G128641BNHDWB

DATA SHEET

ISSUE	VERSION	APPROVER	CHECKER	ENGINEER
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CONTENTS

1. SCOPE

This specification covers the engineering requirements for the G128641BNHDWB liquid crystal module.

2. PRODUCT SPECIFICATIONS

2.1 General

- 128 × 64 dot matrix LCD
- STN (Blue mode) , Negative mode LCD panel
- Transmissive , Wide temperature type
- 6 o'clock
- Back-light : Edge LED , White
- Multiplexing driving : 1/64duty, 1/9bias

2.2 Mechanical Characteristics

Item	Characteristic
Dot configuration	128 × 64
Dot dimensions(mm)	0.40 × 0.56
Dot spacing (mm)	0.04
Module dimensions (Horizontal × Vertical × Thickness, mm)	78.0 × 70.0 × 13.0 max.
Viewing area (Horizontal × Vertical, mm)	62.0 × 44.0
Active area (Horizontal × Vertical, mm)	56.28 × 38.36

2.3 Absolute Maximum Ratings (Without LED back-light)

[V_{SS}=0V]

Item	Symbol	Min.	Max.	Unit	Note
Supply Voltage	V_{DD}	-0.3	7.0	V	
Input voltage (Signal)	V_I	-0.3	V_{DD}+0.3	V	
Operating temperature	T_{OP}	-20	70	°C	
Storage temperature	T_{STG}	-30	80	°C	
Humidity	--	--	90	%RH	1)

Note 1) Referenced to VSS=0V

2.4 Electrical Characteristics (Without LED back-light)

DC CHARACTERISTICS
TEST CONDITIONS(Unless otherwise noted, V_{SS}=0V, V_{DD}=5.0V±10%,Ta=-20 to 70°C

ITEM		SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	PIN NAME
Operating Voltage		V_{DD}	--	4.5	5.5	5.5	V	V_{DD}
Input	H Level	V_{IH}	--	VDD-2.2	--		V	Input pins
	L Level	V_{IL}	--	0	--		V	Input pins
Output Voltage	H Level	V_{OH}	--	VDD-0.3	--		V	Output pins
	L Level	V_{OL}	--	0	--		V	Output pins
Output Resistance	H Level	R_{OH}	V_{OUT}=V_{DD}-0.5V	--	--		Ω	Output pins
	L Level	R_{OL}	V_{OUT}=0.5V	--	--		Ω	Output pins
Input Pull-up Resistance		RPU	--	50	100		kΩ	(Note 1)
Operating Frequency		f_{OSC}	--	0.4	--		MHz	
Current Consumption (Operating)		I_{DD}(1)	V_{DD}=5.0V(Note 2) f_{OSC}=3.0MHz	--	3.3		mA	V_{DD}
Current Consumption (Halt)		I_{DD}(2)	V_{DD}=5.0V	--	--		μA	V_{DD}

(Note 1) Applied $\overline{T1}$, $\overline{T2}$, $\overline{RESET}$
(Note 2) MDS=L,MD0=L,MD1=L,MD2=H,MD3=H,FS0=L,FS1=L, $\overline{SDSEL}$ = L, $\overline{DUAL}$ = H
D7 to D0=LHLHLHLH

2.5 Optical Characteristics Absolute maximum ratings

Item	Symbol	Rating	Unit
Applied voltage AC	VAC	10.7	V
Applied voltage DC	VDC	150	mV
Operating temperature range	Top	-20~70	°C
Storage temperature range	Tst	-30~80	°C

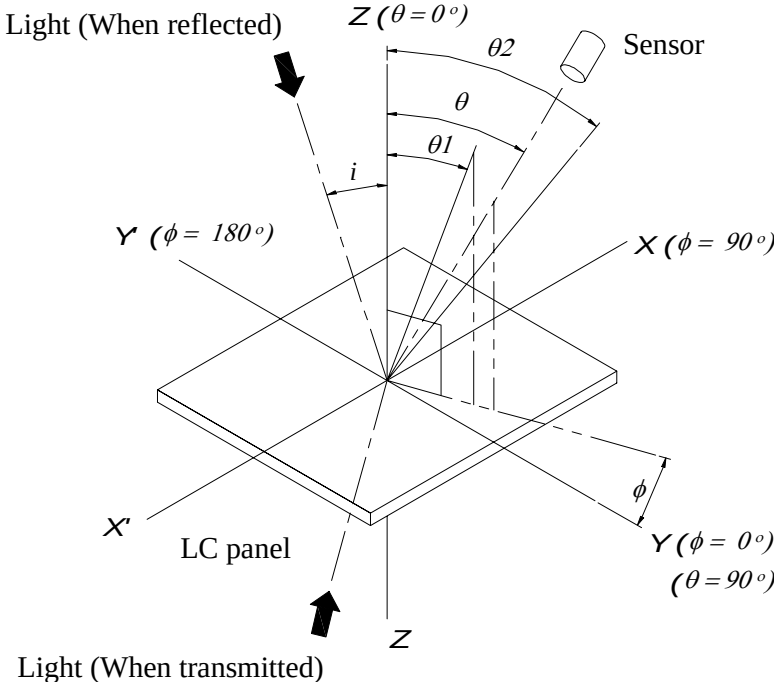
2.6 Optical Characteristics

1/64 duty, 1/9 bias

Item	Symbol	Temp.	Min.	Typ.	Max.	Unit
Driving voltage	Vop	0 °C	8.7	9.2	9.7	V
		25 °C	8.4	8.9	9.4	
		50 °C	8.1	5.6	9.1	
Contrast	K	θ=0° ϕ=0°	2	4	--	--
Frame freq.	fF	--	--	78	--	Hz
Viewing angle*	θ_1	25 °C	--	-25	--	deg.
	θ_2		--	25	--	
Response time	t_{on}	25 °C	--	200	400	ms
	t_{off}		--	250	500	

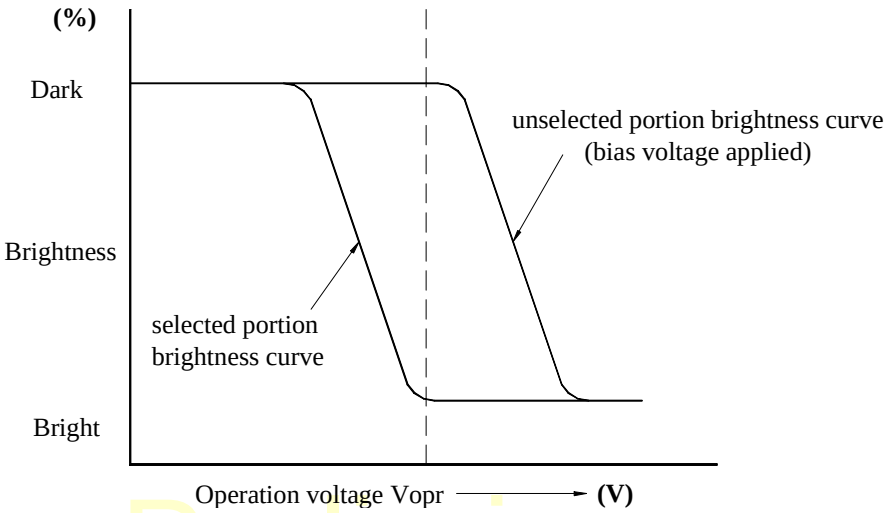
2.6.1 Definition of optical characteristics

* Definition of angles ϕ and θ

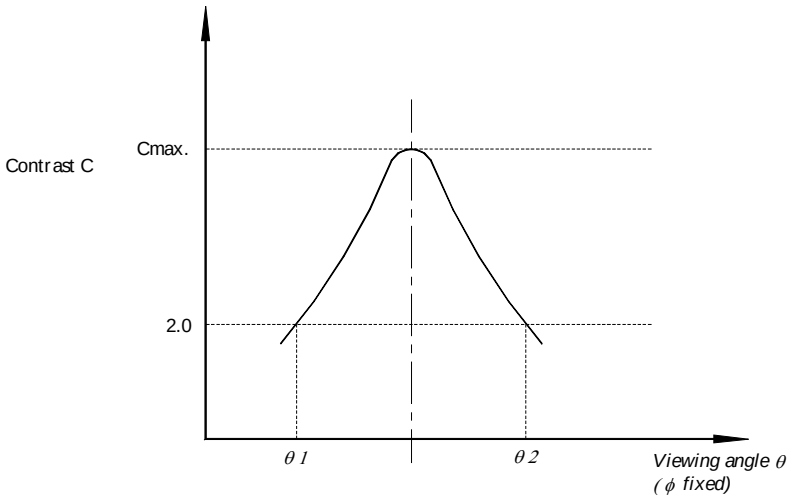


*Definition of contrast C

$$C = \frac{B1}{B2} = \frac{\text{Brightness of selected portion}}{\text{Brightness of unselected portion}}$$

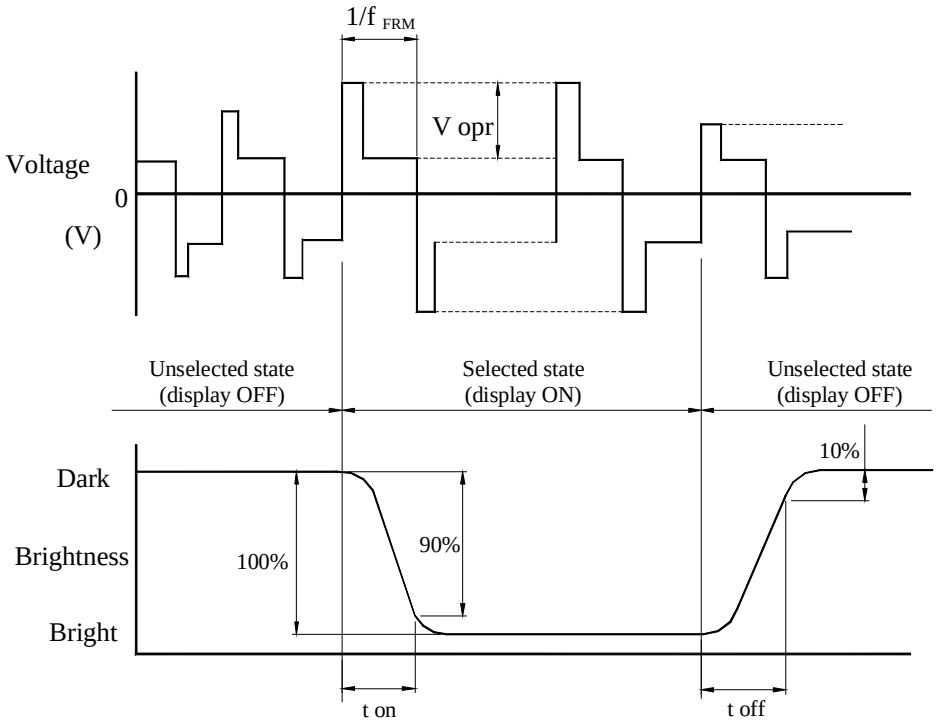


* Definition of viewing angles θ1 and θ2



Note : Optimum vision with the naked eye and viewing angle θ at Cmax above are not always the same.

* Definition of response time



Vop : Operating voltage (V)
fFRM : Frame frequency (Hz)
ton : Response time (rise) (ms)
toff : Response time (fall) (ms)

2.7 LED Back-light Characteristics

2.7.1 Electrical / Optical specifications

Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward voltage	V_f	If=80mA, White	3.3	3.4	3.5	V
*Luminous Intensity	I_V	If=80mA, White	--	200	--	cd/m^2
Luminous Tolerance	--	If=80mA, White	--	--	20	%
Reverse Current	I_R	VR=5V, White	--	--	--	mA
Chromaticity	X	If=80mA, White	--	0.31	--	--
	Y		--	0.32	--	

Note: * Please refer to CIE 1931 chromaticity diagram.

2.7.2 LED Maximum Operating Range

Item	Symbol	White	Unit
Power Dissipation	P_{AD}	2.0	W
Forward Current	I_F	100	mA
Reverse Voltage	V_R	5	V

3. RELIABILITY

3.1 Reliability

Test item	Test condition	Evaluation and assessment
Operation at high temperature and humidity	40 °C±2 °C 90%RH for 500hours	No abnormalities in functions* and appearance**
Operation at high temperature	60 °C±2 °C for 500 hours	No abnormalities in functions* and appearance**
Heat shock	-20± ~ +60 °C Left for 1 hour at each temperature, transition time 5 min, repeated 10times	No abnormalities in functions* and appearance**
Low temperature	-20±2 °C for 500 hours	No abnormalities in functions* and appearance**
Vibration	Sweep for 1 min at 10 Hz, 55Hz, 10Hz, amplitude 1.5mm 2 hrs each in the X,Y and Z directions	No abnormalities in functions* and appearance**
Drop shock	Dropped onto a board from a height of 10cm	No abnormalities in functions* and appearance**

* Dissipation current, contrast and display functions

** Polarizing filter deterioration, other appearance defects

3.2 Liquid crystal panel service life

100,000 hours minimum at 25 °C±10 °C

3.3 Definition of panel service life

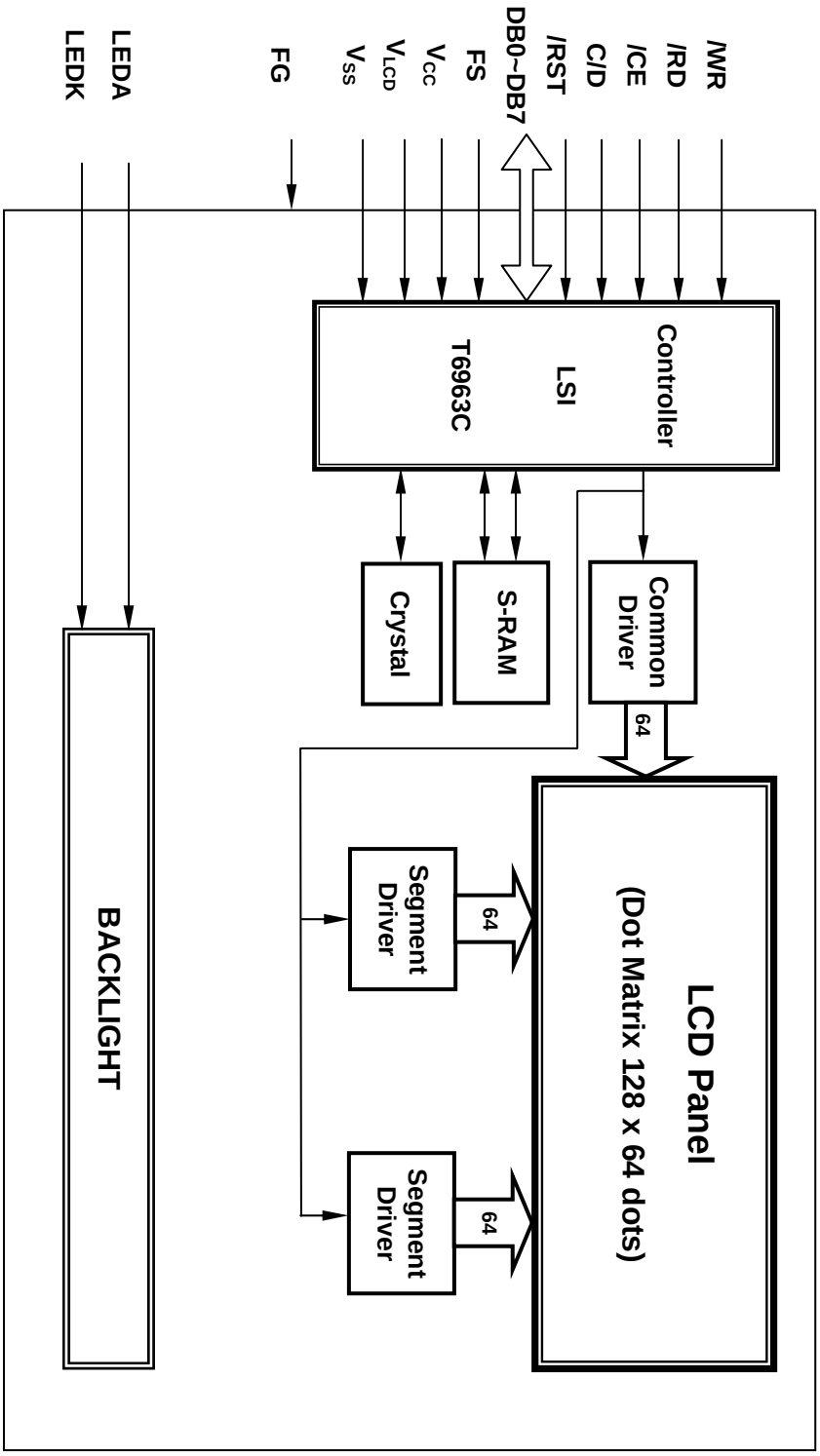
- Contrast becomes 30% of initial value
- Current consumption becomes three times higher than initial value
- Remarkable alignment deterioration occurs in LCD cell layer
- Unusual operation occurs in display functions

4. OPERATING INSTRUCTIONS

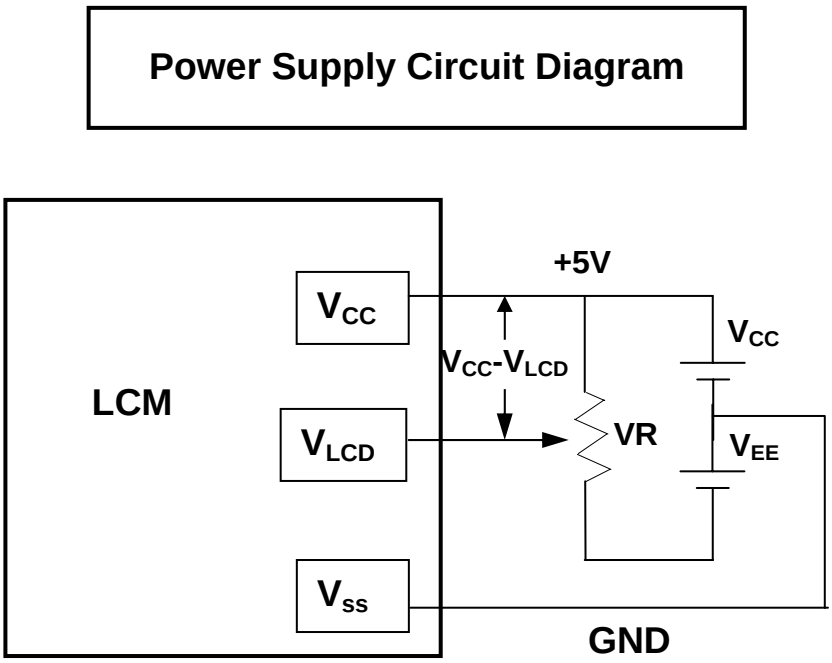
4.1 Input signal Function

NO.	Symbol	Function
1	FG	Frame ground
2	VSS	Ground (0V)
3	VCC	Power supply for Logic circuit (+)
4	VLCD	LCD Drive Voltage (-)
5	/WR	Write Data
6	/RD	Read Data
7	/CE	Chip Enable
8	C/D	Code/Data
9	/RST	Reset Active “L”
10-17	DB0-DB7	Data Bus Line
18	FS	Font select
19	LED A	Power supply for LED
20	LED K	Power supply for LED

4.2 Circuit Block Diagram



4.3 Voltage Generator Circuit

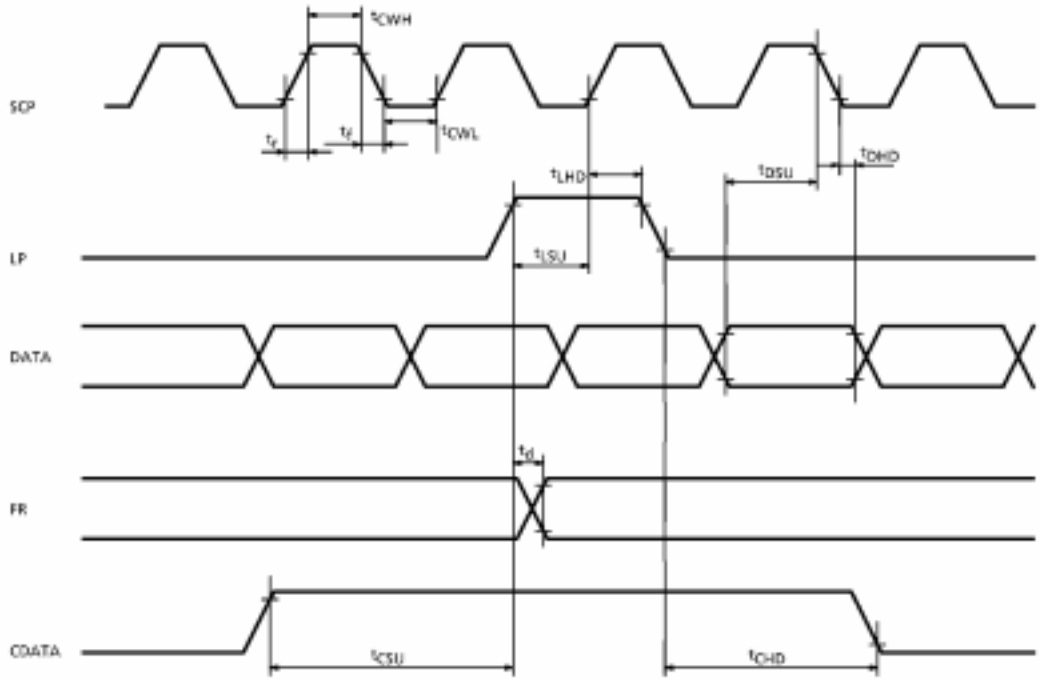


V_{CC} – V_{LCD} : LCD Driving Voltage
VR : 10K~20K

4.4 Timing Characteristics

AC CHARACTERISTICS

- Switching Characteristics (1)

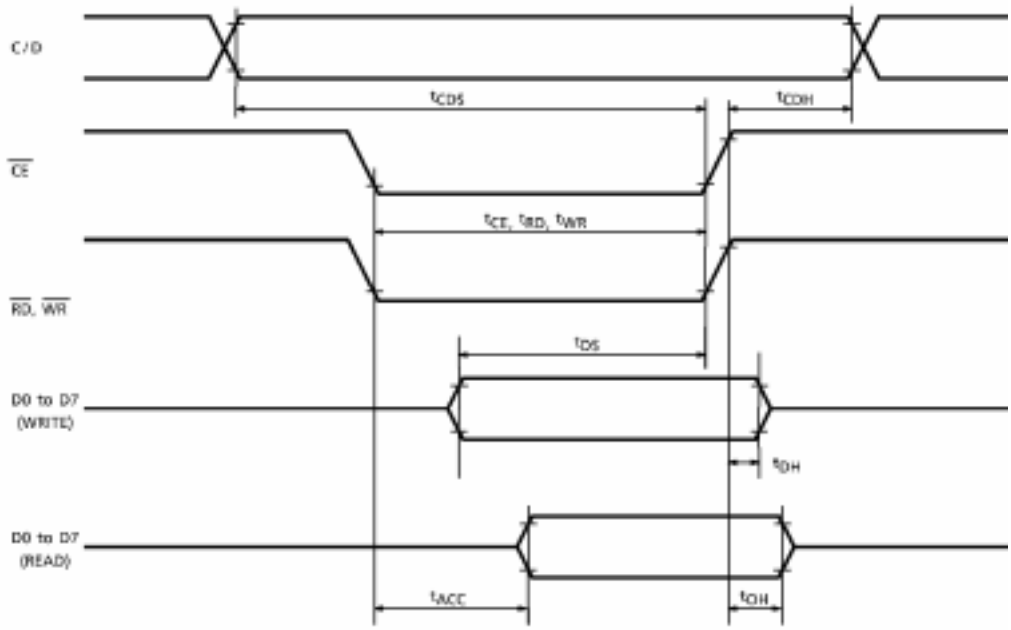


TEST CONDITIONS (Unless otherwise noted, V_{DD} = 5.0V ± 10%, V_{SS} = 0V, Ta = −20 to 70°C)

ITEM	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
Operating Frequency	f_{SCP}	Ta = −10~70°C	—	2.75	MHz
SCP Pulse Width	t_{CWH}, t_{CWL}	—	150	—	ns
SCP Rise / Fall Time	t_r, t_f	—	—	30	ns
LP Set-up Time	t_{LSU}	—	150	290	ns
LP Hold Time	t_{LHD}	—	5	40	ns
Data Set-up Time	t_{DSU}	—	170	—	ns
Data Hold Time	t_{DHD}	—	80	—	ns
FR Delay Time	t_d	—	0	90	ns
CDATA Set-up Time	t_{CSU}	—	450	850	ns
CDATA Hold Time	t_{CHD}	—	450	950	ns

- Switching Characteristics (2)

Bus Timing

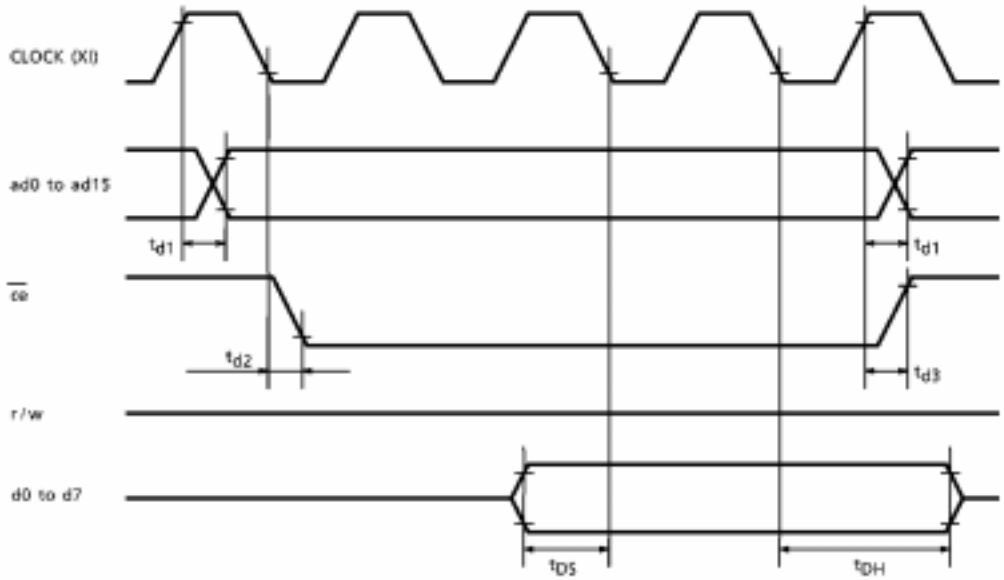


TEST CONDITIONS (Unless otherwise noted, V_{DD} = 5.0V ± 10%, V_{SS} = 0V, Ta = −20 to 75°C)

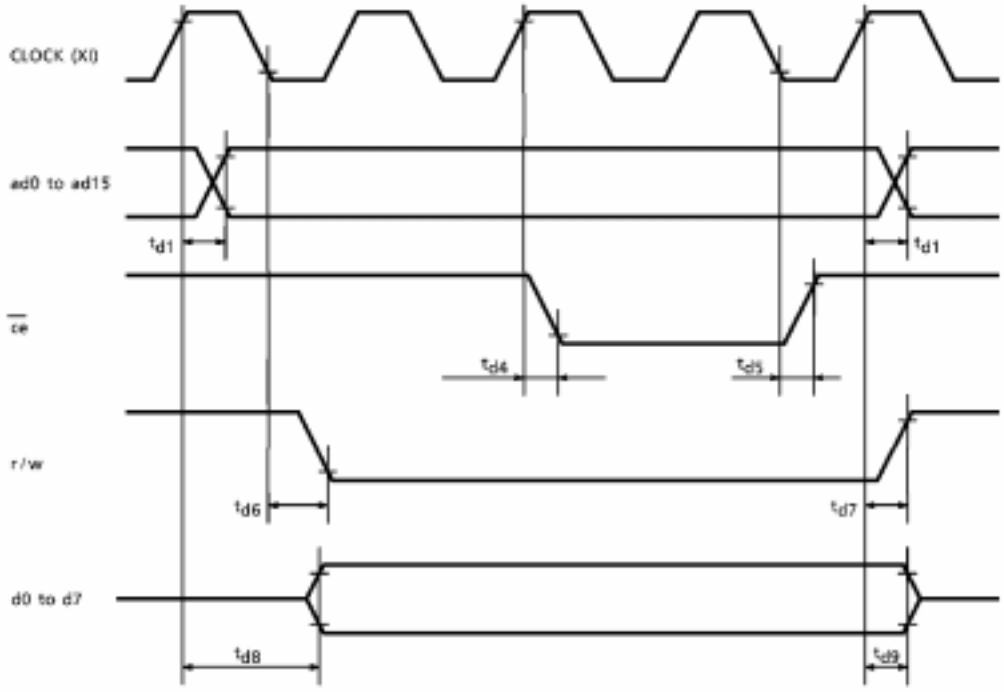
ITEM	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
C/D Set-up Time	t_{CDS}	—	100	—	ns
C/D Hold Time	t_{CDH}	—	10	—	ns
CE, RD, WR Pulse Width	t_{CE}, t_{RD}, t_{WR}	—	80	—	ns
Data Set-up Time	t_{DS}	—	80	—	ns
Data Hold Time	t_{DH}	—	40	—	ns
Access Time	t_{ACC}	—	—	150	ns
Output Hold Time	t_{OH}	—	10	50	ns

- Switching Characteristics (3)

(1) External RAM Read mode



(2) External RAM Write mode



TEST CONDITIONS (Unless otherwise noted, V_{DD} = 5.0V ± 10%, V_{SS} = 0V, Ta = −20 to 70°C)

ITEM	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
Address Delay Time	t_{d1}	—	—	250	ns
ce Fall Delay Time (Read)	t_{d2}	—	—	180	ns
ce Rise Delay Time (Read)	t_{d3}	—	—	180	ns
Data Set-up Time	t_{DS}	—	0	—	ns
Data Hold Time	t_{DH}	—	30	—	ns
ce Fall Delay Time (Write)	t_{d4}	—	—	200	ns
ce Rise Delay Time (Write)	t_{d5}	—	—	200	ns
r/w Fall Delay Time	t_{d6}	—	—	180	ns
r/w Rise Delay Time	t_{d7}	—	—	180	ns
Data Stable Time	t_{d8}	—	—	450	ns
Data Hold Time	t_{d9}	—	—	200	ns

4.5 Character Code Map

CHARACTER CODE MAP
ROM code 0101

LSB / MSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0																
1																
2																
3																
4																
5																
6																
7																

4.6 Command Definitions

COMMAND	CODE	D1	D2	FUNCTION
REGISTERS SETTING	00100001 00100010 00100100	X address Data Low address	Y address 00H High address	Set Cursor Pointer Set Offset Register Set Address Pointer
SET CONTROL WORD	01000000 01000001 01000010 01000011	Low address Columns Low address Columns	High address 00H High address 00H	Set Text Home Address Set Text Area Set Graphic Home Address Set Graphic Area
MODE SET	1000X000 1000X001 1000X011 1000X100 10000XXX 10001XXX	-- -- -- -- -- --	-- -- -- -- -- --	OR mode EXOR mode AND mode Text Attribute mode Internal CG ROM mode External CG RAM mode
DISPLAY MODE	10010000 1001XX10 1001XX11 100101XX 100110XX 100111XX	-- -- -- -- -- --	-- -- -- -- -- --	Display off Cursor on, blink off Cursor on, blink on Text on, graphic off Text off, graphic on Text on, graphic on
CURSOR PATTERN SELECT	10100000 10100001 10100010 10100011 10100100 10100101 10100110 10100111	-- -- -- -- -- -- -- --	-- -- -- -- -- -- -- --	1-line cursor 2-line cursor 3-line cursor 4-line cursor 5-line cursor 6-line cursor 7-line cursor 8-line cursor
DATA AUTO READ/WRITE	10110000 10110001 10110010	-- -- --	-- -- --	Set Data Auto Write Set Data Auto Read Auto Reset
DATA READ/WRITE	11000000 11000001 11000010 11000011 11000100 11000101	DATA -- DATA -- DATA --	-- -- -- -- -- --	Data Write and Increment ADP Data Read and Increment ADP Data Write and Decrement ADP Data Read and Increment ADP Data Write and Nonvariable ADP Data Read and Nonvariable ADP
SCREEN PEEK	11100000	--	--	Screen Peek
SCREEN COPY	11101000	--	--	Screen Copy
BIT SET/RESET	11110XXX 11111XXX 1111X000 1111X001 1111X010 1111X011 1111X100 1111X101 1111X110 1111X111	-- -- -- -- -- -- -- -- -- --	-- -- -- -- -- -- -- -- -- --	Bit Reset Bit Set Bit 0 (LSB) Bit 1 Bit 2 Bit 3 Bit 4 Bit 5 Bit 6 Bit 7 (MSB)

X: invalid

5. NOTES

Safety

- If the LCD panel breaks, be careful not to get the liquid crystal in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Handling

- Avoid static electricity as this can damage the CMOS LSI.
- The LCD panel is plate glass; do not hit or crush it.
- Do not remove the panel or frame from the module.
- The polarizing plate of the display is very fragile; handle it very carefully

Mounting and Design

- Mount the module by using the specified mounting part and holes.
- To protect the module from external pressure, leave a small gap by placing transparent plates (e.g. acrylic or glass) on the display surface, frame, and polarizing plate
- Design the system so that no input signal is given unless the power-supply voltage is applied.
- Keep the module dry. Avoid condensation, otherwise the transparent electrodes may break.

Storage

- Store the module in a dark place where the temperature is 25 ^{o}C±10 ^{o}C and the humidity below 65% RH.
- Do not store the module near organic solvents or corrosive gases.
- Do not crush, shake, or jolt the module (including accessories).

Cleaning

- Do not wipe the polarizing plate with a dry cloth, as it may scratch the surface.
- Wipe the module gently with soft cloth soaked with a petroleum benzine.
- Do not use ketonic solvents (ketone and acetoe) or aromatic solvents (toluene and xylene), as they may damage the polarizing plate.

6. OPERATION PRECAUTIONS

Any changes that need to be made in this specification or any problems arising from it will be dealt with quickly by discussion between both companies.

7. LCM Dimension