

Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 128160A1 TMH-PW-N

1,8" TFT

Product Specification

Ver.: 3

08.09.2015

Revision History

Revision	Date	Detail	Remarks
0	14.01.2015	Initial Release	-
1	30.01.2015	Modify Chromaticity Transmissive Modify Interface Pins Definition Modify Outline Drawing	P6 P10 P26
2	29.07.2015	Correct Drawing	-
3	08.09.2015	Add Weight Add Current Consumption All Black Add LED Brand Modify Chromacity Transmissive	P4 P5 P5 P6

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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 and a backlight unit.

2. Module Parameter

Features	Details	Unit
Display Size (Diagonal)	1.77"	-
LCD Type	TN TFT	-
Display Mode	Transmissive / Normally White	-
Resolution	128 x RGB x 160	Pixels
View Direction	6 O'clock	Best Image
Gray Scale Inversion Direction	12 O'clock	-
Module Outline	36.30 x 47.80 x 2.43 (Note1)	mm
Active Area	28.032 x 35.04	mm
Pixel Size	0.219 x 0.219	mm
Pixel Arrangement	Stripe	-
Polarizer Surface Treatment	Anti-glare	-
Display Colors	65k	-
Interface	8080 MCU 16-Bit-Parallel-Interface	-
With or without Touch Panel	without	-
Driver IC	ST7735S (Sitronix)	-
Operating Temperature	-20 to +70	°C
Storage Temperature	-30 to +80	°C
Weight	10	g

Note 1: Exclusive hooks, posts, FFC/FPC tail etc.

3. Absolute Maximum Ratings

V_{SS}=0V, Ta=25°C

Item	Symbol	Min.	Max.	Unit
Supply Voltage	VDD	-0.3	4.6	V
Storage Temperature	T _{STG}	-30	+80	°C
Operating Temperature	T _{OP}	-20	+70	°C

Note 1: If Ta below 50°C, the maximal humidity is 90%RH, if Ta over 50°C, absolute humidity should be less than 60%RH.

Note 2: The response time will be extremely slow when the operating temperature is around -10°C, and the back ground will become darker at high temperature operating.

4. DC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	
Supply Voltage	VDD	2.5	2.8	3.7	V	
Logic Low Input Voltage	V _{IL}	GND	-	0.3*VDD	V	
Logic High Input Voltage	V _{IH}	0.7*VDD	-	VDD	V	
Logic Low Output Voltage	V _{OL}	GND	-	0.2*VDD	V	
Logic High Output Voltage	V _{OH}	0.8*VDD	-	VDD	V	
Current Consumption All Black	Logic Analog	I _{CC+} I _{IN}	-	~3	-	mA

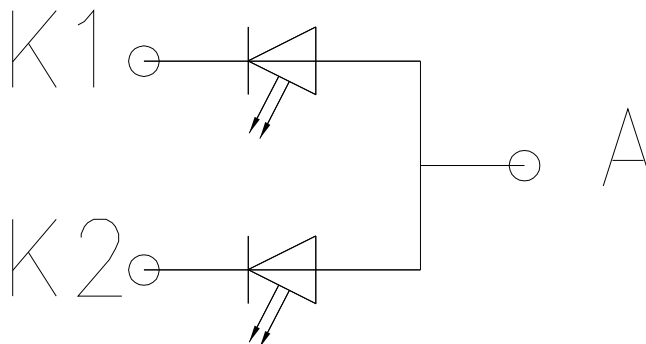
5. Backlight Characteristic

5.1. Backlight Characteristic

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	V _F	T _a =25 °C, I _F =15mA/LED	2.9	3.1	3.3	V
Forward Current	I _F	T _a =25 °C, V _F =3.1V/LED	-	30	-	mA
Power Dissipation	P _D		-	93	-	mW
LED Life Time(25 °C)	-	-		50,000	-	Hr
Uniformity	Avg		80	-	-	%
Drive Method	Constant current					
LED Configuration	2 White LEDs in parallel					

Note: LED life time defined as follows: The final brightness is at 50% of original brightness. The environmental conducted under ambient air flow, at T_a=25±2 °C, 60%RH±5%, I_F=20mA/LED.
LED Brand: Nichia

5.2. Backlight Characteristic



Backlight

6. Optical Characteristics

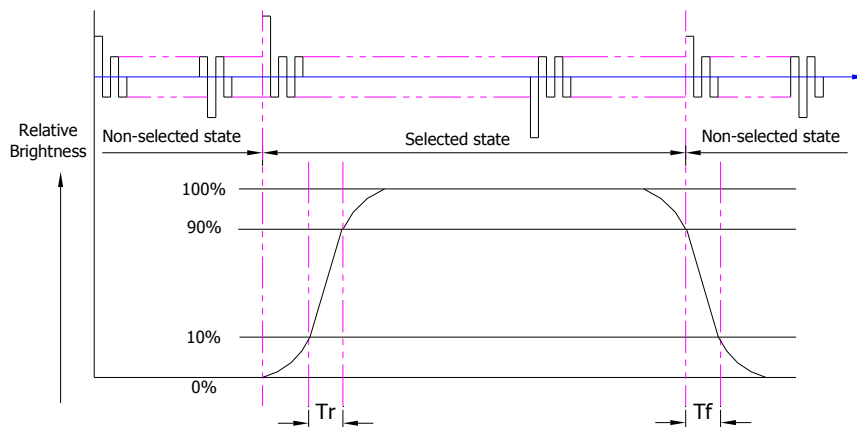
6.1. Optical Characteristics

Ta=25°C, VDD=2.8V, TN LC+ Polarizer

	Item	Symbol	Condition	Specification			Unit	
				Min.	Typ.	Max.		
Backlight On (Transmissive Mode)	Luminance on TFT ($I_f = 15\text{mA/LED}$)	Lv	Normally viewing angle $\theta_x = \phi_y = 0^\circ$	350	-	-	cd/m ²	
	Contrast ratio(See 6.3)	CR		400	500	-		
	Response time (See 6.2)	TR+TF		-	8	16	ms	
	Chromaticity Transmissive (See 6.5)	Red	XR	Center CR ≥ 10	0.566	0.616	0.666	
			YR		0.299	0.349	0.399	
		Green	XG		0.237	0.287	0.337	
			YG		0.570	0.620	0.670	
		Blue	XB		0.095	0.145	0.195	
			YB		0.038	0.088	0.138	
	White	XW	0.233	0.283	0.333			
		YW	0.269	0.319	0.369			
	Viewing Angle (See 6.4)	Horizontal	θ_{x+}	Center CR ≥ 10	50	60	-	Deg.
			θ_{x-}		50	60	-	
Vertical		ϕ_{y+}	50		60	-		
		ϕ_{y-}	30		40	-		
NTSC Ratio(Gamut)				-	60	-	%	

6.2. Definition of Response Time

6.2.1. Normally Black Type (Negative)

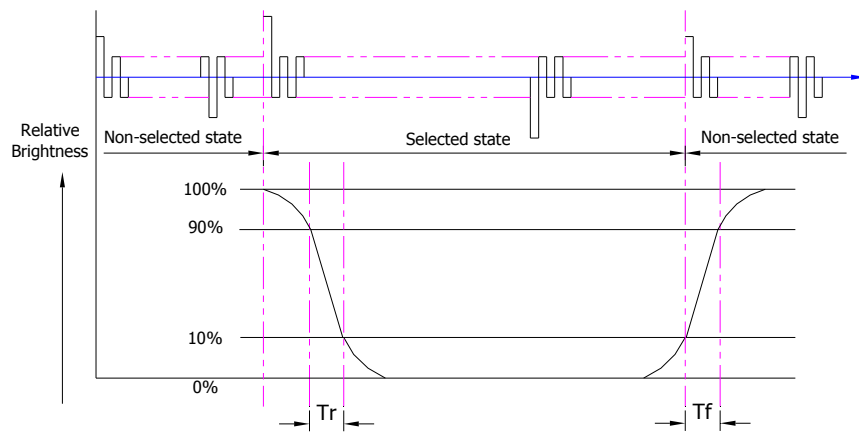


Tr is the time it takes to change from non-selected stage with relative luminance 10% to selected state with relative luminance 90%;

Tf is the time it takes to change from selected state with relative luminance 90% to non-selected state with relative luminance 10%.

Note : Measuring machine: LCD-5100

6.2.2. Normally White Type (Positive)



Tr is the time it takes to change from non-selected stage with relative luminance 90% to selected state with relative luminance 10%;

Tf is the time it takes to change from selected state with relative luminance 10% to non-selected state with relative luminance 90%;

Note: Measuring machine: LCD-5100 or EQUI

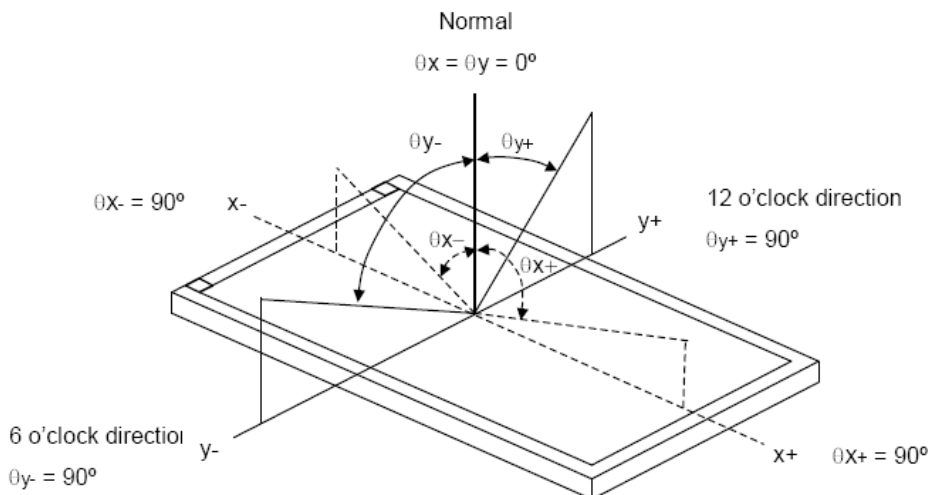
6.3. Definition of Contrast Ratio

Contrast is measured perpendicular to display surface in reflective and transmissive mode. The measurement condition is:

Measuring Equipment	Eldim or Equivalent
Measuring Point Diameter	3mm//1mm
Measuring Point Location	Active Area centre point
Test pattern	A: All Pixels white
	B: All Pixel black
Contrast setting	Maximum

Definitions: CR (Contrast) = Luminance of White Pixel / Luminance of Black Pixel

6.4. Definition of Viewing Angles



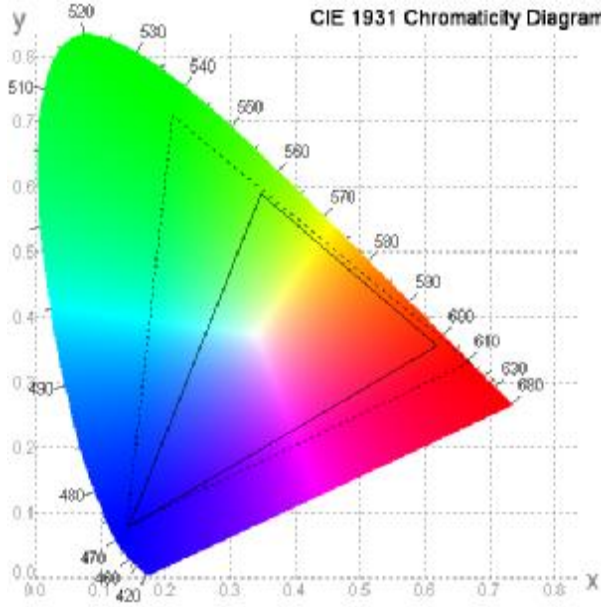
Measuring machine: LCD-5100 or EQUI

6.5. Definition of Color Appearance

R,G,B and W are defined by (x, y) on the IE chromaticity diagram

NTSC=area of RGB triangle/area of NTSC triangleX100%

Measuring picture: Red, Green, Blue and White (Measuring machine: BM-7)



6.6. Definition of Surface Luminance, Uniformity and Transmittance

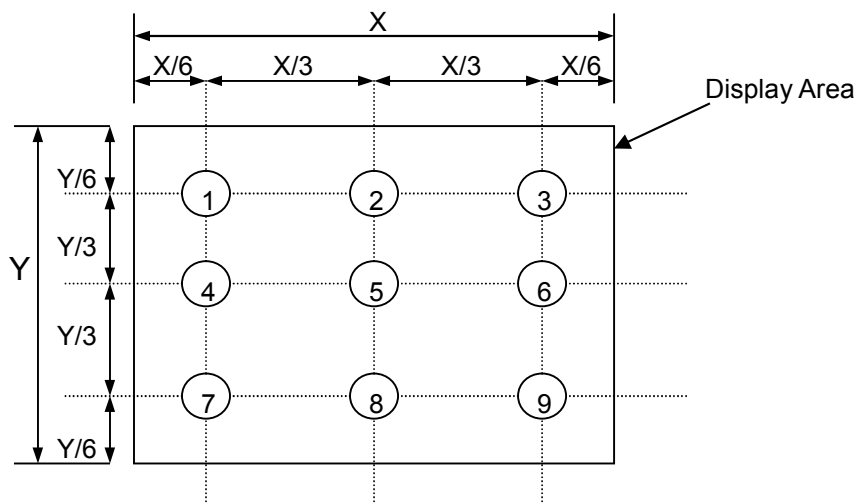
Using the transmissive mode measurement approach, measure the white screen luminance of the display panel and backlight.

6.6.1. Surface Luminance: $L_v = \text{average} (L_{P1}:L_{P9})$

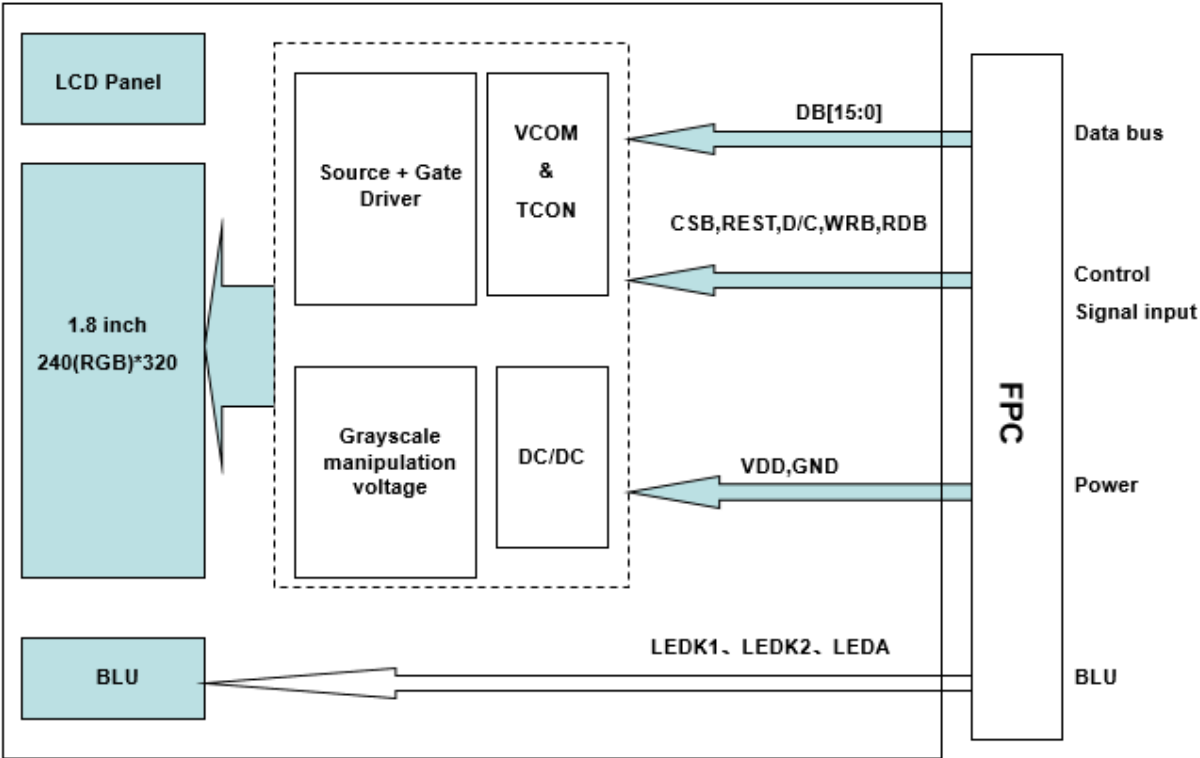
6.6.2. Uniformity = $\text{Minimal} (L_{P1}:L_{P9}) / \text{Maximal} (L_{P1}:L_{P9}) * 100\%$

6.6.3. Transmittance = $L_v \text{ on LCD} / L_v \text{ on Backlight} * 100\%$

Note: Measuring machine: BM-7



7. Block Diagram and Power Supply

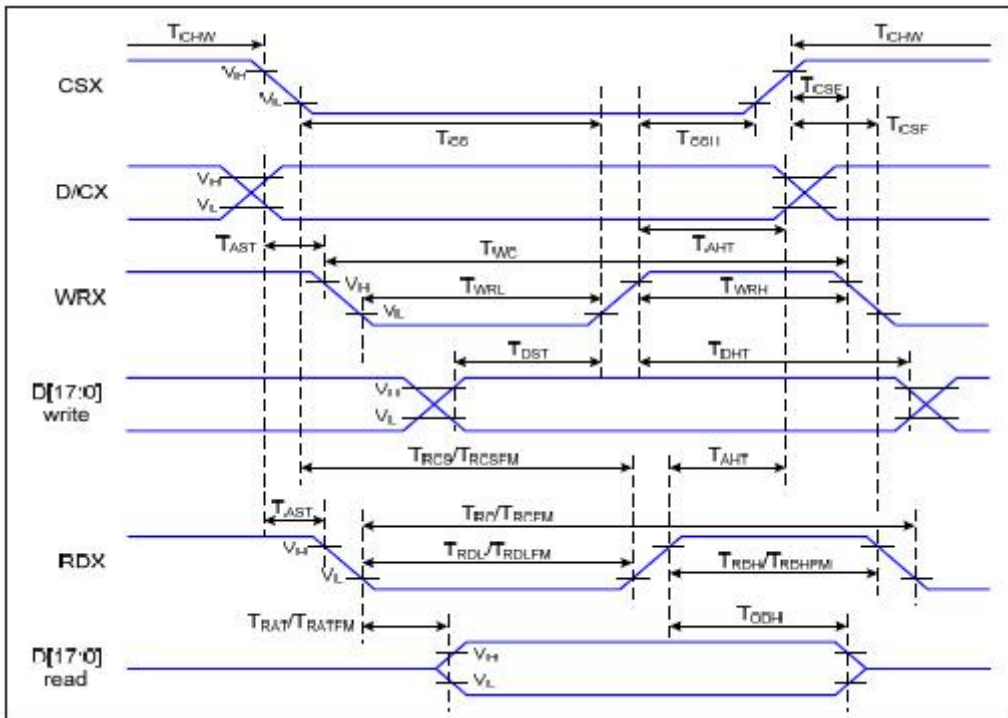


8. Interface Pins Definition

No.	Symbol	Function	Remark
1	VDD	Power supply for Analog	
2	GND	Ground.	
3	WRB	Write Enable in MCU Parallel Interface.	
4	D0	Data bus; IM2=0, D0 is the serial input/output signal in serial interface mode.	
5	D2	Data bus.	
6	D4	Data bus.	
7	D6	Data bus.	
8	CSB	Chip Selection Pin Low Enable.	
9	REST	This signal will reset the device and it must be applied to properly initialize the chip	
10	D7	Data bus.	
11	D5	Data bus.	
12	D3	Data bus.	
13	D1	Data bus.	
14	D8	Data bus.	
15	D9	Data bus.	
16	D10	Data bus.	
17	D11	Data bus.	
18	D12	Data bus.	
19	D13	Data bus.	
20	D14	Data bus.	
21	D15	Data bus.	
22	D/C	Data/Command Signal; IM2=0, this is used as SCL.	
23	RDB	Read Enable in 8080 MCU Parallel Interface.	
24	LEDK1	LED Cathode.	
25	LEDK2	LED Cathode.	
26	LEDA	LED Anode.	

9. AC Characteristics

9.1. Parallel Interface Characteristics: 16, 9 or 8-bit Bus (8080 Series MCU Interface)

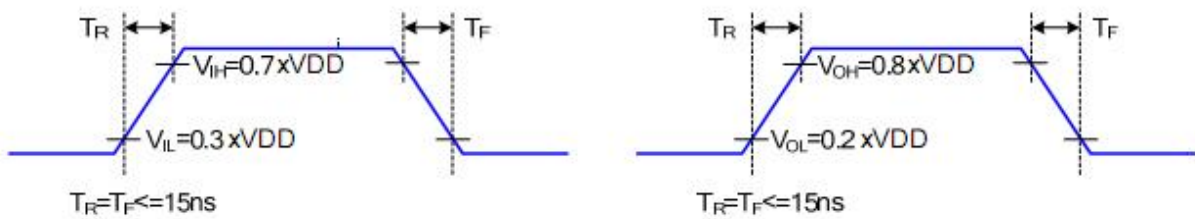


Parallel Interface Timing Characteristics

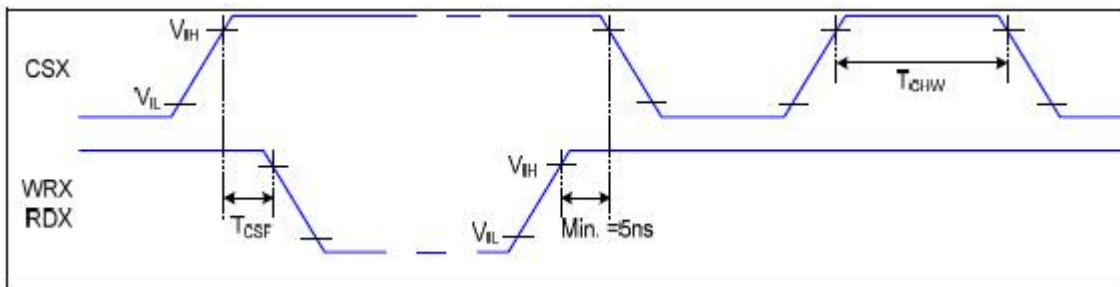
Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	TAST	Address Setup Time	0		ns	
	TAHT	Address Hold Time (Write/Read)	10		ns	
CSX	TCHW	Chip Select "H" Pulse Width	0		ns	
	TCS	Chip Select Setup Time (Write)	15		ns	
	TRCS	Chip Select Setup Time (Read ID)	45		ns	
	TRCSFM	Chip Select Setup time (Read FM)	355		ns	
	TCSF	Chip Select Wait Time (Write/Read)	10		ns	
	TCSH	Chip Select Hold Time	10		ns	
WRX	TWC	Write Cycle	66		ns	
	TWRH	Control Pulse "H" Duration	15		ns	
	TWRL	Control Pulse "L" Duration	15		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)	90		ns	
	TRDLFM	Control Pulse "L" Duration (FM)	355		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)		340	ns	
	TODH	Output Disable Time	20	80	ns	

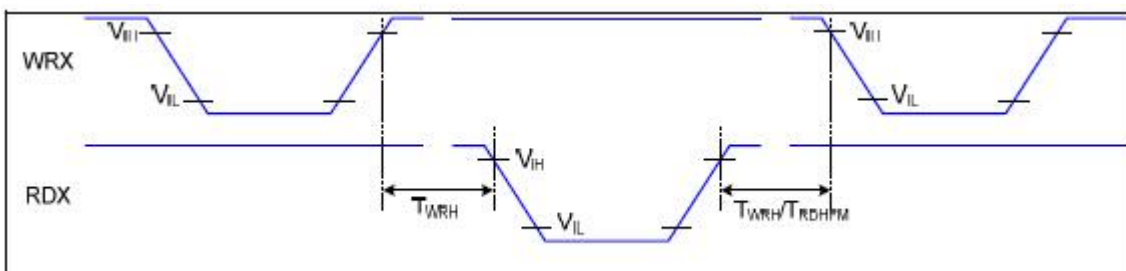
8080 Parallel Interface Characteristics



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 15ns or less. Logic high and low levels are specified as 30% and 70% of VCI for Input signals

10. Command Table

Instruction	Refer	D/CX	WRX	RDX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Function
NOP	0	0	↑	1	-	0	0	0	0	0	0	0	0	(00h)	No Operation
SWRESET	0	0	↑	1	-	0	0	0	0	0	0	0	1	(01h)	Software Reset
RDDID	0	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	0	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	0	0	↑	1	-	0	0	0	0	1	0	1	0	(0Ah)	Read Display Power Mode
		1	1	↑	-	-	-	-	-	-	-	-	-	-	Dummy Read
		1	1	↑	-	BSTON	IDMON	PTLON	SLPOUT	NORON	DISON	-	-	-	-
RDMADCTL	0	0	↑	1	-	0	0	0	0	1	0	1	1	(0Bh)	Read Display MADCTL
		1	1	↑	-	-	-	-	-	-	-	-	-	-	Dummy Read
		1	1	↑	-	MY	MX	MV	ML	RGB	MH	-	-	-	-
RDCOLMOD	0	0	↑	1	-	0	0	0	0	1	1	0	0	(0Ch)	Read Display Pixel Format
		1	1	↑	-	-	-	-	-	-	-	-	-	-	Dummy Read
		1	1	↑	-	0	0	0	0	-	IFPF2	IFPF1	IFPF0	-	-
RDDIM	0	0	↑	1	-	0	0	0	0	1	1	0	1	(0Dh)	Read Display Image Mode
		1	1	↑	-	-	-	-	-	-	-	-	-	-	Dummy Read
		1	1	↑	-	VSSON	D6	INVON	-	-	GCS2	GCS1	GCS0	-	-
RDDSM	0	0	↑	1	-	0	0	0	0	1	1	1	0	(0Eh)	Read Display Signal Mode
		1	1	↑	-	-	-	-	-	-	-	-	-	-	Dummy Read
		1	1	↑	-	TEON	TEM	-	-	-	-	-	-	-	-
RDDSDR	0	0	↑	1	-	0	0	0	0	1	1	1	1	(0Fh)	Read Display Self-diagnostic result
		1	1	↑	-	-	-	-	-	-	-	-	-	-	Dummy Read
		1	1	↑	-	RELD	FUND	ATTD	BRD	-	-	-	-	-	-

Instruction	Refer	D/CX	WRX	RDX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Function
SLPIN	0	0	↑	1	-	0	0	0	1	0	0	0	0	(10h)	Sleep In & Booster Off
SLPOUT	0	0	↑	1	-	0	0	0	1	0	0	0	1	(11h)	Sleep Out & Booster On
PTLON	0	0	↑	1	-	0	0	0	1	0	0	1	0	(12h)	Partial Mode On
NORON	0	0	↑	1	-	0	0	0	1	0	0	1	1	(13h)	Partial Off (Normal)
INVOFF	0	0	↑	1	-	0	0	1	0	0	0	0	0	(20h)	Display Inversion Off (Normal)
INVON	0	0	↑	1	-	0	0	1	0	0	0	0	1	(21h)	Display Inversion On
GAMSET	0	0	↑	1	-	0	0	1	0	0	1	1	0	(26h)	Gamma Curve Select
		1	↑	1	-	-	-	-	-	GC3	GC2	GC1	GC0		-
DISPOFF	0	0	↑	1	-	0	0	1	0	1	0	0	0	(28h)	Display Off
DISPON	0	0	↑	1	-	0	0	1	0	1	0	0	1	(29h)	Display On
CASET	0	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	0	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	0	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	0	0	↑	1	-	0	0	1	0	1	1	0	1	(2Dh)	LUT for 4k,65k,262k Color display
		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
RAMRD	0	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

Instruction	Refer	D/CX	WRX	RDX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex	Function
PTLAR	10.1.25	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	-	PEL15	PEL14	PEL13	PEL12	PEL11	PEL10	PEL9	PEL8		Partial End Address (0,1,2...P)
		1	↑	1	-	PEL7	PEL6	PEL5	PEL4	PEL3	PEL2	PEL1	PEL0		
SCRLAR	10.1.26	0	↑	1	-	0	0	1	1	0	0	1	1	(33h)	Scroll area set
		1	↑	1	-	-	-	-	-	-	-	-	-		Top fixed area (0,1, 2, ... 161)
		1	↑	1	-	TFA7	TFA6	TFA5	TFA4	TFA3	TFA2	TFA1	TFA0		Vertical scroll area (0,1, 2, ... 161)
		1	↑	1	-	VSA7	VSA6	VSA5	VSA4	VSA3	VSA2	VSA1	VSA0		Bottom fixed area (0,1, 2, ... 161)
		1	↑	1	-	-	-	-	-	-	-	-	-		
		1	↑	1	-	BFA7	BFA6	BFA5	BFA4	BFA3	BFA2	BFA1	BFA0		
TEOFF	10.1.27	0	↑	1	-	0	0	1	1	0	1	0	0	(34h)	Tearing effect line off
TEON	10.1.28	0	↑	1	-	0	0	1	1	0	1	0	1	(35h)	Tearing Effect Mode Set & on
		1	↑	1	-	-	-	-	-	-	-	-	TEM	Mode1: TEM="0" Mode2: TEM="1"	
MADCTL	10.1.29	0	↑	1	-	0	0	1	1	0	1	1	0	(36h)	Memory Data Access Control
		1	↑	1	-	MY	MX	MV	ML	RGB	MH	-	-		
VSCSAD	10.1.30	0	↑	1	-	0	0	1	1	0	1	1	1	(37h)	Scroll Start Address of RAM
		1	1	1	-	-	-	-	-	-	-	-	-		SSA=0,1,2,...,161
		1	1	1	-	SSA7	SSA6	SSA5	SSA4	SSA3	SSA2	SSA1	SSA0		
IDMOFF	10.1.31	0	↑	1	-	0	0	1	1	1	0	0	0	(38h)	Idle Mode Off
IDMON	10.1.32	0	↑	1	-	0	0	1	1	1	0	0	1	(39h)	Idle Mode On
COLMOD	10.1.33	0	↑	1	-	0	0	1	1	1	0	1	0	(3Ah)	Interface Pixel Format
		1	↑	1	-	-	-	-	-	-	IFPF2	IFPF1	IFPF0		Interface Format
RDID1	10.1.34	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	10.1.35	0	↑	1	-	1	1	0	1	1	0	1	1	(DBh)	Read ID2
		1	1	↑	-	-	-	-	-	-	-	-	-		Dummy Read
		1	1	↑	-	1	ID28	ID25	ID24	ID23	ID22	ID21	ID20		Read Parameter
RDID3	10.1.36	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 H/W reset by RESX pin or S/W 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).

11. Quality Assurance

11.1. Purpose

This standard for Quality Assurance assures the quality of LCD module products supplied to customer.

11.2. Standard for Quality Test

11.2.1 Sampling Plan:

GB2828.1-2012

Single sampling, general inspection level II.

11.2.2 Sampling Criteria:

Visual inspection: AQL 1.5%

Electrical functional: AQL 0.65%.

11.2.3 Reliability Test:

Detailed requirement refer to Reliability Test Specification.

11.3. Nonconforming Analysis & Disposition

11.3.1 Nonconforming analysis:

11.3.1.1 Customer should provide overall information of non-conforming sample for their complaints.

11.3.1.2 After receipt of detailed information from customer, the analysis of nonconforming parts usually should be finished in one week.

11.3.1.3 If can not finish the analysis on time, customer will be notified with the progress status.

11.3.2 Disposition of nonconforming:

11.3.2.1 Non-conforming product over PPM level will be replaced.

11.3.2.2 The cause of non-conformance will be analyzed. Corrective action will be discussed and implemented.

11.4. Agreement Items

Shall negotiate with customer if the following situation occurs:

11.4.1 There is any discrepancy in standard of quality assurance.

11.4.2 Additional requirement to be added in product specification.

11.4.3 Any other special problem.

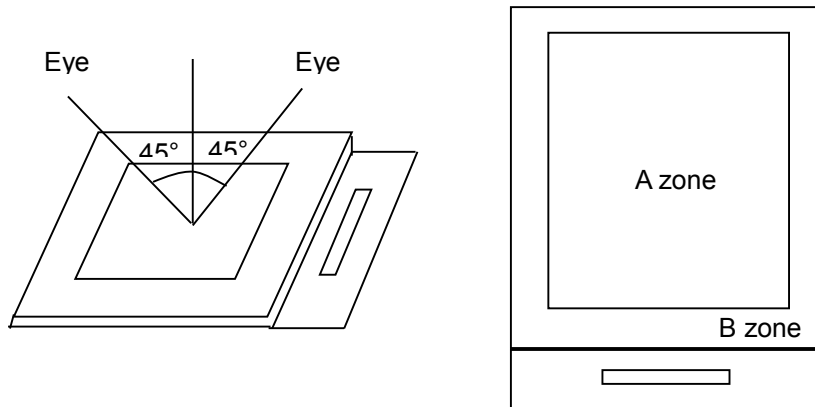
11.5. Standard of the Product Visual Inspection

11.5.1 Appearance inspection:

11.5.1.1 The inspection must be under illumination about 1000 – 1500 lx, and the distance of view must be at 30cm ± 2cm.

11.5.1.2 The viewing angle should be 45° from the vertical line without reflection light or follows customer's viewing angle specifications.

11.5.1.3 Definition of area: A Zone: Active Area, B Zone: Viewing Area,



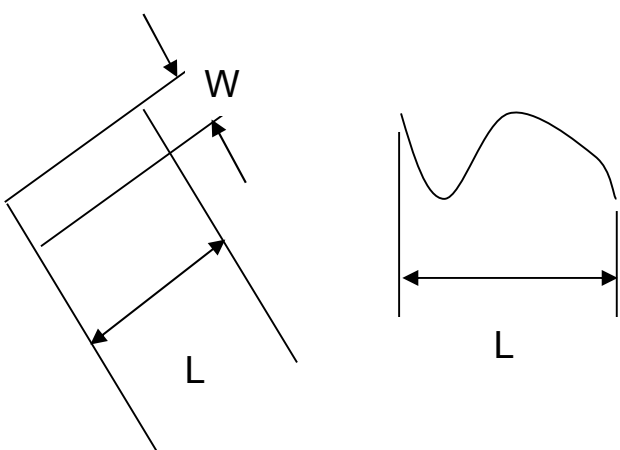
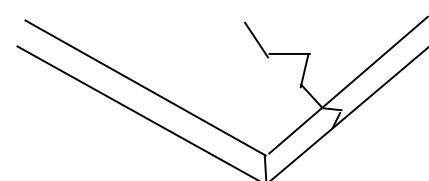
11.5.2 Basic principle:

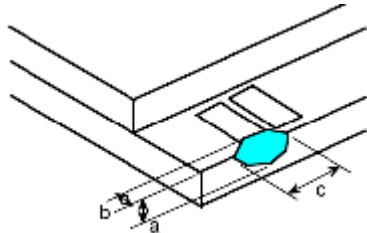
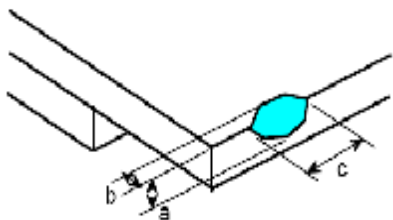
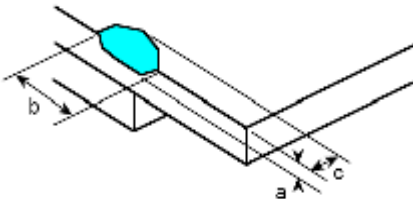
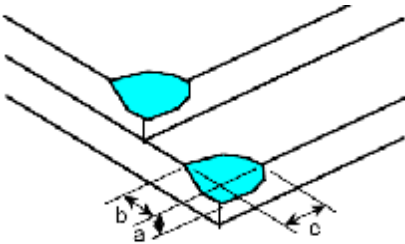
11.5.2.1 A set of sample to indicate the limit of acceptable quality level must be discussed by both us and customer when there is any dispute happened.

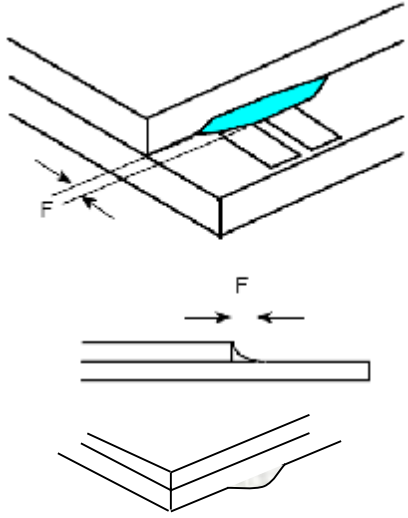
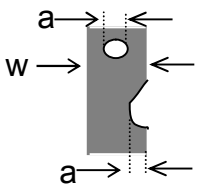
11.5.2.2 New item must be added on time when it is necessary.

Inspection Specification

No.	Item	Criteria (Unit: mm)													
01	Black / White spot Foreign material (Round type) Pinholes Stain Particles inside cell. (Minor defect)	<p>$\phi = (a + b) / 2$</p> <p>Distance between 2 defects should more than 3mm apart.</p>	<table border="1"> <thead> <tr> <th>Size \ Area</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 0.10$</td> <td>Ignore</td> </tr> <tr> <td>$0.10 < \phi \leq 0.15$</td> <td>2</td> </tr> <tr> <td>$0.15 < \phi \leq 0.25$</td> <td>1</td> </tr> <tr> <td>$0.25 < \phi$</td> <td>0</td> </tr> <tr> <td>Total</td> <td>2 no include $\phi \leq 0.10$</td> </tr> </tbody> </table>	Size \ Area	Acc. Qty	$\phi \leq 0.10$	Ignore	$0.10 < \phi \leq 0.15$	2	$0.15 < \phi \leq 0.25$	1	$0.25 < \phi$	0	Total	2 no include $\phi \leq 0.10$
			Size \ Area	Acc. Qty											
$\phi \leq 0.10$	Ignore														
$0.10 < \phi \leq 0.15$	2														
$0.15 < \phi \leq 0.25$	1														
$0.25 < \phi$	0														
Total	2 no include $\phi \leq 0.10$														

02	Electrical Defect (Minor defect)	<table border="1"> <tr> <th></th> <th>Display Area</th> <th>Total</th> <th rowspan="3">Note1</th> </tr> <tr> <td>Bright dot</td> <td>0</td> <td>0</td> </tr> <tr> <td>Dark dot</td> <td>$N \leq 2$</td> <td>$N \leq 2$</td> </tr> <tr> <td>Total dot</td> <td>$N \leq 2$</td> <td>$N \leq 2$</td> <td></td> </tr> <tr> <td>Mura</td> <td colspan="2">Not visible through 5% ND filters.</td> <td>Note 2</td> </tr> </table>		Display Area	Total	Note1	Bright dot	0	0	Dark dot	$N \leq 2$	$N \leq 2$	Total dot	$N \leq 2$	$N \leq 2$		Mura	Not visible through 5% ND filters.		Note 2
			Display Area	Total	Note1															
		Bright dot	0	0																
		Dark dot	$N \leq 2$	$N \leq 2$																
		Total dot	$N \leq 2$	$N \leq 2$																
Mura	Not visible through 5% ND filters.		Note 2																	
<p>Remark:</p> <p>1. Bright dot caused by scratch and foreign object accords to item 1.</p>																				
04	Black and White line Scratch Foreign material (Line type) (Minor defect)																			
		<table border="1"> <thead> <tr> <th>Length</th> <th>Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>/</td> <td>$W \leq 0.03$</td> <td>Ignore</td> </tr> <tr> <td>$L \leq 2.5$</td> <td>$0.03 < W \leq 0.05$</td> <td>3</td> </tr> <tr> <td>$L \leq 2.5$</td> <td>$0.05 < W \leq 0.10$</td> <td>2</td> </tr> <tr> <td>/</td> <td>$0.1 < W$</td> <td>0</td> </tr> <tr> <td colspan="2">Total</td> <td>3</td> </tr> </tbody> </table>	Length	Width	Acc. Qty	/	$W \leq 0.03$	Ignore	$L \leq 2.5$	$0.03 < W \leq 0.05$	3	$L \leq 2.5$	$0.05 < W \leq 0.10$	2	/	$0.1 < W$	0	Total		3
		Length	Width	Acc. Qty																
/	$W \leq 0.03$	Ignore																		
$L \leq 2.5$	$0.03 < W \leq 0.05$	3																		
$L \leq 2.5$	$0.05 < W \leq 0.10$	2																		
/	$0.1 < W$	0																		
Total		3																		
<p>Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable.</p>																				
05	Glass Crack (Minor defect)	 <p>Crack is potential to enlarge, any type is not allowed.</p>																		

<p>06</p>	<p>Glass Chipping Pad Area: (Minor defect)</p> 	<table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c > 3.0, b < 1.0$</td> <td>1</td> </tr> <tr> <td>$c < 3.0, b < 1.0$</td> <td>3</td> </tr> <tr> <td colspan="2">$a < \text{Glass Thickness}$</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c > 3.0, b < 1.0$	1	$c < 3.0, b < 1.0$	3	$a < \text{Glass Thickness}$			
Length and Width	Acc. Qty											
$c > 3.0, b < 1.0$	1											
$c < 3.0, b < 1.0$	3											
$a < \text{Glass Thickness}$												
<p>07</p>	<p>Glass Chipping Rear of Pad Area: (Minor defect)</p> 	<table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c > 3.0, b < 1.0$</td> <td>1</td> </tr> <tr> <td>$c < 3.0, b < 1.0$</td> <td>2</td> </tr> <tr> <td>$c < 3.0, b < 0.5$</td> <td>4</td> </tr> <tr> <td colspan="2">$a < \text{Glass Thickness}$</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c > 3.0, b < 1.0$	1	$c < 3.0, b < 1.0$	2	$c < 3.0, b < 0.5$	4	$a < \text{Glass Thickness}$	
Length and Width	Acc. Qty											
$c > 3.0, b < 1.0$	1											
$c < 3.0, b < 1.0$	2											
$c < 3.0, b < 0.5$	4											
$a < \text{Glass Thickness}$												
<p>08</p>	<p>Glass Chipping Except Pad Area: (Minor defect)</p> 	<table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c > 3.0, b < 1.0$</td> <td>1</td> </tr> <tr> <td>$c < 3.0, b < 1.0$</td> <td>2</td> </tr> <tr> <td>$c < 3.0, b < 0.5$</td> <td>4</td> </tr> <tr> <td colspan="2">$a < \text{Glass Thickness}$</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c > 3.0, b < 1.0$	1	$c < 3.0, b < 1.0$	2	$c < 3.0, b < 0.5$	4	$a < \text{Glass Thickness}$	
Length and Width	Acc. Qty											
$c > 3.0, b < 1.0$	1											
$c < 3.0, b < 1.0$	2											
$c < 3.0, b < 0.5$	4											
$a < \text{Glass Thickness}$												
<p>09</p>	<p>Glass Corner Chipping: (Minor defect)</p> 	<table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c < 3.0, b < 3.0$</td> <td>Ignore</td> </tr> <tr> <td colspan="2">$a < \text{Glass Thickness}$</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c < 3.0, b < 3.0$	Ignore	$a < \text{Glass Thickness}$					
Length and Width	Acc. Qty											
$c < 3.0, b < 3.0$	Ignore											
$a < \text{Glass Thickness}$												

<p>10</p>	<p>Glass Burr: (Minor defect)</p> 	<table border="1" data-bbox="869 264 1343 353"> <thead> <tr> <th>Length</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$F < 1.0$</td> <td>Ignore</td> </tr> </tbody> </table> <p>Glass burr don't affect assemble and module dimension.</p>	Length	Acc. Qty	$F < 1.0$	Ignore						
Length	Acc. Qty											
$F < 1.0$	Ignore											
<p>11</p>	<p>FPC Defect: (Minor defect)</p> 	<p>11.1 Dent, pinhole width $a < w/3$. (w: circuitry width.) 11.2 Open circuit is unacceptable. 11.3 No oxidation, contamination and distortion.</p>										
<p>12</p>	<p>Bubble on Polarizer (Minor defect)</p>	<table border="1" data-bbox="746 1258 1220 1473"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\varphi \leq 0.20$</td> <td>Ignore</td> </tr> <tr> <td>$0.20 < \varphi \leq 0.30$</td> <td>4</td> </tr> <tr> <td>$0.30 < \varphi \leq 0.50$</td> <td>1</td> </tr> <tr> <td>$0.50 < \varphi$</td> <td>None</td> </tr> </tbody> </table>	Diameter	Acc. Qty	$\varphi \leq 0.20$	Ignore	$0.20 < \varphi \leq 0.30$	4	$0.30 < \varphi \leq 0.50$	1	$0.50 < \varphi$	None
Diameter	Acc. Qty											
$\varphi \leq 0.20$	Ignore											
$0.20 < \varphi \leq 0.30$	4											
$0.30 < \varphi \leq 0.50$	1											
$0.50 < \varphi$	None											
<p>13</p>	<p>Dent on Polarizer (Minor defect)</p>	<table border="1" data-bbox="746 1534 1220 1749"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\varphi \leq 0.20$</td> <td>Ignore</td> </tr> <tr> <td>$0.20 < \varphi \leq 0.30$</td> <td>4</td> </tr> <tr> <td>$0.30 < \varphi \leq 0.50$</td> <td>1</td> </tr> <tr> <td>$0.50 < \varphi$</td> <td>None</td> </tr> </tbody> </table>	Diameter	Acc. Qty	$\varphi \leq 0.20$	Ignore	$0.20 < \varphi \leq 0.30$	4	$0.30 < \varphi \leq 0.50$	1	$0.50 < \varphi$	None
Diameter	Acc. Qty											
$\varphi \leq 0.20$	Ignore											
$0.20 < \varphi \leq 0.30$	4											
$0.30 < \varphi \leq 0.50$	1											
$0.50 < \varphi$	None											
<p>14</p>	<p>Bezel</p>	<p>14.1 No rust, distortion on the Bezel. 14.2 No visible fingerprints, stains or other contamination.</p>										

15	Touch Panel	<p>D: Diameter W: width L: length</p> <p>15.1 Spot: $D < 0.25$ is acceptable $0.25 \leq D \leq 0.4$</p> <p>2dots are acceptable and the distance between defects should more than 10 mm.</p> <p>$D > 0.4$ is unacceptable</p> <p>15.2 Dent: $D > 0.40$ is unacceptable</p> <p>15.3 Scratch: $W \leq 0.03$, $L \leq 10$ is acceptable, $0.03 < W \leq 0.10$, $L \leq 10$ is acceptable</p> <p>Distance between 2 defects should more than 10 mm. $W > 0.10$ is unacceptable.</p>
16	PCB	<p>16.1 No distortion or contamination on PCB terminals.</p> <p>16.2 All components on PCB must same as documented on the BOM/component layout.</p> <p>16.3 Follow IPC-A-600F.</p>
17	Soldering	Follow IPC-A-610C standard
18	Electrical Defect (Major defect)	<p>The below defects must be rejected.</p> <p>18.1 Missing vertical / horizontal segment,</p> <p>18.2 Abnormal Display.</p> <p>18.3 No function or no display.</p> <p>18.4 Current exceeds product specifications.</p> <p>18.5 LCD viewing angle defect.</p> <p>18.6 No Backlight.</p> <p>18.7 Dark Backlight.</p> <p>18.8 Touch Panel no function.</p>

Remark: LCD Panel Broken shall be rejected. Defect out of LCD viewing area is acceptable.

11.6. Classification of Defects

11.7.1 Visual defects (Except no / wrong label) are treated as minor defect and electrical defect is major.

11.7.2 Two minor defects are equal to one major in lot sampling inspection.

11.7. Identification/marketing criteria

Any unit with illegible / wrong /double or no marking/ label shall be rejected.

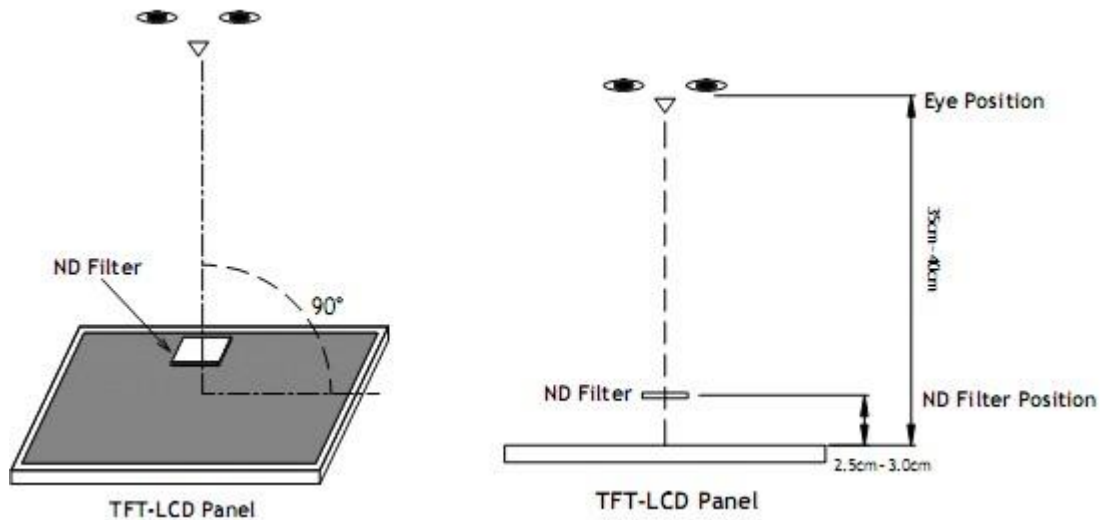
11.8. Packing

11.9.1 There should be no damage of the outside carton box, each packaging box should have one identical label.

11.9.2 Modules inside package box should have compliant mark.

11.9.3 All direct package materials shall offer ESD protection

Note1: Bright dot is defined as the defective area of the dot is larger than 50% of one sub-pixel area.



Bright dot: The bright dot size defect at black display pattern. It can be recognized by 2% transparency of filter when the distance between eyes and panel is $350\text{mm} \pm 50\text{mm}$.

Dark dot: Cyan, Magenta or Yellow dot size defect at white display pattern. It can be recognized by 5% transparency of filter when the distance between eyes and panel is $350\text{mm} \pm 50\text{mm}$.

Note2: Mura on display which appears darker / brighter against background brightness on parts of display area.

12. Reliability Specification

No	Item	Condition	Quantity	Criteria
1	High Temperature Operating	70°C, 96Hrs	2	GB/T2423.2-2008
2	Low Temperature Operating	-20°C, 96Hrs	2	GB/T2423.1-2008
3	High Humidity	50°C, 90%RH, 96Hrs	2	GB/T2423.3-2006
4	High Temperature Storage	80°C, 96Hrs	2	GB/T2423.2-2008
5	Low Temperature Storage	-30°C, 96Hrs	2	GB/T2423.1-2008
6	Thermal Cycling Test	-20°C, 60min~70°C, 60min, 20 cycles.	2	GB/T2423.22-2012
7	Packing vibration	Frequency range:10Hz~50Hz Acceleration of gravity:5G X, Y, Z 30 min for each direction.	2	GB/T5170.14-2009
8	Electrical Static Discharge	Air:±8KV 150pF/330Ω 5 times Contact:±4KV 150pF/330Ω 5 times	2	GB/T17626.2-2006
9	Drop Test (Packaged)	Height:80 cm,1 corner, 3 edges, 6 surfaces.	2	GB/T2423.8-1995

Note1. No defection cosmetic and operational function allowable.

Note2. Total current Consumption should be below double of initial value

13. Precautions and Warranty

13.1 Safety

- 13.1.1. The liquid crystal in the LCD is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.
- 13.1.2. Since the liquid crystal cells are made of glass, do not apply strong impact on them. Handle with care.

13.2. Handling

- 13.2.1. Reverse and use within ratings in order to keep performance and prevent damage.
- 13.2.2. Do not wipe the polarizer with dry cloth, as it might cause scratch. If the surface of the LCD needs to be cleaned, wipe it swiftly with cotton or other soft cloth soaked with petroleum IPA, do not use other chemicals.

13.3. Storage

- 13.3.1 Do not store the LCD module beyond the specified temperature ranges.

13.4. Metal Pin (Apply to Products with Metal Pins)

13.4.1. Pins of LCD and Backlight

- 13.4.1.1. Solder tip can touch and press on the tip of Pin LEAD during the soldering

13.4.1.2. Recommended Soldering Conditions

Solder Type: Sn96.3~94-Ag3.3~4.3-Cu0.4~1.1

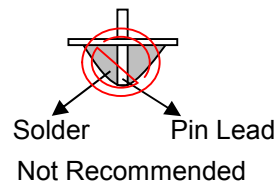
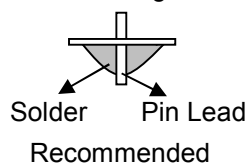
Maximum Solder Temperature: 370℃

Maximum Solder Time: 3s at the maximum temperature

Recommended Soldering Temp: 350±20℃

Typical Soldering Time: ≤3s

13.4.1.3. Solder Wetting



13.4.2. Pins of EL

- 13.4.2.1. Solder tip can touch and press on the tip of EL leads during soldering.

- 13.4.2.2. No Solder Paste on the soldering pad on the motherboard is recommended.

13.4.2.3. Recommended Soldering Conditions

Solder type: Nippon Alimit Leadfree SR-34, size 0.5mm

Recommended Solder Temperature: 270~290℃

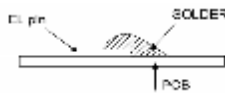
Typical Soldering Time: ≤2s

Minimum solder distance from EL lamp (body):2.0mm

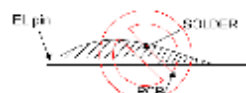
- 13.4.2.4. No horizontal press on the EL leads during soldering.

- 13.4.2.5. 180° bend EL leads three times is not allowed.

13.4.2.6. Solder Wetting

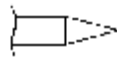


Recommended

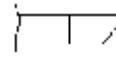


Not Recommended

13.4.2.7. The type of the solder iron:

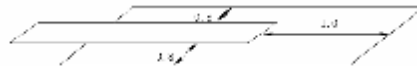


Recommended



Not Recommended

13.4.2.8. Solder Pad



13.5. Operation

- 13.5.1. Do not drive LCD with DC voltage
- 13.5.2. Response time will increase below lower temperature
- 13.5.3. Display may change color with different temperature
- 13.5.4. Mechanical disturbance during operation, such as pressing on the display area, may cause the segments to appear “fractured”.

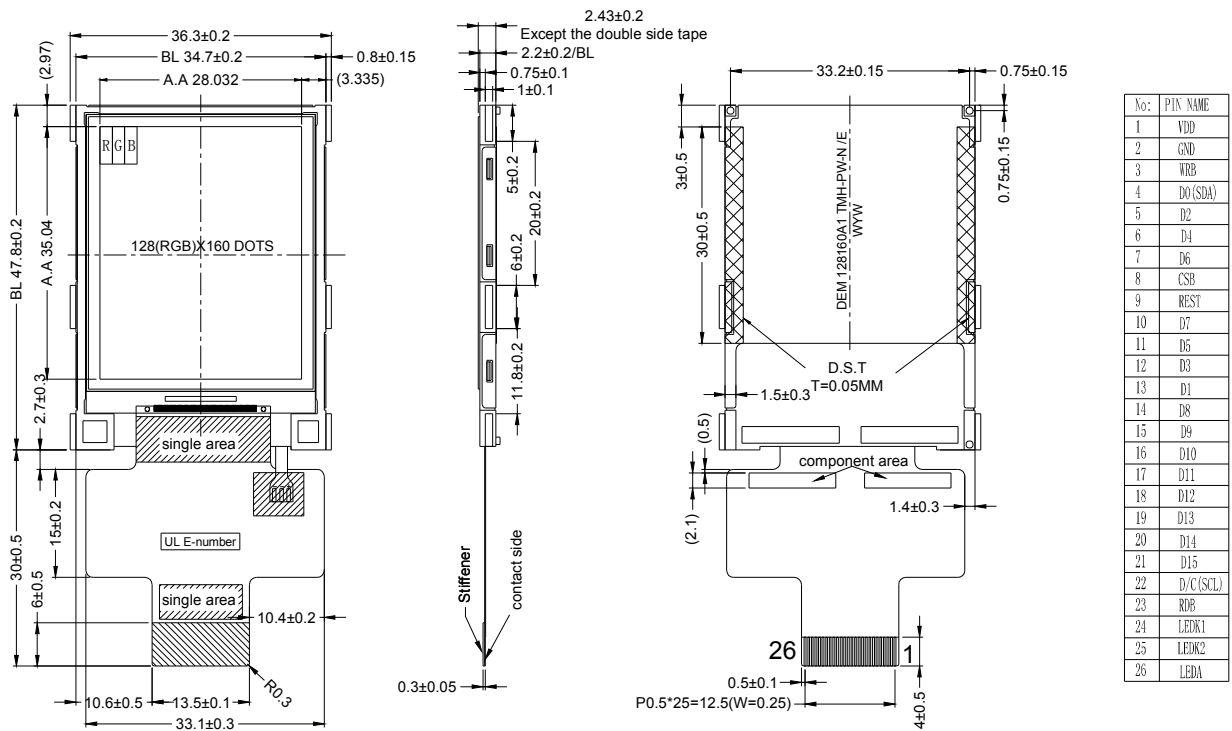
13.6. Static Electricity

- 13.6.1. CMOS LSIs are equipped in this unit, so care must be taken to avoid the electro-static charge, by ground human body, etc.
- 13.6.2. The normal static prevention measures should be observed for work clothes and benches.
- 13.6.3. The module should be kept into anti-static bags or other containers resistant to static for storage.

13.7. Limited Warranty

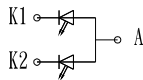
- 13.7.1. Our warranty liability is limited to repair and/or replacement. We will not be responsible for any consequential loss.
- 13.7.2. If possible, we suggest customer to use up all modules in six months. If the module storage time over twelve months, we suggest that recheck it before the module be used.
- 13.7.3. After the product shipped, any product quality issues must be feedback within three months, otherwise, we will not be responsible for the subsequent or consequential events.

14. Outline Drawing



NOTES:

1. Display size: 1.77" TFT
 2. Viewing direction: 6 O'CLOCK
 3. Gary Scale inversion direction: 12 O'CLOCK
 4. Display mode: Transmissive/Normal white/Anti-glare
 5. Operation temperature: -20°C~+70°C
 6. Storage temperature: -30°C~+80°C
 7. Driver IC: ST7735S
 8. Power supply voltage: 2.8V
 9. Backlight : White(2 LED)/3.1(TYP)V/30mA/350cd/m2(min)
LED lifetime: 5W hrs/LED brand: NICHIA
 10. ROHS must be complied
- * Unspecification tolerance are ±0.2mm



IM2	0	Serial interface	SCL/SDA	Default(On our FPC)
	1	parallel interface	RS/WR/D0-D7	

