



**SPECIFICATION
FOR
LCD MODULE**

**MODULE NO: AFS128128TG-1.4-C200021
REVISION NO: 01**

Customer's Approval:

--

	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)	YLH	MAY-13-2011
CHECKED BY	FR. LI	MAY-13-2011
APPROVED BY	SEAN	MAY-13-2011

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
00	Dec-29-2010	First Issue	
01	May-13-2011	Added Double Sided Tape	YLH

CONTENTS

1. Features & Mechanical specifications	1
2. Dimensional Outline	2
3. Block Diagram	3
4. Pin Description	4
5. Absolute Maximum Ratings	5
6. Electrical Characteristics	5
7. Backlight Specification	5
8. Electro-Optical Characteristics	6
9. Instruction Description	8
10. AC Characteristics	11
11. Quality Specification	14

1. Features & Mechanical Specifications

Item	Contents	Unit
	LCD	
LCD Type	TFT/ Transmissive/ Normally White	--
Viewing direction	12:00	--
Backlight	White LED x 1	--
Interface	8080-8bit parallel	--
Driver IC	ST7735R	--
Module Outline Dimension	33.0(W) × 36.0(V) × 2.7(T)	mm
LCD Outline Dimension	27.7(W) × 32.24(V) × 0.5(T)	mm
LCD Active area	25.4976(W) × 26.496(V)	mm
Number of Dots	128(RGB) × 128	--
Dot pitch	0.1992(W) × 0.207(V)	mm
Pixel pitch	0.0664(W) × 0.207(V)	mm
Operating Temperature	-20 ~ +70	°C
Storage temperature	-30 ~ +80	°C

2. Dimensional Outline

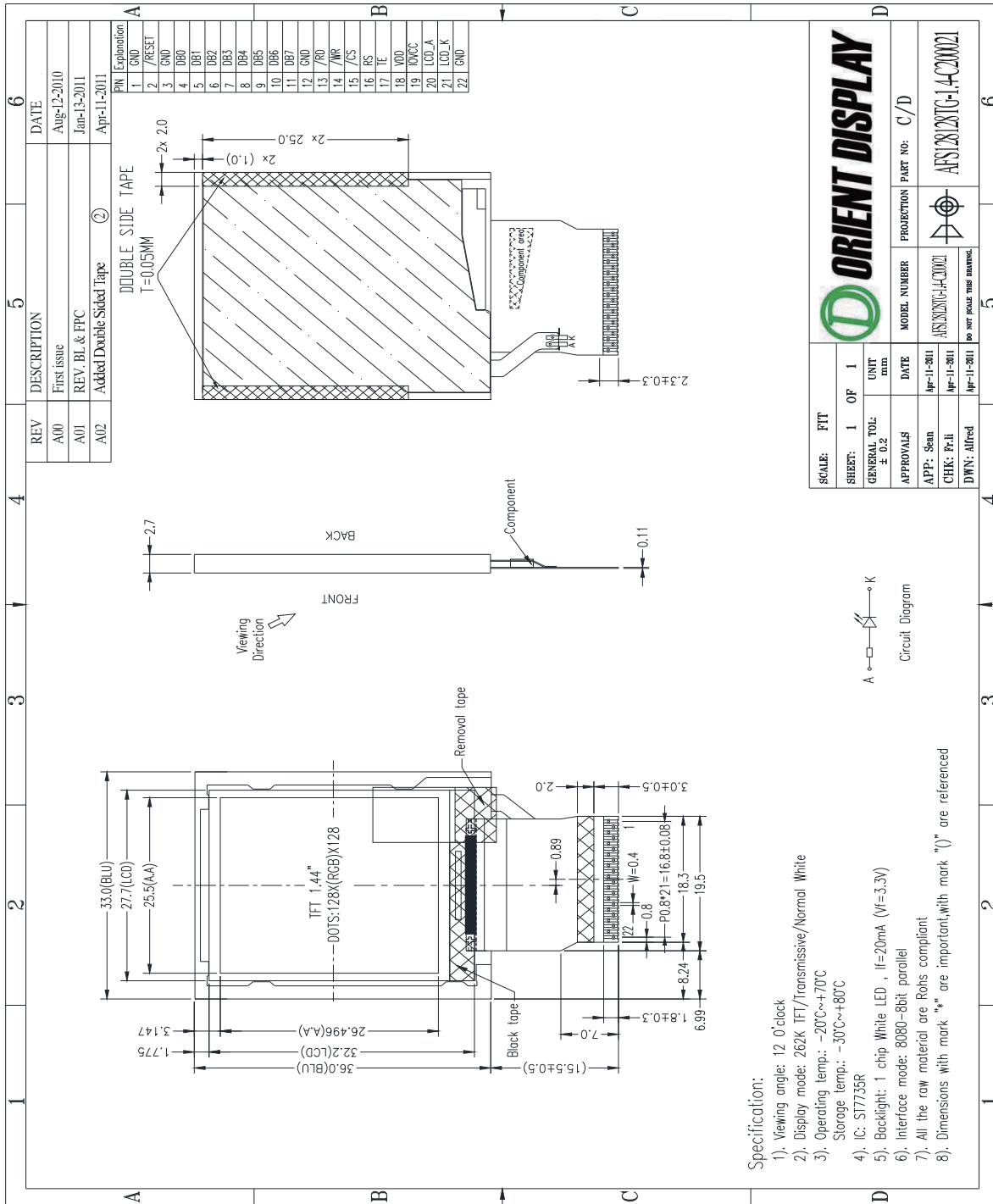


Figure 1. Dimensional outline

3. Block Diagram

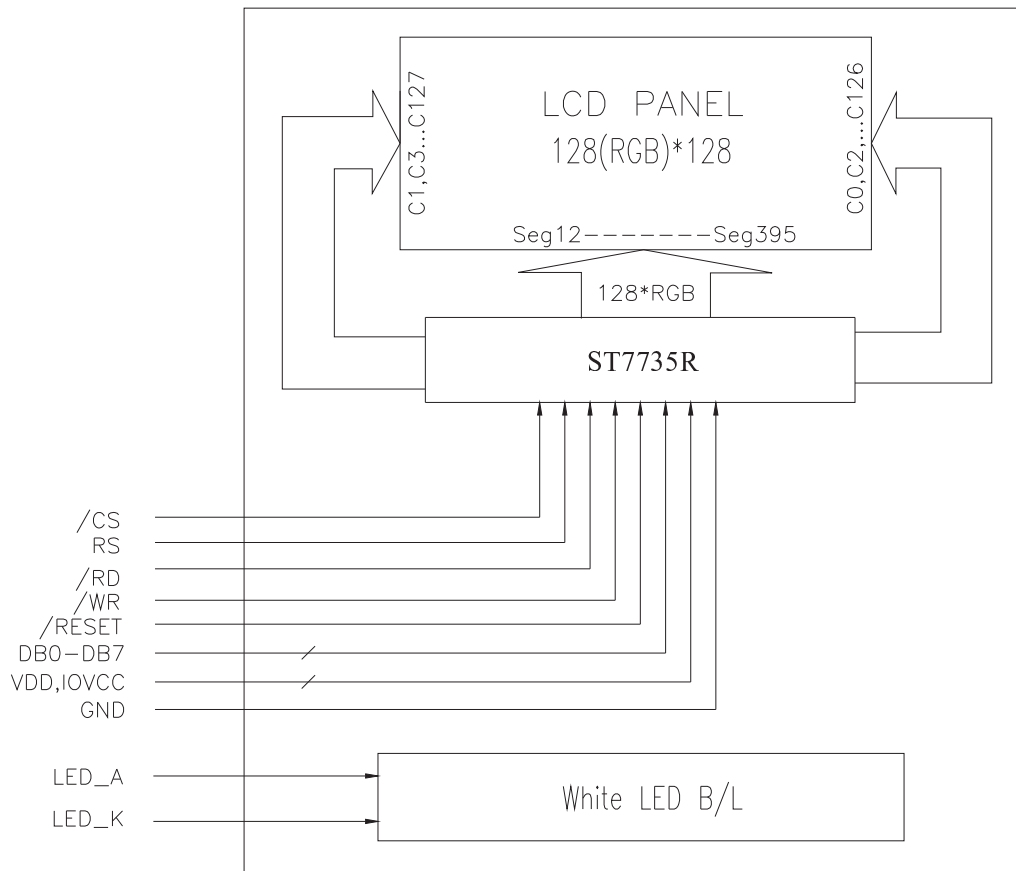


Figure 2. Block diagram

4. Pin Description

PIN No.	SYMBOL	Function
1	GND	System Ground.
2	/RESET	Reset input pin. Active 'L'.
3	GND	System Ground.
4	DB0	Data Bus
5	DB1	Data Bus
6	DB2	Data Bus
7	DB3	Data Bus
8	DB4	Data Bus
9	DB5	Data Bus
10	DB6	Data Bus
11	DB7	Data Bus
12	GND	System Ground.
13	/RD	Read signal
14	/WR	Write signal
15	/CS	Chip select signal, Active 'L'.
16	RS	Command / Display data selection 'L': Command, 'H': Display data or parameter.
17	TE	Tearing effect output pin
18	VDD	Power supply for analog, digital system and booster circuit.
19	IOVCC	Power supply for I/O system.
20	LED_A	LED Backlight Anode.
21	LED_K	LED Backlight Cathode.
22	GND	System Ground.

5. Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage range	V _{DD}	-0.3 to +4.8	V
Supply Voltage range	V _{DDIO}	-0.3 to +4.6	V
Operating Temperature range	T _{OP}	-20 to +70	°C
Storage Temperature range	T _{ST}	-30 to +80	°C

6. Electrical Characteristics

DC Characteristics

Item	Symbol	Min.	Type.	Max.	Unit
Supply Voltage	V _{DD}	2.3	2.75	4.8	V
Supply Voltage	V _{DDIO}	1.65	1.8	3.7	V

7. Backlight Characteristics

White LED × 1

(T_a = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Current	I _f	V _f =3.3V	-	20	25	mA
Uniformity	Avg	-	80	-	-	%
Luminance for LCD	L _v	V _f =3.3V	500	-	-	cd/m ²

8. Electro-Optical Characteristics

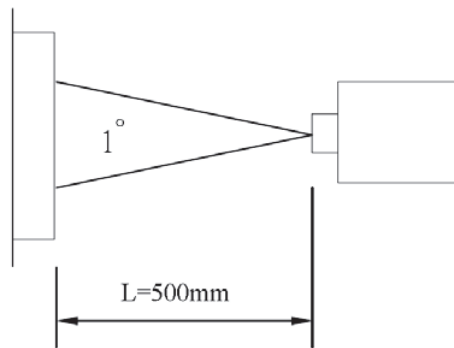
(Note1・Note2)

(Using CPT LC+ CPT Polarizer+Corresponding Backlight, reference only)

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	REMARK		
Transmittance	T		-	6	-	%			
Contrast Ratio	CR	*1)	-	350	-	--	Note 3		
Response Time	Tr+ Tf	*3)	-	25	-	ms	Note 4		
Viewing Angle	Vertical	θ *2)	ϕ *2)	$CR \geq 10$	-	35	-	°	Note 5
					-	15	-		
	Horizontal				-	45	-		
					-	45	-		
Color Filter Chromacity	White	x y Y	$\theta = \phi = 0^\circ$	0.285	0.305	0.325	-	Note 6	
				0.314	0.334	0.354			
				29.9	32.9	35.9			
	Red	x y Y	$\theta = \phi = 0^\circ$	0.588	0.608	0.628			
				0.296	0.316	0.336			
				17.8	20.8	23.8			
	Green	x y Y	$\theta = \phi = 0^\circ$	0.285	0.305	0.325			
				0.536	0.556	0.576			
				57.6	61.6	65.6			
	Blue	x y Y	$\theta = \phi = 0^\circ$	0.115	0.135	0.155			
				0.117	0.137	0.157			
				13.2	16.2	19.2			
NTSC				-	53	-	%		

Note 1.Ambient condition : 25°C±2°C , 60±10%RH , under 10 Lux in the darkroom ◦

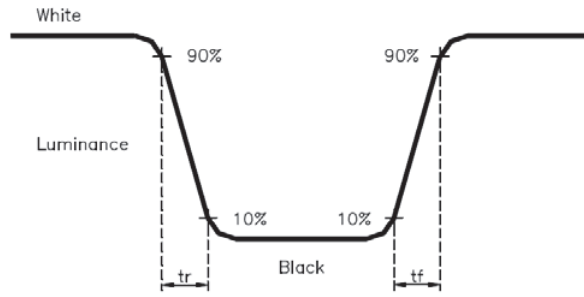
Note 2.Measure device : BM-5A (TOPCON) , viewing cone= 1° , I_L=20mA ◦



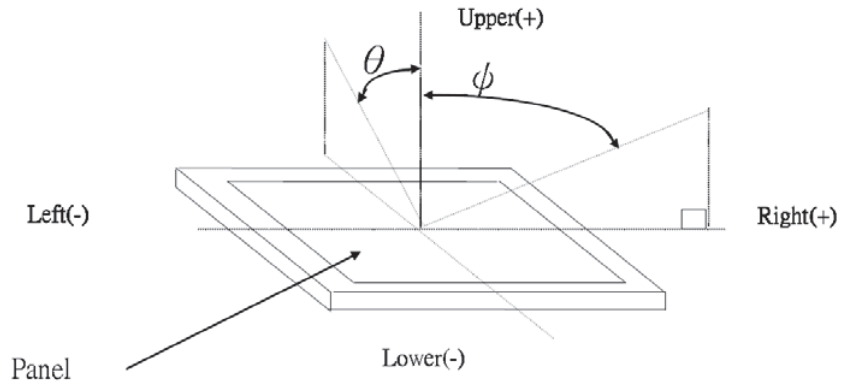
Note 3. Definition of Contrast Ratio :

$$CR = \text{White Luminance (ON)} / \text{Black Luminance (OFF)}$$

Note 4. Definition of response time : The response time is defined as the time interval between the 10% and 90% amplitudes.



Note 5. Definition of view angle(θ , ϕ) :



Note 6. Light source: C light.

9. Instruction Description

System Function command List (1)

Instruction	Refer	D/CX	WRX	RDX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Function	
NOP	10.1.1	0	↑	1	-	0	0	0	0	0	0	0	0	(00h)	No Operation	
SWRESET	10.1.2	0	↑	1	-	0	0	0	0	0	0	0	1	(01h)	Software reset	
RDDID	10.1.3	0	↑	1	-	0	0	0	0	0	1	0	0	(04h)	Read Display ID	
		1	1	↑	-	-	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	ID17	ID16	ID15	ID14	ID13	ID12	ID11	ID10	-	-	ID1 read
		1	1	↑	-	1	ID26	ID25	ID24	ID23	ID22	ID21	ID20	-	-	ID2 read
		1	1	↑	-	ID37	ID36	ID35	ID34	ID33	ID32	ID31	ID30	-	-	ID3 read
RDDST	10.1.4	0	↑	1	-	0	0	0	0	1	0	0	1	(09h)	Read Display Status	
		1	1	↑	-	-	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	BSTON	MY	MX	MV	ML	RGB	MH	ST24	-	-	-
		1	1	↑	-	ST23	IFPF2	IFPF1	IFPF0	IDMON	PTLON	SLOUT	NORON	-	-	-
		1	1	↑	-	VSSON	ST14	INVON	ST12	ST11	DISON	TEON	GCS2	-	-	-
		1	1	↑	-	GCS1	GCS0	TEM	ST4	ST3	ST2	ST1	ST0	-	-	-
RDDPM	10.1.5	0	↑	1	-	0	0	0	0	1	0	1	0	(0Ah)	Read Display Power	
		1	1	↑	-	-	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	BSTON	IDMON	PTLON	SLPOUT	NORON	DISON	-	-	-	-	-
RDD MADCTL	10.1.6	0	↑	1	-	0	0	0	0	1	0	1	1	(0Bh)	Read Display	
		1	1	↑	-	-	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	MY	MX	MV	ML	RGB	MH	-	-	-	-	-
RDD COLMOD	10.1.7	0	↑	1	-	0	0	0	0	1	1	0	0	(0Ch)	Read Display Pixel	
		1	1	↑	-	-	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	0	0	0	0	-	IFPF2	IFPF1	IFPF0	-	-	-
RDDIM	10.1.8	0	↑	1	-	0	0	0	0	1	1	0	1	(0Dh)	Read Display Image	
		1	1	↑	-	-	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	VSSON	D6	INVON	-	-	GCS2	GCS1	GCS0	-	-	-
RDDSM	10.1.9	0	↑	1	-	0	0	0	0	1	1	1	0	(0Eh)	Read Display Signal	
		1	1	↑	-	-	-	-	-	-	-	-	-	-	-	Dummy read
		1	1	↑	-	TEON	TEM	-	-	-	-	-	-	-	-	-

“-”: Don't care

System Function command List (2)

Instruction	Refer.	D/C	WR	RDX	D17-	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Function
SLPIN	10.1.10	0	↑	1	-	0	0	0	1	0	0	0	0	(10h)	Sleep in & booster off
SLPOUT	10.1.11	0	↑	1	-	0	0	0	1	0	0	0	1	(11h)	Sleep out & booster on
PTLON	10.1.12	0	↑	1	-	0	0	0	1	0	0	1	0	(12h)	Partial mode on
NORON	10.1.13	0	↑	1	-	0	0	0	1	0	0	1	1	(13h)	Partial off (Normal)
INVOFF	10.1.14	0	↑	1	-	0	0	1	0	0	0	0	0	(20h)	Display inversion off
INVON	10.1.15	0	↑	1	-	0	0	1	0	0	0	0	1	(21h)	Display inversion on
GAMSET	10.1.16	0	↑	1	-	0	0	1	0	0	1	1	0	(26h)	Gamma curve select
		1	↑	1	-	-	-	-	-	GC3	GC2	GC1	GC0	-	
DISPOFF	10.1.17	0	↑	1	-	0	0	1	0	1	0	0	0	(28h)	Display off
DISPON	10.1.18	0	↑	1	-	0	0	1	0	1	0	0	1	(29h)	Display on
CASET	10.1.19	0	↑	1	-	0	0	1	0	1	0	1	0	(2Ah)	Column address set
		1	↑	1	-	XS15	XS14	XS13	XS12	XS11	XS10	XS9	XS8		X address start: $0 \leq XS \leq X$
		1	↑	1	-	XS7	XS6	XS5	XS4	XS3	XS2	XS1	XS0		
		1	↑	1	-	XE15	XE14	XE13	XE12	XE11	XE10	XE9	XE8		X address end: $S \leq XE \leq X$
RASET	10.1.20	0	↑	1	-	0	0	1	0	1	0	1	1	(2Bh)	Row address set
		1	↑	1	-	YS15	YS14	YS13	YS12	YS11	YS10	YS9	YS8		Y address start: $0 \leq YS \leq Y$
		1	↑	1	-	YS7	YS6	YS5	YS4	YS3	YS2	YS1	YS0		
		1	↑	1	-	YE15	YE14	YE13	YE12	YE11	YE10	YE9	YE8		Y address end: $S \leq YE \leq Y$
RAMWR	10.1.21	0	↑	1	-	0	0	1	0	1	1	0	0	(2Ch)	Memory write
		1	↑	1	-	D7	D6	D5	D4	D3	D2	D1	D0		Write data
RGBSET	10.1.22	0	↑	1	-	0	0	1	0	1	1	0	1	(2Dh)	LUT for 4k,65k,262k color
		1	↑	1	-	-	-	R005	R004	R003	R002	R001	R000		Red tone 0
		1	↑	1	-	-	-	:	:	:	:	:	:		:
		1	↑	1	-	-	-	Ra5	Ra4	Ra3	Ra2	Ra1	Ra0		Red tone "a"
		1	↑	1	-	-	-	G005	G004	G003	G002	G001	G000		Green tone 0
		1	↑	1	-	-	-	:	:	:	:	:	:		:
		1	↑	1	-	-	-	Gb5	Gb4	Gb3	Gb2	Gb1	Gb0		Green tone "b"
		1	↑	1	-	-	-	B005	B004	B003	B002	B001	B000		Blue tone 0
		1	↑	1	-	-	-	:	:	:	:	:	:		:
RAMRD	10.1.23	0	↑	1	-	0	0	1	0	1	1	1	0	(2Eh)	Memory read
		1	↑	1	-	-	-	-	-	-	-	-	-		Dummy read
		1	↑	1	-	D7	D6	D5	D4	D3	D2	D1	D0		Read data

"-": Don't care

System Function command List (3)

Instruction	Refer	D/CX	WRX	RDX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Function
PTLAR	10.1.24	0	↑	1	-	0	0	1	1	0	0	0	0	(30h)	Partial start/end address set
		1	↑	1	-	PSL15	PSL14	PSL13	PSL12	PSL11	PSL10	PSL9	PSL8		Partial start address (0,1,2,...P)
		1	↑	1	-	PSL7	PSL6	PSL5	PSL4	PSL3	PSL2	PSL1	PSL0		
		1	↑	1	-	PEL15	PEL14	PEL13	PEL12	PEL11	PEL10	PEL9	PEL8		Partial end address (0,1,2,...,P)
TEOFF	10.1.25	0	↑	1	-	0	0	1	1	0	1	0	0	(34h)	Tearing effect line off
		0	↑	1	-	0	0	1	1	0	1	0	1	(35h)	Tearing effect mode set & on
TEON	10.1.26	0	↑	1	-	-	-	-	-	-	-	-	-		Mode1: TEM="0"
		1	↑	1	-	-	-	-	-	-	-	-	TEM		Mode2: TEM="1"
MADCTL	10.1.27	0	↑	1	-	0	0	1	1	0	1	1	0	(36h)	Memory data access control
		1	↑	1	-	MY	MX	MV	ML	RGB	MH	-	-		-
IDMOFF	10.1.28	0	↑	1	-	0	0	1	1	1	0	0	0	(38h)	Idle mode off
IDMON	10.1.29	0	↑	1	-	0	0	1	1	1	0	0	1	(39h)	Idle mode on
COLMOD	10.1.30	0	↑	1	-	0	0	1	1	1	0	1	0	(3Ah)	Interface pixel format
		1	↑	1	-	-	-	-	-	-	IFPF2	IFPF1	IFPF0		Interface format
RDID1	10.1.31	0	↑	1	-	1	1	0	1	1	0	1	0	(DAh)	Read ID1
		1	↑	1	-	-	-	-	-	-	-	-	-		Dummy read
		1	↑	1	-	ID17	ID16	ID15	ID14	ID13	ID12	ID11	ID10		Read parameter
RDID2	10.1.32	0	↑	1	-	1	1	0	1	1	0	1	1	(DBh)	Read ID2
		1	↑	1	-	-	-	-	-	-	-	-	-		Dummy read
		1	↑	1	-	1	ID26	ID25	ID24	ID23	ID22	ID21	ID20		Read parameter
RDID3	10.1.33	0	↑	1	-	1	1	0	1	1	1	0	0	(DCh)	Read ID3
		1	↑	1	-	-	-	-	-	-	-	-	-		Dummy read
		1	↑	1	-	ID37	ID36	ID35	ID34	ID33	ID32	ID31	ID30		Read parameter

"-": Don't care

Note 1: After the HW reset by RESX pin or SW reset by SWRESET command, each internal register becomes default state (Refer "RESET TABLE" section)

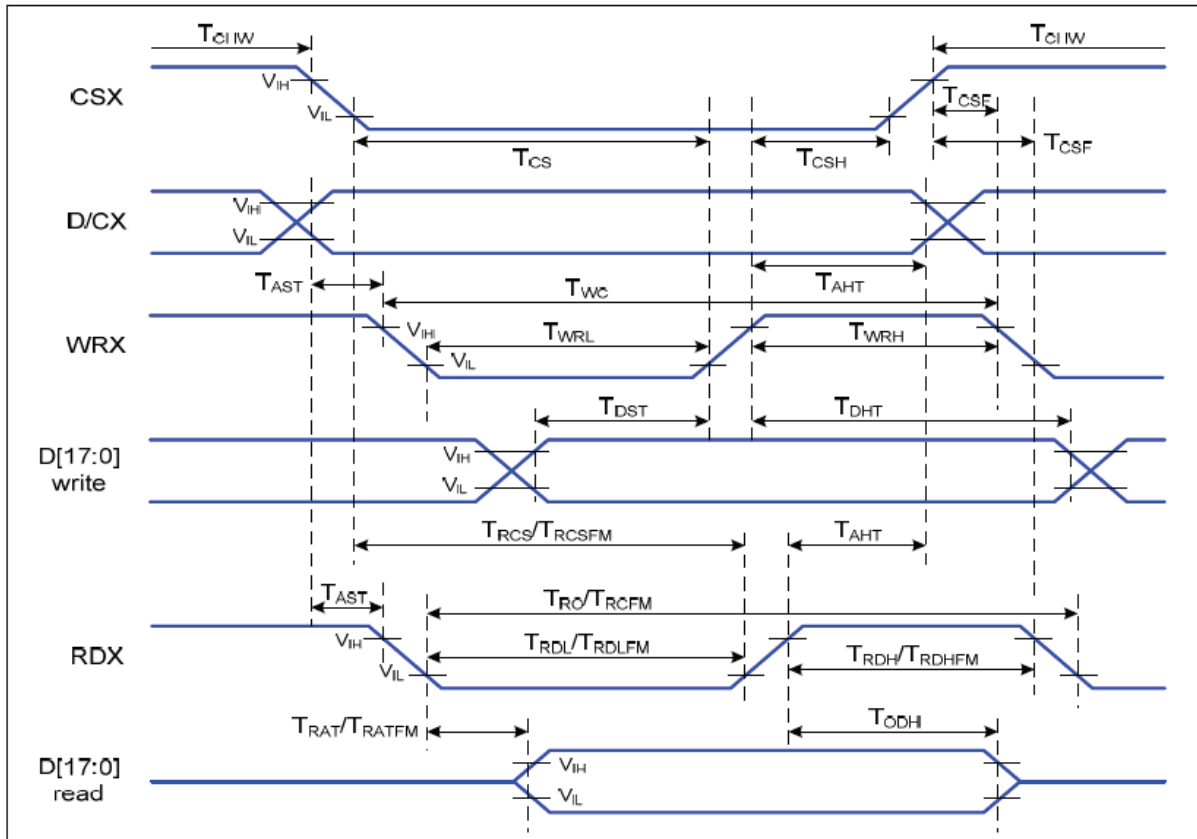
Note 2: Undefined commands are treated as NOP (00 h) command.

Note 3: B0 to D9 and DA to F are for factory use of driver supplier.

Note 4: Commands 10h, 12h, 13h, 20h, 21h, 26h, 28h, 29h, 30h, 33h, 36h (ML parameter only), 37h, 38h and 39h are updated during V-sync when Module is in Sleep Out Mode to avoid abnormal visual effects. During Sleep In mode, these commands are updated immediately. Read status (09h), Read Display Power Mode (0Ah), Read Display MADCTL (0Bh), Read Display Pixel Format (0Ch), Read Display Image Mode (0Dh), Read Display Signal Mode (0Eh).

10. AC Characteristics

Parallel interface characteristics: 18, 16, 9 or 8-bit bus (8080 series MCU interface)



Parallel interface timing characteristics (8080 series MCU interface)

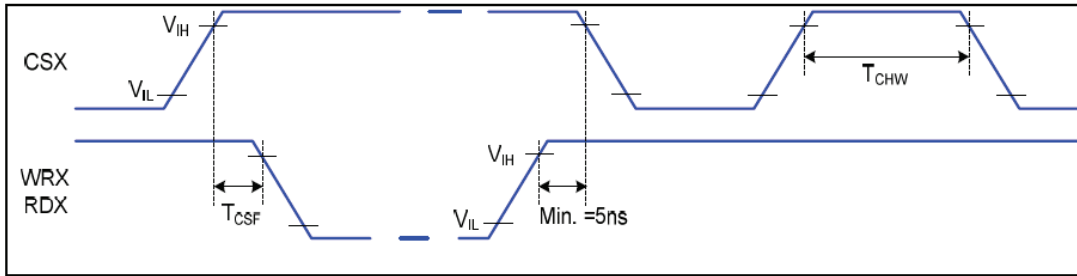
Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	TAST	Address setup time	10		ns	-
	TAHT	Address hold time (Write/Read)	10		ns	
CSX	TCHW	Chip select "H" pulse width	0		ns	-
	TCS	Chip select setup time (Write)	15		ns	
	TRCS	Chip select setup time (Read ID)	45		ns	
	TRCSFM	Chip select setup time (Read FM)	350		ns	
	TCSF	Chip select wait time (Write/Read)	10		ns	
	TCSH	Chip select hold time	10		ns	
WRX	TWC	Write cycle	100		ns	
	TWRH	Control pulse "H" duration	30		ns	
	TWRL	Control pulse "L" duration	30		ns	
RDX (ID)	TRC	Read cycle (ID)	160		ns	When read ID data
	TRDH	Control pulse "H" duration (ID)	90		ns	
	TRDL	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	TRCFM	Read cycle (FM)	450		ns	When read from frame memory
	TRDHFM	Control pulse "H" duration (FM)	150		ns	
	TRDLFM	Control pulse "L" duration (FM)	150		ns	
D[17:0]	TDST	Data setup time	10		ns	For CL=30pF
	TDHT	Data hold time	10		ns	
	TRAT	Read access time (ID)		40	ns	
	TRATFM	Read access time (FM)		40	ns	
	TODH	Output disable time		80	ns	

Parallel Interface Characteristics

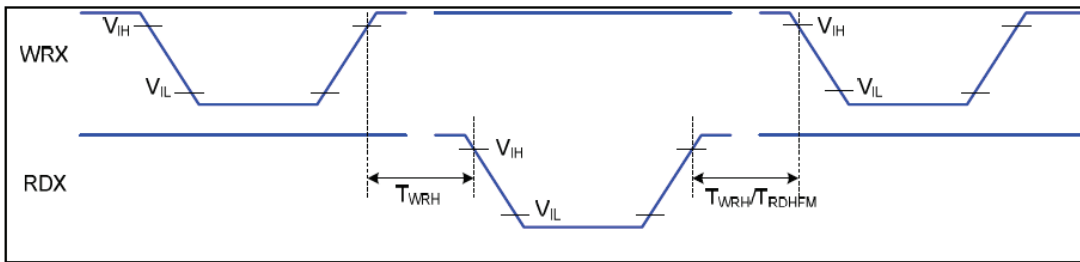
Note: VDDI=1.65 to 3.3V, VDD=2.6 to 3.3V, AGND=DGND=0V, Ta=25 °C



Fig. 8.1.2 Rising and falling timing for input and output signal



Chip selection (CSX) timing



Write-to-read and read-to-write timing

Note: The rising time and falling time (T_r , T_f) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

11. Quality Specifications

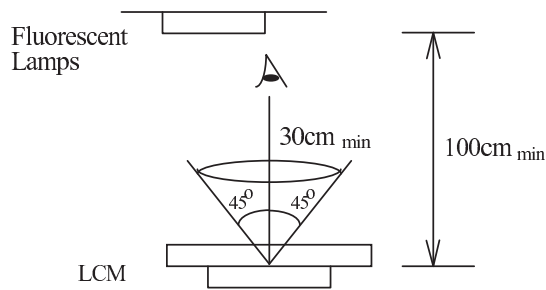
All The raw material are Rohs compliant.

11.1 Standard of the product appearance test

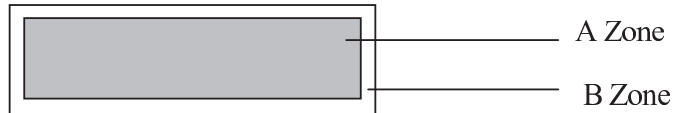
Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps.

Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM and inspector eyes should be 30 cm or more.

Viewing direction for inspection is 45° from vertical against LCM.



Definition of zone:



A Zone: viewing area

B Zone: outside viewing area

11.2 Specification of quality assurance


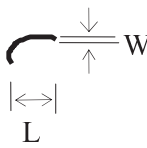
AQL inspection standard

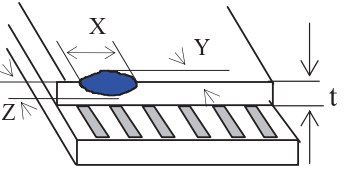
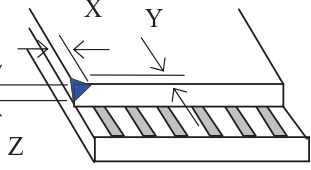
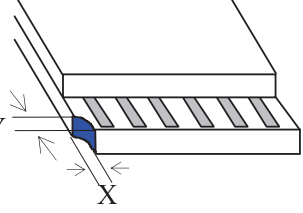
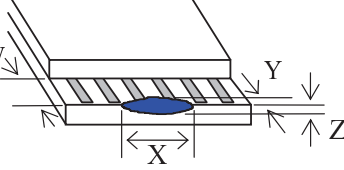
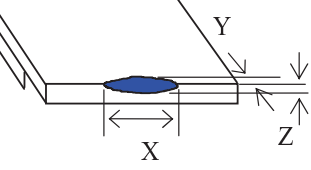
Sampling method: MIL-STD-105E, Level II, single sampling

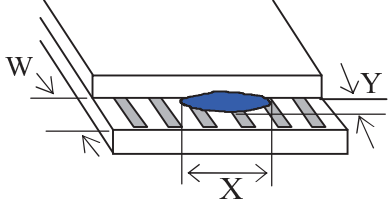
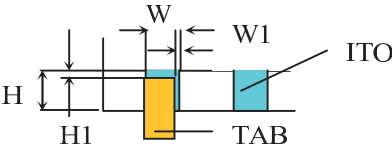
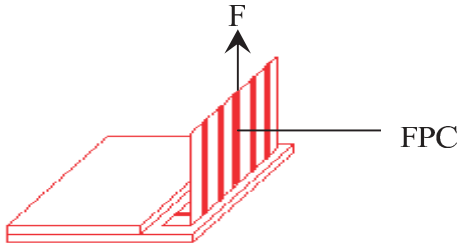
Defect classification (Note: * is not including)

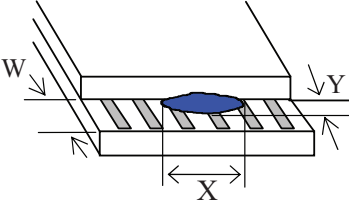
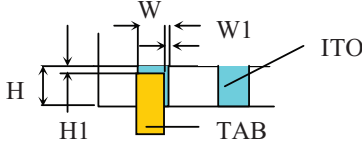

Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
	Back-light	1,8		
	Non-display	Flat cable or pin reverse	10	
Wrong or missing component		11		
Minor	Display state	Background color deviation	2	1.0
		Black spot and dust	3	
		Line defect, Scratch	4	
		Rainbow	5	
		Chip	6	
		Pin hole	7	
	Polarizer	Protruded	12	
		Bubble and foreign material	3	
	Soldering	Poor connection	9	
	Wire	Poor connection	10	
	TAB	Position, Bonding strength	13	

Note on defect classification

No.	Item	Criterion																				
1	Short or open circuit	Not allow																				
	LC leakage																					
	Flickering																					
	No display																					
	Wrong viewing direction																					
	Wrong Back-light																					
2	Contrast defect	Refer to approval sample																				
	Background color deviation																					
3	Point defect, Black spot, dust (including Polarizer) $\phi = (X+Y)/2$	 <table border="1" data-bbox="922 903 1318 1176"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty.</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 0.10$</td> <td>Disregard</td> </tr> <tr> <td>$0.10 < \phi \leq 0.20$</td> <td>3</td> </tr> <tr> <td>$0.20 < \phi \leq 0.25$</td> <td>2</td> </tr> <tr> <td>$0.25 < \phi \leq 0.30$</td> <td>1</td> </tr> <tr> <td>$\phi > 0.30$</td> <td>0</td> </tr> </tbody> </table> <p>Unit: mm</p>	Point Size	Acceptable Qty.	$\phi \leq 0.10$	Disregard	$0.10 < \phi \leq 0.20$	3	$0.20 < \phi \leq 0.25$	2	$0.25 < \phi \leq 0.30$	1	$\phi > 0.30$	0								
Point Size	Acceptable Qty.																					
$\phi \leq 0.10$	Disregard																					
$0.10 < \phi \leq 0.20$	3																					
$0.20 < \phi \leq 0.25$	2																					
$0.25 < \phi \leq 0.30$	1																					
$\phi > 0.30$	0																					
4	Line defect, Scratch	 <table border="1" data-bbox="857 1333 1356 1570"> <thead> <tr> <th colspan="2">Line</th> <th>Acceptable Qty.</th> </tr> <tr> <th>L</th> <th>W</th> <th></th> </tr> </thead> <tbody> <tr> <td>--</td> <td>$0.015 \geq W$</td> <td>Disregard</td> </tr> <tr> <td>$3.0 \geq L$</td> <td>$0.03 \geq W$</td> <td rowspan="2">2</td> </tr> <tr> <td>$2.0 \geq L$</td> <td>$0.05 \geq W$</td> </tr> <tr> <td>$1.0 \geq L$</td> <td>$0.1 > W$</td> <td>1</td> </tr> <tr> <td>--</td> <td>$0.05 < W$</td> <td>Applied as point defect</td> </tr> </tbody> </table> <p>Unit: mm</p>	Line		Acceptable Qty.	L	W		--	$0.015 \geq W$	Disregard	$3.0 \geq L$	$0.03 \geq W$	2	$2.0 \geq L$	$0.05 \geq W$	$1.0 \geq L$	$0.1 > W$	1	--	$0.05 < W$	Applied as point defect
Line		Acceptable Qty.																				
L	W																					
--	$0.015 \geq W$	Disregard																				
$3.0 \geq L$	$0.03 \geq W$	2																				
$2.0 \geq L$	$0.05 \geq W$																					
$1.0 \geq L$	$0.1 > W$	1																				
--	$0.05 < W$	Applied as point defect																				
5	Rainbow	Not more than two color changes across the viewing area.																				

No	Item	Criterion																																	
6	<p>Chip</p> <p>Remark: X: Length direction Y: Short direction Z: Thickness direction t: Glass thickness W: Terminal Width</p>	 <p>Acceptable criterion</p> <table border="1" data-bbox="966 430 1323 514"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤ 2</td> <td>0.5mm</td> <td>$\leq t/2$</td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1" data-bbox="958 724 1323 798"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤ 2</td> <td>0.5mm</td> <td>$\leq t$</td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1" data-bbox="966 987 1323 1102"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤ 3</td> <td>≤ 2</td> <td>$\leq t$</td> </tr> <tr> <td colspan="2">shall not reach to ITO</td> <td></td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1" data-bbox="958 1333 1323 1407"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>Disregard</td> <td>≤ 0.2</td> <td>$\leq t$</td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1" data-bbox="958 1585 1299 1669"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤ 5</td> <td>≤ 2</td> <td>$\leq t/3$</td> </tr> </tbody> </table>	X	Y	Z	≤ 2	0.5mm	$\leq t/2$	X	Y	Z	≤ 2	0.5mm	$\leq t$	X	Y	Z	≤ 3	≤ 2	$\leq t$	shall not reach to ITO			X	Y	Z	Disregard	≤ 0.2	$\leq t$	X	Y	Z	≤ 5	≤ 2	$\leq t/3$
X	Y	Z																																	
≤ 2	0.5mm	$\leq t/2$																																	
X	Y	Z																																	
≤ 2	0.5mm	$\leq t$																																	
X	Y	Z																																	
≤ 3	≤ 2	$\leq t$																																	
shall not reach to ITO																																			
X	Y	Z																																	
Disregard	≤ 0.2	$\leq t$																																	
X	Y	Z																																	
≤ 5	≤ 2	$\leq t/3$																																	

No	Item	Criterion
12	Protruded W: Terminal Width	 <p>Acceptable criteria: $Y \leq 0.4$</p>
13	TAB	<p>1. Position</p>  <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: auto; margin-right: auto;"> $W1 \leq 1/3W$ $H1 \leq 1/3H$ </div> <p>2 FPC bonding strength test</p>  <p> $P (=F/FPC \text{ bonding width}) \geq 650\text{gf/cm}$, (speed rate: 1mm/min) 5pcs per SOA (shipment) </p>
14	Total no. of acceptable Defect	<p>A. Zone</p> <p>Maximum 2 minor non-conformities per one unit. Defect distance: each point to be separated over 10mm</p> <p>B. Zone</p> <p>It is acceptable when it is no trouble for quality and assembly in customer's end product.</p>

No	Item	Criterion
12	Protruded W: Terminal Width	 <p>Acceptable criteria: $Y \leq 0.4$</p>
13	TAB	<p>1. Position</p>  <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: auto; margin-right: auto;"> $W1 \leq 1/3W$ $H1 \leq 1/3H$ </div> <p>2 FPC bonding strength test</p>  <p> $P (=F/FPC \text{ bonding width}) \geq 650gf/cm$,(speed rate: 1mm/min) 5pcs per SOA (shipment) </p>
14	Total no. of acceptable Defect	<p>A. Zone</p> <p>Maximum 2 minor non-conformities per one unit. Defect distance: each point to be separated over 10mm</p> <p>B. Zone</p> <p>It is acceptable when it is no trouble for quality and assembly in customer's end product.</p>

11.3 Reliability of LCM

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	60°C	48	No abnormalities in functions and appearance
High temp. Operating	50°C	48	
Low temp. Storage	-20°C	48	
Low temp. Operating	-10°C	48	
Humidity	40°C/ 90%RH	48	
Temp. Cycle	-20°C ← 25°C →60°C (60 min ← 5 min → 60min)	10cycles	

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature ($20\pm 8^{\circ}\text{C}$), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

11.4 Precaution for using LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isopropyl alcohol, ethyl alcohol or trichlorotrifluoroethane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not make any modification on the PCB without consulting ORIENT DISPLAY.
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: $280^{\circ}\text{C}\pm 10^{\circ}\text{C}$
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage V_o .
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%, and avoid direct sunlight.

Limited Warranty

ORIENT DISPLAY LCDs and modules are not consumer products, but may be incorporated by OD's customers into consumer products or components thereof, OD does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of OD is limited to repair or replacement on the terms set forth below. OD will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between OD and the customer, OD will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with OD general LCD inspection standard. (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.