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1. SCOPE

This specification is applied to the MD-TFD LCD module L2F50052T01 manufactured by SEIKO EPSON.

2. FEATURES

The MD-TFD LCD module is designed to be suitable for use in display.

* Combined unit that consists of a LCD panel, backlight unit, and a control circuit for driving the LCD panel.
* Active matrix driving.
* semi transparent reflective type display.

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3. BASIC SPECIFICATIONS

3.1 STRUCTURES

PARAMETER	SPECIFICATIONS
outward	37.6 (W) x 49.132 (H) x 4.25 (D) mm (excluding the FPC, mould, and the part of protruding)
weight	TBD g (excluding protective film and tab)
screen size	28.908 (W) x 38.544 (H) mm
number of dots	396(132xRGB)(horizontal) x 176(vertical) dots
dot pitch	0.073(horizontal) x 0.219(vertical) μm
dot layout	stripe
viewing direction	12:00
liquid crystal mode	RTN (normally white)
polarizer	low reflective type with hard coating
polarize hardness	2H

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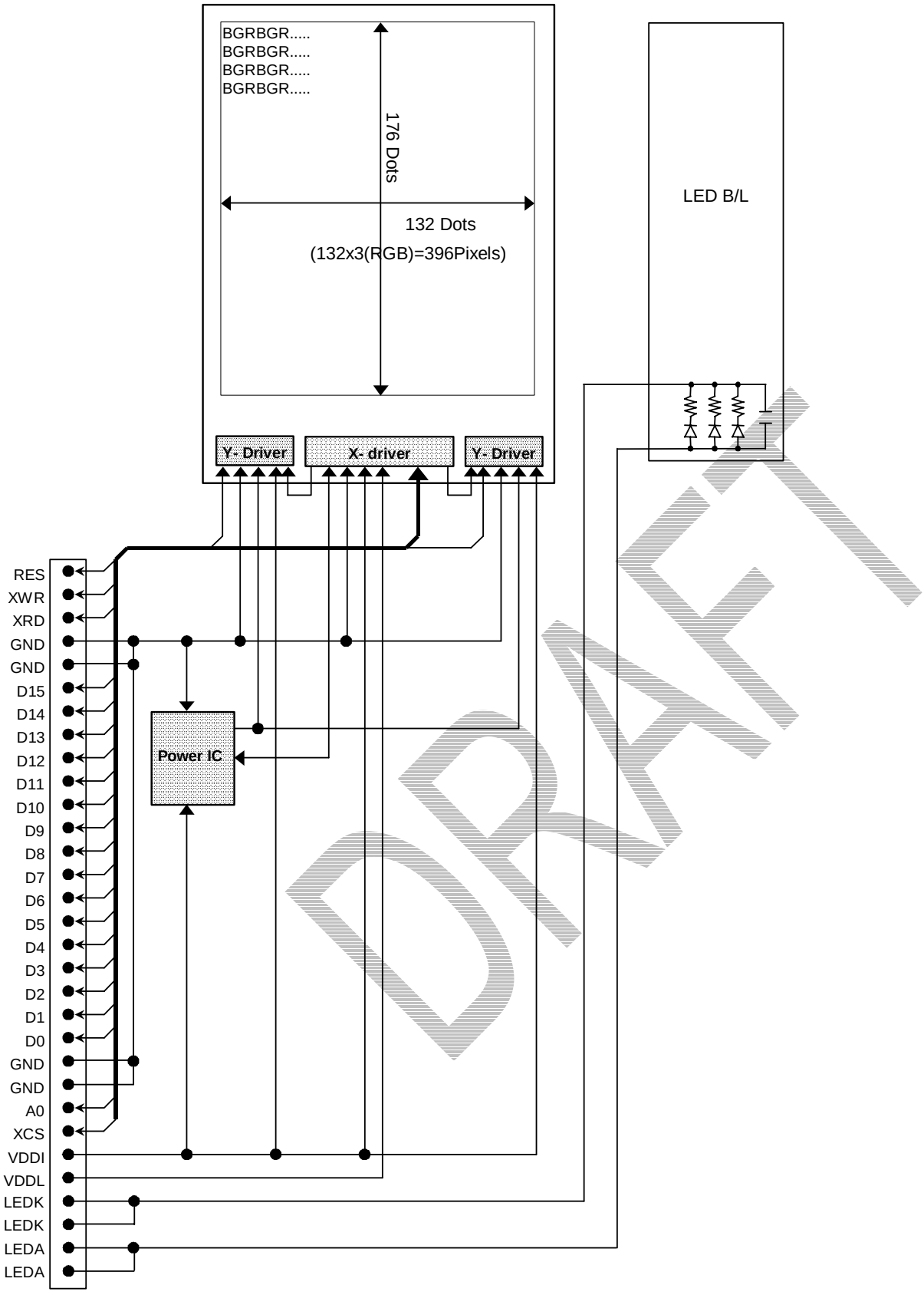
3.2 BLOCK DIAGRAM



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3.3 I/O PINS

PIN.	SYMBOL	FUNCTION	I/O	REMARKS
1	XRES	initial reset	I	Low active
2	XWR	write control	I	rising edge operation
3	XRD	read control	I	falling edge operation
4	GND	ground	P	
5	GND	ground	P	
6	D15	data bus	I/O	display content
7	D14	data bus	I/O	display content
8	D13	data bus	I/O	display content
9	D12	data bus	I/O	display content
10	D11	data bus	I/O	display content
11	D10	data bus	I/O	display content
12	D9	data bus	I/O	display content
13	D8	data bus	I/O	display content
14	D7	data bus	I/O	command / parameter / display content
15	D6	data bus	I/O	command / parameter / display content
16	D5	data bus	I/O	command / parameter / display content
17	D4	data bus	I/O	command / parameter / display content
18	D3	data bus	I/O	command / parameter / display content
19	D2	data bus	I/O	command / parameter / display content
20	D1	data bus	I/O	command / parameter / display content
21	D0	data bus	I/O	command / parameter / display content
22	GND	ground	P	
23	GND	ground	P	
24	A0	data type ID signal	I	
25	XCS	chip select signal	I	H; D15~0 = high impedance
26	VDDI	power supply	P	(2.8V)
27	VDDL	power supply	P	(2.5V)
28	LEDK	power supply for LED B/L	P	
29	LEDK	power supply for LED B/L	P	
30	LEDA	power supply for LED B/L	P	
31	LEDA	power supply for LED B/L	P	

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4. INTERFACES

4.1 OVERVIEW

LCD module has an MPU interface using 16/8 bit parallel bus for transfers of command, parameter and display content.

4.1.1 signal identification

LCD module defines the type of signals on data bus using input A0 for both writing and reading operation.

A0	XWR	XRD	type of signals
1	0↑	1	parameter / display content to write
0	0↑	1	command to write
1	1	0	display content to read (incremented by every falling edge of XRD)
0	1	0	status to read

When this module is in any other than chip select active state, D15~0 have high impedance and input signals on A0 , XRD, and XWR pins are invalid.
If XCS turns to "H" before command, required subsequent parameters, and display content are completely entered, function must be specified as following.

XCS turns to "H" when	function
during entering parameters	Waits to be entered parameters completely. The command accompanied with parameters is executed when the parameters are entered completely. If another command is entered before this command and subsequent parameters are completely entered, <all commands except for PTLIN> ... parameters entered up to that time are valid. <PTLIN> ... command PTLIN is invalid.
during entering display content	<when the write command is executing> retains write command / waits for display content * turn XCS to "L" and input XWR to continue write operation <when the read command is executing> retains write command and address / waits for display content * turn XCS to "L" and input XRD to continue read operation

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4.1.2 input data mode

The data modes are set by DATCTL command. In any case, 666 mode-8 is set after a reset.

5.6.5 mode-16 (16bit bus)

Cycle count	0	1	2	…	n+1
A0	0	1	1	…	1
D15	x	0DR5	1DR5	…	nDR5
D14	x	0DR4	1DR4	…	nDR4
D13	x	0DR3	1DR3	…	nDR3
D12	x	0DR2	1DR2	…	nDR2
D11	x	0DR1	1DR1	…	nDR1
D10	x	0DG5	1DG5	…	nDG5
D9	x	0DG4	1DG4	…	nDG4
D8	x	0DG3	1DG3	…	nDG3
D7	CD7	0DG2	1DG2	…	nDG2
D6	CD6	0DG1	1DG1	…	nDG1
D5	CD5	0DG0	1DG0	…	nDG0
D4	CD4	0DB5	1DB5	…	nDB5
D3	CD3	0DB4	1DB4	…	nDB4
D2	CD2	0DB3	1DB3	…	nDB3
D1	CD1	0DB2	1DB2	…	nDB2
D0	CD0	0DB1	1DB1	…	nDB1

- CD: 5CH when writing memory
  5DH when reading memory
- When writing memory, nDR0 is set to nDR5, and nDB0 is set to nDB5.
- x: Invalid data ("H" or "L")

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6.6.6 mode-8 (8bit bus)

Cycle count	0	1	2	3	4	…	3n+1	3n+2	3n+3
A0	0	1	1	1	1	…	1	1	1
D7	CD7	0DR5	0DG5	0DB5	1DR5	…	nDR5	nDG5	nDB5
D6	CD6	0DR4	0DG4	0DB4	1DR4	…	nDR4	nDG4	nDB4
D5	CD5	0DR3	0DG3	0DB3	1DR3	…	nDR3	nDG3	nDB3
D4	CD4	0DR2	0DG2	0DB2	1DR2	…	nDR2	nDG2	nDB2
D3	CD3	0DR1	0DG1	0DB1	1DR1	…	nDR1	nDG1	nDB1
D2	CD2	0DR0	0DG0	0DB0	1DR0	…	nDR0	nDG0	nDB0
D1	CD1	x	x	x	x	…	x	x	x
D0	CD0	x	x	x	x	…	x	x	x

• CD: 5CH when writing memory
5DH when reading memory
• x: Invalid data ("H" or "L")

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4.2 COMMANDS

4.2.1 command list

	Command	A0	RD	WRB	D7	D6	D5	D4	D3	D2	D1	D0	Function	Hex	Parameters
1	DISON	0	1	0	1	0	1	0	1	1	1	1	display on	AF	No
2	DISOFF	0	1	0	1	0	1	0	1	1	1	0	display off	AE	No
3	DISNOR	0	1	0	1	0	1	0	0	1	1	0	display normal	A6	No
4	DISINV	0	1	0	1	0	1	0	0	1	1	1	display inverted	A7	No
5	DISCTL	0	1	0	1	1	0	0	1	0	1	0	display control	CA	Yes
6	SLPIN	0	1	0	1	0	0	1	0	1	0	1	sleep in	95	No
7	SLPOUT	0	1	0	1	0	0	1	0	1	0	0	sleep out	94	No
8	PASET	0	1	0	0	1	1	1	0	1	0	1	page address set	75	Yes
9	CASET	0	1	0	0	0	0	1	0	1	0	1	column address set	15	Yes
10	GCP64	0	1	0	1	1	0	0	1	0	1	1	64 grayscale pulse position set	CB	Yes
11	GCP16	0	1	0	1	1	0	0	1	1	0	0	16 grayscale pulse position set	CC	Yes
12	GSSET	0	1	0	1	1	0	0	1	1	0	1	grayscale set	CD	Yes
13	DATCTL	0	1	0	1	0	1	1	1	1	0	0	data control	BC	Yes
14	RAMWR	0	1	0	0	1	0	1	1	1	0	0	memory write	5C	display content
15	RAMRD	0	1	0	0	1	0	1	1	1	0	1	memory read	5D	display content
16	PTLIN	0	1	0	1	0	1	0	1	0	0	0	partial in	A8	Yes
17	PTLOUT	0	1	0	1	0	1	0	1	0	0	1	partial out	A9	No
18	ASCSET	0	1	0	1	0	1	0	1	0	1	0	area scroll set	AA	Yes
19	SCSTART	0	1	0	1	0	1	0	1	0	1	1	scroll start set	AB	Yes
20	VOLCTR	0	1	0	1	1	0	0	0	1	1	0	Power IC control for EVR	C6	Yes
21	EPCTIN	0	1	0	0	1	1	0	0	0	0	1	Power IC control for EVR	61	Yes
22	EPCTOUT	0	1	0	0	1	1	0	0	0	1	0	Power IC control for EVR	62	No
23	EPSRWR	0	1	0	0	1	1	0	0	0	1	1	Power IC control for EEPROM	63	Yes
24	EPMWR	0	1	0	0	1	1	0	0	1	0	0	Power IC control for EEPROM	64	No
25	EPMRD	0	1	0	0	1	1	0	0	1	0	1	Power IC control for EEPROM	65	No
26	EPSRRD	0	1	0	0	1	1	0	0	1	1	0	Power IC control for EEPROM	66	Yes
27	NOP	0	1	0	0	0	1	0	0	1	0	1	NOP command	25	No
	(STREAD)	0	0	1									status read		No

4.2.2 command details

(1) DISON

This command is used to control the display to the operative state. It should be executed after SLPOUT. Once this command has been entered, wait 60(TBD) ms before entering DISOFF command.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
DISON	1	0	1	0	1	1	1	1	

The default setting is DISOFF active state.

(2) DISOFF

This command is used to forcibly control the fully display OFF state. Once this command has been entered, wait 80(TBD) ms before entering DISON command.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
DISOFF	1	0	1	0	1	1	1	0	

The default setting is DISOFF active state.

(3) DISNOR

This command can be used to set the display to normal image (means positive image) without overwriting the contents of display data RAM. It is not possible to set normal image in part.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
DISNOR	1	0	1	0	0	1	1	0	

The default setting is DISNOR active state.

(4) DISINV

This command can be used to set the display to inverted image (means negative image) without overwriting the contents of display data RAM. It is not possible to set inverted image in part. The display cannot be inverted for non-displayed area under partial display state or under Display OFF state.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
DISINV	1	0	1	0	0	1	1	1	

The default setting is DISNOR active state.

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(5) DISCTL (TBD)

This command and the subsequent parameters set the various timing for display. Be sure to enter this command before entering the DISON command. All parameters are in TBD. After the LCD panel is fabricated and measured, they will be defined in apart. P5 must be defined according to the number of partial line. Be sure to retain a scope for modification.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
DISCTL	1	1	0	0	1	0	1	0	
P1	0	1	0	0	1	1	0	0	0.5H period setting for 64 grayscale (lower bit)
P2	x	x	x	x	x	x	x	1	0.5H period setting for 64 grayscale (upper bit)
P3	x	1	1	0	0	1	1	0	0.5H period setting for 16 grayscale
P4	x	x	x	x	x	0	x	0	LCD alternation
P5	x	x	P55	P54	P53	P52	P51	P50	LCD alternation / mode for partial display
P6	1	0	1	1	0	1	0	0	driving duty
P7	1	0	1	0	1	1	1	1	number of display pages (-1)
P8	x	x	0	0	0	0	1	0	number of display OFF pages for each top and bottom
P9	x	x	x	x	x	x	x	0	0.5H period setting for 2 grayscale
P10	0	0	0	0	0	0	0	0	1.0H period setting
P11	0	0	0	0	0	0	0	0	1.0H period setting

x: an invalid bit; does not affect operation.

Even if P10 and/or P11 are not transferred, the display image is not affected.

(6) SLPIN

This command is used to set the LCD module to sleep state. Before entering this SLPIN command, be sure to enter the DISOFF command to turn off the display. After using SLPIN, the power supply voltage (VDD) must be maintained for 40ms(TBD) to discharge the voltage of output system. SLPOUT can be entered after more than 40ms(TBD) period from the SLPIN command. While in sleep state, the oscillator circuit is stopped. Also, the DC-DC converter circuit is stopped. If this command is executed during EPMWR operation, EPMWR operation is aborted.(TBD)

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
SLPIN	1	0	0	1	0	1	0	1	

The default setting is SLPIN active state.

(7) SLPOUT

This command is used to cancel the LCD module's sleep state. Oscillation circuit and DC-DC converter circuit start when this command is entered. DISON can be entered after more than 80ms(TBD) period from the sleep state is canceled by this command during which the output achieves a stable voltage. SLPIN can be entered after more than 80ms(TBD) period from the SLPOUT command. By execution of this command, EVR setting is replaced to the pre-set value fixed by SEIKO EPSON.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
SLPOUT	1	0	0	1	0	1	0	0	

The default setting is SLPIN active state.

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(8) PASET

This command and the two subsequent parameters can be used to set the page address area. When column address is incremented to the end column, the column address returns to the start column and the page address is incremented. After page address is incremented to the end page, the page address returns to the start page. Be sure to specify the start page and the end page as a pair. The start page value must be less than the end page value.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
PASET	0	1	1	1	0	1	0	1	
P1	P17	P16	P15	P14	P13	P12	P11	P10	start page
P2	P27	P26	P25	P24	P23	P22	P21	P20	end page

The default setting is P1=0d, P2=183d.

(183 is not relate to a total page number)

(9) CASET

This command and the subsequent parameters can be used to set the column address area. When column address is incremented to the end column, the column address returns to the start column and the page address is incremented. After page address is incremented to the end page, the page address returns to the start page. Be sure to specify the start column and the end column as a pair. The start column value must be less than the end column value.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
CASET	0	0	0	1	0	1	0	1	
P1	P17	P16	P15	P14	P13	P12	P11	P10	start column (lower bit)
P2	x	x	x	x	x	x	X	P18	start column (upper bit)
P3	P27	P26	P25	P24	P23	P22	P21	P20	End column (lower bit)
P4	x	x	x	x	x	x	x	P28	End column (upper bit)

x: an invalid bit; does not affect operation.

The default setting is P1=0d, P2=135d.

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(10) GCP64

This command and the subsequent parameters can be set the 64-gray scale control pulse's position. This command and its parameters should be set before executing DISON and should not be set while the display is being shown. All parameters are in TBD. After the LCD panel is fabricated and measured, they will be defined in apart. Be sure to retain a scope for modification. P63 must not be equal to the value of parameter P1 or P2 of the command DISCTL.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
GCP64	1	1	0	0	1	0	1	1	
P1L	0	0	1	0	0	1	0	1	
P1M	x	x	x	x	x	x	x	0	
P2L	0	0	1	1	0	1	1	0	
P2M	x	x	x	x	x	x	x	0	
P3L	0	1	0	0	1	0	0	1	
P3M	x	x	x	x	x	x	x	0	
P4L	0	1	0	1	1	0	1	0	
P4M	x	x	x	x	x	x	x	0	
P5L	0	1	1	0	1	1	0	0	
P5M	x	x	x	x	x	x	x	0	
P6L	0	1	1	1	1	0	1	1	
P6M	x	x	x	x	x	x	x	0	
P7L	1	0	0	0	1	0	1	0	
P7M	x	x	x	x	x	x	x	0	
P8L	1	0	0	1	0	1	1	0	
P8M	x	x	x	x	x	x	x	0	
P9L	1	0	1	0	0	0	0	1	
P9M	x	x	x	x	x	x	x	0	
P10L	1	0	1	0	1	0	1	0	
P10M	x	x	x	x	x	x	x	0	
P11L	1	0	1	1	0	1	0	0	
P11M	x	x	x	x	x	x	x	0	
P12L	1	0	1	1	1	1	0	1	
P12M	x	x	x	x	x	x	x	0	
P13L	1	1	0	0	0	1	0	1	
P13M	x	x	x	x	x	x	x	0	
P14L	1	1	0	0	1	1	0	1	
P14M	x	x	x	x	x	x	x	0	
P15L	1	1	0	1	0	1	0	0	
P15M	x	x	x	x	x	x	x	0	
P16L	1	1	0	1	1	0	1	0	
P16M	x	x	x	x	x	x	x	0	
P17L	1	1	1	0	0	0	0	1	
P17M	x	x	x	x	x	x	x	0	

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P18L	1	1	1	0	0	1	1	0
P18M	x	x	x	x	x	x	x	0
P19L	1	1	1	0	1	1	0	0
P19M	x	x	x	x	x	x	x	0
P20L	1	1	1	1	0	0	0	0
P20M	x	x	x	x	x	x	x	0
P21L	1	1	1	1	0	1	0	1
P21M	x	x	x	x	x	x	x	0
P22L	1	1	1	1	1	0	0	1
P22M	x	x	x	x	x	x	x	0
P23L	1	1	1	1	1	1	1	0
P23M	x	x	x	x	x	x	x	0
P24L	0	0	0	0	0	0	0	1
P24M	x	x	x	x	x	x	x	1
P25L	0	0	0	0	0	1	0	1
P25M	x	x	x	x	x	x	x	1
P26L	0	0	0	0	1	0	0	0
P26M	x	x	x	x	x	x	x	0
P27L	0	0	0	0	1	1	0	0
P27M	x	x	x	x	x	x	x	1
P28L	0	0	0	1	0	0	0	0
P28M	x	x	x	x	x	x	x	1
P29L	0	0	0	1	0	0	1	1
P29M	x	x	x	x	x	x	x	1
P30L	0	0	0	1	0	1	1	0
P30M	x	x	x	x	x	x	x	1
P31L	0	0	0	1	1	0	0	1
P31M	x	x	x	x	x	x	x	1
P32L	0	0	0	1	1	1	0	0
P32M	x	x	x	x	x	x	x	1
P33L	0	0	0	1	1	1	1	0
P33M	x	x	x	x	x	x	x	1
P34L	0	0	1	0	0	0	0	1
P34M	x	x	x	x	x	x	x	1
P35L	0	0	1	0	0	1	0	0
P35M	x	x	x	x	x	x	x	1
P36L	0	0	1	0	0	1	1	0
P36M	x	x	x	x	x	x	x	1
P37L	0	0	1	0	1	0	0	1
P37M	x	x	x	x	x	x	x	1
P38L	0	0	1	0	1	0	1	1
P38M	x	x	x	x	x	x	x	1

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P39L	0	0	1	0	1	1	1	0
P39M	x	x	x	x	x	x	x	1
P40L	0	0	1	1	0	0	0	0
P40M	x	x	x	x	x	x	x	1
P41L	0	0	1	1	0	0	1	0
P41M	x	x	x	x	x	x	x	1
P42L	0	0	1	1	0	1	0	0
P42M	x	x	x	x	x	x	x	1
P43L	0	0	1	1	0	1	1	0
P43M	x	x	x	x	x	x	x	1
P44L	0	0	1	1	1	0	0	0
P44M	x	x	x	x	x	x	x	1
P45L	0	0	1	1	1	0	0	1
P45M	x	x	x	x	x	x	x	1
P46L	0	0	1	1	1	0	1	1
P46M	x	x	x	x	x	x	x	1
P47L	0	0	1	1	1	1	0	0
P47M	x	x	x	x	x	x	x	1
P48L	0	0	1	1	1	1	0	1
P48M	x	x	x	x	x	x	x	1
P49L	0	0	1	1	1	1	1	0
P49M	x	x	x	x	x	x	x	1
P50L	0	0	1	1	1	1	1	1
P50M	x	x	x	x	x	x	x	1
P51L	0	1	0	0	0	0	0	0
P51M	x	x	x	x	x	x	x	1
P52L	0	1	0	0	0	0	0	1
P52M	x	x	x	x	x	x	x	1
P53L	0	1	0	0	0	0	1	0
P53M	x	x	x	x	x	x	x	1
P54L	0	1	0	0	0	0	1	1
P54M	x	x	x	x	x	x	x	1
P55L	0	1	0	0	0	1	0	0
P55M	x	x	x	x	x	x	x	1
P56L	0	1	0	0	0	1	0	1
P56M	x	x	x	x	x	x	x	1
P57L	0	1	0	0	0	1	1	0
P57M	x	x	x	x	x	x	x	1
P58L	0	1	0	0	0	1	1	1
P58M	x	x	x	x	x	x	x	1
P59L	0	1	0	0	1	0	0	0
P59M	x	x	x	x	x	x	x	1

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P60L	0	1	0	0	1	0	0	1	
P60M	x	x	x	x	x	x	x	1	
P61L	0	1	0	0	1	0	1	0	
P61M	x	x	x	x	x	x	x	1	
P62L	0	1	0	0	1	0	1	1	
P62M	x	x	x	x	x	x	x	1	
P63L	1	1	1	1	0	1	0	0	
P63M	x	x	x	x	x	x	x	1	

x: an invalid bit; does not affect operation.

(11) GCP16

This command and the subsequent parameters can be set to specify the 16-gray scales control pulse's position. This command and its parameters should be set before executing DISON and should not be set while the display is being shown. . All parameters are in TBD. After the LCD panel is fabricated and measured, they will be defined in apart. Be sure to retain a scope for modification. P15 must not be equal to the value of parameter P3 of the command DISCTL.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
GCP16	1	1	0	0	1	1	0	0	
P1	0	0	0	1	1	0	1	1	
P2	0	0	1	0	1	1	1	0	
P3	0	0	1	1	1	0	1	0	
P4	0	1	0	0	0	0	1	0	
P5	0	1	0	0	1	0	0	1	
P6	0	1	0	0	1	1	1	0	
P7	0	1	0	1	0	0	1	1	
P8	0	1	0	1	0	1	1	1	
P9	0	1	0	1	1	0	1	0	
P10	0	1	0	1	1	1	0	1	
P11	0	1	0	1	1	1	1	1	
P12	0	1	1	0	0	0	0	1	
P13	0	1	1	0	0	0	1	0	
P14	0	1	1	0	0	0	1	1	
P15	0	1	1	1	1	1	1	0	

x: an invalid bit; does not affect operation.

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(12) GSSET

This command and the subsequent parameter set the grayscale. If this command is executed during DISON active state, there is the possibility of disorder in the display in one frame period. Once the GSSET command has been sent, wait 85ms (TBD) to stabilize the oscillation before sending the next command. D4, D3, and D2 of parameter P1 must be set to the value described in the following table.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
GSSET	1	1	0	0	1	1	0	1	
P1	x	x	x	0	0	0	P11	P10	

x: an invalid bit; does not affect operation.

P11	P10	grayscales
0	0	64
0	1	16
1	0	2
1	1	invalid

The default is 64-grayscales.

(13) DATCTL

This command and the subsequent parameter are used to specify various settings to control display content data in the internal RAM and to set the MPU interface's data mode. D3, D2, D1, and D0 of parameter P1 must be set to the value mentioned in the following table.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
DATCTL	1	0	1	1	1	1	0	0	
P1	x	x	P15	P14	1	0	0	0	column, page, data mode, RGB assignment(TBD)
P2	x	x	x	P24	x	x	x	x	data mode

P15	P14	P24	data mode
0	0	0	666 mode-8
0	1	0	(332 mode-8)
1	0	0	565 mode-16
1	1	0	(444 mode-8)
x	x	1	(565 mode-8)

x: an invalid bit; does not affect operation.

The default setting is 666 mode-8.

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(14) RAMWR

This command puts the system in display content entry state. Additionally, the result of entering this command is that the page address and the column address are always set to the start address. Writing data subsequent to this command causes the content of the RAM to be overwritten and at the same time the column address or the page address to be incremented. Inputting commands other than the NOP automatically cancels data writing state.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
RAMWR	0	1	0	1	1	1	0	0	
Write Data	display content								

(15) RAMRD

This command puts the system in display content reading state. Additionally, the result of entering this command is that the page address and the column address are always set to the start address. Reading data subsequent to this command causes the column address or the page address to be incremented. Data can be read according to the data mode set up. XRD should be entered repeatedly by times of dummy read and required data. Inputting commands other than the NOP automatically cancels data reading state.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
RAMRD	0	1	0	1	1	1	0	1	
Read Data	display content								

(16) PTLIN

This command and the subsequent parameters are used to set the partial display area. In order to reduce power consumption, this command is used to display only parts (specified number of pages) of the screen.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
PTLIN	1	0	1	0	1	0	0	0	
P1	P17	P16	P15	P14	P13	P12	P11	P10	start page-1
P2	P27	P26	P25	P24	P23	P22	P21	P20	end page-1

The default setting is PTLOUT active state.

<example>

P1	0	0	0	0	0	0	0	0	page-0 (line-1)
P2	0	0	0	0	1	0	0	1	page-9 (line-10)

(17) PTLOUT

This command cancels partial display.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
PTLOUT	1	0	1	0	1	0	0	1	

The default setting is PTLOUT active state.

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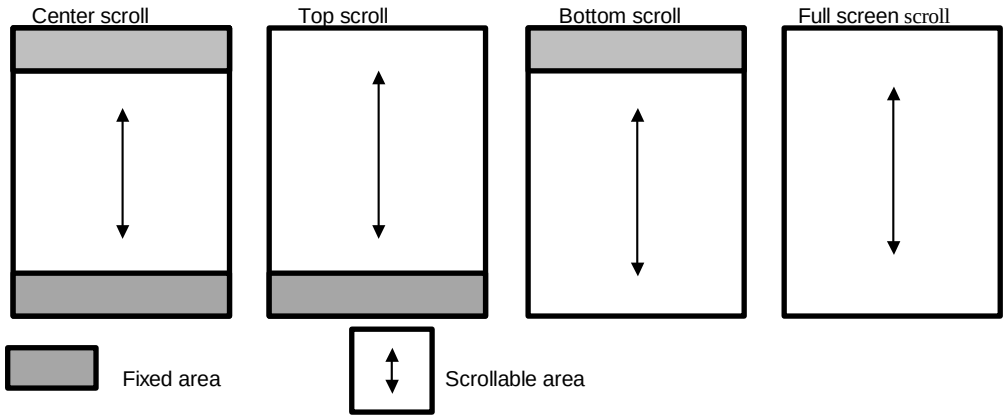
(18) ASCSET

This command is used to set area (specified numbers of pages) in the screen to be used for scrolling. The command and the four subsequent parameters are used to set type of area scroll, scroll area, and data required for scrolling. Any of the four patterns below may be chosen as area scroll type. The "page-0" means the top line of the screen named "line-1"(TBD).



The scroll area and specific page number can be set in page units in the RAM. Do not reverse the relation of lager or smaller between the start page and the end page.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
ASCSET	1	0	1	0	1	0	1	0	
P1	P17	P16	P15	P14	P13	P12	P11	P10	start page
P2	P27	P26	P25	P24	P23	P22	P21	P20	end page
P3	P37	P36	P35	P34	P33	P32	P31	P30	specified page
P4	x	x	x	x	x	x	P41	P40	scroll mode setting

x: an invalid bit; does not affect operation.

P1 sets the area scroll start page.
Be sure to set as page 0 for Top-scroll or Full-screen scroll.
Until a setting is made with SCSTSRT, the scroll start page is also this starting page.
The default setting is 0d.

P2 sets the area scroll end page.
Enter the value of "176 - the bottom fixed page number - 1".
The default setting is 175d.

P3 sets the specified page number.
Enter the value of "display page number - bottom fixed page number-1".
The default setting is 175d.

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P4 sets the area scroll type.

Parameter	Center scroll	Top scroll	Bottom scroll	Full screen scroll
P41	0	0	1	1
P40	0	1	0	1

Full screen scroll is the default setting.

[Examples of area scroll settings]

In a case of scroll area from line 24d to 151d in the Center scroll of 1/180 duty for 176 lines display (2 top timings OFF, 2 bottom timings OFF).

P1: Start page is 24d.

P2: End page is 176d(total pages)-24d(bottom fixed pages)-1d=151d.

P3: Specified page number is 176d(display pages)-24d(bottom fixed pages) -1d= 151d.

Parameter	D7	D6	D5	D4	D3	D2	D1	D0	
P1	0	0	0	1	1	0	0	0	page 24d
P2	1	0	0	1	0	1	1	1	page 151d
P3	1	0	0	1	0	1	1	1	151d pages
P4	x	x	x	x	x	x	0	0	Center scroll

If the set number of pages does not fit with this formula, the display cannot be specified.

(19) SCSTART

This command and the subsequent parameter set the top scroll page within the scroll area. Do not set a page that is outside of the scroll area. Send this command after the ASCSET has been executed. Setting the display start page makes it possible to scroll.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
SCSTART	1	0	1	0	1	0	1	1	
P1	P17	P16	P15	P14	P13	P12	P11	P10	start page

The default setting is 0d.

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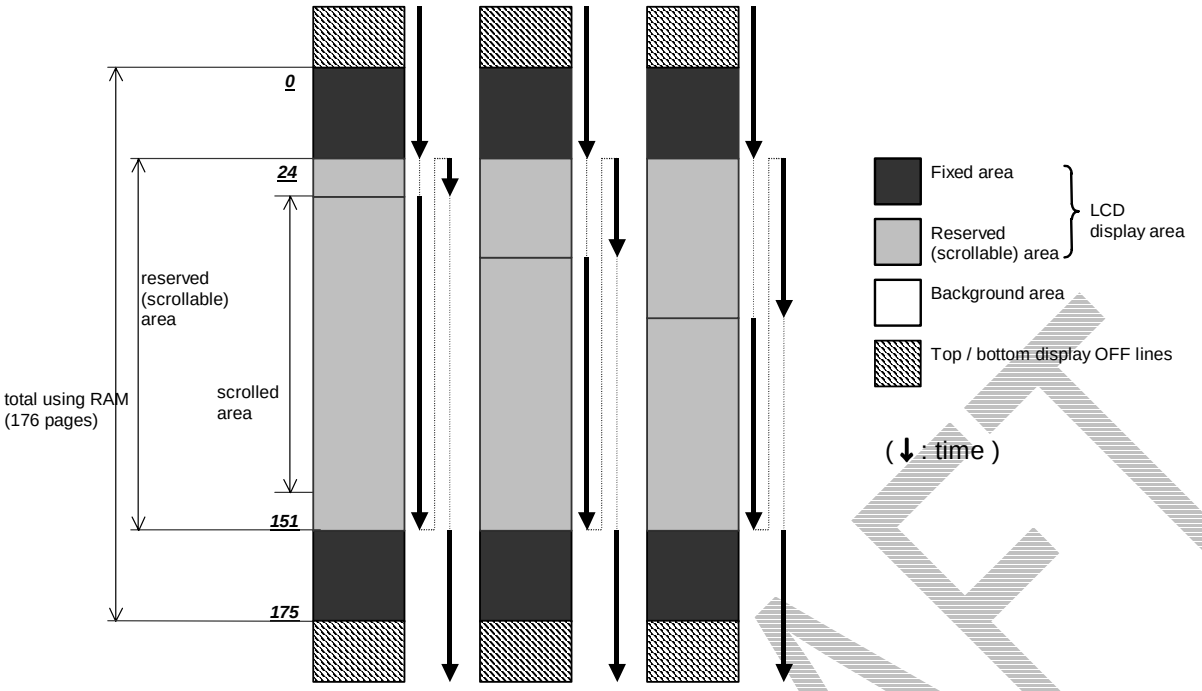
[Examples of area scroll]
176 pages (180 duty - 2 top and 2 bottom off timings) are used for display for one frame.
128 pages (176 display pages - 24 top and 24 bottom fixed pages) are scrolled pages.
128 pages (176 total pages – 24 top and 24 bottom fixed pages) are reserved (scrollable) pages
Consequently, (128 reserved pages – 128 scrolled pages =) 0 pages can be used as background pages.

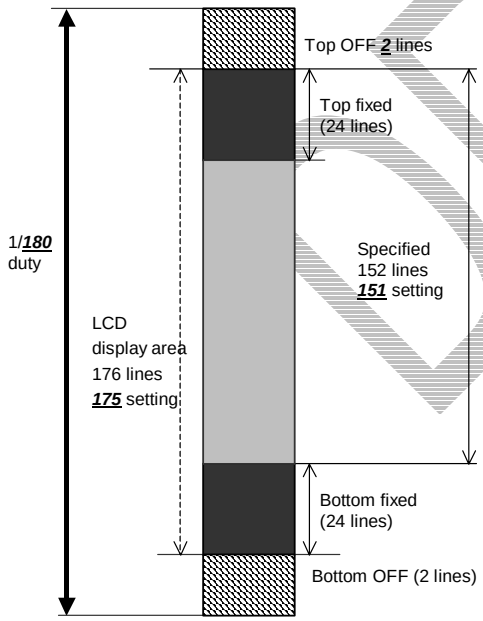
- an example of scroll up – (TBD)

< RAM chart >



< LCD chart >

999 : setting by command



(20) VOLCTR

This command and the subsequent parameter are used to specify the Power IC's EVR value setting (up or down or direct setting). This command is valid only when XPOFF="H" under a SLPOUT active state.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
VOLCTR	1	1	0	0	0	1	1	0	
P1	P17	P16	P15	P14	P13	P12	P11	P10	

EVR direct setting:

1. Enter VOLCTR command and P1 = 10000000b (instruction for Power IC).
2. Enter VOLCTR command and P1 = from 00000000b to 01111111b (EVR value for Power IC).

EVR up: Enter VOLCTR command and P1 = 10011101b.

EVR down: Enter VOLCTR command and P1 = 10011100b.

If entering this command more than once in succession, use both parameters alternatively leaving an interval of at least 3ms.

The default setting is 00000000b.

(21) EPCTIN

This command and the subsequent parameter set enable of the controls for EEPROM. This command is valid under a SLPOUT active state.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
EPCTIN	0	1	1	0	0	0	0	1	
P1	x	x	x	x	x	x	x	0	

x: an invalid bit; does not affect operation.

(22) EPCTOUT

This command sets disable of the controls for EEPROM. This command is valid under a SLPOUT active state.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
EPCTOUT	0	1	1	0	0	0	1	0	

(23) EPSRWR

This command and the subsequent parameters set an instruction and a EVR value to the Driver-IC's resister for Power-IC. Additionally, the result of entering this command is that the address pointer is set to P1.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
EPSRWR	0	1	1	0	0	0	1	1	
P1	P17	P16	P15	P14	P13	P12	P11	P10	Power-IC instruction for EEPROM
P2	P27	P26	P25	P24	P23	P22	P21	P20	EVR value for EEPROM

When the signal XRES is set to "L", both P1 and P2 are initialized to 00000000b.

[Example1: to transfer an instruction and a EVR value to the Power-IC]

P1: 10000000b P2: any of one value from 00000000b to 01111111b

[Example2: to transfer an instruction to increment the EVR value of the Power IC]

P1: 10011101b P2: 00000000b

[Example3: to transfer an instruction to decrement the EVR value of the Power IC]

P1: 10011100b P2: 00000000b

(24) EPMWR

This command transfers an instruction and a EVR value in the Driver-IC's resister for Power-IC. The destination is the Power-IC. Once this command has been executed, wait 3ms (TBD) at least before sending the next command. This command turns into valid after 40ms from the execution of SLPOUT.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
EPMWR	0	1	1	0	0	1	0	0	

(25) EPMRD

This command reads the value stored in EEPROM of Power-IC and writes it onto the Driver-IC's resister P2 for Power-IC. Content of P1 is retained. This command is valid under a SLPOUT active state. Once this command has been executed, wait 3ms (TBD) at least before sending the next command. Use EPMWR and EPMRD orderly conferring the following sequence.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
EPMRD	0	1	1	0	0	1	0	1	

(26) EPSRRD

This command reads the content of Driver-IC's resister for Power-IC. Use this command orderly conferring the following sequence.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
EPSRRD	0	1	1	0	0	1	1	0	
P1									see EPSRWR
P2									see EPSRWR

<u>EEPROM related command sequence</u>

Be sure not to execute the following routine under SLPIN active state.

[transferring data to the Power-IC for EEPROM)]
1. EPCTIN : controls for EEPROM enable
2. EPSRWR : sets a write instruction (P1) and a EVR value (P2) to the Driver-IC's resister for Power-IC
3. EPMWR : transfers a write instruction and a EVR value to the Power-IC
4. EPCTOUT: controls for EEPROM disable

Repeat 2 and 3 to write more than 2 bytes.

[transferring data to the Power-IC for EEPROM)]
1. EPCTIN : controls for EEPROM enable
2. EPSRWR : sets a read instruction (P1) to the Driver-IC's resister for Power-IC
3. EPMRD : transfers a read instruction (P1) to the Power-IC
   … content of EEPROM is sent back to the Driver-IC's resister for Power-IC
4. EPSRRD : reads content of the Driver-IC's resister for Power-IC
5. EPCTOUT: controls for EEPROM disable

Repeat 2,3 and 4 to read more than 2 bytes.

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(27) NOP (Non-operating)

This command has no effect on operation.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
NOP	0	0	1	0	0	1	0	1	

(28) STREAD

This operation at the state of A0="L", is used to read the current status. Dummy read sequence is not required.

	D7	D6	D5	D4	D3	D2	D1	D0	Function / Remark
(STREAD)	*	*	*	*	*	*	*	*	status

*: refer following table

bit	status		
		0	1
D7	ASCSET P41	see ASCSET	
D6	ASCSET P40		
D5	EEPROM control status	EPCTIN	EPCTOUT
D4	XPOFF status	XPOFF="L"	XPOFF="H"
D3	display ON/OFF status	OFF	ON
D2	sleep IN/OUT status	OUT	IN
D1	EVR input	prohibited	allowed
D0	partial IN/OUT status	OUT	IN

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4.3 MEMORY MAP

This map express the relationship between total memory and display position according to the command settings described in "4.2 COMMANDS" as example.

	Column Address	0			1			2				133			134			135		
		B	G	R				B	G	R		B	G	R				B	G	R
		1st pixel			2nd pixel			3rd pixel				134th pixel			135th pixel			136th pixel		
Page Address	LCD line																			
0	1							fixed area												
~	~																			
23	24																			
24	(var.)																			
25	(var.)																			
26	(var.)																			
27	(var.)																			
28	(var.)																			
~	~							reserved (scrollable) area												
149	(var.)																			
150	(var.)																			
151	(var.)																			
152	1							fixed area												
~	~																			
175	176																			
176																				
177																				
178																				
179								disable to access												
180																				
181																				
182																				
183																				

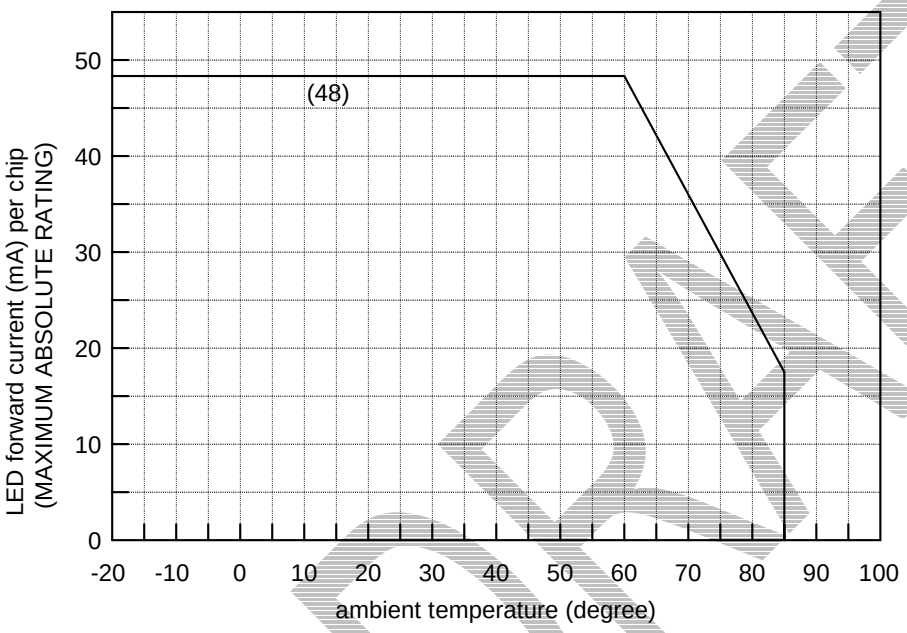
5. ABSOLUTE MAXIMUM RATINGS (TBD)

GND=0V

PARAMETER	SYMBOL	RATINGS	UNIT	REMARKS
power supply voltage	VDDI	0 to 3.3	V	pin 26
	VDDL	0 to 2.7	V	pin 27 VDDL<=VDDI
Input voltage	VIN	0 to VDDI+0.5	V	
storage temperature range (ambient temperature)	TST	(TBD)	℃	no dew condition
operating temperature range (ambient temperature)	TOP	(TBD)	℃	no dew condition
LED forward current *1)	IF	~48	mA	per chip (25℃)

Stress beyond those listed under "ABSOLUTE MAXIMUM RATINGS" may cause permanent damage to the device.

*1: The temperature dependence of the LED forward current rating is described below.



6. ELECTRICAL SPECIFICATIONS

6.1 DC SPECIFICATIONS / OSCILLATION (TBD)

GND = 0 V, ambient temperature = 25°C unless otherwise specified

Item	Symbol	Condition	Rating			Unit	Use
			Min.	Typ.	Max.		
Power supply voltage *1)	VDDI		2.70	2.85	3.00	V	Pin 26
	VDDL		2.45	2.50	2.55	V	Pin 27
Low-level input voltage	VIL		0	-	0.2 x VDDI	V	All pins
High-level input voltage	VIH		0.8 x VDDI	-	VDDI	V	
Low-level output voltage	VOL	IOL = +0.5mA	0	-	0.4	V	All pins
High-level output voltage	VOH	IOH = -0.5mA	VDD-0.4	-	VDDI	V	
Input leak current	ILI		-	-	10	µA	All pins except power supply pins
Power supply current (RMS) *2)	IDDI	full display *2)	-	(TBD)	(TBD)	uA	VDDI
	IDDL			(TBD)	(TBD)		VDDL
	IDDI	sleep state *3)	-	(TBD)	(TBD)	uA	VDDI
	IDDL			(TBD)	(TBD)		VDDL
Frame frequency	fFR	*4)	(TBD)	-	(TBD)	Hz	

*1: Rated values indicate operating range of electrical functions.

*2: Typ. values are at the condition of power supply voltage is Typ., the ambient temperature is 25°C, full screen color bar still display, and no data is being transferred.
Max. values are at the condition of power supply voltage is Max., the ambient temperature is –20°C, full screen color bar still display, and no data is being transferred.

*3: When D15~D0, A0, and XWR are fixed to "H" or "L" with the state of not chip selected,

*4: In operating temperature range.

<Color bar display>

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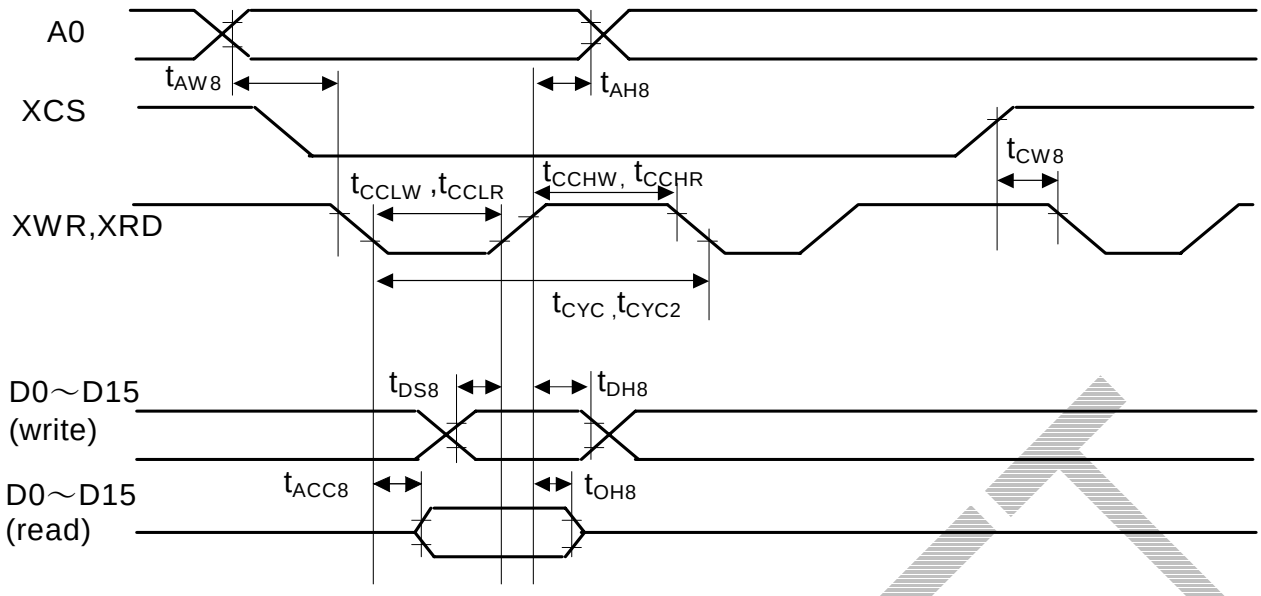
6.2 AC SPECIFICATIONS

6.2.1 read / write (TBD)



Be sure not to alternate the signal XCS and/or A0 when XWR="L" or when XRD="L".

Ta=(TBD)℃, VDDI=2.7~3.0V, VDDL=2.45~2.55V

Signal	Symbol	Item	Min.	Max.	Unit	Remarks
XCS	tCW8	XCS-XWR,XRD time	(10)	–	ns	
A0	tAH8	address hold time	(10)	–	ns	
	tAW8	address setup time	(10)	–	ns	
XWR	tCYC	write cycle	(150)	–	ns	
XRD	tCYC2	read cycle	(250)	–	ns	
	tCCHW	control pulse H width (WR)	(80)	–	ns	
	tCCHR	control pulse H width (RD)	(80)	–	ns	
	tCCLW	control pulse L width (WR)	(60)	–	ns	
	tCCLR	control pulse L width (RD)	(160)	–	ns	
D0~	tDS8	data setup time	(10)	–	ns	CL=100pF
D15	tDH8	data hold time	(10)	–	ns	
	tACC8	read access time	-	(130)	ns	
	tOH8	output disable tome	(10)	(60)	ns	

*: When both the rising time (tr) and the falling time (tf) of input signals are less than 15 ns.

*: tACC8 and tOH8 are rated with respect to the 30% and 70% of VDDI-GND voltage.

*: All other values are rated with respect to the 20% and 80% of VDDI-GND voltage.

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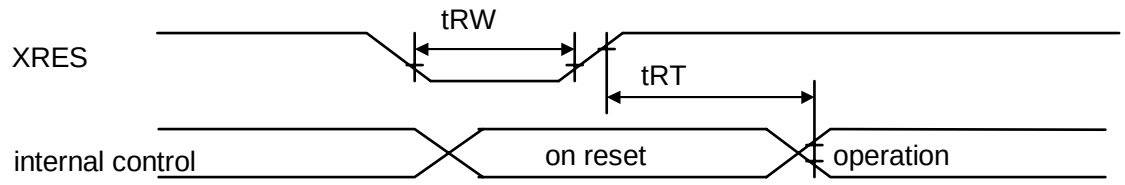
6.2.2 reset (TBD)



Ta=(TBD)℃, VDDI=2.7~3.0V, VDDL=2.45~2.55V

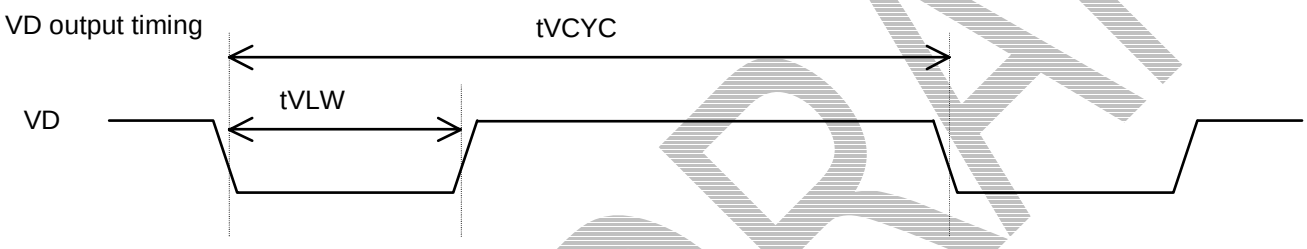
signal	symbol	parameter	Min.	Max.	unit	remarks
XRES	tRW	reset pulse width	(100)		us	
	tRT	operation delay		(100)	us	

*: When both the rising time (tr) and the falling time (tf) of input signals are less than 15 ns.

*: All values are rated with respect to the 20% and 80% of VDDI-GND voltage.

Both tRW and tRT are in TBD. They are to be changed if the LCD panel is modified.

6.3 OUTPUT SPECIFICATIONS (TBD)



Ta=(TBD)℃, VDDI=2.7~3.0V

signal	symbol	parameter	Min.	Typ.	Max.	unit	remarks
VD	tVLW	VD pulse L width	(TBD)	(TBD)	(TBD)	us	CL=20pF
	tVCYC	VD cycle	(13300)	(16700)	(20000)	us	

* All values are rated with respect to the 20% and 80% of VDDI-GND voltage.

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6.4 RECOMMENDED SEQUENCE

-1) * turn on system power (VDDI,VDDL))

-2) * system reset（XRES="L")
= SLPIN active state
= DISOFF active state
= DISNOR active state
= GSSET : 64 gray scales
= DATCTL : 666 mode-8

-3) (execute following commands)
* DISCTL
* GCP64
* GCP16
* CASET
* PASET
* ASCSET (P1=0d, P2=175d, P3=175d, P4=3d)
* SCSTART (P1=0d)
* DATCTL
and other commands to be changed

-4) * execute SLPOUT command after more than 100us (TBD) from system reset

-5) * wait around 1ms (TBD)

-6) * transfer display data to the display data RAM
RAMWR (command + required parameters)

-7) * execute DISON command after over 80ms (TBD) from SLPOUT

-8) * overwrite a part of the display data RAM if necessary
PASET, CASET, RAMWR (command + required parameters)

-9) * execute DISOFF command

-10) * execute command and change control if necessary

-11) * execute DISON command

-12) * execute DISOFF command (after over 60ms(TBD) from DISON)

-13) * execute SLPIN command (after over 60ms (TBD) from DISOFF)

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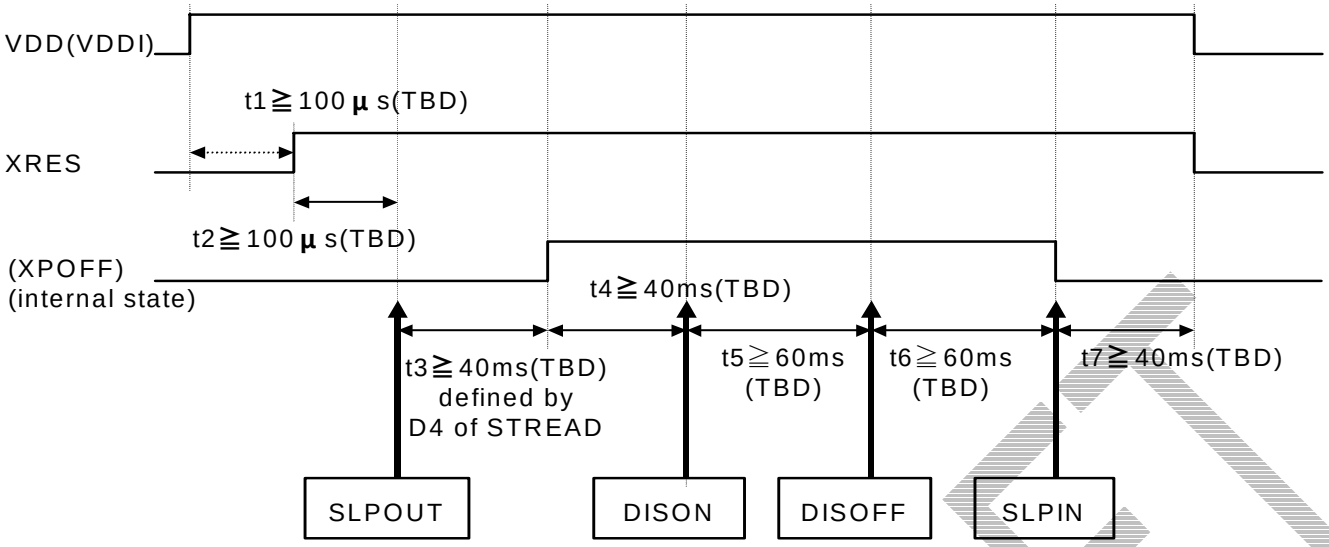
-14) * turn off the system power (VDD, VCC) after over 40ms (TBD) from SLPIN

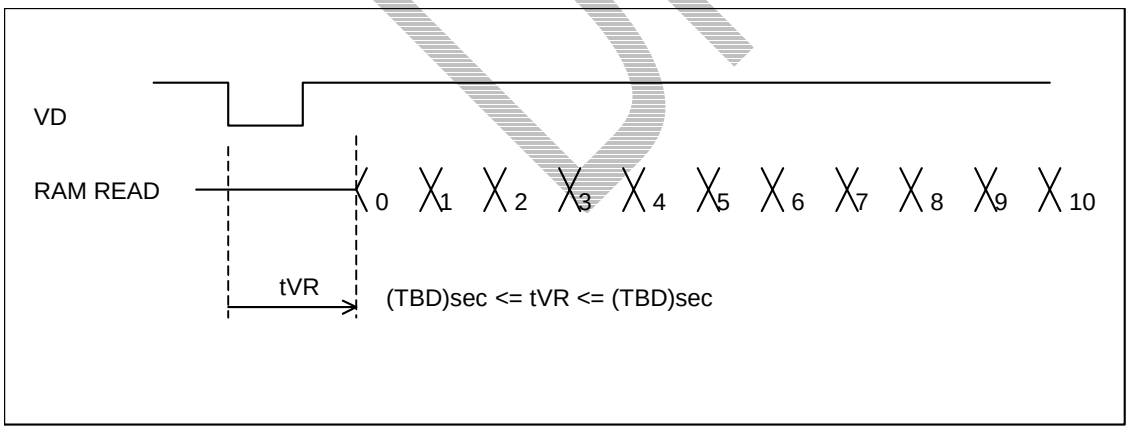
-15) * turn off system power (VDD)

Be sure to follow the correct sequence described below to control sleep state and display ON/OFF state. System reset must be carried out.



6.5 VD AND RAM READ TIMING (TBD)

RAM read timing is specified upon the VD output as following. Be sure to input display data not to cause outrunning.



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7. DISPLAY SPECIFICATIONS

Values in “DISPLAY SPECIFICATIONS“ are provided for the following conditions.

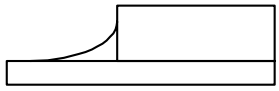
* Frame Frequency : 60Hz (TBD)
* VDDI : 2.85V (TBD)
*VDDL : 2.50V (TBD)

7.1 ELECTRO-OPTICAL SPECIFICATIONS (TBD)

	parameter		temp. (℃)	symbol	ratings			unit	(condition)
					Min.	Typ.	Max.		
REFLECTANCE	contrast ratio		25	CR25	(TBD)	(TBD)	-	ratio	
	reflectance		25	R25	(TBD)	(TBD)	-	%	
	display color CIE-xy coordinates	RED-x	25	Rx	(TBD)	(TBD)	-		
		RED-y		Ry	-	(TBD)	(TBD)		
		GREEN-x		Gx	-	(TBD)	(TBD)		
		GREEN-y		Gy	(TBD)	(TBD)	-		
		BLUE-x		Bx	-	(TBD)	(TBD)		
		BLUE-y		By	-	(TBD)	(TBD)		
		WHITE-x		Wx	(TBD)	(TBD)	(TBD)		
		WITE-y		Wy	(TBD)	(TBD)	(TBD)		
	color area		25		(TBD)	(TBD)	-	%	
	optical response	rise(W→B)	0	tr0	-	(TBD)	(TBD)	ms	
		fall(B→W)		tf0	-	(TBD)	(TBD)		
		rise(W→B)	25	tr25	-	(TBD)	(TBD)		
		fall(B→W)		tf25	-	(TBD)	(TBD)		
TRANSPARENT	contrast ratio		25	CR25	(TBD)	(TBD)	-	ratio	
	display color CIE-xy coordinates	RED-x	25	Rx	(TBD)	(TBD)	-		
		RED-y		Ry	-	(TBD)	(TBD)		
		GREEN-x		Gx	-	(TBD)	(TBD)		
		GREEN-y		Gy	(TBD)	(TBD)	-		
		BLUE-x		Bx	-	(TBD)	(TBD)		
		BLUE-y		By	-	(TBD)	(TBD)		
		WHITE-x		Wx	(TBD)	(TBD)	(TBD)		
		WITE-y		Wy	(TBD)	(TBD)	(TBD)		
	color area		25		(TBD)	(TBD)	-	%	
	screen brightness	center	25		(TBD)	(TBD)	-	cd/m^2	

* all values are measured under the condition of SEIKO EPSON standard.

7.2 GENERAL APPEARANCE SPECIFICATIONS (TBD)

<table>
<tr><th>No.</th><th>ITEM</th><th>CRITERION</th><th>CLASS</th></tr>
<tr><td>1</td><td>different specifications</td><td>Not permitted.</td><td>major defect</td></tr>
<tr><td>2</td><td>missing parts</td><td>All parts must be complete.</td><td>major defect</td></tr>
<tr><td>3</td><td>damaged resist on FPC</td><td>Copper patterns on FPC must not be visible.</td><td>minor defect</td></tr>
<tr><td>4</td><td>circuit pattern</td><td>Must not be peeled or separated from FPC.</td><td>major defect</td></tr>
<tr><td>5</td><td>conductive refuses</td><td>allowable range
<table><tr><th>size</th><th>number</th></tr><tr><td>ϕ<=0.1mm</td><td>permitted
(be not crowded)</td></tr><tr><td>0.1mm<ϕ<=0.2mm</td><td>fixed in flux: permitted
free to move: 0</td></tr><tr><td>0.2mm<ϕ</td><td>0</td></tr></table>ϕ : diameter
crowded: more than 5 refuses per 5mm diameter</td><td>minor defect</td></tr>
<tr><td>6</td><td>dirt</td><td>Should not be prominent.</td><td>major defect</td></tr>
<tr><td>7</td><td>Damaged or dirty interface pins</td><td>Should not be prominent.
No criterion on backside.</td><td>minor defect</td></tr>
<tr><td>8</td><td>plating</td><td>Must not be peeled, no rust, no discoloration.</td><td>minor defect</td></tr>
<tr><td>9</td><td>soldering</td><td>Solder omissions are not permitted at any solder point.
Solder bridges are not permitted.
Cold soldering are not permitted.</td><td>major defect
major defect
minor defect</td></tr>
<tr><td>10</td><td>parts soldering</td><td> 
There must be fillet</td><td>minor defect</td></tr>
</table>

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7.3 DISPLAY APPEARANCE SPECIFICATIONS (TBD)

For each item, if marginal samples are accepted by both customer and SEIKO EPSON, description in this table don't have a priority as criterion.

<Inspection condition>

Inspect the screen by naked eye from a distance of about 30 cm on a vertical direction front on.

Inspections especially related to transparent are performed under at most 50 LUX environment.

All other Inspections are performed under at 800 to 2000 LUX environment..

<Application scope>

The application scope is limited to the active area.

The product should be judged non-defective if all defects are outside of the active area and do not interfere with product quality or the assembly process.

Each dot indicates the smallest display unit for R, G, or B.

Each set of three adjacent R, G, and B dots comprise one pixel.

<table>
<tr><th>No.</th><th>ITEM</th><th>CRITERION</th><th>CLASS</th></tr>
<tr><td>1</td><td>display problems</td><td>Must not include any nonfunctioning or failure to display correct pattern corresponding to input signal.</td><td>major defect</td></tr>
<tr><td>2</td><td>missing lines</td><td>No missing lines permitted.</td><td>major defect</td></tr>
<tr><td>3</td><td>dot defects

*1)</td><td>Following table of the dot defect's allowable range should be met for each white, black, and R, G, B raster in display. The criterion shown below apply to the entire area.
Missing white in 60% or more of typical pixel aperture is defined as a bright defect, less than 60% is permitted.
Black spot in 60% or more of typical pixel aperture is defined as a dark defect, less than 60% is permitted.</td><td>minor defect</td></tr>
<tr><td>4</td><td>Inconsistent display</td><td>Should not be prominent.
If necessary, marginal samples should be provided.</td><td>minor defect</td></tr>
<tr><td>5</td><td>refuses and scratches on polarization plate

*2)</td><td><dot shape>
allowable range
1. distinctly recognized
<table><tr><th>size d(mm)</th><th>numbers permitted</th></tr><tr><td>d<=0.10</td><td></td></tr><tr><td>0.10<d<=0.15</td><td>2</td></tr><tr><td>0.15<d<=0.20</td><td>0</td></tr><tr><td>0.20<d</td><td>0</td></tr></table>2. blurred
<table><tr><th>size d(mm)</th><th>numbers permitted</th></tr><tr><td>d<=0.20</td><td></td></tr><tr><td>0.20<d<=0.30</td><td>2</td></tr><tr><td>0.30<d<=0.40</td><td>1</td></tr><tr><td>0.40<d</td><td>0</td></tr></table>Criterion is applied also to pin-holes.
Defects should not be crowded.

<line shape>
<table><tr><th>Length L (mm)</th><th>Width W (mm)</th><th>numbers</th></tr><tr><td>any</td><td>W<=0.02</td><td>permitted</td></tr><tr><td>L<=2.0</td><td>0.02<W<=0.03</td><td>3</td></tr><tr><td>L<=1.0</td><td>0.03<W<=0.05</td><td>1</td></tr><tr><td>-</td><td>0.05<W</td><td>manage as a dot defect</td></tr></table></td><td>minor defect</td></tr>
<tr><td>6</td><td>bubbles in polarization plate (display area)

*2)</td><td>allowable range
<table><tr><th>diameter d(mm)</th><th>numbers</th></tr><tr><td>d>1.0</td><td>0</td></tr><tr><td>1.0>=d>0.5</td><td>1</td></tr><tr><td>0.5>=d>0.3</td><td>3</td></tr><tr><td>0.3>=d</td><td>permitted</td></tr></table></td><td>minor defect</td></tr>
</table>

*1:

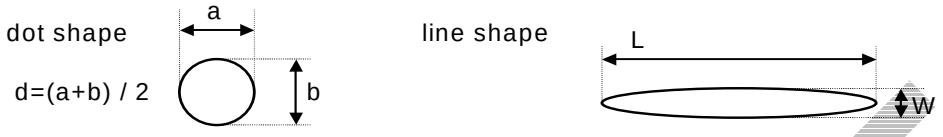
<dot defect's allowable range>

No.	item	white	black	total
1	lone defects	3	3	3
2	two horizontal combined defects	1		

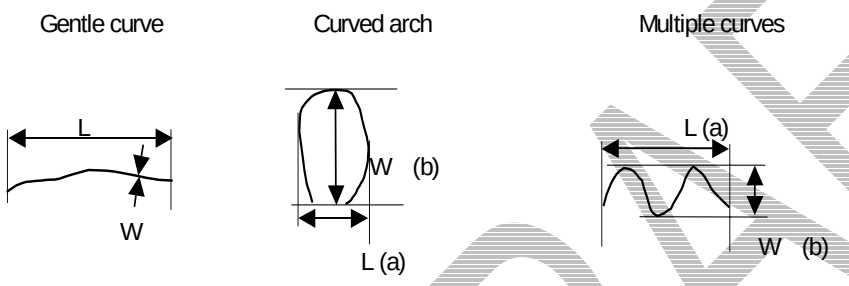
* Three or more combined defects and two vertical combined defects are not admitted.
* Two horizontal combined defects is count as 2 for a total.

*2:

outward of refuses, scratches, and bubbles



* On the outside of display area, these are admitted.
* When viewing with the naked eye, any bent or dot-shaped item must be measured and checked according to the dot shape defect's standard. Refer to the following examples of measurement methods for dot-shaped defects.



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8. DURABILITY TESTING CONDITIONS

8.1 ENVIRONMENTAL RESISTANCE (TBD)

No.	Item	Parameter	Standard
1	High temperature storage	(TBD)	(TBD)
2	Low-temperature storage	(TBD)	(TBD)
3	Temperature cycle	(TBD)	(TBD)
4	High-temperature operation	(TBD)	(TBD)
5	Low-temperature operation	(TBD)	(TBD)
6	High-temperature/high humidity storage	(TBD)	(TBD)
7	High-temperature/high humidity operation	(TBD)	(TBD)
8	Electrostatic voltage resistance -1	(TBD)	(TBD)
9	Electrostatic voltage resistance -2	(TBD)	(TBD)
10	temperature/humidity cycle -1	(TBD)	(TBD)

*: Testing must be performed on condensation-free environment.
*: Operation test condition: Power supply voltage VDDI = 2.85V, VDDL=2.50V.

8.2 MECHANICAL PERFORMANCE (TBD)

No.	Item	Condition
1	Package drop test	Based on JIS-Z0202 Drop heights: on plane = 50 cm on edge, on corner = 30 cm
2	Package vibration resistance	10 to 55 Hz varied, 15 minutes per a round 1.5 G X, Y, and Z directions for 20 minutes each
3	FPC insertion / removing	50 times at the condition of non-operating Using receptacle: 00-6255-031X00-851 (Kyocera)
4	FPC adhesion strength	+90° direction Tensile strength to peel: 2.94 N/cm minimum

8.3 FAULT JUDGMENT CRITERIA

After completing the reliability tests described above, check for the following inspection items under room temperature/humidity conditions.

1) No clearly visible defects or deterioration of display quality allowed.
2) Contrast ratio must be at least 50% of initial value.
3) No function-related abnormalities.
4) Current consumption must not exceed 2 x initial value.
5) R, G, and B color area must be at least 0.7 x initial value.

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9. INSPECTION

9.1 ACCEPTABLE QUALITY LEVEL (TBD)

The AQL (Acceptable Quality Level) is the quality level used to judge whether or not product lots pass during acceptance inspections of products delivered to your company. The AQL standards are shown below.

(1) Quality level

Defect type	AQL
Major defects	TBD
Minor defects	TBD

(2) Inspection method: Compliant with ANSI/ASQC Z1.4-1993, ordinary inspection level II, inspection by one time sampling.

9.2 ACCEPTANCE INSPECTIONS AND TREATMENT OF NONCONFORMING LOTS

(1) Acceptance inspection
When a lot is judged as nonconforming at your company's acceptance inspection, notification should be provided to our company within three weeks of delivery of said lot to your company.

(2) Treatment of nonconforming lots
When a lot has failed to pass your company's acceptance inspection, please return the entire lot to our company. Our company will investigate the causes of defects and will report both the causes and the responses taken to them. Non-defective products shall be delivered to replace all defective products within nonconforming lots.

(3) Defective products within conforming lots
Non-defective products shall be delivered to replace all defective products within conforming lots.

9.3 OTHERS

If any troubles should occur concerns our products that have been assembled at your company's manufacturing processes, both companies shall jointly investigate and resolve the causes.

9.4 WARRANTY

SEIKO EPSON warrants this product for a period of 14 months from the date of shipment.

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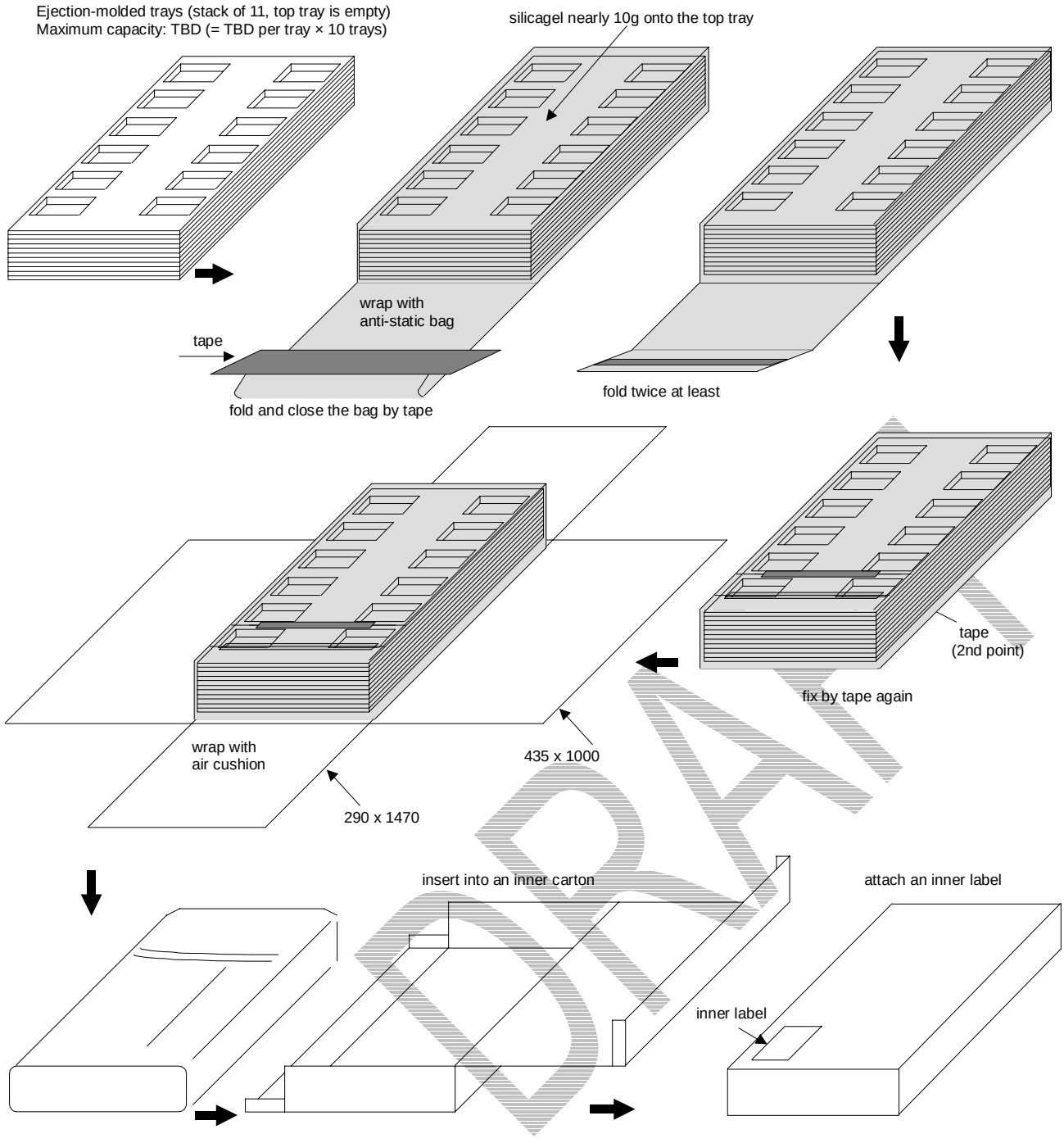
10. PACKING SPECIFICATIONS (TBD)



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<contents of the inner label>

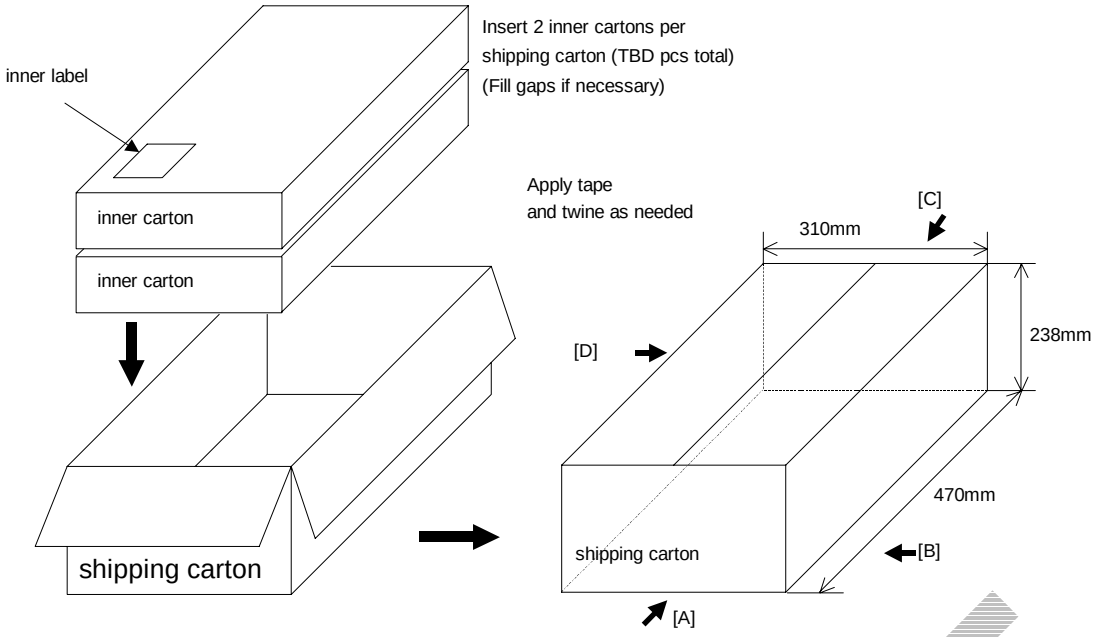
Product No. L2F50052T01	
Q'ty TBD pcs	Lot
Customer Product No.	
EPSON	SEIKO EPSON CORP LIQUID CRYSTAL DISPLAY DIVISION

Lot number will be made according to the following fromat. The lot number has the same description with the printed number on each products. If plural lots are packed together into one package, plural lot numbers must be printed on the inner label.

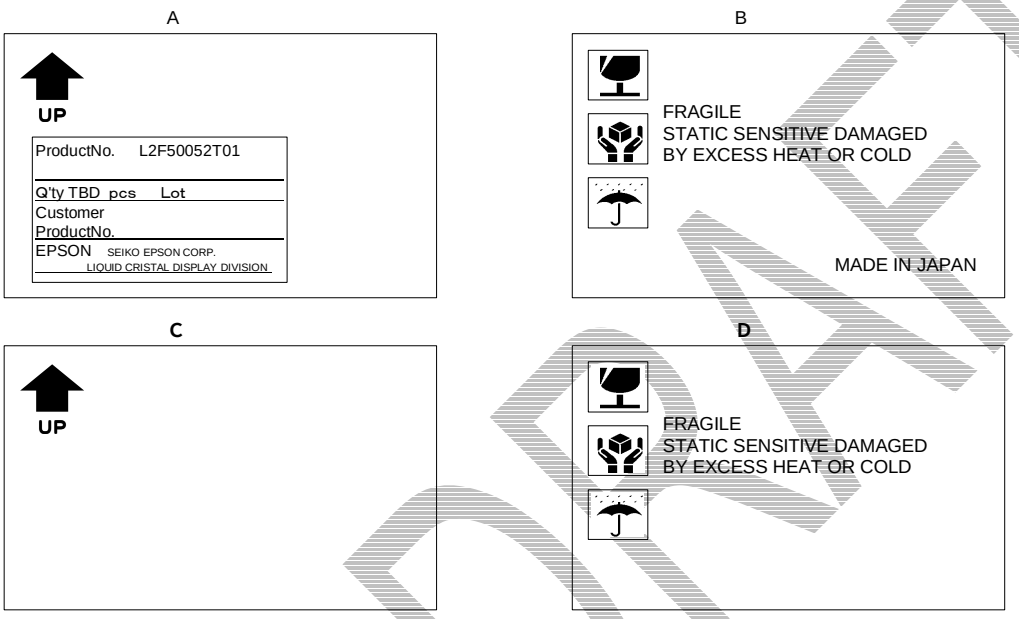
<Lot No.description>

lower 2,1 digits	:year code
lower 4,3 digits	:week code
lower 5 digit	:day of the week
upper digit	:factory code

...date indicates the processe's finished day



Label [A] to [D] on shipping carton are shown below.



Items per carton : (TBD) maximum

Package materials :

Part	Material
Shipping box	corrugated cardboard (No.33)
Inner box	corrugated cardboard (EM-2)
Tray	(TBD) Color: Black

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11. ATTENTION

11.1 STRUCTURAL DESIGN AND ASSEMBLAGE IN APPLICATION

(1) The glass is the main element of the LCD panel. Do not drop the panel from a height and avoid mechanical impacts.
(2) If the LCD panel breaks and causes leakage of liquid crystal material, do not try to swallow or lick the liquid crystal material. If any liquid crystal material gets onto your hands or clothing, be sure to wash the area with soap immediately.
(3) Application of pressure onto the LCD panel can cause color tone change and should therefore be avoided.
(4) The polarization plate that covers the LCD panel is soft and easily damaged, so handle it with care.
(5) If the surface of the LCD panel becomes dirty, use the following type of adhesive tape to lift off the dirt from the surface.

- Scotch-brand mending tape (No. 810) or similar product

(6) Do not try to remove dirt by blowing on the surface or by rubbing it with a cloth dipped in a solvent such as ethyl alcohol, since such methods may leave a white smudge on the surface of polarization plate. Also, the following solvents may seep into the polarization plate.

- Water
- Ketones
- Aromatic solvents

(7) A protective film has been attached to the surface of the LCD panel. Be sure to peel off this film prior to assembly. After long periods of storage, some adhesive may remain on the panel's surface. In such cases, use the method described above to remove the adhesive.
(8) To prevent electronic damage due to static electricity, follow the operation steps completely and carefully.

- Be sure to ground your body before handling the LCD module.
- Make sure that solder guns and all other tools required for assembly have been grounded.
- To reduce occurrence of static electricity, avoid using this product in dry environments.
- A protective film has been attached to the surface of the LCD panel. When peeling off the protective film, be careful to prevent electrostatic discharges.

(9) To help prevent deterioration of performance of the LCD module due to electrostatic damage, avoid touching the following parts of this product when handling it.

- Copper naked section in interface pin
- COG section
- Surface of FPC mounted components

(10) When installing the LCD module, be careful to avoid twisting, flexing, or otherwise making strain on the LCD module, which can affect the screen display. Also, be sure to maintain the case's rigidity.
(11) Fix the plastic case of the LCD module to settle in the target article. Otherwise, the circuits on FPC may be damaged.
(12) Do not apply pressure to any IC chips or plastic molds.
(13) Take precaution not to expose LCD module to the dew or damp condition under operating, or it can cause erosion on electrodes.
(14) Do not disassemble or modify the LCD module.

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(15) The LCD module is affected by light exposure easily because the Driver IC is mounted as a bare chip on the LCD module. To avoid higher levels of current consumption and accompanied shut-down of power supply, give consideration to taking light-blocking methods in the target article. In inspection process, the light blocking method also will be needed for accurate observation because the LCD module may not be assembled.
If it becomes necessary to touch the backside of an IC chip, be sure to maintain a grounded potential (for X-driver IC) or a VSS potential (for Y-driver IC). Any other potential touching of the IC may damage it.
(16) FPC is not fixed to the plastic case firmly regarding to the disassembling of products. Electric components on the FPC may therefore protrude from the outward of LCD module by bending of FPC. Take consideration to prevent electrical short circuit in assembling process of target article.
(17) Originated in some functional IC equipped, the LCD module may get into an erroneous operation by static electricity unexpectedly. If the LCD module is assembled near the surface of a target article, make consideration in mechanical design to keep IC away from the path of static electricity.

11.2 CIRCUIT DESIGN OF APPLICATION

(1) Stress beyond listing in "ABSOLUTE MAXIMUM RATINGS" may cause permanent damage to the device.
(2) Do not apply any input signals unless the logic circuit's power supply is turned on.
(3) Be sure to meet the VIL.VIH specification requirement to prevent noise-related operation problems. Also, if necessary, consider options such as shortening the length of signal cables.
(4) SEIKO EPSON recommends installing an over current protection device (such as a current fuse of 0.5A) for the power supply (VDD).
(5) Be careful to prevent electro-magnetic mutual interference caused by peripheral devices (especially input devices such as touch panels). Be sure to perform a noise evaluation and take required countermeasures for the actual environment.
(6) EMI-related countermeasures should be performed on a target article.
(7) When the power supply to the LCD module is forcibly cut off, such as when removing the main battery, there is no guarantee that problems will not occur in the LCD module. Although an abnormal display may appear briefly on the LCD, this will not cause any deterioration of the LCD quality unless the power supply is forcibly cut off rather often. If necessary, countermeasures or evaluations against this matter should be performed by customer on a target article.
(8) When the power supply is turned on, rising speed of VDD should be less than 2V/100us. Note with caution that starting VDD at any higher speed may cause an excessive rush current to flow into the LCD module, which can adversely affect the system.

11.3 DISPLAY CHARACTERISTICS

(1) The display on LCD module may be invisible at the temperature that exceeds the range specified in the "recommended conditions".
(2) In the LCD module, the liquid crystal voltage is a factor that can be used to adjust the contrast, and VOLCTR is a command used to adjust the liquid crystal voltage.
(3) Although the optimum liquid crystal voltage varies from product to product, the voltage is stored as a preset data in the EEPROM in the LCD module, and this data is referred and set to register whenever the power supply is turned on or the SLPOUT command is executed. The data in this resister is modified when direct settings are made using the VOLCTR command or when an increment or decrement operation occurs, and the contrast can be adjusted as a result. However, the data stored in the EEPROM do not change. When the power supply is turned off and then turned on again, or when the SLPOUT command is executed, the preset data stored in the EEPROM is referred again by the register.

(4) Although the optimum liquid crystal voltage depends on the ambient temperature, the LCD module is designed to compensate the temperature dependency internally so that a constant VOLCTR data can be maintained regardless of the ambient temperature. However, the optimum VOLCTR value still depends slightly on the ambient temperature due to factors such as variation in processes, dispersion of component characteristics, and temperature gradients inside of the target article. We recommend using the user-control function that is provided for the VOLCTR value.
(5) One of the special characteristics of liquid crystal is that it freezes when stored at the temperature below the storage temperature range. Such freezing may cause orientation defects or bubbles (black or white) to appear in the LCD panel. Bubbles may also occur if the panel receives an impact in a low-temperature environment.
(6) If the LCD module is left operating for a long time with the same display showing, the displayed pattern may leave traces on the screen or the contrast may become inconsistent.

11.4 OTHERS

(1) When storing this product, keep it out of direct sunlight or direct exposure to fluorescent lamps, be sure to avoid high-temperature/high-humidity or very low-temperature (below 0°C) environments, and wrap the product in an anti-static bag. (We recommend using our shipping boxes for storage whenever possible.) Store products where they will not be exposed to water droplets, condensation, etc.
(2) Recommended storage conditions: +15°C to +35°C, less than 65% RH, storage for up to two months (after our company's date of shipment)
(3) Note with caution that operating in the environment with water droplets or condensation of water vapor, or with high-humidity air may cause corrosion of the LCD module's electrodes.
(4) When discarding a panel module, be sure to use an authorized industrial waste handler. If incinerating, be sure to follow all relevant environmental and health regulations.
(5) This product is designed to be used in ordinary electronic devices. Do not use this product in other devices, especially devices that may directly cause bodily damage to users (such as aerospace equipment, traffic control equipment, medical equipment, life-support system equipment, or safety equipment).
(6) SEIKO EPSON shall not be responsible for defects that occur in this product or in equipment connected to this product if the product is used in an environment that exceeds the ranges specified in this document, or in an environment not described in this document.
(7) The shipping carton must not be piled up over 2m.

12. MAKING CHANGES

When making any changes in manufacturing site, manufacturing methods, manufacturing conditions, specified components, design, dies, moulds, or package, Quality Assurance Division of SEIKO EPSON will notify a customer of that matter and will obtain customer's consent.
Modification to the characteristics, standards or other descriptions in this document shall be made after consultation with the customer.

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