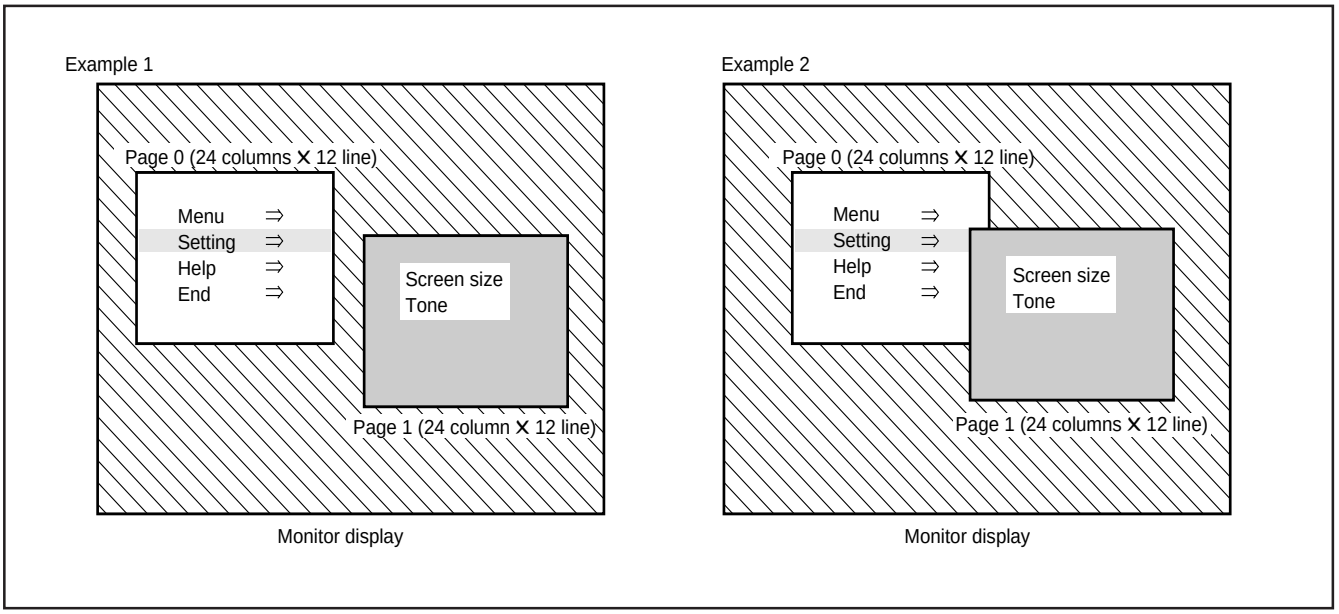


Fig.6 Example of 2 pages display

Example 1: Display position, display size, color, etc., can be freely set for each page, and the 2 pages can be displayed on top of each other or side-by-side.

Example 2: When the display range of the 2 pages overlap on the monitor screen, they can be displayed in the 5 below ways using registers MODE0 (address 127_{16}), MODE1 (address 128_{16}) and POPUP (address 126_{16}). (The POPUP register is effective only when MODE0 = "0" and MODE1 = "0".)

MODE1	MODE0	POPUP	Display mode
0	0	0	Standard (Page 1 priority)
		1	Standard (Page 0 priority)
0	1	—	AND
1	0	—	EXOR
1	1	—	OR

(1) Standard (page 1 priority) … Page 1 has priority in overlapping areas. Page 0 is not displayed in those areas.
(2) Standard (page 0 priority) … Page 0 has priority in overlapping areas. Page 1 is not displayed in those areas.
(3) AND ..... In overlapping areas, the RGB output of the 2 pages is AND processed and output.
(4) EXOR ..... In overlapping areas, the RGB output of the 2 pages is EXOR processed and output.
(5) OR ..... In overlapping areas, the RGB output of the 2 pages is OR processed and output.

CHARACTER FONT

Images are composed on a 12 × 18 dot matrix, and characters can be linked vertically and horizontally with other characters to allow the display the continuous symbols.
Character code FF_{16} is fixed as a blank without background. Therefore, cannot register a character font in this code.

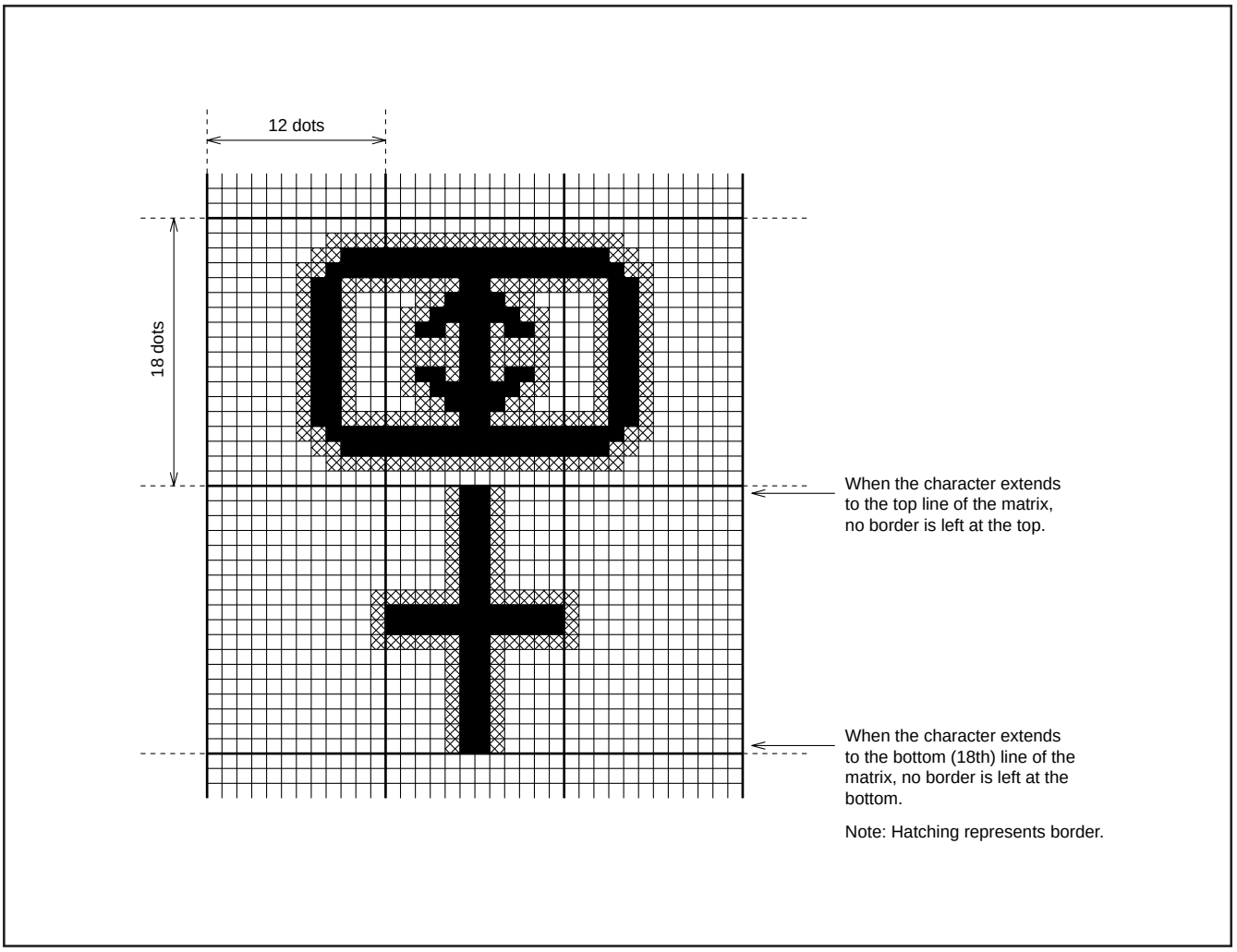


Fig.7 Example of border display

DATA INPUT EXAMPLE

Data of display RAM and display control registers can be set by the 16-bit serial input function. Example of data setting is shown in Figure 8.

Data input example (M35049-XXXFP)

Address/data	DAF (Note1)	DAE	DAD	DAC	DAB	DAA	DA9	DA8	DA7	DA6	DA5	DA4	DA3	DA2	DA1	DA0	Remarks
	200m sec hold																System set up
Address 120₁₆	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	Address setting
Data 120₁₆	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 page: Frequency value setting (Note2)
Data 121₁₆	0	0	PTD7	PTD6	1	PTD4	1	PTD2	1	1	1	0	1	0	1	1	0 page: Output setting
Data 122₁₆	0	0	0	0	0	0	0	HP8	HP7	HP6	HP5	HP4	HP3	HP2	HP1	HP0	0 page: Horizontal display location setting
Data 123₁₆	0	0	0	0	0	0	0	0	VP7	VP6	VP5	VP4	VP3	VP2	VP1	VP0	0 page: Vertical display location setting
Data 124₁₆	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 page: Display form setting
Data 125₁₆	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 page: Character size setting
Data 126₁₆	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 page: Character size setting
Data 127₁₆	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 page: Color, character size setting
Data 128₁₆	0	0	0	0	0	0	0	0	0	0	0	POLH	POLV	0	0	0	Page 0 display OFF
Address 122₁₆	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	Address setting
Data 122₁₆	1	0	0	0	0	0	0	HP8	HP7	HP6	HP5	HP4	HP3	HP2	HP1	HP0	1 page: Horizontal display location setting
Data 123₁₆	1	0	0	0	0	0	0	0	VP7	VP6	VP5	VP4	VP3	VP2	VP1	VP0	1 page: Vertical display location setting
Data 124₁₆	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 page: Display form setting
Data 125₁₆	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 page: Character size setting
Data 126₁₆	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 page: Character size setting
Data 127₁₆	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 page: Color, character size setting
Data 128₁₆	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Page 1 display OFF
Data 000₁₆	0	BB	BG	BR	BLINK	B	G	R	C7	C6	C5	C4	C3	C2	C1	C0	0 page: Character setting
⋮	⋮	Background coloring			Blink-ing	Character color			Character code								0 page: Character setting
Data 11F₁₆	0	BB	BG	BR	BLINK	B	G	R	C7	C6	C5	C4	C3	C2	C1	C0	0 page: Character setting
Address 000₁₆	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Data 000₁₆	1	BB	BG	BR	BLINK	B	G	R	C7	C6	C5	C4	C3	C2	C1	C0	1 page: Character setting
⋮	⋮	Background coloring			Blink-ing	Character color			Character code								1 page: Character setting
Data 11F₁₆	1	BB	BG	BR	BLINK	B	0	R	C7	C6	C5	C4	C3	C2	C1	C0	1 page: Character setting
Address 128₁₆	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	Address setting
Data 128₁₆	1	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	Page 1 display ON Display form setting (Note 2)
Address 128₁₆	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	Address setting
Data 128₁₆	0	0	0	0	0	1	0	0	0	1	1	POLH	POLV	0	0	0	Page 0 display ON Display form setting (Note 2)

Notes 1 : The page in which data is written is controlled by the address. To write data into page 0, set "0". To write data into page 1, set "1".
2 : Matrix-outline display in this data.
3 : Input a continuous clock of constant period from the TCK pin.

Fig 8. Example of data setting

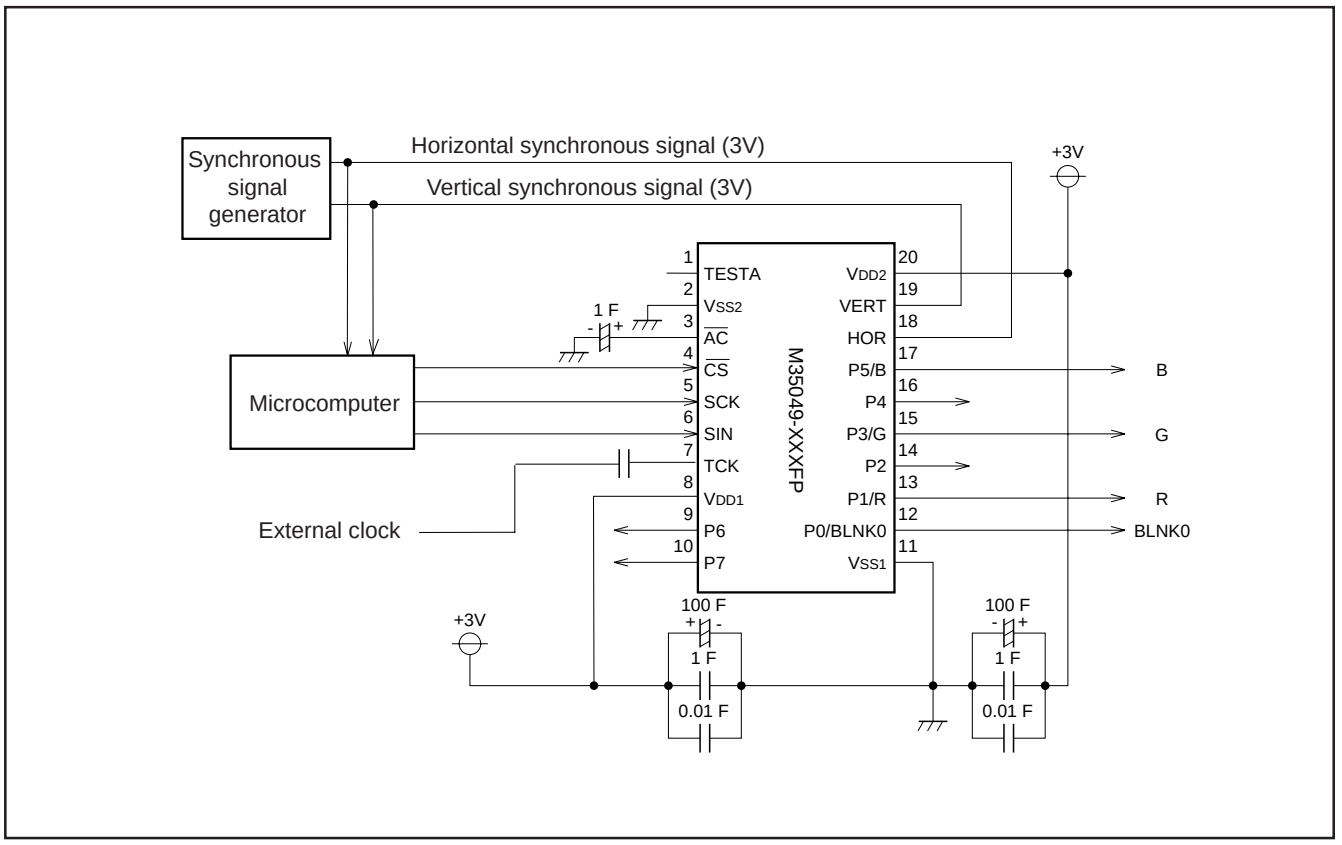


Fig. 9 Example of the M35049-XXXFP peripheral circuit

SERIAL DATA INPUT TIMING

(1)Serial data should be input with the LSB first.
(2)The address consists of 16 bits.
(3)The data consists of 16 bits.
(4)The 16 bits in the SCK after the $\overline{CS}$ signal has fallen are the address, and for succeeding input data, the address is incremented every 16 bits. Therefore, it is not necessary to input the address from the second data.

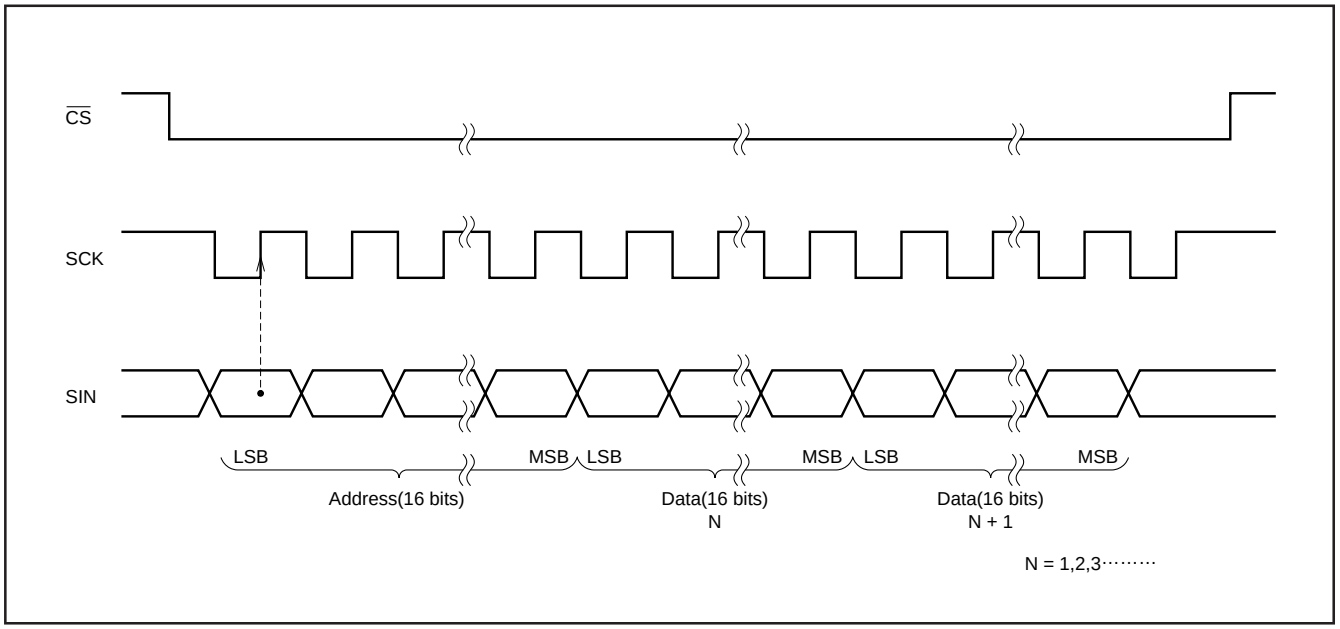


Fig.10 Serial input timing

TIMING REQUIREMENTS (Ta = –20°C to + 85°C, V_{DD} = 2.2 to 3.5V, unless otherwise noted)

Data input

Symbol	Parameter	Limits			Unit	Remarks
		Min.	Typ.	Max.		
$t_{w(SCK)}$	SCK width	200	—	—	ns	See Figure 11
$t_{su(\overline{CS})}$	$\overline{CS}$ setup time	200	—	—	ns	
$t_{h(\overline{CS})}$	$\overline{CS}$ hold time	2	—	—	µs	
$t_{su(SIN)}$	SIN setup time	200	—	—	ns	
$t_{h(SIN)}$	SIN hold time	200	—	—	ns	
t_{word}	1 word writing time	10	—	—	µs	

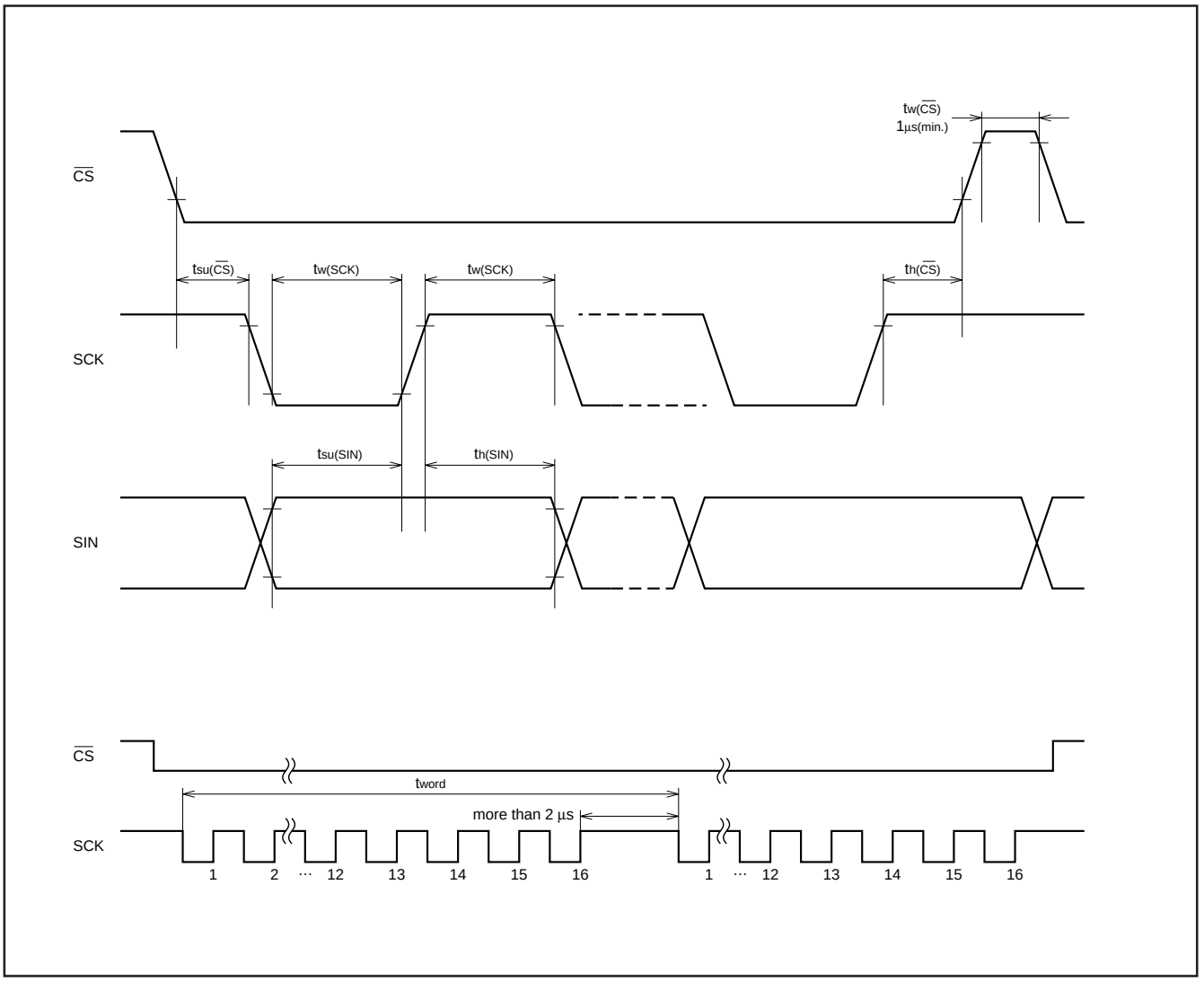


Fig. 11 Serial input timing requirements

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
V_{DD}	Supply voltage	With respect to V_{SS}.	–0.3 to +4.0	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	Ta = +25°C	+300	mW
T_{opr}	Operating temperature		–20 to +85	°C
T_{stg}	Storage temperature		–40 to +125	°C

RECOMMENDED OPERATING CONDITIONS (V_{DD} = 3.00V, Ta = –20 to +85°C, unless otherwise noted)

Symbol	Parameter		Limits			Unit
			Min.	Typ.	Max.	
V_{DD}	Supply voltage		2.2	3.0	3.5	V
V_{IH}	“H” level input voltage	$\overline{AC}$,$\overline{CS}$,HOR,SIN,SCK,VERT	0.8V_{DD}	V_{DD}	V_{DD}	V
V_{IL}	“L” level input voltage	$\overline{AC}$,$\overline{CS}$,HOR,SIN,SCK,VERT	0	0	0.2V_{DD}	V
F_{OSC}	Oscillating frequency for display		6.3	—	16.0	MHz
H.sync	Horizontal synchronous signal input frequeney		15.0	—	32.0	kHz

ELECTRICAL CHARACTERISTICS (V_{DD} = 3.00V, Ta = 25°C, unless otherwise noted)

Symbol	Parameter		Test conditions	Limits			Unit
				Min.	Typ.	Max.	
V_{DD}	Supply voltage		Ta = –20 to +85°C	2.20	3.00	3.50	V
I_{DD}	Supply current		V_{DD} = 3.00V	—	5	10	mA
V_{OH}	“H” level output voltage	P0 to P7 (Note1)	V_{DD} = 2.20V, I_{OH} = -0.1mA	1.80	—	—	V
V_{OL}	“L” level output voltage	P0 to P7 (Note2)	V_{DD} = 2.20V, I_{OH} = 0.1mA	—	—	0.4	V
R_I	Pull-up resistance $\overline{AC}$		V_{DD} = 3.00V	30	—	150	kΩ
V_{TCK}	External clock input width		2.20V ≤ V_{DD} ≤ 3.50V	0.7V_{DD}	—	V_{DD}	V

Notes 1. The current from the IC must not exceed – 0.1 mA/port at any of the port pins (P0 to P7).
2. The current flowing into the IC must not exceed 0.1 mA/port at any of port pins (P0 to P7).

NOTE FOR SUPPLYING POWER

(1)Timing of power supplying to $\overline{AC}$ pin
The internal circuit of M35049-XXXFP is reset when the level of the auto clear input pin $\overline{AC}$ is "L". This pin in hysteresis input with the pull-up resistor.
The timing about power supplying of $\overline{AC}$ pin is shown in Figure 12.

After supplying the power (V_{DD} and V_{SS}) to M35049-XXXFP and the supply voltage becomes more than 0.8 × V_{DD}, it needs to keep V_{IL} time; tw of the $\overline{AC}$ pin for more than 1ms.
Start inputting from microcomputer after $\overline{AC}$ pin supply voltage becomes more than 0.8 × V_{DD} and keeping 200ms wait time.

(2)Timing of power supplying to V_{DD1} and V_{DD2}.
Supply power to V_{DD1} and V_{DD2} at the same time.

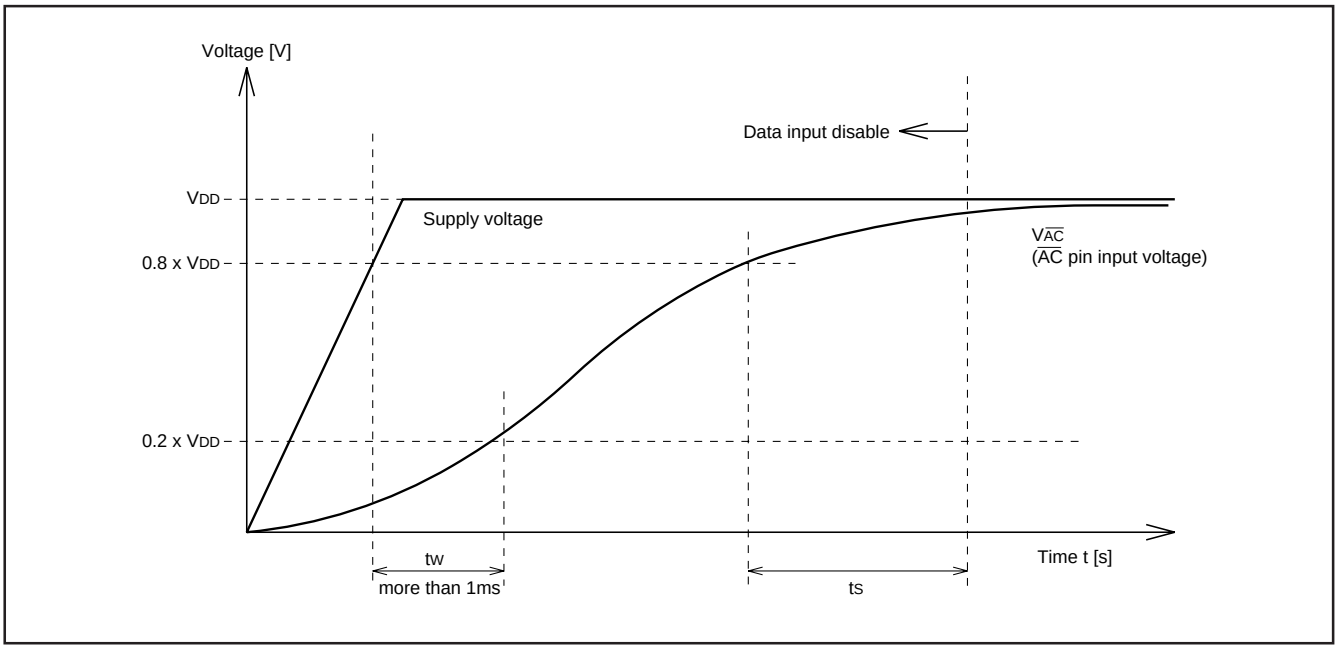


Fig. 12 Timing of power supplying to $\overline{AC}$ pin

PRECAUTION FOR USE

Notes on noise and latch-up

In order to avoid noise and latch-up, connect a bypass capacitor (≈0.1µF) directly between the V_{DD1} pin and V_{SS1} pin, and the V_{DD2} pin and V_{SS2} pin using a heavy wire.

Note for horizontal synchronous signal input to the HOR pin

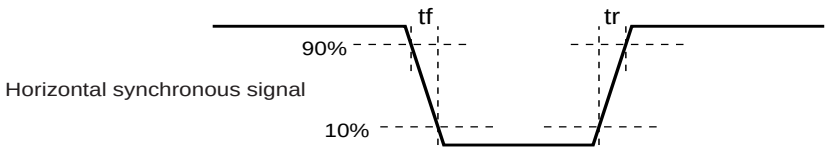
Set horizontal synchronous signal edge* waveform timing to under 5ns and input to HOR pin.
Set only the side which set by B/$\overline{F}$ register waveform timing under 5ns and input to HOR pin.
*: Set front porch edge or back porch edge by B/$\overline{F}$ register (address 12816).

Note for external clock input to the TCK pin

Input to the TCK pin a constant-period continuous external clock that synchronizes with the horizontal synchronous signal. Never stop inputting the clock while displaying.

DATA REQUIRED FOR MASK ROM ORDERING

Please send the following data for mask orders.
(1) M35049-XXXFP mask ROM order confirmation form
(2) 20P2Q-A mask specification from
(3) ROM data : EPROMs or floppy disks
*In the cace of EPROMs, three sets of EPROMs are required per pattern.
*In the cace of floppy disks, 3.5-inch 2HD disk (IBM format) is required per pattern.



STANDARD ROM TYPE : M35049-001FP

M35049-001FP is a standard ROM type of M35049-XXXFP. The character patterns for 0 page are fixed to the contents of Figure 13 to 16, the character patterns for page 1 are fixed to the contents of Figure 17 to 20.

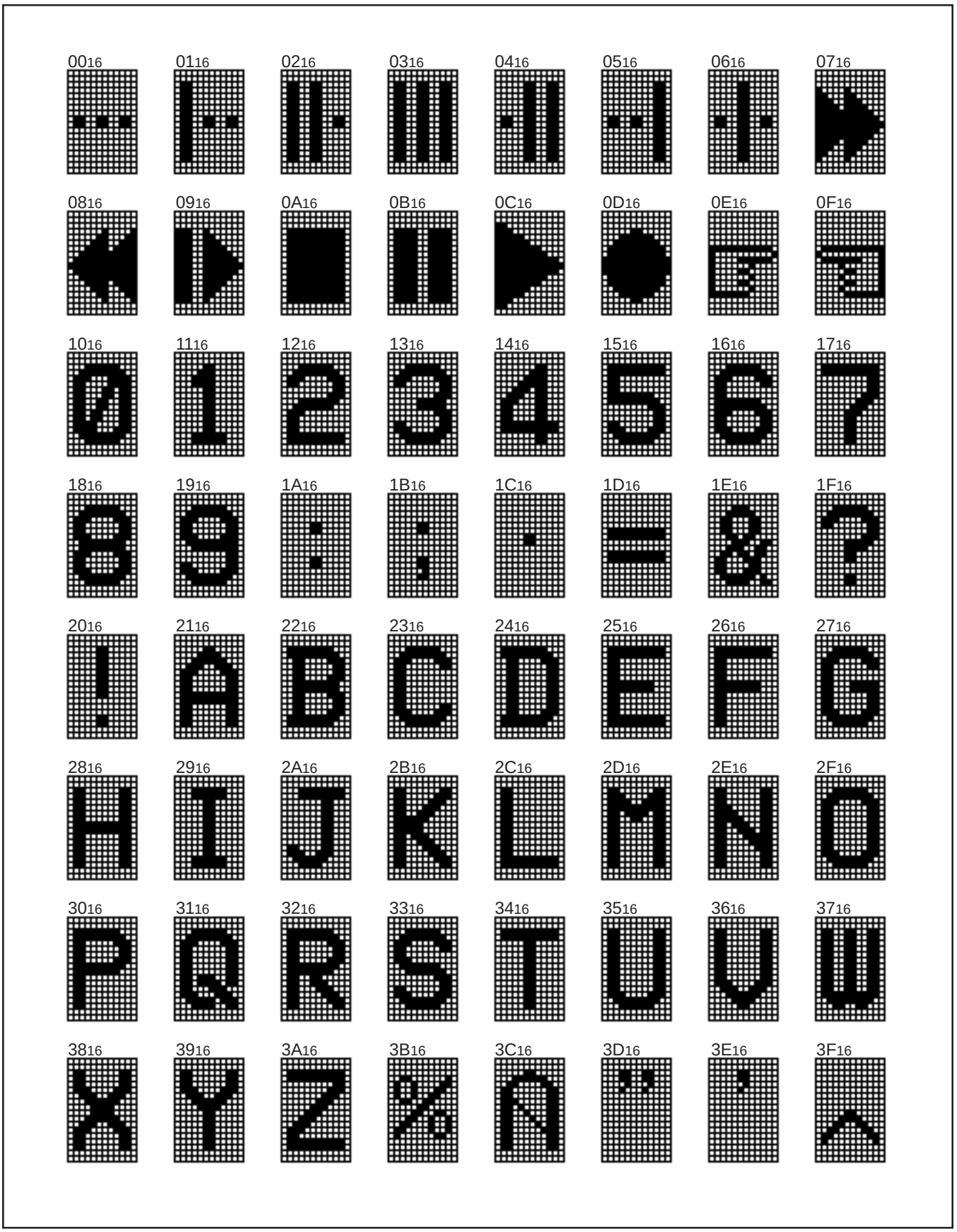


Fig. 13 M35049-001FP character pattern for page 0 (1)

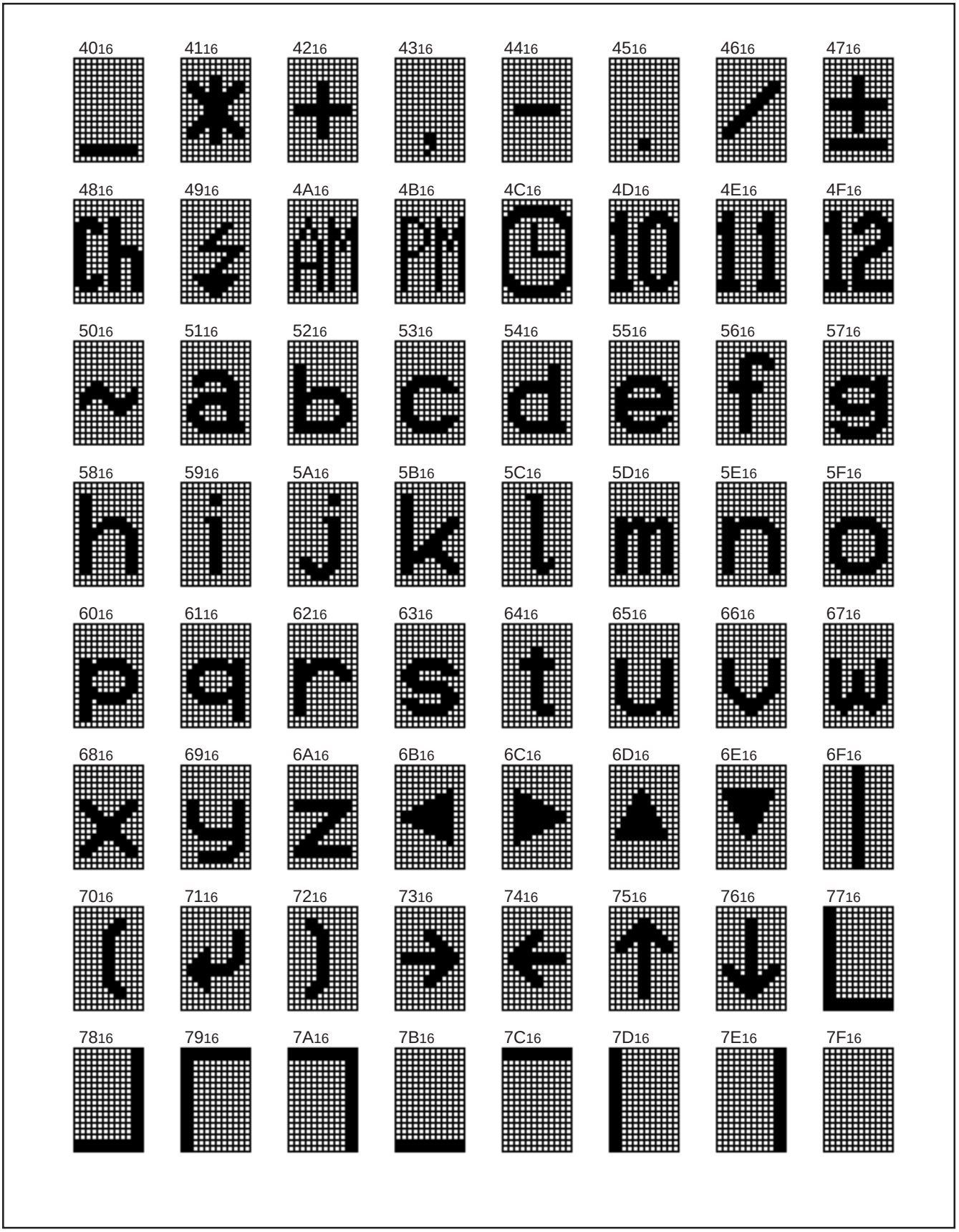


Fig. 14 M35049-001FP character pattern for page 0 (2)

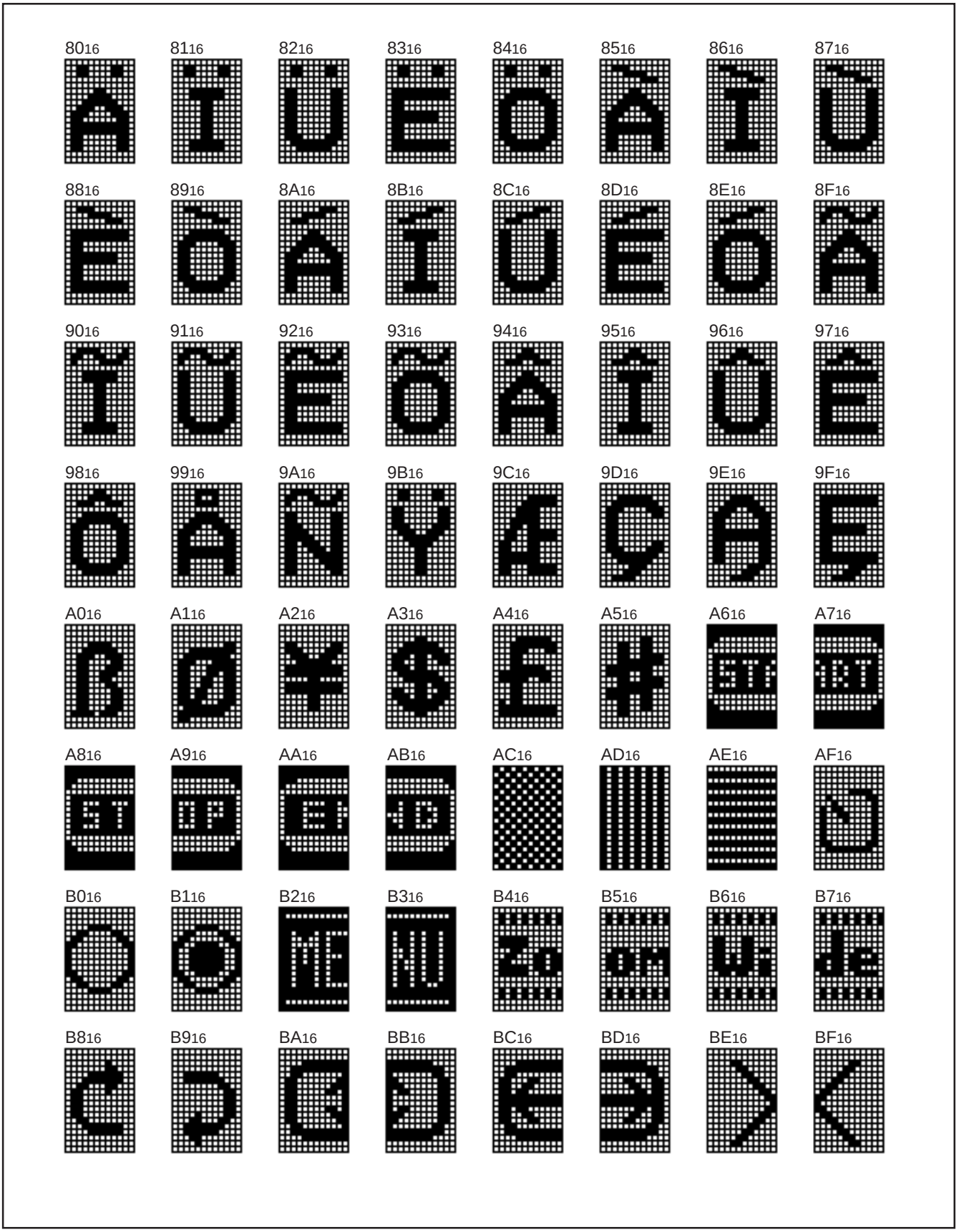


Fig. 15 M35049-001FP character pattern for page 0 (3)

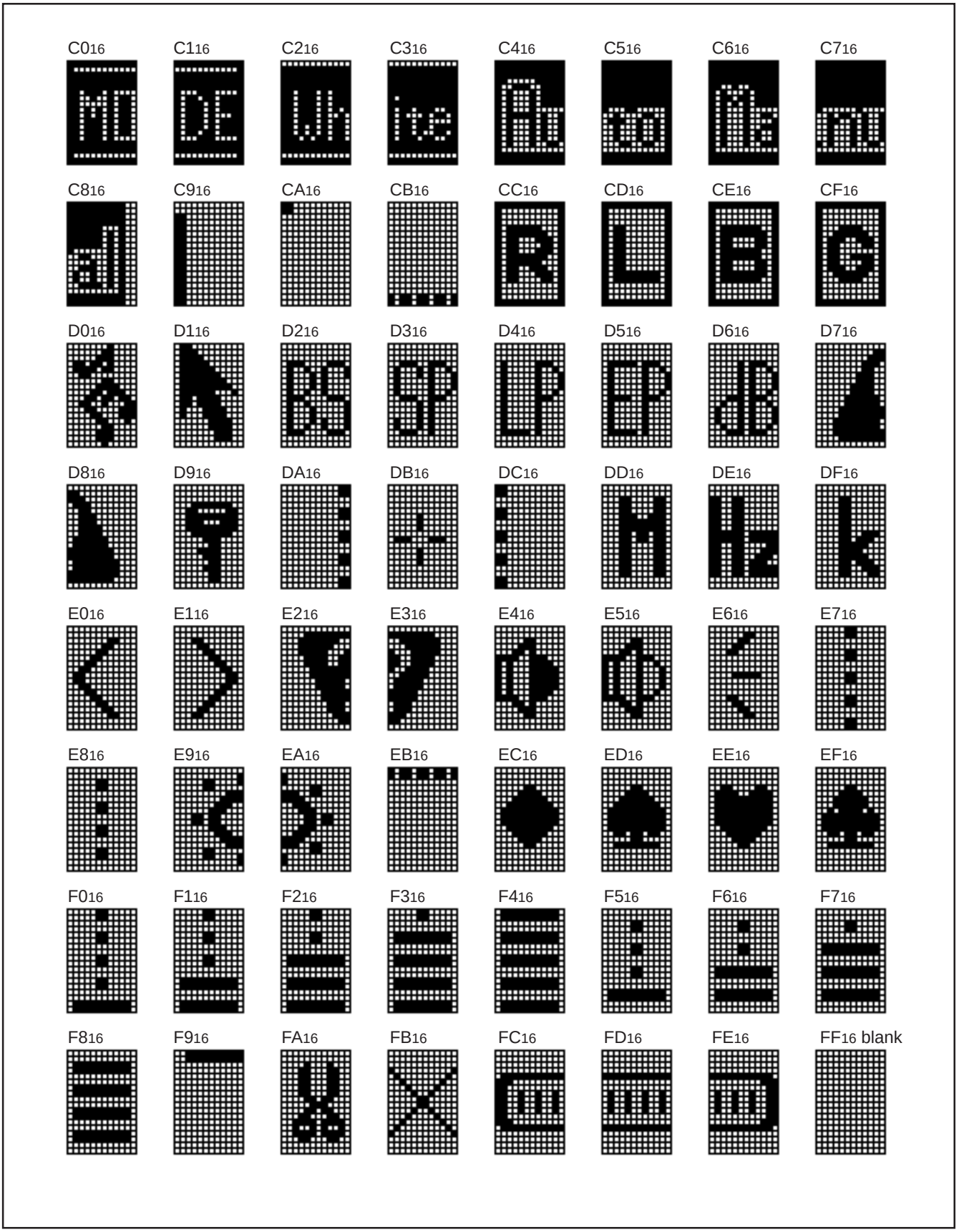


Fig. 16 M35049-001FP character pattern for page 0 (4)

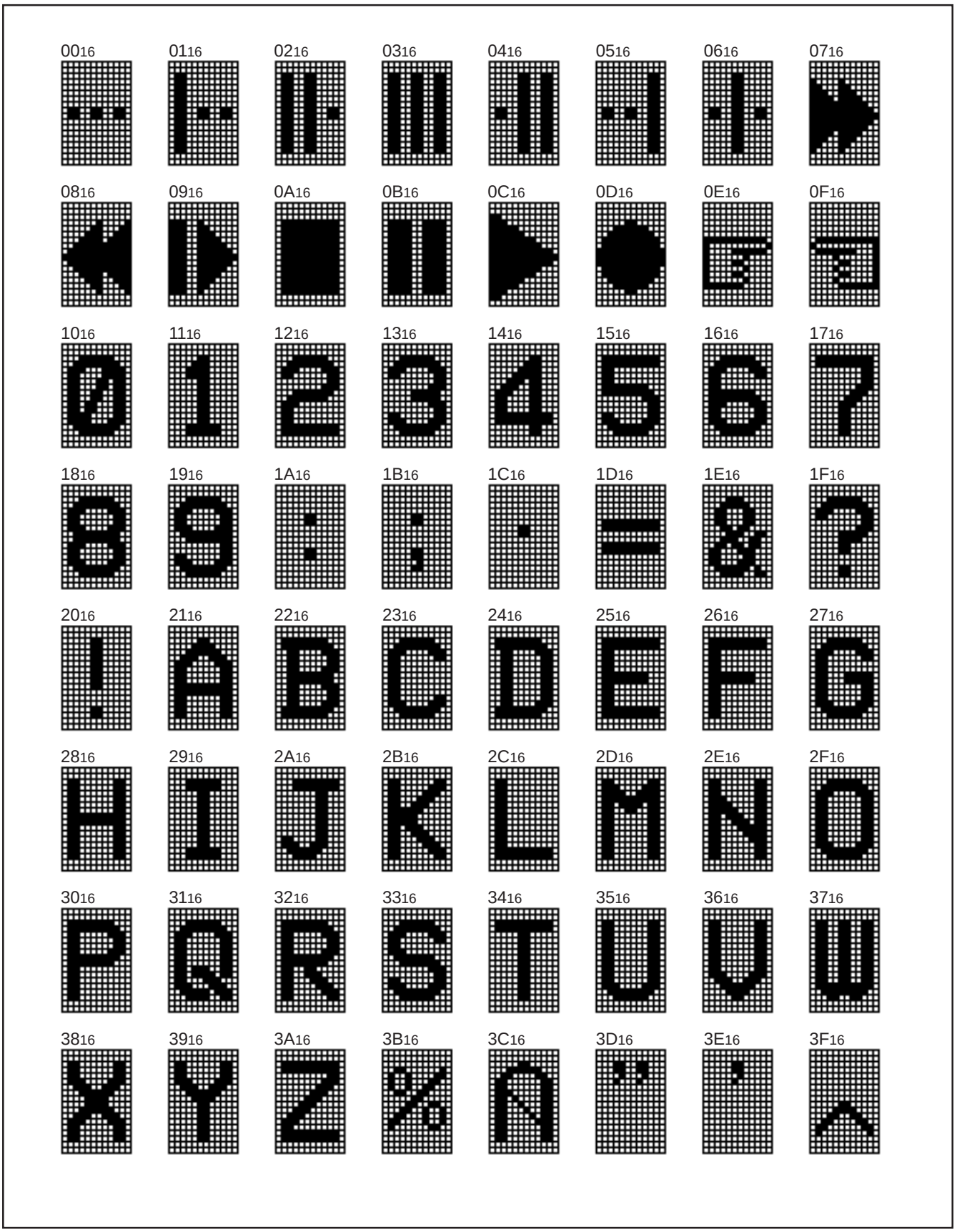


Fig. 17 M35049-001FP character pattern for page 1 (1)

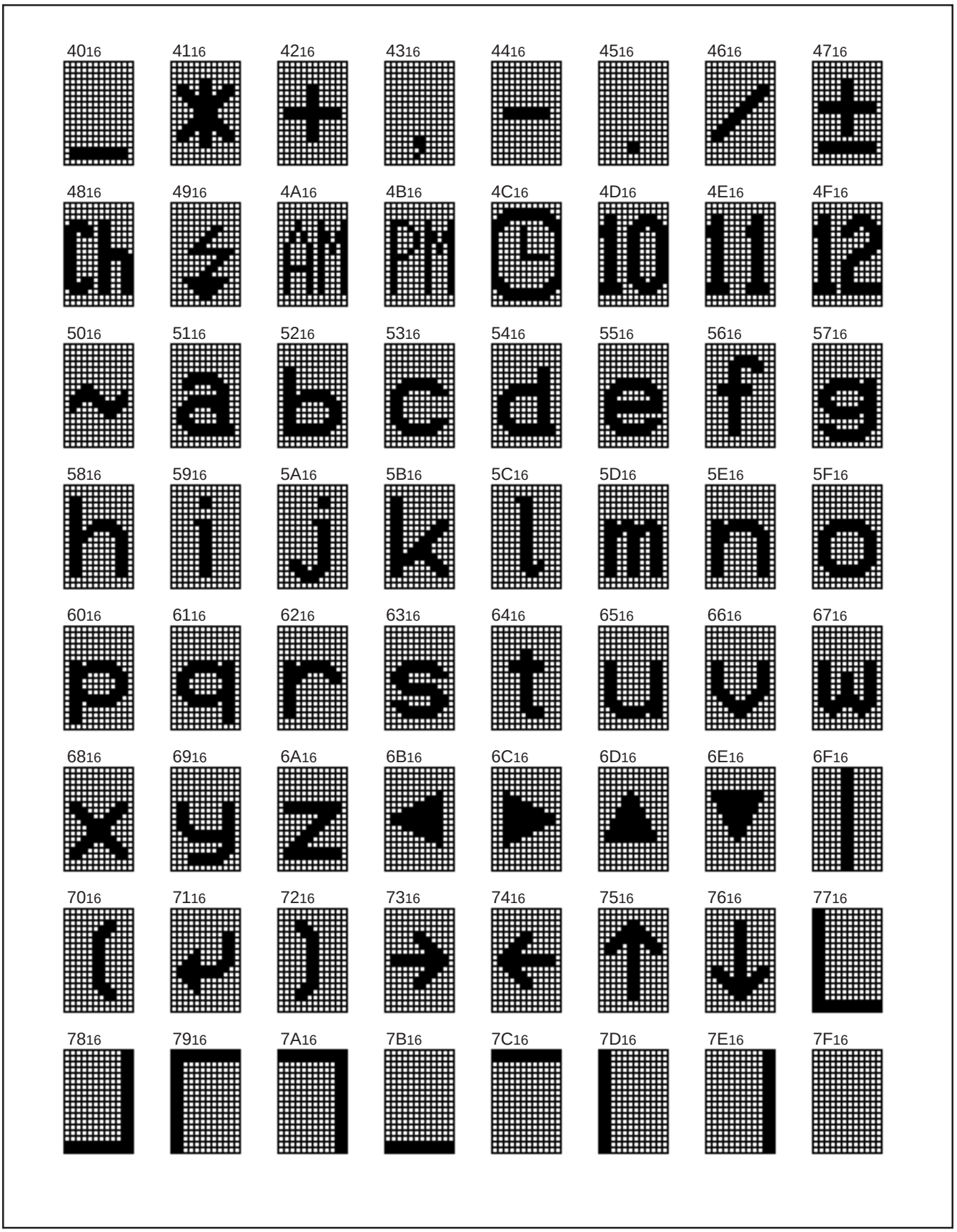


Fig. 18 M35049-001FP character pattern for page 1 (2)

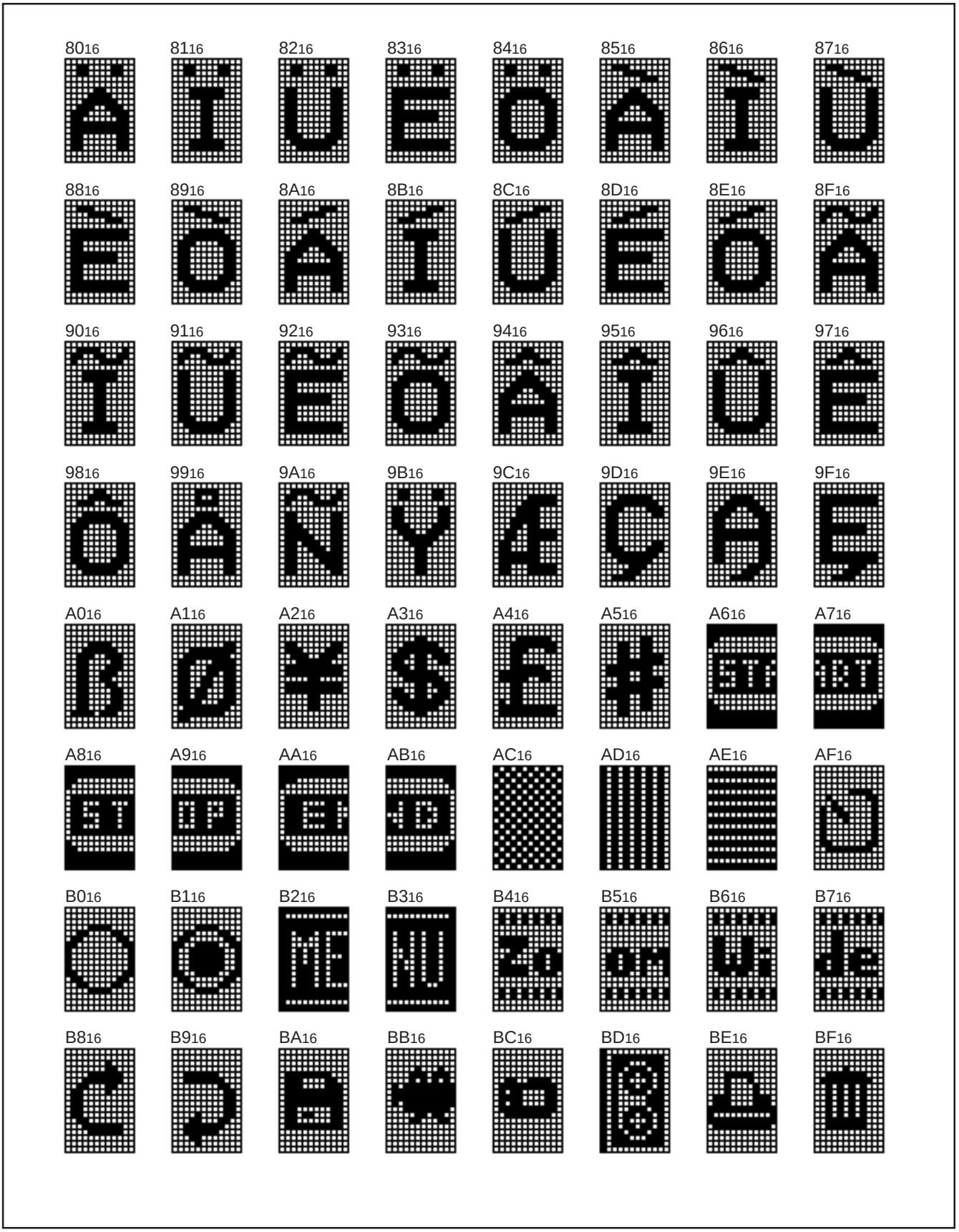


Fig. 19 M35049-001FP character pattern for page 1 (3)

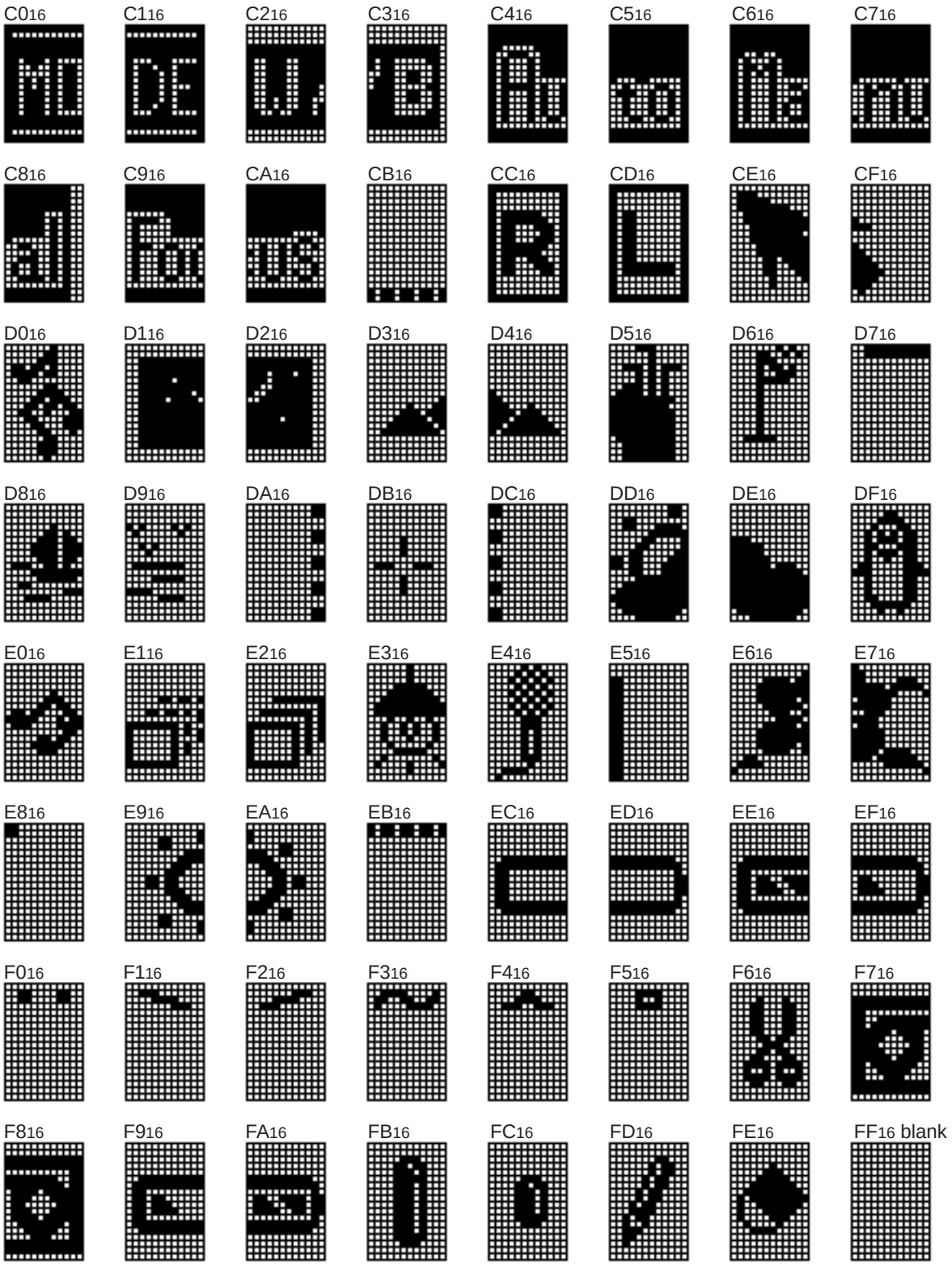


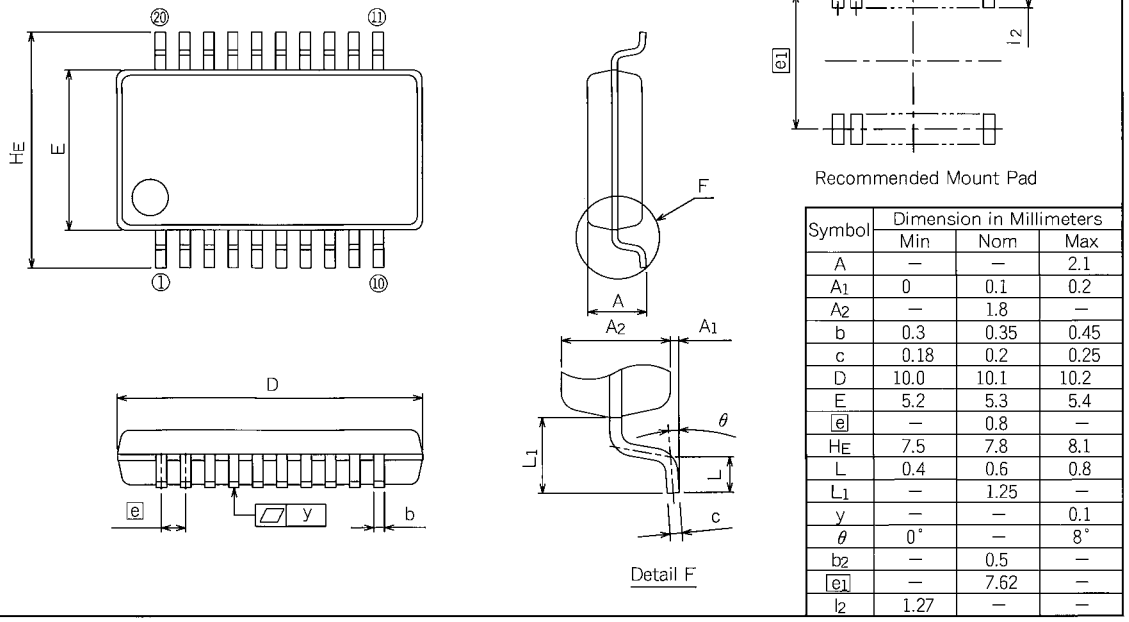
Fig. 20 M35049-001FP character pattern for page 1 (4)

20P2Q−A

Plastic 20pin 300mil SSOP

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
SSOP020-P-0300	—	0.2	Cu Alloy

Scale : 4/1



Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	—	—	2.1
A_1	0	0.1	0.2
A_2	—	1.8	—
b	0.3	0.35	0.45
c	0.18	0.2	0.25
D	10.0	10.1	10.2
E	5.2	5.3	5.4
e	—	0.8	—
H_E	7.5	7.8	8.1
L	0.4	0.6	0.8
L_1	—	1.25	—
y	—	—	0.1
θ	0°	—	8°
b_2	—	0.5	—
e_1	—	7.62	—
l_2	1.27	—	—

M35049-XXXFP

SCREEN CHARACTER and PATTERN DISPLAY CONTROLLERS

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

RENESAS
Renesas Technology Corp.

REVISION DESCRIPTION LIST	M35049-XXXFP DATA SHEET

Rev. No.	Revision Description	Rev. date
1.0	First Edition	980402
1.1	P47 20P2Q-A (20-PIN SSOP) MARK SPECIFICATION FORM B: Note 4 added	000707
1.2	Delete Mask ROM ORDER CONFIRMATION FORM and MASK SPECIFICATION FORM	000829