BATRON

Specification

12002377

BTFT-030M-01

Doc. No.: GCX125AKN REV.A

Version: January 2013

Note: This specification is subject to change without prior notice

Date/Rev.	Contents of change			Reasons	Remarks
Jan.25.2013 Rev.00			-Initial release ("Rev.00" is issued for MP)		

(C): Changed (A): Appended (D): Deleted (F): Filled in

1. BASIC SPECIFICATIONS

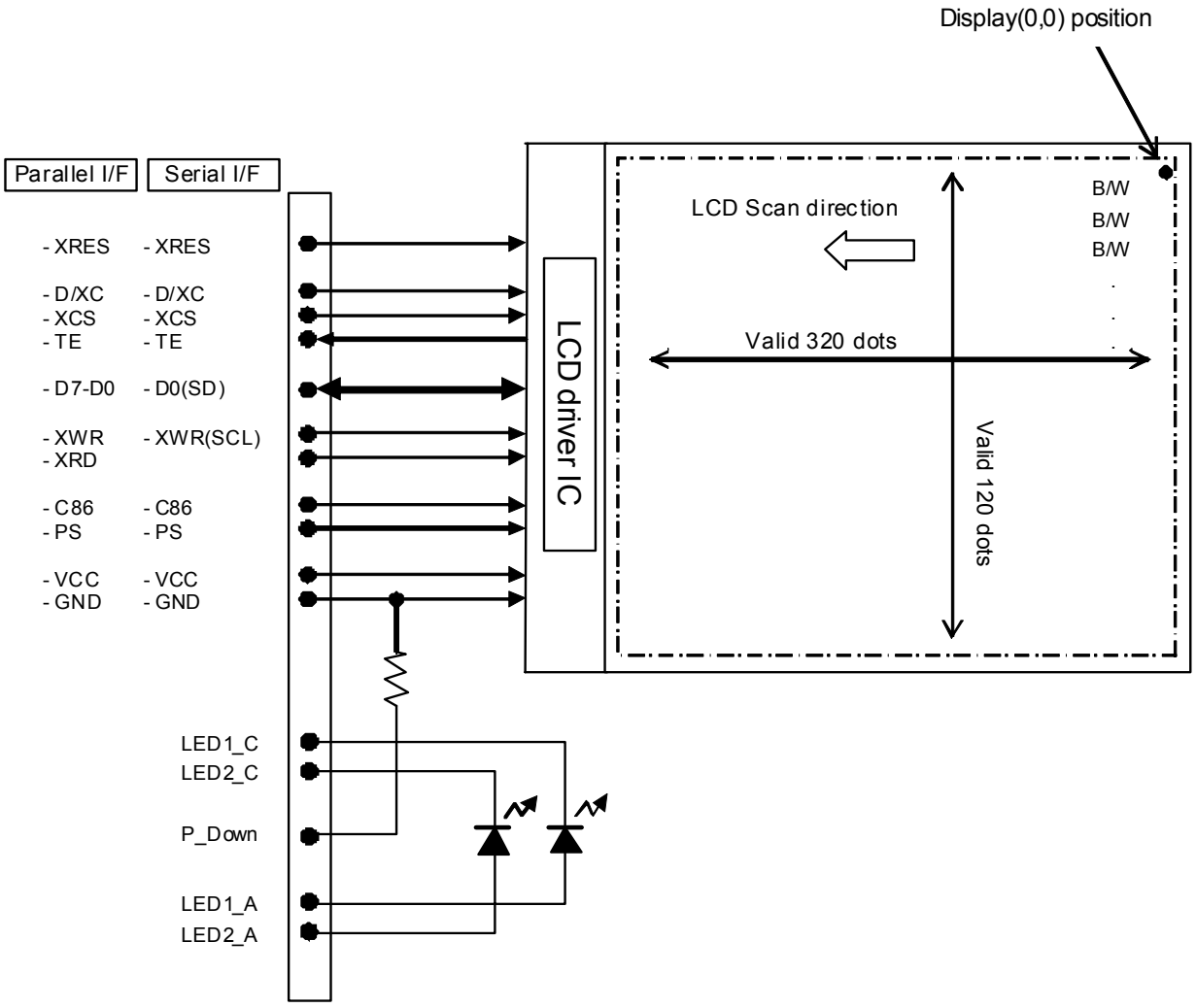
This document gives the characteristics of the active matrix 3.0 inch monochrome TFT LCD.

1.1 STRUCTURES

No.	FACTOR	SPECIFICATIONS	UNIT
1	LCD structure	a-TFT LCD	-
2	Module size	87.15(W) x 36.7(H) x 10.5(D) (Max)	mm
3	Weight	36(without protective film)	g
4	Active Area [Screen Dimension]	72(W)×27(H) 【3.0 inch】	mm
5	Viewing Area	74.9(W)×29.9(H)	mm
6	Number of dots	320 X 120 dots	-
7	Dot pitch	0.225(W) × 0.225(H)	mm
8	Dot layout	Square	-
9	Viewing direction	all-round view	-
10	Liquid crystal mode	Vistarich, normally black, transmissive type	-
11	Polarization plate	Anti glare	-

*1) See attached drawing for details.

1.2 BLOCK DIAGRAM



1.3 I/O TERMINALS

Pin No.	Name	I/O	Remarks
1	GND	P	Ground
2	GND	P	Ground
3	XRES	I	Display is initialized when XRES is set to "L".
4	D/XC	I	Data command select signal. This pin is used for 8bit parallel and 4wire 8bit serial interface. " L " = Command, " H " = Data
5	XCS	I	Chip select signal. Active low. When XCS is "H", D7-D0 outputs are set to the high impedance.
6	TE	O	Tearing effect output
7	D7	I/O	Parallel interface : data bus D1-D7 Serial interface : unused
8	D6	I/O	
9	D5	I/O	
10	D4	I/O	
11	D3	I/O	
12	D2	I/O	
13	D1	I/O	
14	D0(SD)	I/O	Parallel interface : Data bus D0 Serial interface : Serial data input / output
15	XWR (SCL)	I	Parallel interface: I80 parallel interface : connecting XWR signal M68 parallel interface : connecting R/W signal Serial interface : connecting the SCL signal
16	GND	P	Ground
17	XRD	I	Parallel interface: I80 parallel interface : connecting XRD signal M68 parallel interface : connecting E signal Serial interface : unused
18	C86	I	Interface selection pin. Parallel interface: "H" M68 8bit parallel interface "L" I80 8bit parallel interface Serial interface: "H" 4wire 8bit serial interface "L" 3wire 9bit serial interface Please do not change input level for this terminal while operating.
19	PS	I	Interface selection pin. "H" parallel interface "L" serial interface Please do not change input level for this terminal while operating.
20	VCC	P	Power supply
21	VCC	P	Power supply
22	GND	P	Ground
23	NC	-	Non connection
24	LED1_C	P	LED cathode 1
25	LED2_C	P	LED cathode 2
26	P_Down	P	10K ohm (typ) resistor connected to GND
27	NC	-	Non connection
28	LED1_A	P	LED anode 1
29	LED2_A	P	LED anode 2
30	NC	-	Non connection

P: power supply, I: input O: output

2. FUNCTIONS

2.1 OVERVIEW

This LCD module has four types of MPU Interface used for transferring of command and pixel data.

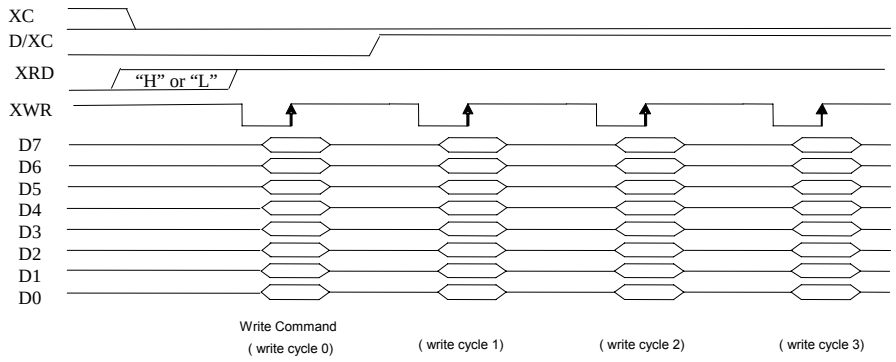
1) Parallel interface
   - I80 8bit parallel bus for transferring of commands and pixel data.
   - M68 8bit parallel bus for transferring of commands and pixel data.

2) Serial interface
   - 4 wire serial bus for transferring of commands and pixel data.
   - 3 wire Serial bus for transferring of commands and pixel data.

2.1.1 Parallel interface

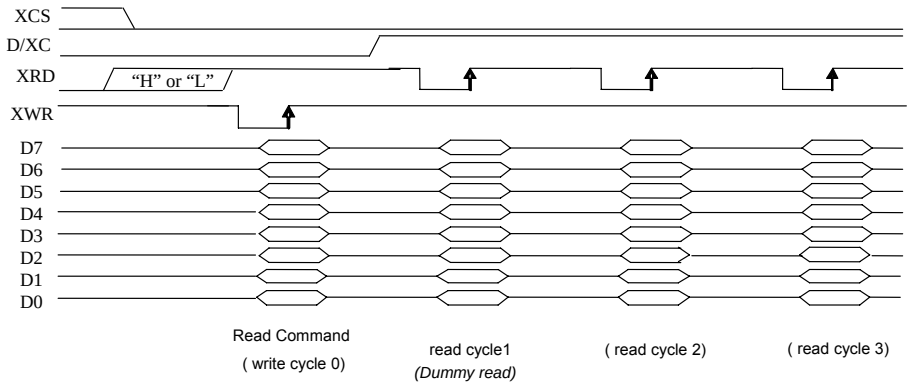
1) I80 8bit parallel interface

Write data mode



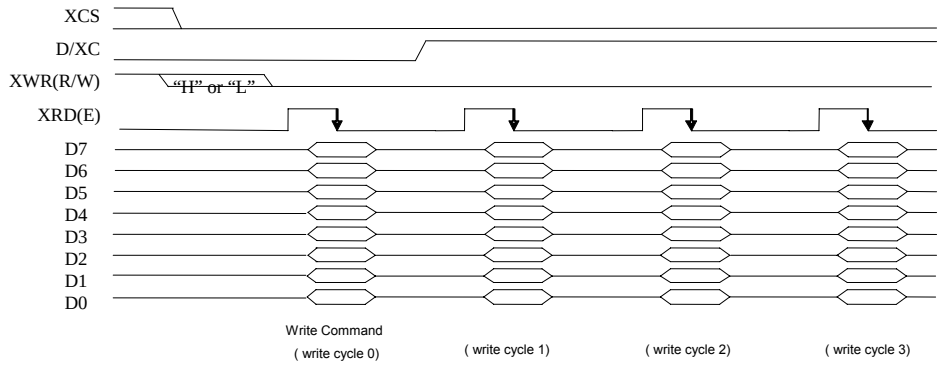
Read data mode

States, RAM contents and ID read commands (0Fh, 2Eh, DAh, DBh, DCh) are used this mode.



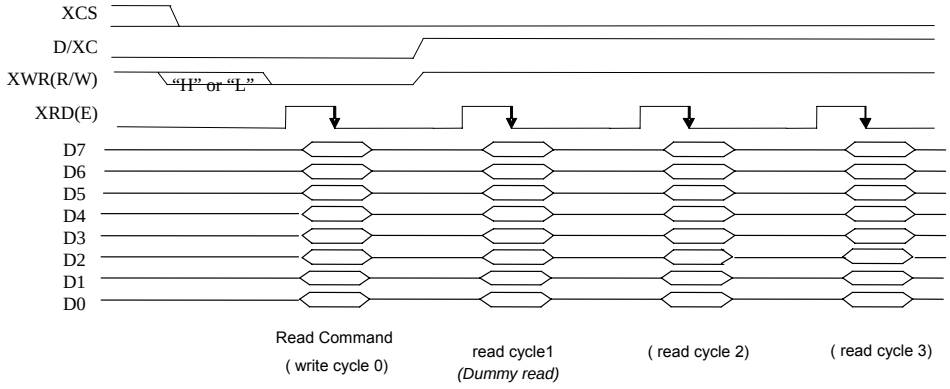
2) M68 8bit parallel interface

Write data mode



Read data mode

States, RAM contents and ID read commands (0Fh, 2Eh, DAh, DBh, DCh) are used this mode.

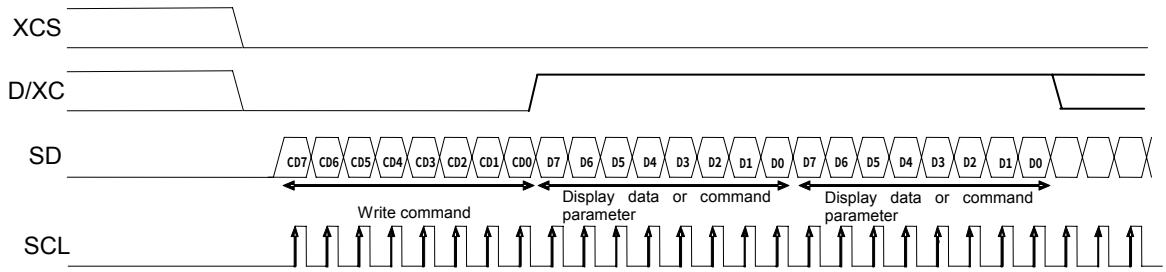


2.1.2 Serial interface

1) 4 wire 8bit serial interface

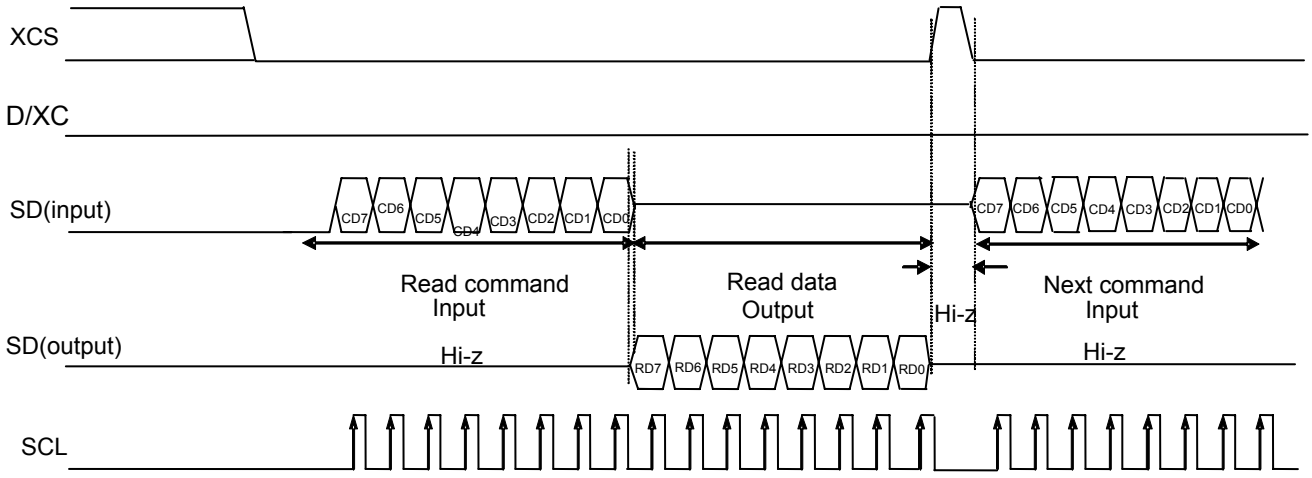
Command input and data input are possible by using the following 4 pins: XCS, SCL, D/XC and SD. However, RAM data cannot be read. The input format of data is 8 bits data. When it is inputting command and parameters, as well as display, use the following methods.

Write data mode



Read data mode

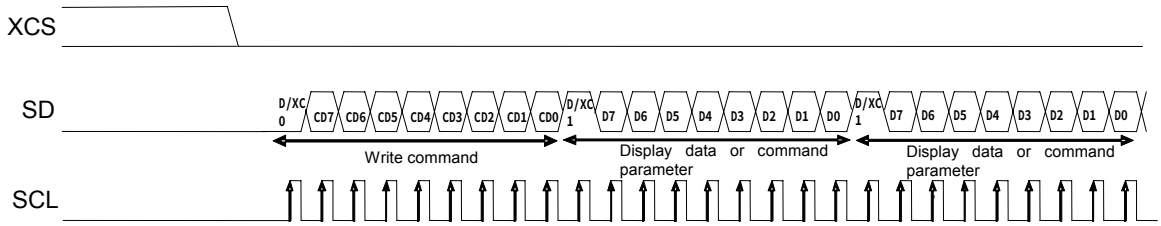
Status and ID read commands (0Fh, DAh, DBh, DCh) are used this mode.



2) 3 wire 9bit serial interface

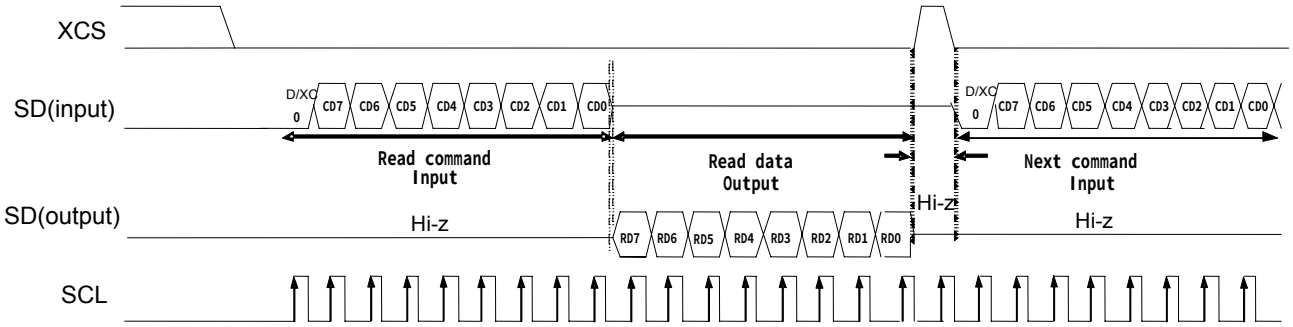
Command input and data input are possible by using the following three pins: XCS, SCL, and SD. However, RAM data cannot be read. The input format of data is D/XC + 8 bits. When it is inputting command and parameters, as well as display data, use the following methods.

Write data mode



Read data mode

Status and ID read commands (0Fh, DAh, DBh, DCh) are used this mode.



2.1.3 Display data format

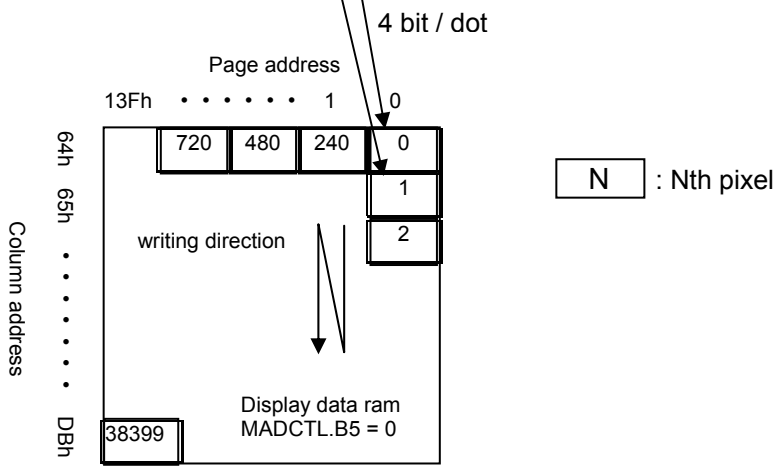
320x120 dot, 16 gray scale

Write cycle	0	1	2	…	19200
D/XC	0	1	1	1	1
D7	CD7	0D3	2D3	…	38398D3
D6	CD6	0D2	2D2	…	38398D2
D5	CD5	0D1	2D1	…	38398D1
D4	CD4	0D0	2D0	…	38398D0
D3	CD3	1D3	3D3	…	38399D3
D2	CD2	1D2	3D2	…	38399D2
D1	CD1	1D1	3D1	…	38399D1
D0	CD0	1D0	3D0	…	38399D0

CD：Memory write command: 2Ch

nD3: MSB of n_{th} dot

nD0: LSB of n_{th} dot



2.2 COMMANDS

See 4.4 recommended sequence to design a command sequence and intervals.

No.	Comand	D7	D6	D5	D4	D3	D2	D1	D0	HEX	Function	Parameter
1	NOP	0	0	0	0	0	0	0	0	00	No operation	none
2	SWRESET	0	0	0	0	0	0	0	1	01	Software reset	none
3	RDDSDR	0	0	0	0	1	1	1	1	0F	Read display self diagnostic results	2
4	SLPIN	0	0	0	1	0	0	0	0	10	Sleep in	none
5	SLPOUT	0	0	0	1	0	0	0	1	11	Sleep out	none
6	NORON	0	0	0	1	0	0	1	1	13	Normal display	none
7	DISINOFF	0	0	1	0	0	0	0	0	20	Display inversion off	none
8	DISINV	0	0	1	0	0	0	0	1	21	Display inversion on	none
9	DISPOFF	0	0	1	0	1	0	0	0	28	Display off	none
10	DISPON	0	0	1	0	1	0	0	1	29	Display on	none
11	CASET	0	0	1	0	1	0	1	0	2A	Column address set	4
12	PASET	0	0	1	0	1	0	1	1	2B	Page address set	4
13	RAMWR	0	0	1	0	1	1	0	0	2C	Ram write	xx
14	RAMRD	0	0	1	0	1	1	1	0	2E	Ram read	xx
15	TEOFF	0	0	1	1	0	1	0	0	34	Tearing output off	none
16	TEON	0	0	1	1	0	1	0	1	35	Tearing output on	1
17	MADCTL	0	0	1	1	0	1	1	0	36	Ram address control	1
18	COLMOD	0	0	1	1	1	0	1	0	3A	I/F format	1
19	RDID1	1	1	0	1	1	0	1	0	DA	Read ID1	2
20	RDID2	1	1	0	1	1	0	1	1	DB	Read ID2	2
21	RDID3	1	1	0	1	1	1	0	0	DC	Read ID3	2

Parameter : It is the number of the parameters of each command.

(1) NOP Command: 1 Parameter: 0

This command does not affect the operation or other effect to the LCD module (visual).

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
NOP	0	0	0	0	0	0	0	0	00	Non operating

(2) SWRESET Command: 1 Parameter: 0

This command resets LCD module by software.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
SWRESET	0	0	0	0	0	0	0	1	01	Soft ware reset

(3) RDDSDR Command: 1 Parameter: 2

This command indicates the current status of the display. However this diagnostic function doesn't ensure to detect all of fault. It is necessary to wait for 150ms to obtain a correct diagnostic outcome after the sleep out command is executed.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
RDDSDR	0	0	0	0	1	1	1	1	0F	Read Display Self-Diagnostic Result
1st	DD	DD	DD	DD	DD	DD	DD	DD	xx	dummy
2nd	B7	B6	B5	x	0	0	0	0	xx	

Refer to the following tables for the meaning of each bit.

No.	Function
B7	OK : Set to 0 after RESET. It is inverted by each SLPOUT command.
B6	NG : Set to 0 after RESET. It is NOT inverted by each SLPOUT command.
B5	
B4	X (1 or 0)
B3	0
B2	0
B1	0
B0	0

(4) SLPIN Command: 1 Parameter: 0

This command sets the sleep state of the LCD module. Please maintain the power supply to 150ms after SLPIN command executed.

See 4.4 recommended sequence to design a command sequence and intervals.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
SLPIN	0	0	0	1	0	0	0	0	10	Sleep in

(5) SLPOUT Command: 1 Parameter: 0

This command releases the sleep state of the LCD module. It is necessary to wait for 10msec for stabilizing internal power circuit

See 4.4 recommended sequence to design a command sequence and intervals.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
SLPOUT	0	0	0	1	0	0	0	1	11	Sleep out

(6) NORON Command: 1 Parameter: 0

This command sets the normal display is used.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
NORON	0	0	0	1	0	0	1	1	13	Normal display on

(7) DISINOFF Command: 1 Parameter: 0

This command allows inversion off display.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
DISINOFF	0	0	1	0	0	0	0	0	20	Display inversion off

(8) DISINV Command: 1 Parameter: 0

This command allows inverse the display without having to update the content of the display data RAM.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
DISINV	0	0	1	0	0	0	0	1	21	Display inversion on

(9) DISPOFF Command: 1 Parameter: 0

This command makes the display a blank.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
DISOFF	0	0	1	0	1	0	0	0	28	Display off

(10) DISPON Command: 1 Parameter: 0

This command turns on the display.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
DISON	0	0	1	0	1	0	0	1	29	Display on

(11) CASET Command: 1 Parameter: 4

This command sets the column address region when display data RAM is accessed from the MPU.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
CASET	0	0	1	0	1	0	1	0	2A	Column address set
P1	*	*	*	*	*	*	*	SC8	xx	Start (Upper data byte)
P2	SC7	SC6	SC5	SC4	SC3	SC2	SC1	SC0	xx	Start (Lower data byte)
P3	*	*	*	*	*	*	*	EC8	xx	End (Upper data byte)
P4	EC7	EC6	EC5	EC4	EC3	EC2	EC1	EC0	xx	End (Lower data byte)

(12) PASET Command: 1 Parameter: 4

This command sets the page address region when display data RAM is accessed from the MPU.

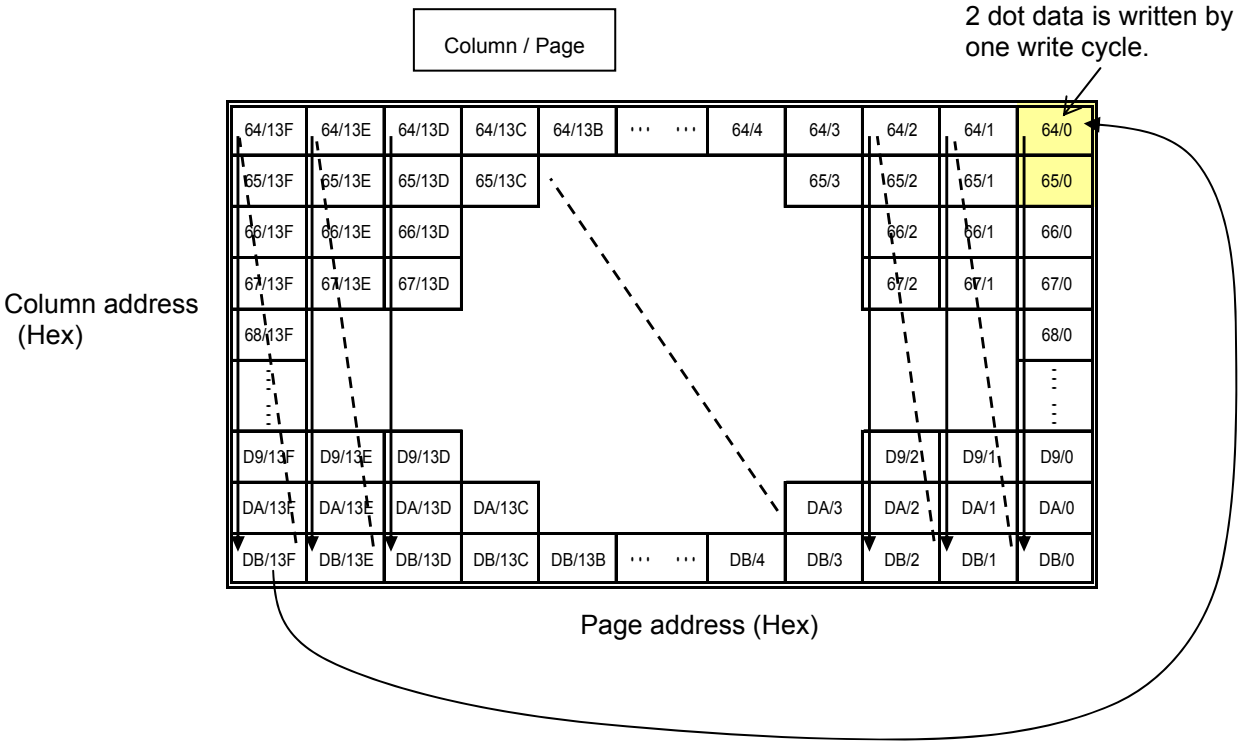
Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
PASET	0	0	1	0	1	0	1	1	2B	Page address set
P1	*	*	*	*	*	*	*	SP8	xx	Start (Upper data byte)
P2	SP7	SP6	SP5	SP4	SP3	SP2	SP1	SP0	xx	Start (Lower data byte)
P3	*	*	*	*	*	*	*	EP8	xx	End (Upper data byte)
P4	EP7	EP6	EP5	EP4	EP3	EP2	EP1	EP0	xx	End (Lower data byte)

(13) RAMWR Command: 1Parameter: write data count

This command enables writing the data MPU to the display memory.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
RAMWR	0	0	1	0	1	1	0	0	2C	RAMWR
P1	*	*	*	*	*	*	*	*	xx	Write data
There is no limitation in the number of data.										
Px	*	*	*	*	*	*	*	*	xx	Write data

Display RAM access order according to 4.4 recommended sequence.



Setting value for memory mapping

MADCTL command	:	00h
Page address	:	00h to 13Fh
Column address	:	64h to DBh

(14) RAMRD Command: 1 Parameter: read data count

This command enables the data read state when the MPU reads data from the display memory.

This command can not be used for serial interface mode.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
RAMRD	0	0	1	0	1	1	1	0	2E	RAMRD
P1	DD	DD	DD	DD	DD	DD	DD	DD	DD	Dummy
P2	*	*	*	*	*	*	*	*	xx	Read data
There is no limitation in the number of data.										
Px	*	*	*	*	*	*	*	*	xx	Read data

(15) TEOFF Command: 1 Parameter: 0

This command disables timing signal output for avoiding tearing effect.

This function is executed next frame, after this command is entered. TE terminal becomes low.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
TEOFF	0	0	1	1	0	1	0	0	34	TEOFF

(16) TEON Command: 1 Parameter: 1

This command enables timing signal output for avoiding tearing effect.

This function is executed next frame, after this command is entered.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
TEON	0	0	1	1	0	1	0	1	35	TEON
P1	0	0	0	0	0	0	0	0	0	Tearing effect output mode

Refer to 4.3 USAGE OF TE OUTPUT.

(17) MADCTL Command: 1 Parameter: 1

This command sets the settings when display data RAM is accessed from the MPU.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
MADCTL	0	0	1	1	0	1	1	0	36	Ram control
P1	B7	B6	B5	B4	*	*	*	B0	xx	

LCD MODULE DEFAULT SETTING

B0: Data send direction (1) 0: Top to bottom

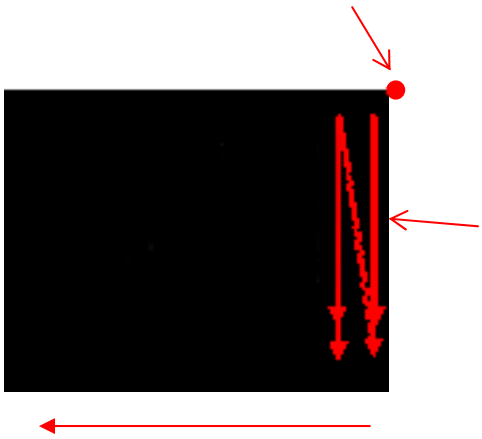
B4: Display scan direction 0: Top to bottom

B5: Data send direction (2) 0: Column direction

B6: Column address origin 0: Left side

B7: Page address origin 0: Top side

B6, B7 defines page address, column address origin.



B0, B5 defines data send direction.

B4 defines Display scan direction.

(18) COLMOD Command: 1 Parameter: 1

This command sets the gray scale mode.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
COLMOD	0	0	1	1	1	0	1	0	3A	I/F format
P1	*	*	*	*	*	P2	P1	P0	xx	I/F

Function	P2	P1	P0
2G/S Mode (Not used)	0	0	0
4G/S Mode (Not used)	0	0	1
Not defined	0	1	0
16G/S Mode	0	1	1
Not define	1	0	0
Not define	1	0	1
Not define	1	1	0
Not define	1	1	1

(19) RDID1 Command: 1 Parameter: 2

This command read the ID1 of LCD module.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
RDID1	1	1	0	1	1	0	1	0	DA	READ ID1
1st	DD	DD	DD	DD	DD	DD	DD	DD	xx	Dummy
2nd	0	0	0	0	0	0	0	0	00	

(20) RDID2 Command: 1 Parameter: 2

This command read the ID2 of LCD module.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
RDID1	1	1	0	1	1	0	1	1	DB	READ ID2
1st	DD	DD	DD	DD	DD	DD	DD	DD	xx	Dummy
2nd	0	0	0	0	0	0	0	0	00	

(21) RDID3 Command: 1 Parameter: 2

This command read the ID3 of LCD module.

Command	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Description
RDID1	1	1	0	1	1	1	0	0	DC	READ ID3
1st	DD	DD	DD	DD	DD	DD	DD	DD	xx	Dummy
2nd	0	0	0	0	0	0	0	0	00	

3. ABSOLUTE MAXIMUM RATINGS

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

3.1 ELECTRICAL ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating	Unit
Power supply voltage	VCC	-0.3 to +4.0	V
Signal input voltage	VIN	-0.3 to VCC+0.3	V

3.2 ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	STMBOL	CONDITION	RATING		UNIT	REMARKS
			Min	Max		
Ambient temperature	TOP	Operation	- 30	85	℃	No dew condition
	TST	Storage	- 40	90		

The absolute maximum ratings represent the rated values which LCD module can not exceed.
When LCD modules are used beyond this rated value, the operating characteristics may be adversely affected.

4. ELECTRICAL SPECIFICATIONS

4.1 DC CHARACTERISTICS

4.1.1 DC specifications of general pins

GND=0V

PARAMETER	Symbol	Rating			Unit	Remarks
		Min.	Typ.	Max.		
Power Supply voltage	VCC	3.0	3.3	3.6	V	
Power Supply current	ICC	-	-	10	mA	Image: All pixels White *2
		-	-	400	uA	Sleep in mode*3
Input voltage	High	0.7VCC	-	VCC	V	IIH = 10[uA](Max)
	Low	0	-	0.3VCC	V	IIL = -10[uA](Max)
Output voltage	High	0.8VCC	-	VCC	V	IOH=-0.5mA
	Low	0	-	0.2VCC	V	IOL=0.5mA
Input leak current	I_L	-10	-	10	uA	Except VCC PIN

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

*2: At the condition of input pins of D0 ～D7, D/XC, XWR, and XRD are fixed to "H" or "L". In-rush current is excluded.

*3: At the condition of input pins of D0 ～D7, D/XC, XWR, and XRD are fixed to "H" or "L", backlight is turned off.

4.1.2 Characteristics of LED and LED driving

PARAMETER	Symbol	Value			Unit	Remarks
		Min.	Typ.	Max.		
LED forward voltage	Vf	-	2.8	3.4	V	Per LED *1
LED forward current	If	-	25	280	mA	*2

*1: If=25mA, Ta=25℃(from Nichia's only one LED specification)

*2: LED allowable forward current is decremented by the ambient temperature. (Refer to Fig.1)

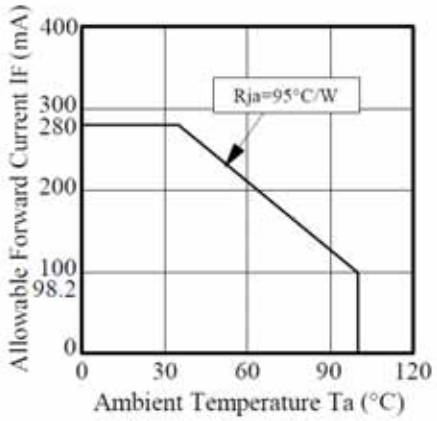
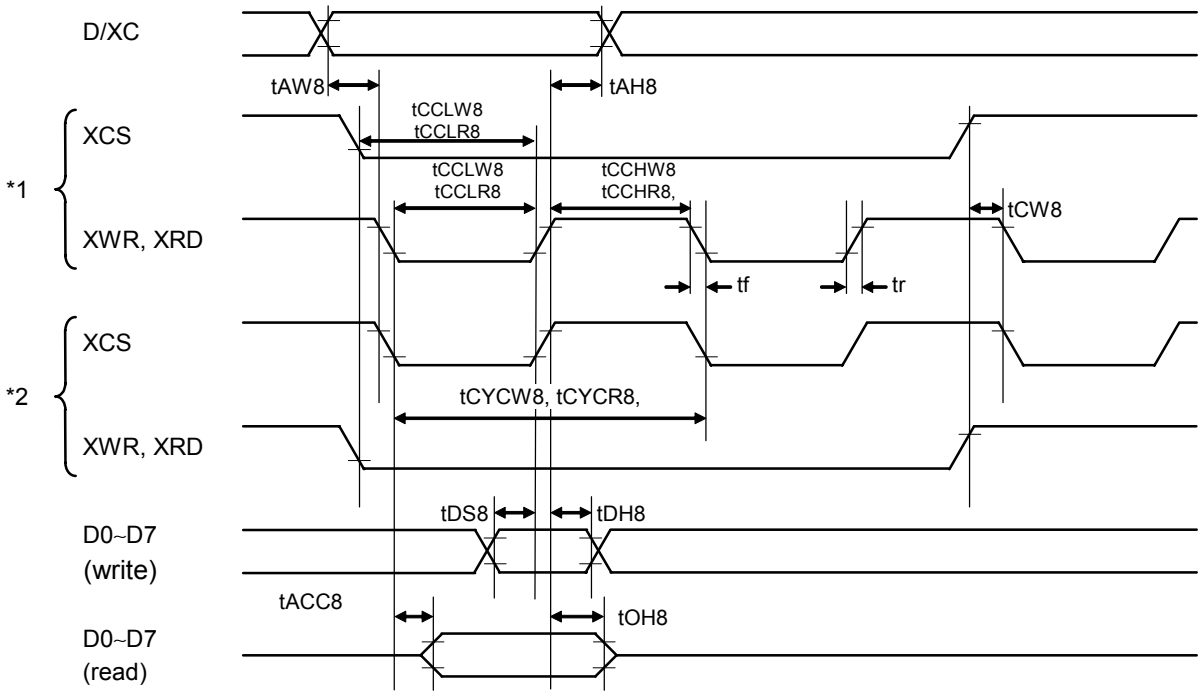


Fig.1: Ambient Temperature vs.
Allowable Forward Current
(from Nichia's specification)

4.2 AC CHARACTERISTICS

4.2.1 Parallel interface timing

(1) I80 8bit parallel interface



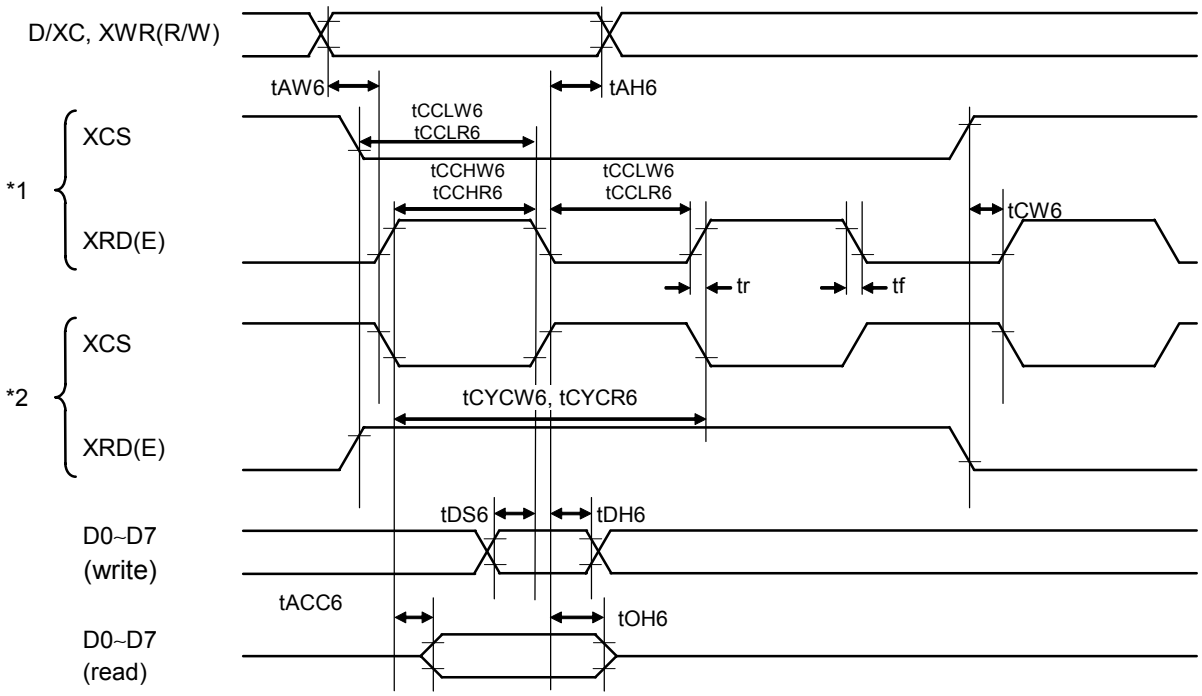
*1 Access at XWR and XRD when XCS is "L".*2 Access at XCS when XWR and XRD are "L".

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
XCS	tCW8	XCS/set up time	20	-	ns	*1, *2, *3
D/XC	tAH8	address hold time	20	-	ns	
	tAW8	address set up time	20	-	ns	
XWR	tCYCW8	Write cycle	150	-	ns	
	tCCHW8	Control pulse H width (WR)	35	-	ns	
	tCCLW8	Control pulse L width (WR)	35	-	ns	
XRD	tCYCR8	Read cycle	440	-	ns	
	tCCHR8	Control pulse H width (RD)	90	-	ns	
	tCCLR8	Control pulse L width (RD)	150	-	ns	
D0 ~ D7	tDS8	data set time	20	-	ns	
	tDH8	data hold time	20	-	ns	
	tACC8	read access time	-	145	ns	*4 *5
	tOH8	output disable time	15	80	ns	

Voltage of VCC is in ranges of 4.1 DC CHARACTERISTICS, ambient temperature is in a range of operating temperature.

*1 The rise and fall times of all input signals (tr, tf) are equal or less than 40ns.
*2 For timing of input signals, they are set using 30 % and 70 % of VCC as the base reference.
*3 TCCLW8 and tCCLR8 are set to the overlapping period when XCS is "L" and XWR and XRD are "L" level.
The timing of D/XC is set to the overlapping period when XCS is "L" and XWR and XRD are "L" level.
*4 For timings of tACC8 and tOH8 are set using 20 % and 80 % of VCC as the base reference.
*5 Measurement condition For maximum value : C_L = 30pF, For minimum value : C_L = 8pF

(1) M68 8bit parallel interface



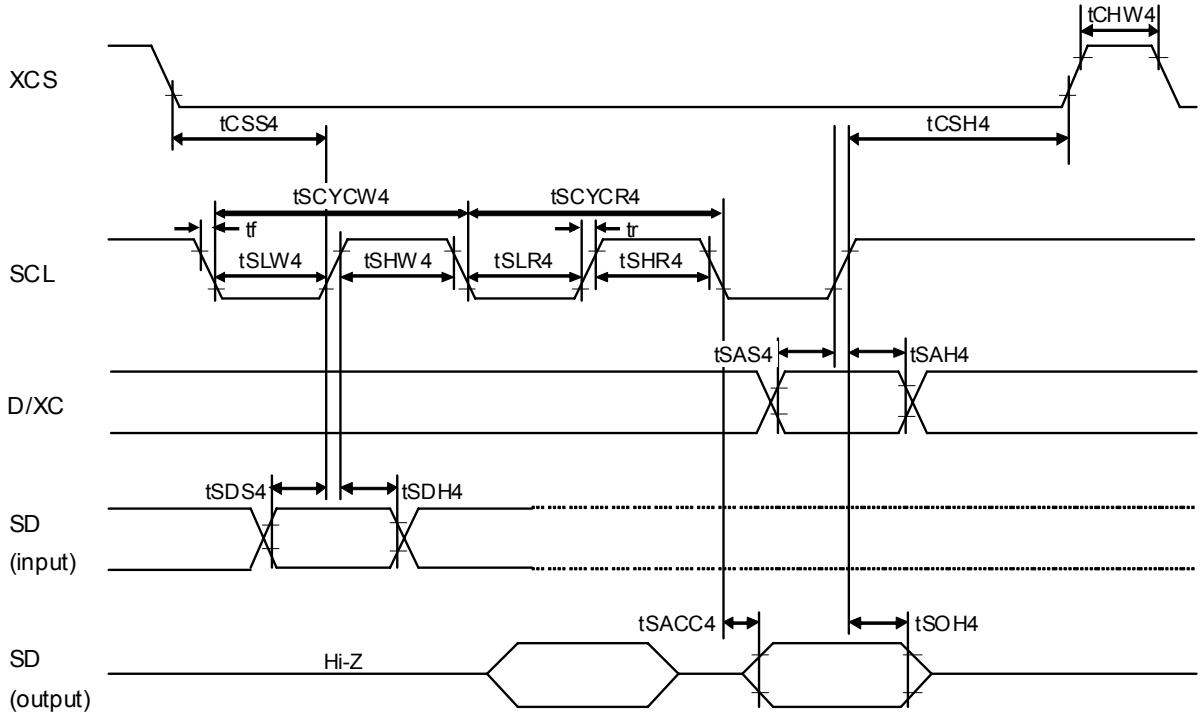
*1 Access at E when XCS is "L". *2 Access at XCS when E is “H”.

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
XCS	tCW6	XCS/set up time	20	-	ns	*1, *2, *3
D/XC	tAH6	address hold time	20	-	ns	
R/W	tAW6	address set up time	20	-	ns	
E	tCYCW6	Write cycle	150	-	ns	
	tCCHW6	Control pulse H width (WR)	35	-	ns	
	tCCLW6	Control pulse L width (WR)	35	-	ns	
E	tCYCR6	Read cycle	440	-	ns	
	tCCHR6	Control pulse H width (RD)	90	-	ns	
	tCCLR6	Control pulse L width (RD)	150	-	ns	
D0 ~ D7	tDS6	data set time	20	-	ns	
	tDH6	data hold time	20	-	ns	
	tACC6	read access time	-	145	ns	*4 *5
	tOH6	output disable time	15	80	ns	

Voltage of VCC is in ranges of 4.1 DC CHARACTERISTICS, ambient temperature is in a range of operating temperature.

*1 The rise and fall times of all input signals (tr, tf) are equal or less than 40ns.
*2 For timing of input signals, they are set using 30 % and 70 % of VCC as the base reference.
*3 TCCLW6 and tCCLR6 are set to the overlapping period when XCS is "L" and XRD(E) is "L" level.
The timing of D/XC is set to the overlapping period when XCS is "L" and XRD(E) is "L" level.
*4 For timings of tACC6 and tOH6 are set using 20 % and 80 % of VCC as the base reference.
*5 Measurement condition For maximum value : C_L = 30pF, For minimum value : C_L = 8pF

4.2.2 4wire 8bit serial interface timing

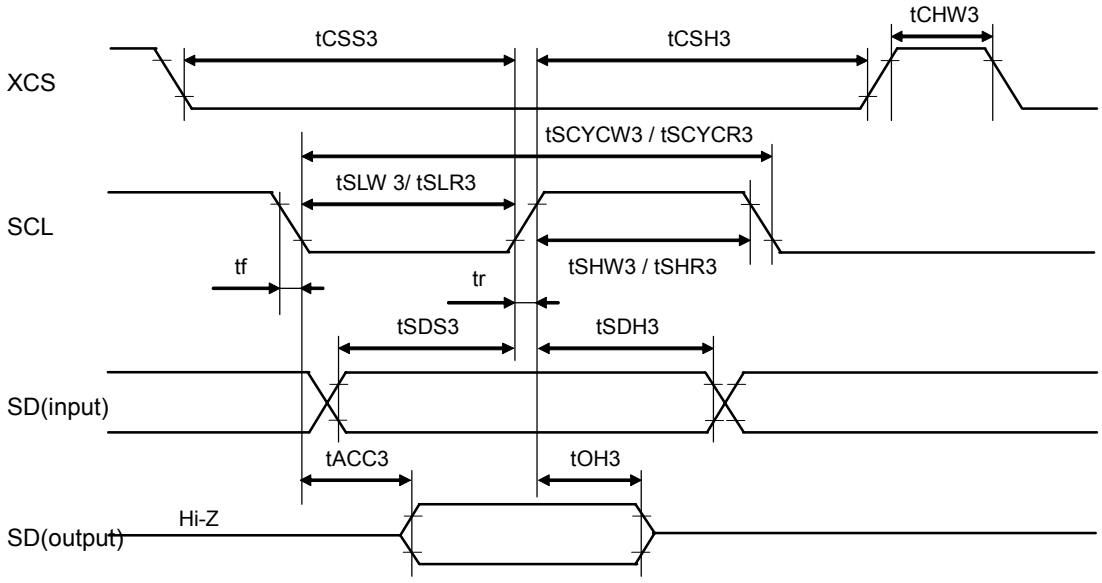


Signal	Symbol	Parameter	MIN	MAX	Unit	Description
XCS	tCSS4	XCS/set up time	60	-	ns	*1, *2
	tCSH4	XCS/hold time	65	-	ns	
	tCHW4	XCS"H" pulse width	45	-	ns	
SCL (Write)	tSCYCW4	clock cycle	150	-	ns	
	tSLW4	"L" pulse width	35	-	ns	
	tSHW4	"H" pulse width	35	-	ns	
SCL (Read)	tSCYCR4	clock cycle	470	-	ns	
	tSLR4	"L" pulse width	135	-	ns	
	tSHR4	"H" pulse width	135	-	ns	
D/XC	tSAS4	Address setup time	30	-	ns	
	tSAH4	Address hold time	30	-	ns	
SD(input)	tSDS4	data set time	30	-	ns	
	tSDH4	data hold time	30	-	ns	
SD(output)	tACC4	data delay time(Hi-z-data)	5	130	ns	*3, *4
	tOH4	data delay time(data-Hi-z)	15	130	ns	

Voltage of VCC is in ranges of 4.1 DC CHARACTERISTICS, ambient temperature is in a range of operating temperature.

*1 The rise and fall times of all input signals (tr, tf) are equal or less than 40ns.
*2 For timing of all input signals, they are set using 30 % and 70 % of VCC as the base reference.
*3 For timing of all outputs signals, they are set using 20% and 80% of VCC as the base reference.
*4 Measurement condition For maximum C_L = 30pF , For minimum C_L = 8pF

4.2.3 3 wire 9bit serial interface timing

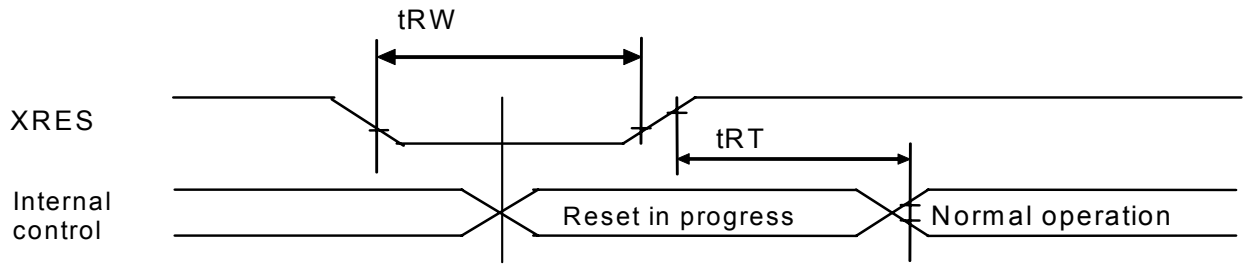


Signal	Symbol	Parameter	MIN	MAX	Unit	Description
XCS	tCSS3	XCS/set up time	60	-	ns	*1, *2
	tCSH3	XCS/hold time	65	-	ns	
	tCHW3	XCS"H" pulse width	45	-	ns	
SCL (Write)	tSCYCW3	clock cycle	150	-	ns	
	tSLW3	"L" pulse width	35	-	ns	
	tSHW3	"H" pulse width	35	-	ns	
SCL (Read)	tSCYCR3	clock cycle	470	-	ns	
	tSLR3	"L" pulse width	135	-	ns	
	tSHR3	"H" pulse width	135	-	ns	
SD(input)	tSDS3	data set time	30	-	ns	
	tSDH3	data hold time	30	-	ns	
SD(output)	tACC3	data delay time(Hi-z-data)	5	130	ns	*3, *4
	tOH3	data delay time(data-Hi-z)	15	130	ns	

Voltage of VCC is in ranges of 4.1 DC CHARACTERISTICS, ambient temperature is in a range of operating temperature.

*1 The rise and fall times of all input signals (tr, tf) are equal or less than 40ns
*2 For timing of all input signals, they are set using 30 % and 70 % of VCC as the base reference.
*3 For timing of all outputs signals, they are set using 20% and 80% of VCC as the base reference.
*4 Measurement condition For maximum value : C_L = 30pF , For minimum value : C_L = 8pF

4.2.4 Reset timing



Signal	Symbol	Parameter	MIN	MAX	Unit	Measurement Condition and Others
XRES	tRW	reset pulse width	50	-	us	*1
	tRT	clear reset	-	10	ms	*1, *2

Voltage of VCC is in ranges of 4.1 DC CHARACTERISTICS, ambient temperature is in a range of operating temperature.

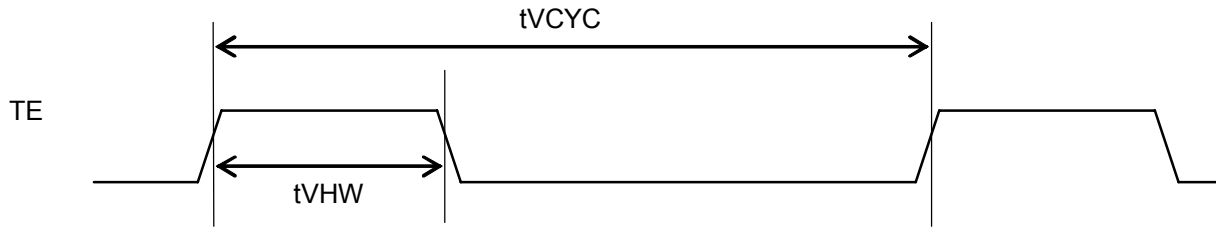
*1 The rise and fall times of the input signal (tr, tf) are equal or less than 100ns.
For all timings are set using 30 % and 70 % of VCC-GND as the base reference.

Technically working if the rise and fall time of the input signal (tr, tf) is longer than 100ns but this case a noise endurance etc. be getting weak and has to be care by customers.

*2 The driver IC initializes logic circuit for this period.

4.3 USAGE OF TE OUTPUT

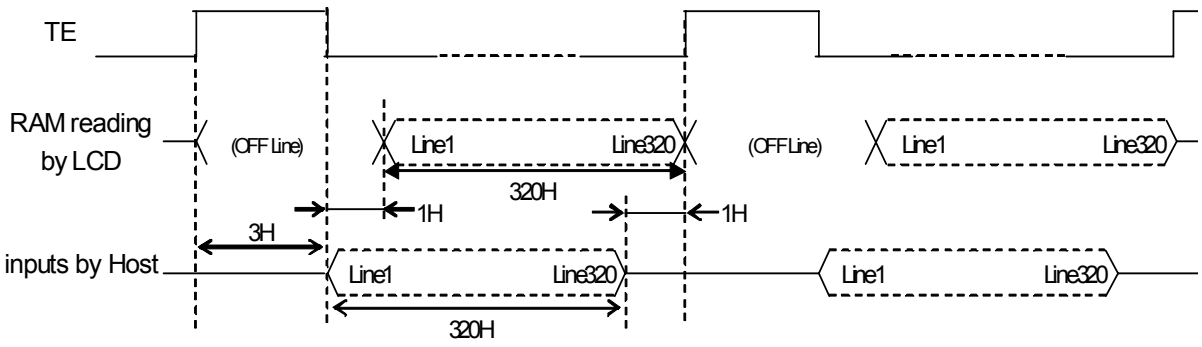
4.3.1 TE output characteristics



Signal	Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
TE	tVHW	TE pulse H width	133	153	181	us	
	tVCYC	TE period	14.4	16.6	19.6	ms	

*: At the condition of power supply voltage is in a range of 4.1 DC CHARCTERISTCS.

4.3.2 TE Output and RAM Writing by Host



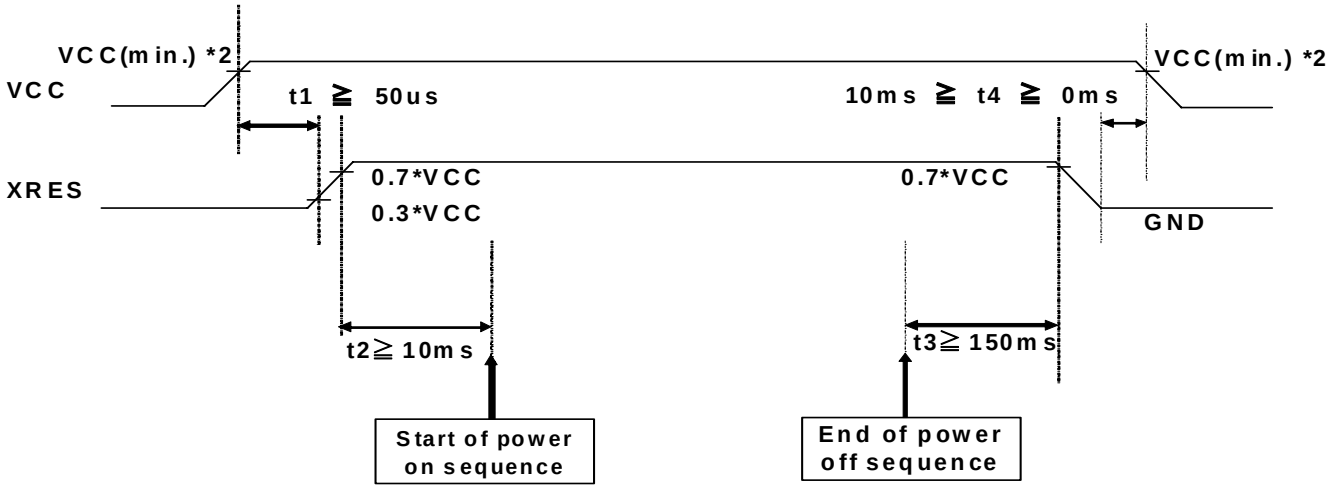
Parameter	Ratings	Unit	Remarks
Line-1 from rising edge of TE	133	us	
RAM writing time at a pixel	0.68 to 10	MHz	

* Timings are mentioned in order to prevent a tearing of display that is caused by running over of writing.

4.4 RECOMMENDED SEQUENCE

-1) Start to supply system power (VCC).
-2) Make a device reset after starting to supply the system power.
(XRES must be kept "L" for more than 50us.)
-3) Input control signal.
-4) Wait more than 10ms after releasing the system reset *1)
-5) Transfer commands for initial setting and turning on. (See 4.4.1 Power on sequence.)
(Display is started.)
-6) Transfer commands to turn off. (See 4.4.2 Power off sequence.)
-7) Stop to supply system power.

Required intervals are described in the following chart and the table of "4.4.1" to "4.4.2".



Notes)
* 1 XRES must be maintained to “LOW” more than 50us after turning on the system power (VCC).
* 2 VCC(min) is minimum voltage of VCC. Please refer to 4.1. DC CHARACTERISTICS
* 3 The rising speed of VCC should be less than 2V/100us.

4.4.1 Power on sequence

Command	Hex	Remarks
Power-ON (VDD)		
XRES = "L" more than 50us		
XRES = "H" (reset release)		
More than 10 [ms]		
SLPOUT	11h	
More than 10 [ms]		
CASET	2Ah	
P1	00h	
P2	64h	
P3	00h	
P4	DBh	
PASET	2Bh	
P1	00h	
P2	00h	
P3	01h	
P4	3Fh	
COLMOD	3Ah	
P1	03h	16 gray scale
TEON	35h	
P1	00h	
NORON	13h	
DISINOFF	20h	
MADCTL	36h	
P1	00h	
RAMWR	2Ch	
dot #0 - #1		Send display data 2 dot / cycle (4 bit / dot)
dot #2 - #3		
. . .		
dot #38396 - #38397		
dot #38398 - #38399		
DISPON	29h	

4.4.2 Power off sequence

Command	Hex	Remarks
Display on state		
DISPOFF	28h	
Wait more than [50ms]		
SLPIN	10h	
More than 150 [ms]		
Power - OFF		

4.4.3 Refresh sequence

This sequence should be implemented continuously in order to recover the display error due to noise etc.

Command	Hex	Remarks
SLPOUT	11h	
More than 10 [ms]		
CASET	2Ah	
P1	00h	
P2	64h	
P3	00h	
P4	DBh	
PASET	2Bh	
P1	00h	
P2	00h	
P3	01h	
P4	3Fh	
COLMOD	3Ah	
P1	03h	16 gray scale
TEON	35h	
P1	00h	
NORON	13h	
DISINOFF	20h	
MADCTL	36h	
P1	00h	
RAMWR	2Ch	
dot #0 - #1		Send picture data 2 dot / cycle (4 bit / dot)
dot #2 - #3		
. . .		
dot #38396 - #38397		
dot #38398 - #38399		
DISPON	29h	

4.4.4 Sleep out sequence

This sequence should be input in order to return from the sleep mode.

Command	Hex	Remarks
SLPOUT	11h	
More than 10 [ms]		
CASET	2Ah	
P1	00h	
P2	64h	
P3	00h	
P4	DBh	
PASET	2Bh	
P1	00h	
P2	00h	
P3	01h	
P4	3Fh	
COLMOD	3Ah	
P1	03h	16 gray scale
TEON	35h	
P1	00h	
NORON	13h	
DISINOFF	20h	
MADCTL	36h	
P1	00h	
RAMWR	2Ch	
dot #0 - #1		Send picture data 2 dot / cycle (4 bit / dot)
dot #2 - #3		
. . .		
dot #38396 - #38397		
dot #38398 - #38399		
DISPON	29h	

4.4.5 Sleep in sequence

This sequence should be input in order to enter the sleep mode.

Command	Hex	Remarks
Display on state		
DISPOFF	28h	
More than 50 [ms]		
SLPIN	10h	
More than 150 [ms]		
Sleep in state		

5. OPTICAL SPECIFICATIONS

5.1 OPTICAL SPECIFICATIONS

5.1.1 transparence

Item		Symbol	Temp. (°C)	Rating			Unit	definition (Condition)	Remark
				Min.	Typ.	Max.			
Contrast Ratio		*CR*	25	500	1000	-	-	1,2	-
Response	tr+tf	t_r	25	-	40	-	ms	1,3	-
Color coordinates	W-x	*Wx*	25	0.275	0.315	0.355	-	1,4	-
	W-y	*Wy*		0.292	0.332	0.372			
Brightness		*B*	25	350	600	-	cd/m^2	1,6	-
Brightness homogeneity		-	25	75	-	-	%	1,7	-
Viewing angle	**ϕ**=-70-+70		25	10	-	-	Deg.	1,5	-
	ϕ=-55-+55		25	40	-	-			
	ϕ=-40-+40		25	150	-	-			

5.2 DEFINITIONS AND CONDITIONS

5.2.1 definitions of optical characteristics

Definition 1

Measuring conditions

(1) Instrument: DMS 803(301) (autronic-MELCHERS GmbH.),or equivalent.
(2) Ambient temperature: Ta=25 °C
(3) Display: white or black display on all screen,VCC=3.3V
(4) Measure after 15 minutes of LED warm up.
(5) Vf=2.8V, If=25mA per LED

Definition 2

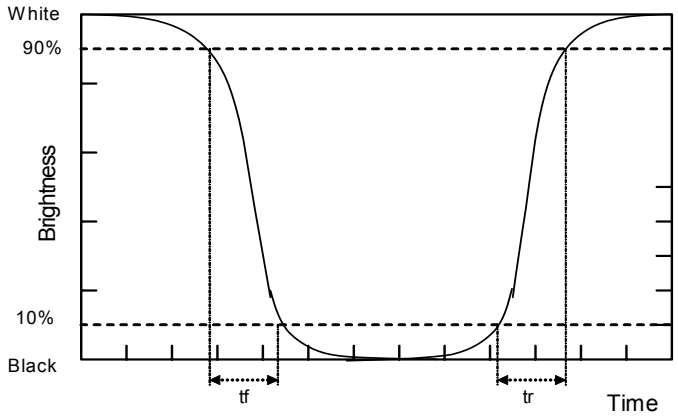
This is a ratio between the screen surface reflectance or brightness of the white raster and the black raster.

$$CR = \frac{\text{White brightness}}{\text{Black brightness}}$$

Definition 3

tf: This is a time that decreases to 10% of total change of the screen surface brightness from the point of 90%, after data signal is switched from white-raster to black-raster.

tr: This is a time that increases to 90% of total change of the screen surface brightness from the point of 10%, after data signal is switched from black-raster to white-raster.



tf：Response time from White to Black

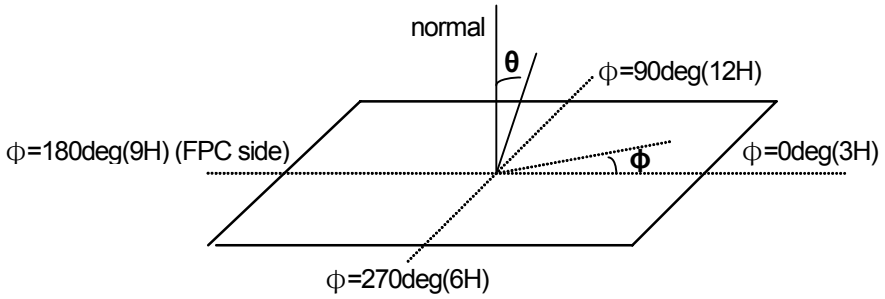
tr：Response time from Black to White

Definition 4

This is the x-y coordinate of White colors specified on the CIE1931 chromaticity diagram.

Definition 5

This is a maximum angle θ from the normal direction that keeps having the contrast ratio more than 10:1,40:1 and 150:1. The angle on surface ϕ is defined respectively.

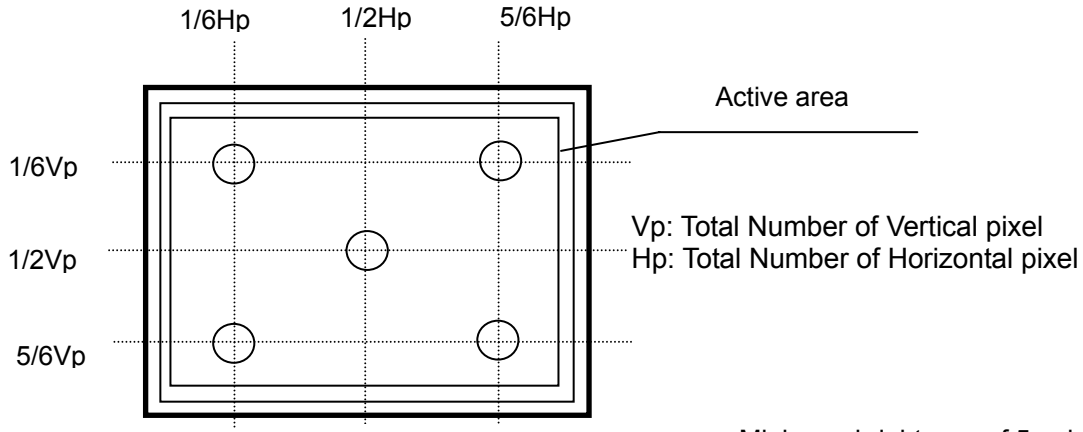


Definition 6

Measured at the center of active display area

Definition 7

Measurement point



$$\text{Luminance homogeneity} = \frac{\text{Minimum brightness of 5 points}}{\text{Maximum brightness of 5 points}} \times 100$$

Characteristics is measured at 5 points in the active area.

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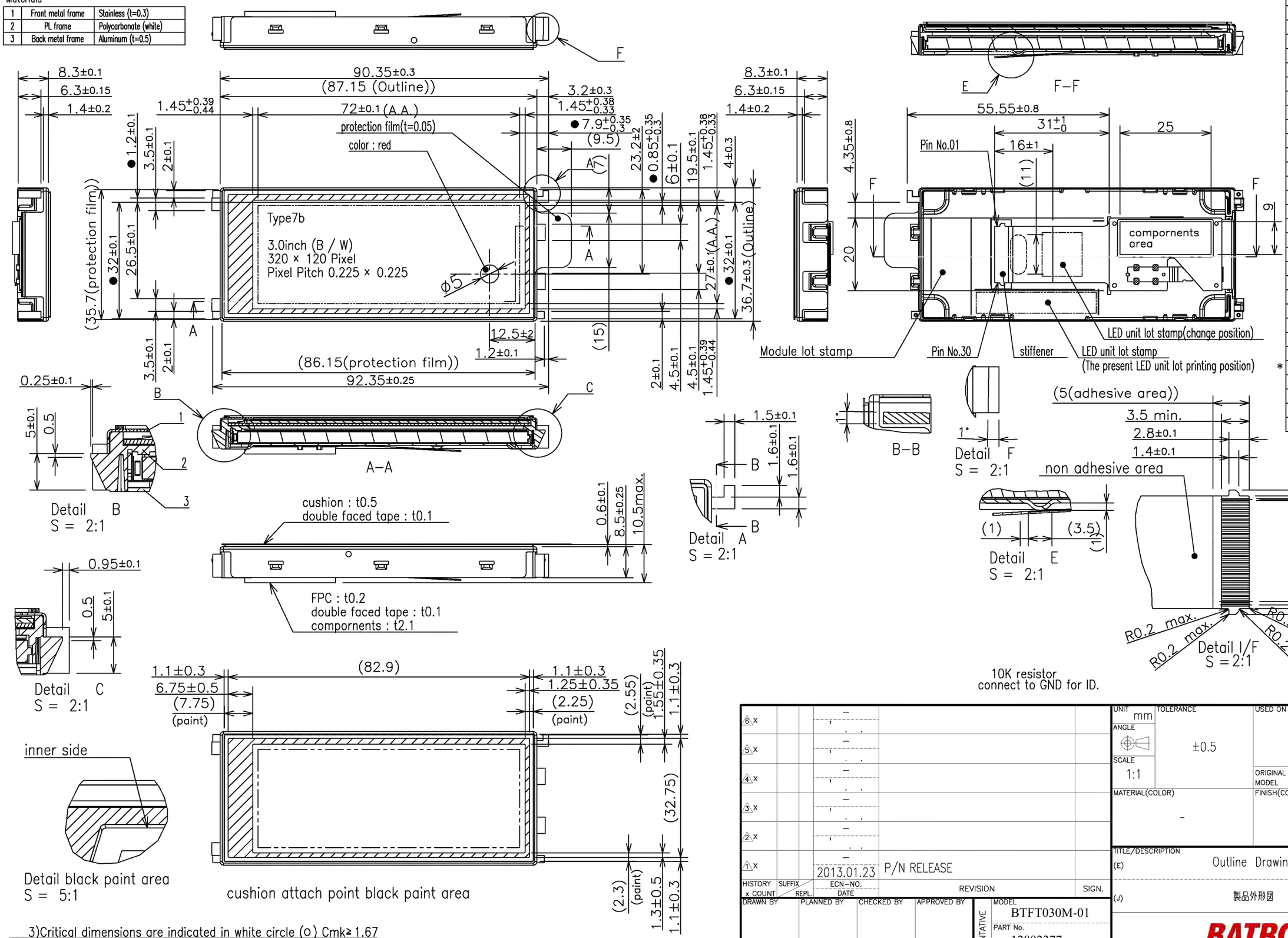
Materials

1	Front metal frame	Stainless (t=0.3)
2	PL frame	Polycarbonate (white)
3	Back metal frame	Aluminum (t=0.5)



10K resistor
connect to GND for ID.

Pin No.	I/F Terminal
01	GND
02	GND
03	XRES
04	D/XC
05	XCS
06	TE
07	D7
08	D6
09	D5
10	D4
11	D3
12	D2
13	D1
14	D0(SD)
15	XWR(SCL)
16	GND
17	XRD
18	C86
19	PS
20	VCC
21	VCC
22	GND
23	N.C.
24	LED1_C
25	LED2_C
26	P_Down
27	N.C.
28	LED1_A
29	LED2_A
30	N.C.

3)Critical dimensions are indicated in white circle (○) Cmk≥ 1.67
2)Critical dimensions are indicated in black circle (●) Cpk≥ 1.33
Note1)Connecter for I/F Terminal : FH28D–30S–0.5SH(05) (HIROSE)

HISTORY x COUNT	SUFFIX REPL	ECN–NO. DATE	REVISION	SIGN.
6 x		– ; – . .		
5 x		– ; – . .		
4 x		– ; – . .		
3 x		– ; – . .		
2 x		– ; – . .		
1 x		– 2013.01.23	P/N RELEASE	

DRAWN BY | PLANNED BY | CHECKED BY | APPROVED BY

TENTATIVE

MODEL: BTFT030M-01
PART No.: 12002377

UNIT: mm | TOLERANCE: ±0.5 | USED ON | RANK | FAMILY
ANGLE | SCALE: 1:1
ORIGINAL MODEL: GCX125AKN–E
MATERIAL(COLOR): – | FINISH(COLOR)

TITLE/DESCRIPTION
(E) Outline Drawing
(J) 製品外形図

BATRON

SHEET 1/1