

PRODUCT SPECIFICATION

2.8" a-Si TFT LCD MODULE MODEL: ET004-A0 Ver:1.0

< ◇ > Preliminary Specification

< ◆ > Finally Specification

CUSTOMER'S APPROVAL	
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1. General Description

The specification is a transmissive type color active matrix liquid crystal display (LCD) which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT-LCD panel, driver ICs, touch panel and a backlight unit.

2. Module Parameters

No.	Item	Specification	Unit
1	Panel Size	2.8"	inch
2	Number of Pixels	240 RGB x 320	pixels
3	Active Area	43.2(H)x57.6(V)	mm
4	Pixel Pitch	153(H) x 153(V)	um
5	Outline Dimension	50(W) x69.2(H) x 4.05(D)	mm
6	Number of Colors	262k	-
7	Pixel Arrangement	RGB Vertical Stripe	-
8	Display Mode	Normally White TN Transmissive	-
9	Brightness	200 (Typ.)	cd/m ²
10	Contrast Ratio	120(Typ.)	-
11	Response time (Tr+Tf)	25(Typ.)	ms
12	Viewing Direction	6 o'clock	-
13	Input Interface	16-bit or 8-bit CPU Interface	-
14	Viewing Angle (H/V)	45/45 (H) ; 15/35 (V)	degree
15	Backlight unit	White(4 LED) / parallel	-
16	Surface Treatment	Normal	-
17	Driver IC	OTM3225A	-
18	Weight	TBD	g

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3. Electrical Specifications

3-1 Absolute Maximum Ratings

(Ta = 25 °C)

Item	Symbol	Values		Unit	Remark
		Min	Max.		
	VDD	-0.3	3.0	V	GND=0
Input signal voltage	Vin	-0.5	VDD+0.3	V	
LED Forward Voltage	V _F	3.2		V	One LED (IF=20mA)
LED Forward Current	IF	20		mA	One LED
Operating Temperature	Top	-20	70	°C	
Storage Temperature	Tst	-30	80	°C	

3-2 DC Characteristics

Item	Symbol	Values			Unit	Remark
		Min	Typ	Max.		
Operating voltage	IOVDD	2.6	2.8	3.0	V	
Input high voltage	V _{IH}	0.8 VDD	-	VDD	V	
Input low voltage	V _{IL}	-0.3	-	0.2 VDD	V	
Current Consumption	I _{VCI}	-	-	-	mA	VDD=2.8V

3-3. Backlight Characteristics

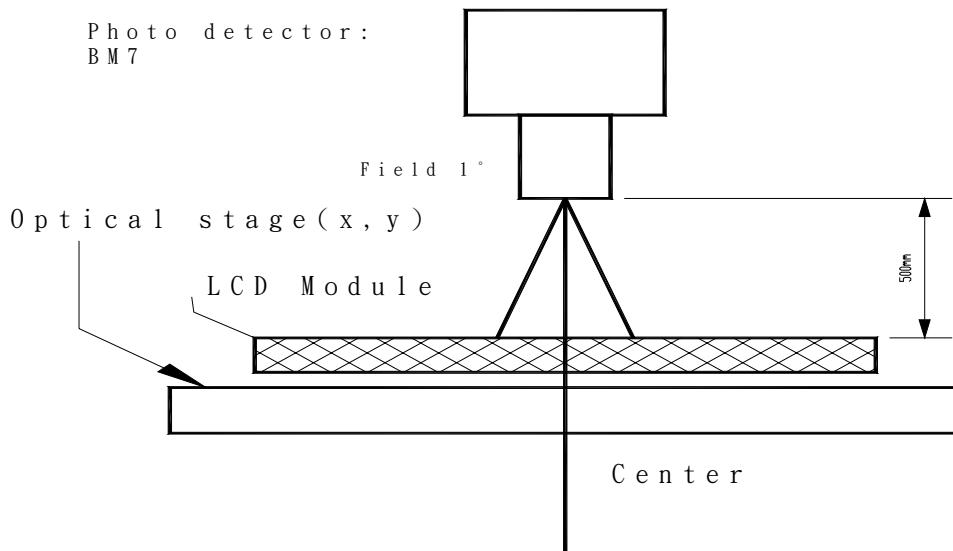
Item	Symbol	Values			Unit	Remark
		Min	Typ	Max.		
Power Supply Voltage	VF	3.0	3.2	3.3	V	Note1
Power Supply Current	IF	-	60	80	mA	
Power Consumption	P _{LED}	-	192	-	mW	

Note: LEDs should be always be driven by an external constant current source

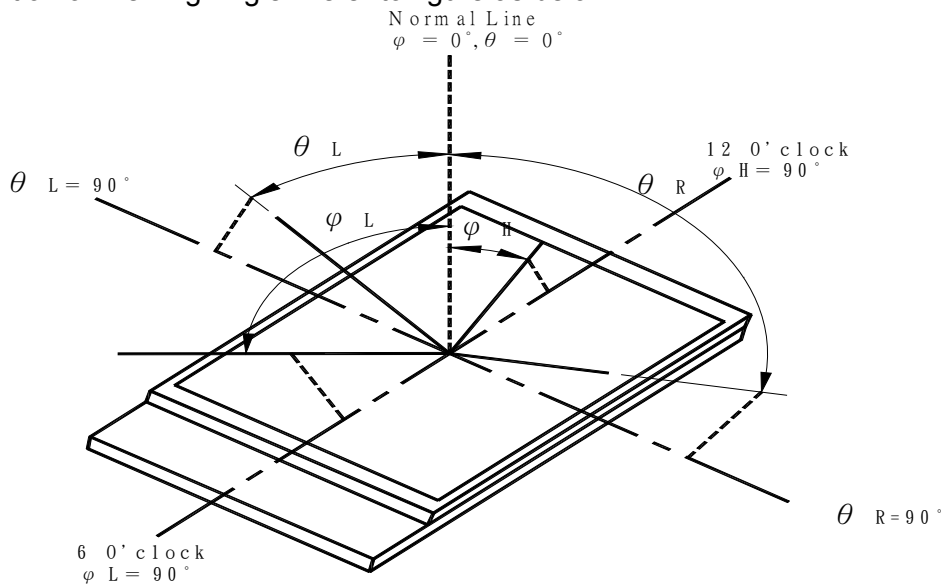
3-4. Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Brightness	L _v		150	200	-	cd/m ²	Note5	
Contrast Ratio	CR	At optimized viewing angle	100	120	-	-	Note4	
Response time	Tr+Tf	θ=0	-	25	40	ms	Note3	
Viewing Angle	Top	φH	Center CR ≥ 10	10	15	-	degree	Note2
	Bottom	φL		30	35	-		
	Left	θL		40	45	-		
	Right	θR		40	45	-		
Color Coordinate	White	X _w	Viewing normal angle φ, θ=0	-	0.314	-	-	-
		Y _w		-	0.334	-		
	Red	X _R		-	0.571	-		
		Y _R		-	0.352	-		
	Green	X _G		-	0.345	-		
		Y _G		-	0.557	-		
	Blue	X _B		-	0.148	-		
		Y _B		-	0.128	-		
Uniformity	Un		80	85	-	%	-	

Note.1: After stabilizing and leaving the panel alone at a given temperature for 30 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7(fast) with a viewing angle of 1° at a distance of 50cm and normal direction.



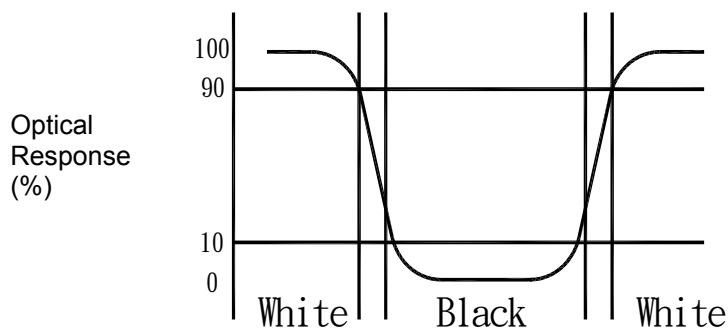
Note.2: Definition of Viewing Angle: Refer to figure as below:



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Note.3: Definition of Response Time: TR and TF

The figure below is the output signal of the photo detector.



Note.4: Definition of Contrast Ratio (CR)

Ratio of gray max (G max)& gray min(G min)

Contrast ratio (CR) =(G max) / (G min)

(G max)=luminance with all pixel white

(G min)=luminance with all pixel black

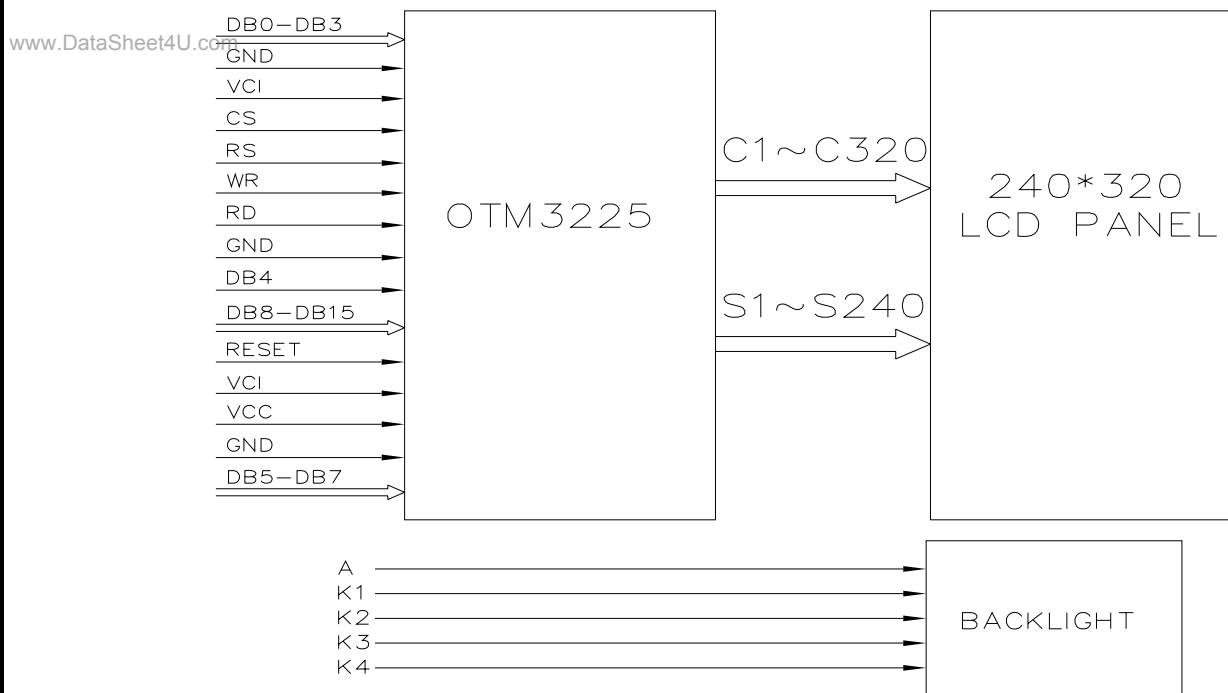
Note.5: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

4. Terminal Functions and Block Diagram

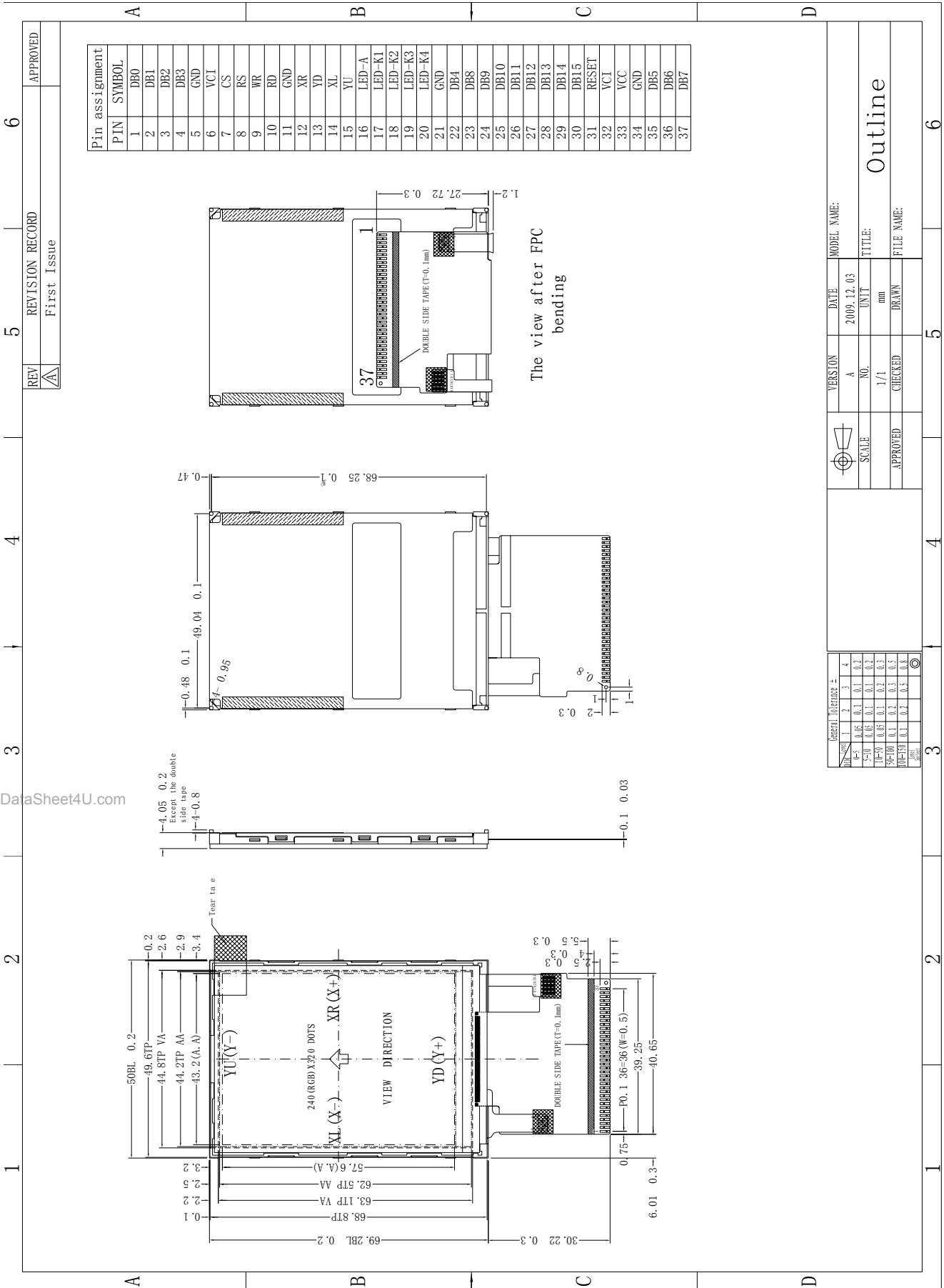
4-1 Interface Pin Function Description

No.	Symbol	Function	Remark
1~4	DB0~DB3	Data Bus DB0~DB3	
5	GND	Ground	
6	VCI	Analog supply power	
7	CS	Chip select signal (Low: active)	
8	RS	Data/Commander selection	
9	WR	Write signal	
10	RD	Read signal	
11	GND	Ground	
12	XR	Touch screen terminal	
13	YD		
14	XL		
15	YU		
16	LED-A	LED anode	
17~20	LED-K1~ LED-K4	LED cathode 1~4	
21	GND	Ground	
22	DB4	Data Bus DB4	
23~30	DB8~DB15	Data Bus DB8~DB15	
31	/RESET	Reset signal	
32	VCI	Analog supply power	
33	VCC	Logic supply power	
34	GND	Ground	
35~37	DB5~DB7	Data Bus DB5~DB7	

4-2 Block Diagram

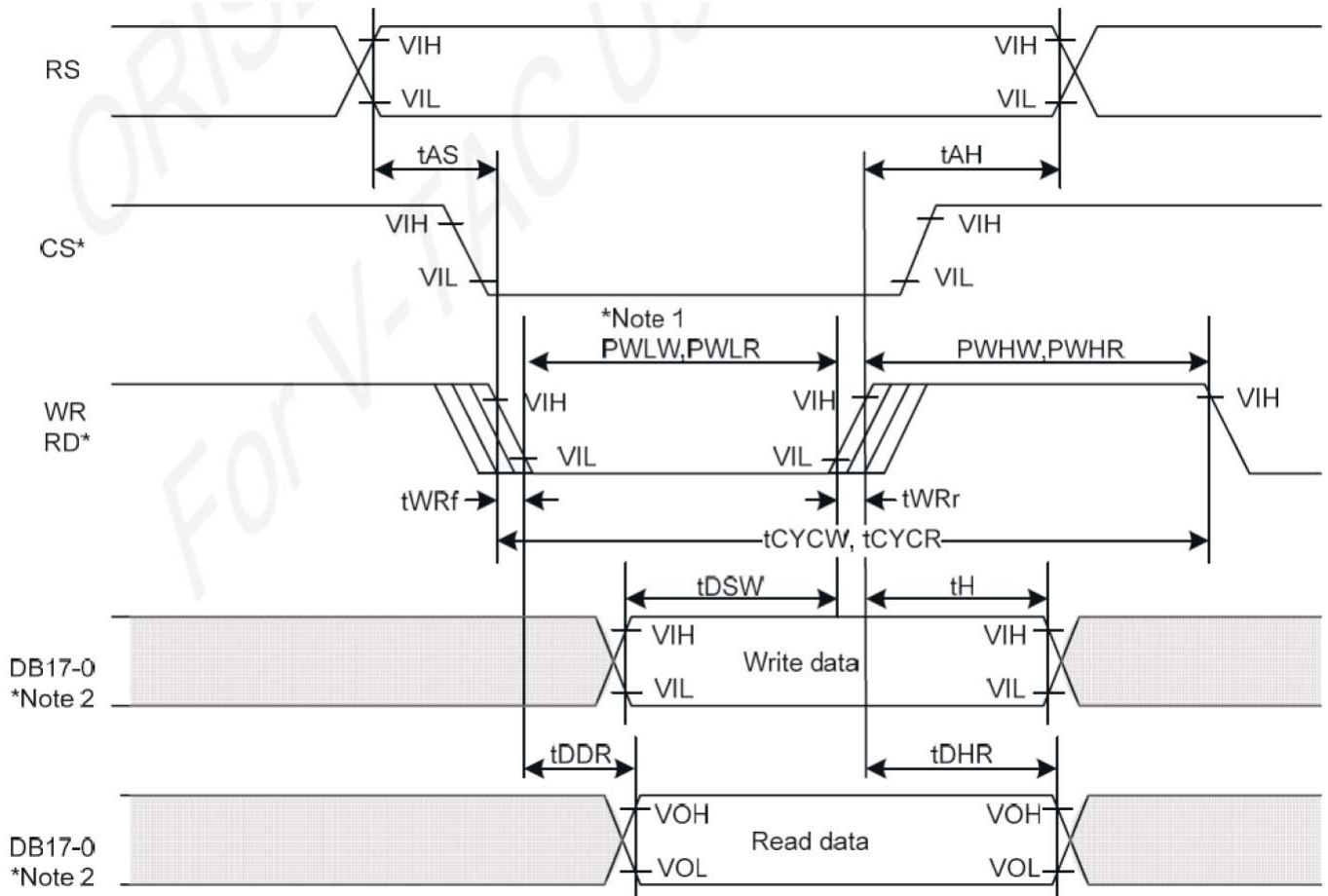


5. Outline Drawing



6. Timing Characteristics

AC Characteristics (8080-series CPU)



Item	Symbol	Unit	Min.	Typ.	Max.	
Bus cycle time	Write	t_{CYCW}	ns	125	-	-
	Read	t_{CYCR}	ns	450	-	-
Write low-level pulse width	PWLW	ns	45	-	-	
Read low-level pulse width	PWLR	ns	170	-	-	
Write high-level pulse width	PWHW	ns	70	-	-	
Read high-level pulse width	PWHR	ns	250	-	-	
Write/Read rise/ fall time	t_{WRr} , t_{WRf}	ns	-	-	25	
Setup time	Write (RS to CS*, WR*)	t_{AS}	ns	0	-	-
	Read (RS to CS*, RD*)	t_{AS}	ns	10	-	-
Address Hold Time	t_{AH}	ns	2	-	-	
Write data setup time	t_{DSW}	ns	25	-	-	
Write data hold time	t_H	ns	10	-	-	
Read data delay time	t_{DDR}	ns	-	-	150	
Read data hold time	t_{DHR}	ns	5	-	-	

7. Command Table

Register No	Register	Upper 8-bit								Lower 8-bit								
		CB15	CB14	CB13	CB12	CB11	CB10	CB9	CB8	CB7	CB6	CB5	CB4	CB3	CB2	CB1	CB0	
00h	ID Read	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0	1/0		
01h	Driver Output Control	0	0	0	0	0	SM (0)	0	SS (0)	0	0	0	0	0	0	0		
02h	LCD Drive Waveform Control	0	0	0	0	0	1	B/C (0)	EOR (0)	0	0	0	0	0	0	0		
03h	Entry Mode	TRIREG (0)	DFM (0)	0	BGR (0)	0	0	0	0	ORG (0)	0	I/D1 (1)	I/D0 (1)	AM (0)	0	0		
04h	Scaling Control	0	0	0	0	0	0	RCV1 (0)	RCV0 (0)	0	0	RCH1 (0)	RCH0 (0)	0	0	RSZ1 (0)	RSZ0 (0)	
07h	Display Control (1)	0	0	PTDE1 (0)	PTDE0 (0)	0	0	0	BASEE (0)	0	0	GON (0)	DTE (0)	CL (0)	0	D1 (0)	D0 (0)	
08h	Display Control (2)	0	0	0	0	FP3 (1)	FP2 (0)	FP1 (0)	FP0 (0)	0	0	0	0	BP3 (1)	BP2 (0)	BP1 (0)	BP0 (0)	
09h	Display Control (3)	0	0	0	0	0	PTS2 (0)	PTS1 (0)	PTS0 (0)	0	0	PTG1 (0)	PTG0 (0)	ISC3 (0)	ISC2 (0)	ISC1 (1)	ISC0 (1)	
0Ah	Frame Cycle Control	0	0	0	0	0	0	0	0	0	0	0	0	FMARKOE (0)	FMI2 (0)	FMI1 (0)	FMI0 (0)	
0Ch	External Display interface control (1)	0	ENC2 (0)	ENC1 (0)	ENC0 (0)	0	0	0	RM (0)	0	0	DM1 (0)	DM0 (0)	0	0	RIM1 (0)	RIM0 (0)	
0Dh	Frame Maker Position	0	0	0	0	0	0	0	FMP8 (0)	FMP7 (0)	FMP6 (0)	FMP5 (0)	FMP4 (0)	FMP3 (0)	FMP2 (0)	FMP1 (0)	FMP0 (0)	
0Fh	External Display interface control (2)	0	0	0	0	0	0	0	0	0	0	VSPL (0)	HSPL (0)	0	0	EPL (0)	DPL (0)	
10h	Power Control (1)	0	0	0	SAP (0)	0	BT2 (0)	BT1 (0)	BT0 (0)	APE (0)	AP2 (1)	AP1 (0)	AP0 (0)	0	0	SLP (0)	STB (0)	
11h	Power Control (2)	0	0	0	0	0	DC12 (1)	DC11 (1)	DC10 (1)	0	DC02 (1)	DC01 (1)	DC00 (1)	0	VC2 (0)	VC1 (0)	VC0 (0)	
12h	Power Control (3)	0	0	0	0	0	0	0	0	VCIRE (0)	0	0	1	VRH3 (0)	VRH2 (0)	VRH1 (0)	VRH0 (0)	
13h	Power Control (4)	0	0	0	VDV4 (0)	VDV3 (0)	VDV2 (0)	VDV1 (0)	VDV0 (0)	0	0	0	0	0	0	0	0	
20h	GRAM address Set Horizontal Address	0	0	0	0	0	0	0	0	AD7 (0)	AD6 (0)	AD5 (0)	AD4 (0)	AD3 (0)	AD2 (0)	AD1 (0)	AD0 (0)	
21h	GRAM address Set Vertical Address	0	0	0	0	0	0	0	AD16 (0)	AD15 (0)	AD14 (0)	AD13 (0)	AD12 (0)	AD11 (0)	AD10 (0)	AD9 (0)	AD8 (0)	
22h	Write Data to GRAM Read Data from GRAM																	
29h	Power Control (7)	0	0	0	0	0	0	0	0	0	0	0	0	VCM4 (0)	VCM3 (0)	VCM2 (0)	VCM1 (0)	VCM0 (0)
2Bh	Frame Rate Control	0	0	0	0	0	0	0	0	0	0	0	0	FRS3 (1)	FRS2 (0)	FRS1 (1)	FRS0 (1)	
30h	γ Control (1)	0	0	0	0	0	KP1[2] (0)	KP1[1] (0)	KP1[0] (0)	0	0	0	0	0	0	KP0[2] (1)	KP0[1] (0)	KP0[0] (0)
31h	γ Control (2)	0	0	0	0	0	KP3[2] (0)	KP3[1] (1)	KP3[0] (1)	0	0	0	0	0	0	KP2[2] (1)	KP2[1] (1)	KP2[0] (0)
32h	γ Control (3)	0	0	0	0	0	KP5[2] (0)	KP5[1] (0)	KP5[0] (0)	0	0	0	0	0	0	KP4[2] (0)	KP4[1] (1)	KP4[0] (1)
35h	γ Control (4)	0	0	0	0	0	RP1[2] (0)	RP1[2] (1)	RP1[0] (1)	0	0	0	0	0	0	RP0[2] (0)	RP0[2] (1)	RP0[0] (1)
36h	γ Control (5)	0	0	0	VRP1[4] (0)	VRP1[3] (1)	VRP1[2] (1)	VRP1[1] (1)	VRP1[0] (0)	0	0	0	0	VRP0[4] (0)	VRP0[3] (0)	VRP0[2] (1)	VRP0[1] (1)	VRP0[0] (0)
37h	γ Control (6)	0	0	0	0	0	KN1[2] (1)	KN1[1] (0)	KN1[0] (0)	0	0	0	0	0	0	KN0[2] (1)	KN0[1] (1)	KN0[0] (1)
38h	γ Control (7)	0	0	0	0	0	KN3[2] (0)	KN3[1] (0)	KN3[0] (0)	0	0	0	0	0	0	KN2[2] (1)	KN2[1] (0)	KN2[0] (0)
39h	γ Control (8)	0	0	0	0	0	KN5[2] (0)	KN5[1] (1)	KN5[0] (1)	0	0	0	0	0	0	KN4[2] (1)	KN4[1] (1)	KN4[0] (1)
3Ch	γ Control (9)	0	0	0	0	0	RN1[2] (0)	RN1[1] (1)	RN1[0] (1)	0	0	0	0	0	0	RN0[2] (0)	RN0[1] (1)	RN0[0] (10)
3Dh	γ Control (10)	0	0	0	VRN1[4] (0)	VRN1[3] (0)	VRN1[2] (1)	VRN1[1] (0)	VRN1[0] (0)	0	0	0	0	VRN0[4] (0)	VRN0[3] (1)	VRN0[2] (0)	VRN0[1] (1)	VRN0[0] (1)
50h	Window Horizontal RAM Address Start	0	0	0	0	0	0	0	0	HSA7 (0)	HSA6 (0)	HSA5 (0)	HSA4 (0)	HSA3 (0)	HSA2 (0)	HSA1 (0)	HSA0 (0)	
51h	Window Horizontal RAM Address End	0	0	0	0	0	0	0	0	HEA7 (1)	HEA6 (1)	HEA5 (1)	HEA4 (0)	HEA3 (1)	HEA2 (1)	HEA1 (1)	HEA0 (1)	
52h	Window Vertical RAM Address Start	0	0	0	0	0	0	0	VSA8 (0)	VSA7 (0)	VSA6 (0)	VSA5 (0)	VSA4 (0)	VSA3 (0)	VSA2 (0)	VSA1 (0)	VSA0 (0)	
53h	Window Vertical RAM Address End	0	0	0	0	0	0	0	VEA8 (1)	VEA7 (0)	VEA6 (0)	VEA5 (1)	VEA4 (1)	VEA3 (1)	VEA2 (1)	VEA1 (1)	VEA0 (1)	

Register No	Register	Upper 8-bit								Lower 8-bit								
		CB15	CB14	CB13	CB12	CB11	CB10	CB9	CB8	CB7	CB6	CB5	CB4	CB3	CB2	CB1	CB0	
60h	Driver Output Control	GS (0)	0	NL5 (1)	NL4 (0)	NL3 (0)	NL2 (1)	NL1 (1)	NL0 (1)	0	0	SCN5 (0)	SCN4 (0)	SCN3 (0)	SCN2 (0)	SCN1 (0)	SCN0 (0)	
61h	Driver Output Control	0	0	0	0	0	0	0	0	0	0	0	0	0	NDL (0)	VLE (0)	REV (0)	
6Ah	Vertical Scroll Control	0	0	0	0	0	0	0	VL8 (0)	VL7 (0)	VL6 (0)	VL5 (0)	VL4 (0)	VL3 (0)	VL2 (0)	VL1 (0)	VL0 (0)	
80h	Display Position - Partial Display 1	0	0	0	0	0	0	0	PTDP08 (0)	PTDP07 (0)	PTDP06 (0)	PTDP05 (0)	PTDP04 (0)	PTDP03 (0)	PTDP02 (0)	PTDP01 (0)	PTDP00 (0)	
81h	RAM Address Start - Partial Display 1	0	0	0	0	0	0	0	PTSA08 (0)	PTSA07 (0)	PTSA06 (0)	PTSA05 (0)	PTSA04 (0)	PTSA03 (0)	PTSA02 (0)	PTSA01 (0)	PTSA00 (0)	
82h	RAM Address End - Partial Display 1	0	0	0	0	0	0	0	PTEA08 (0)	PTEA07 (0)	PTEA06 (0)	PTEA05 (0)	PTEA04 (0)	PTEA03 (0)	PTEA02 (0)	PTEA01 (0)	PTEA00 (0)	
83h	Display Position - Partial Display 2	0	0	0	0	0	0	0	PTDP18 (0)	PTDP17 (0)	PTDP16 (0)	PTDP15 (0)	PTDP14 (0)	PTDP13 (0)	PTDP12 (0)	PTDP11 (0)	PTDP10 (0)	
84h	RAM Address Start - Partial Display 2	0	0	0	0	0	0	0	PTSA18 (0)	PTSA17 (0)	PTSA16 (0)	PTSA15 (0)	PTSA14 (0)	PTSA13 (0)	PTSA12 (0)	PTSA11 (0)	PTSA10 (0)	
85h	RAM Address End - Partial Display 2	0	0	0	0	0	0	0	PTEA18 (0)	PTEA17 (0)	PTEA16 (0)	PTEA15 (0)	PTEA14 (0)	PTEA13 (0)	PTEA12 (0)	PTEA11 (0)	PTEA10 (0)	
90h	Panel interface Control 1	0	0	0	0	0	0	DIV1 (0)	DIV0 (0)	0	0	0	RTN4 (1)	RTN3 (0)	RTN2 (0)	RTN1 (0)	RTN0 (0)	
92h	Panel Interface Control 2	0	0	0	0	0	NOW12 (1)	NOW11 (1)	NOW10 (0)	0	0	0	0	0	0	0	0	
95h	Panel Interface Control 4	0	0	0	0	0	0	DIVE1 (1)	DIVE0 (0)	0	0	0	RTNE5 (0)	RTNE4 (1)	RTNE3 (1)	RTNE2 (1)	RTNE1 (1)	RTNE0 (0)
97h	Panel Interface Control 5	0	0	0	0	NOWE3 (1)	NOWE2 (1)	NOWE1 (0)	NOWE0 (0)	0	0	0	0	0	0	0	0	

The following are detailed explanations of instructions with illustrations of instruction bits (CB15-0) assigned to each interface.

8. Reliability Specification

NO.	Item	Condition	Criterion
1	High Temperature Operating	70°C, 48Hrs	No defect in cosmetic and operational function allowable. Total current Consumption should be below double of initial value.
2	Low Temperature Operating	-20°C, 48Hrs	
3	High Humidity	50°C, 90%RH, 48Hrs	
4	High Temperature Storage	80°C, 48Hrs	
5	Low Temperature Storage	-30°C, 48Hrs	
6	Thermal shock	-20°C, 30min~70°C, 30min, 10 cycles.	

Note: 1) Above conditions are suitable for our company standard products.
 2) For restrict products, the test conditions listed as above must be revised.

9. Precautions for Use

9.1 Safety

- (1) Do not swallow any liquid crystal, even if there is no proof that liquid crystal is poisonous.
- (2) If the LCD panel breaks, be careful not to get liquid crystal to touch your skin.
- (3) If skin is exposed to liquid crystal, wash the area thoroughly with alcohol or soap.

9.2 Storage Conditions

- (1) Store the panel or module in a dark place where the temperature is 23±5°C and the humidity is below 50±20%RH.
- (2) Store in anti-static electricity container.
- (3) Store in clean environment, free from dust, active gas, and solvent.
- (4) Do not place the module near organics solvents or corrosive gases.
- (5) Do not crush, shake, or jolt the module.

9.3 Handling Precautions

- (1) Avoid static electricity which can damage the CMOS LSI.
- (2) The polarizing plate of the display is very fragile. So, please handle it very carefully.
- (3) Do not give external shock.
- (4) Do not apply excessive force on the surface.
- (5) Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.
- (6) Do not use ketonics solvent & Aromatic solvent, use with a soft cloth soaked with a cleaning naphtha solvent.
- (7) Do not operate it above the absolute maximum rating.
- (8) Do not remove the panel or frame from the module.

9.4 Warranty

The period is within twelve months since the date of shipping out under normal using and storage conditions.

10. Package

TBD

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