TCL显示科技有限公司
TCL DISPLAY TECHNOLOGY CO., LTD.

SPECIFICATIONS FOR LCD MODULE

CUSTOMER	
MODEL	TD-T1465
CUSTOMER APPROVED	

ORGANIZED BY	CHECKED BY	APPROVED BY

□ APPROVAL FOR SPECIFICATIONS ONLY
■ APPROVAL FOR SPECIFICATIONS AND SAMPLE

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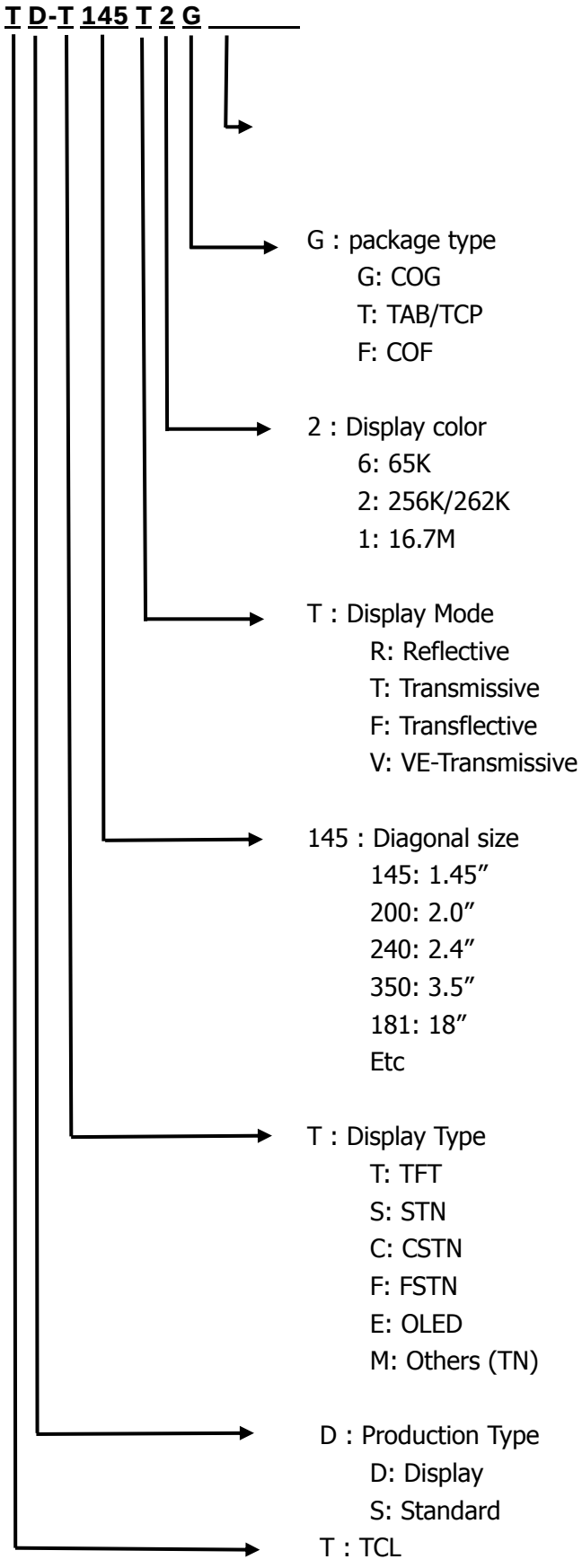
Contents

2. Revision History

Date	Rev.	Page (New)	Item	Old	New	Reason

3. Numbering System



PRODUCT INFORMATION

4. FEATURES

(1) LCD Type: 1.45" Active matrix TFT-LCD
(2) Resolution: 128(RGB)(W) x 128 (H) pixels
(3) Display mode: Transmissive type
(4) Display color: 262K colors
(5) Driver IC: ST7735S
(6) Luminance: 120 cd/m2 (Typ.).
(7) Contrast Ratio: 400:1 (Typ).
(8) Viewing Direction: 6 o'clock (Good Viewing Direction)
(9) Interface: 4wire SPI interface
(10) Back Light : 1 white LED, 18mA, 3.15 V(Typ.)

NOTE : about Viewing Direction, the best viewing direction is 6 o'clock ,and the optimum contrast direction is at 12 o'clock.

5. MECHANICAL SPECIFICATIONS

Item	Specifications
Dimensional Outline (TYP.)	32.36(W) x38.00(H) x2.60(D) mm
Number of Pixels	128(RGB)(W) x 128(H) pixels
Active Area	25.50(W) x 26.50(H) mm
Pixel Pitch	0.1992(W) x 0.2070(H)
Weight (approximately)	4.2g

6. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit	Remarks
Power Supply for Interface	VDDIO	-0.3	4.6	V	
Power Supply for Analog	VDDA	-0.3	4.6	V	
LEDs Reverse Current	I_R	-	85/LED	mA	1 LED
LEDs Forward Current	I_F	-	30/LED	mA	
Operating Humidity	HSTG	10	90	%RH	
Operating Temperature	Top	-20	+70	℃	
Storage Temperature	Tst	-30	+80	℃	

Note : If the LSI is used above these absolute maximum ratings, it may become permanently damaged.

7. ELECTRICAL SPECIFICATIONS(Ta=25°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Power Supply for Interface	VDDIO	1.7/2.7V	1.8/2.8V	1.9/2.9V	V	
Power Supply for Analog	VDDA	2.7V	2.8V	2.9V	V	
Current for LCD	I_{VDD}	-	1.3	3	mA	
LEDs Forward Voltage	V_F	2.85	3.15	3.45	V	
LEDs Forward Current	I_F	-	18	20	mA	1 LED,18mA

Note : The operations are guaranteed under the recommended operating conditions only. These operations are not guaranteed if a quick voltage change occurs during operation. To prevent noise, a bypass capacitor must be inserted into the line close to power pin.

8. OPTICAL SPECIFICATIONS(Ta=25℃)

Item		Symbol	Min.	Typ.	Max.	Unit	Remarks
Contrast Ratio		C/R	350	400	-		Fig.1
Brightness			-	120		cd/m2	Full White Pattern
Brightness Uniformity			80	-	-	%	Full White Pattern Fig.1,2
NTSC			-	50	-	%	
Response Time		Tr+Tf	-	30	40	ms	Fig.3
Color Coordinate	RED	Rx	0.5392	0.5792	0.6192		IBL=18mA
		Ry	0.2821	0.3221	0.3621		
	GREEN	Gx	0.2847	0.3247	0.3647		
		Gy	0.5387	0.5787	0.6187		
	BLUE	Bx	0.1031	0.1431	0.1831		
		By	0.0335	0.0735	0.1135		
	WHITE	Wx	0.2386	0.2786	0.3186		
		Wy	0.2525	0.2925	0.3325		
view angle		θl	55	65	-	Degree	Fig.4 Center (C/R>10)
		θr	55	65	-		
		θu	50	60	-		
		θd	40	50	-		

Note:

1. Contrast Ratio(CR) is defined mathematically as :

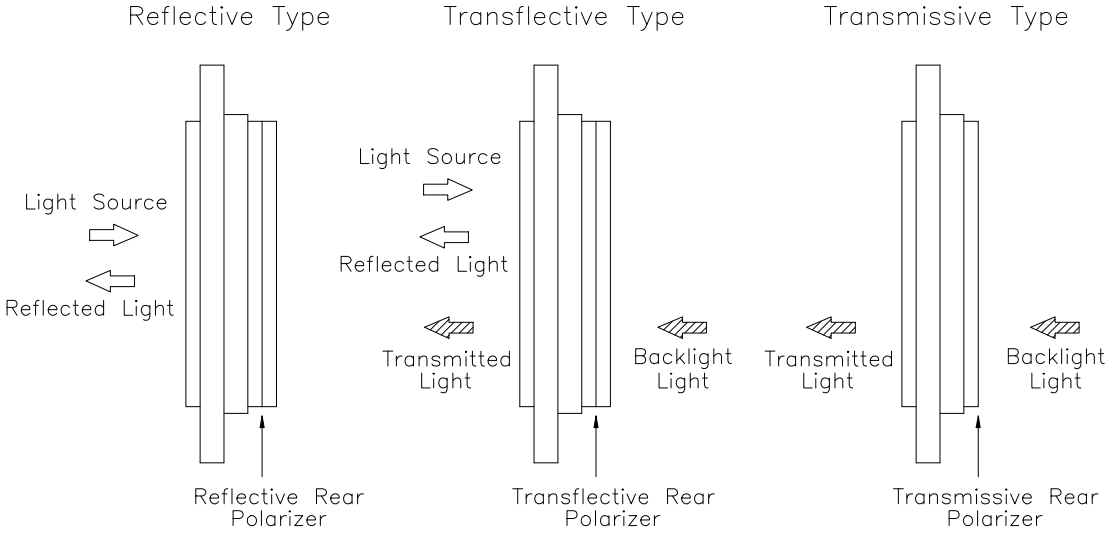
$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all pixels white}(P_1,P_2,P_3,P_4,P_5,P_6,P_7,P_8,P_9)}{\text{Average Surface Luminance with all pixels black}(P_1,P_2,P_3,P_4,P_5,P_6,P_7,P_8,P_9)}$$

2. Brightness is the LCM's luminance from the surface with all pixels white. For more information see FIG 1.
3. Brightness Uniformity represents the consistency of LCM's Brightness,signed for δ BRIGHTNESS. δ BRIGHTNESS is determined by measuring luminance at each test point 1 to 9,then got the maximum and mimimum luminance of 9 piont. For more information,see Fig 2.

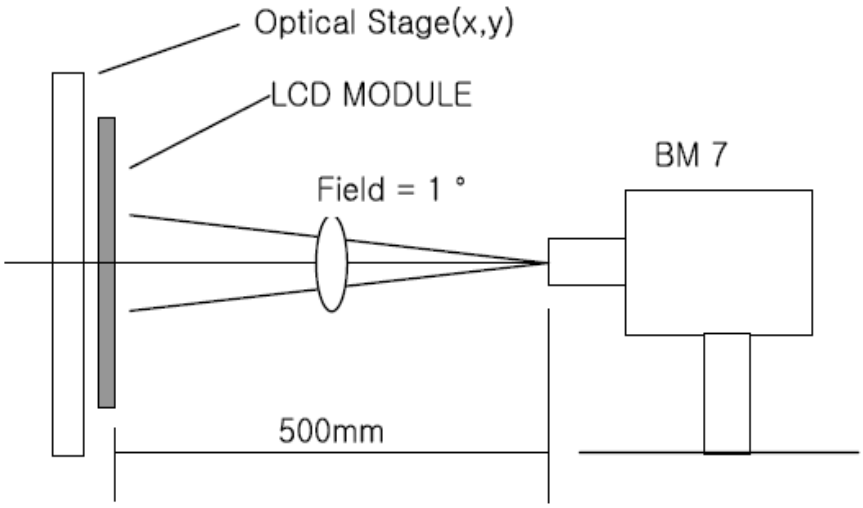
$$\delta\ \text{BRIGHTNESS} = \frac{\text{Minimum Surface Luminance with all pixels white}(P_1,P_2,P_3,P_4,P_5,P_6,P_7,P_8,P_9)}{\text{Maximum Surface Luminance with all pixels white}(P_1,P_2,P_3,P_4,P_5,P_6,P_7,P_8,P_9)}$$

4. Response time is the time required for the display to transit from black to white (Rise Time, Tr) and from white to black(Decay Time, Tf). For additional information see FIG 3.
5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 4.
6. Optimum contrast is obtained by adjusting the LCD Threshold voltage (Vth& Vsat)

9. Viewing Modes

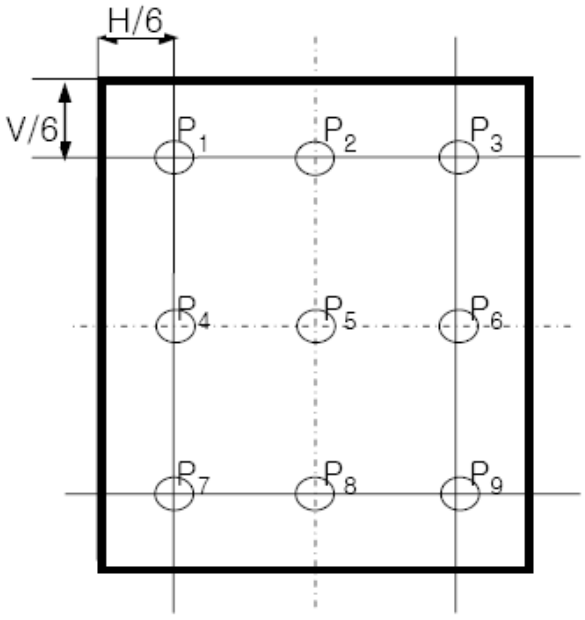


10. Electro-Optical Characteristics Test Method



<Transmissive Mode>

FIG. 1 Optical Characteristic Measurement Equipment and Method



P1-P9: Main Measuring point

Fig. 2 Measuring Points

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".

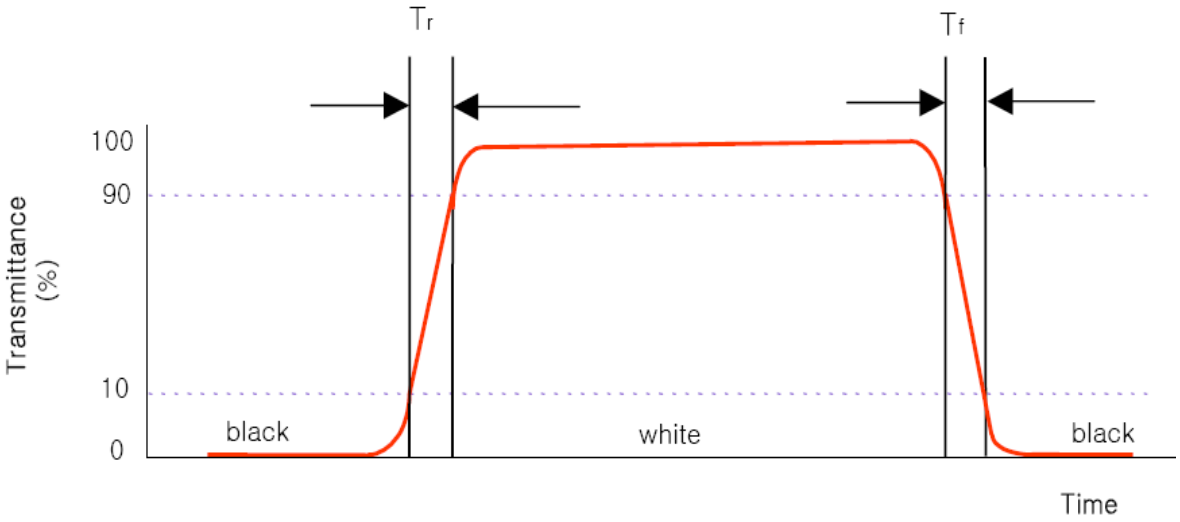


FIG.3 The definition of Response Time

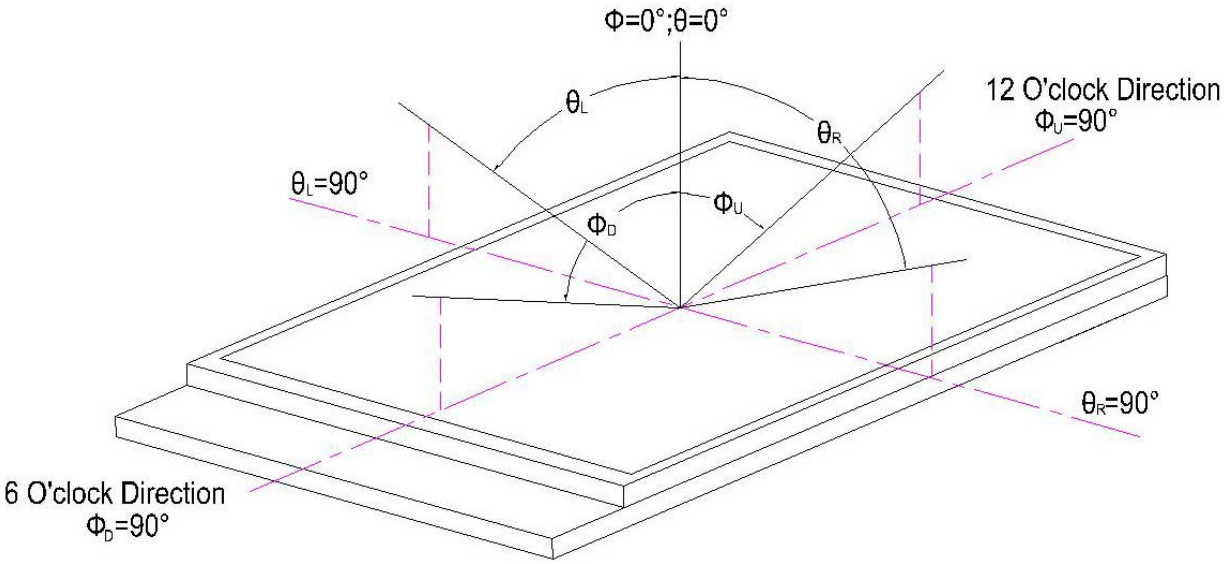
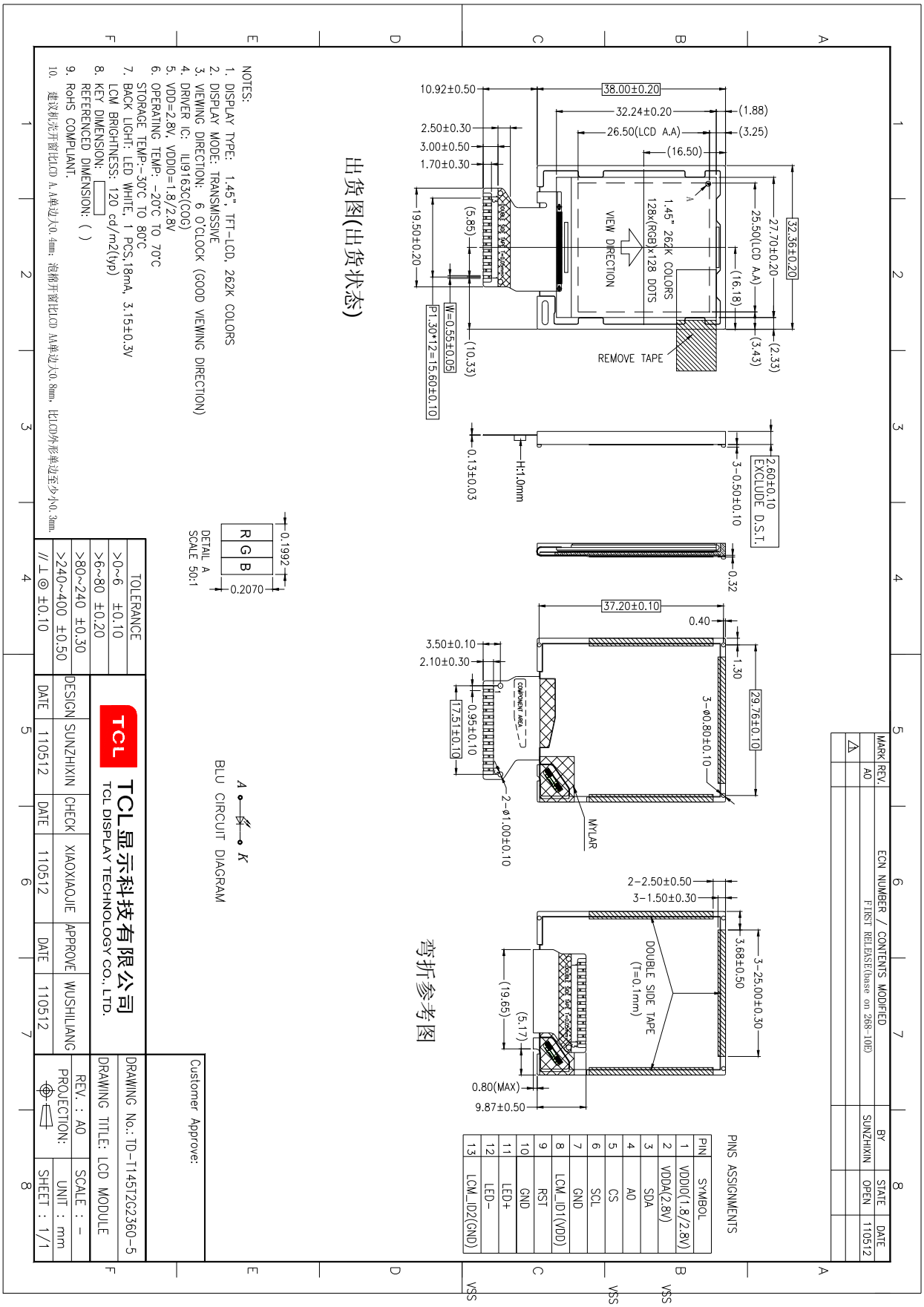
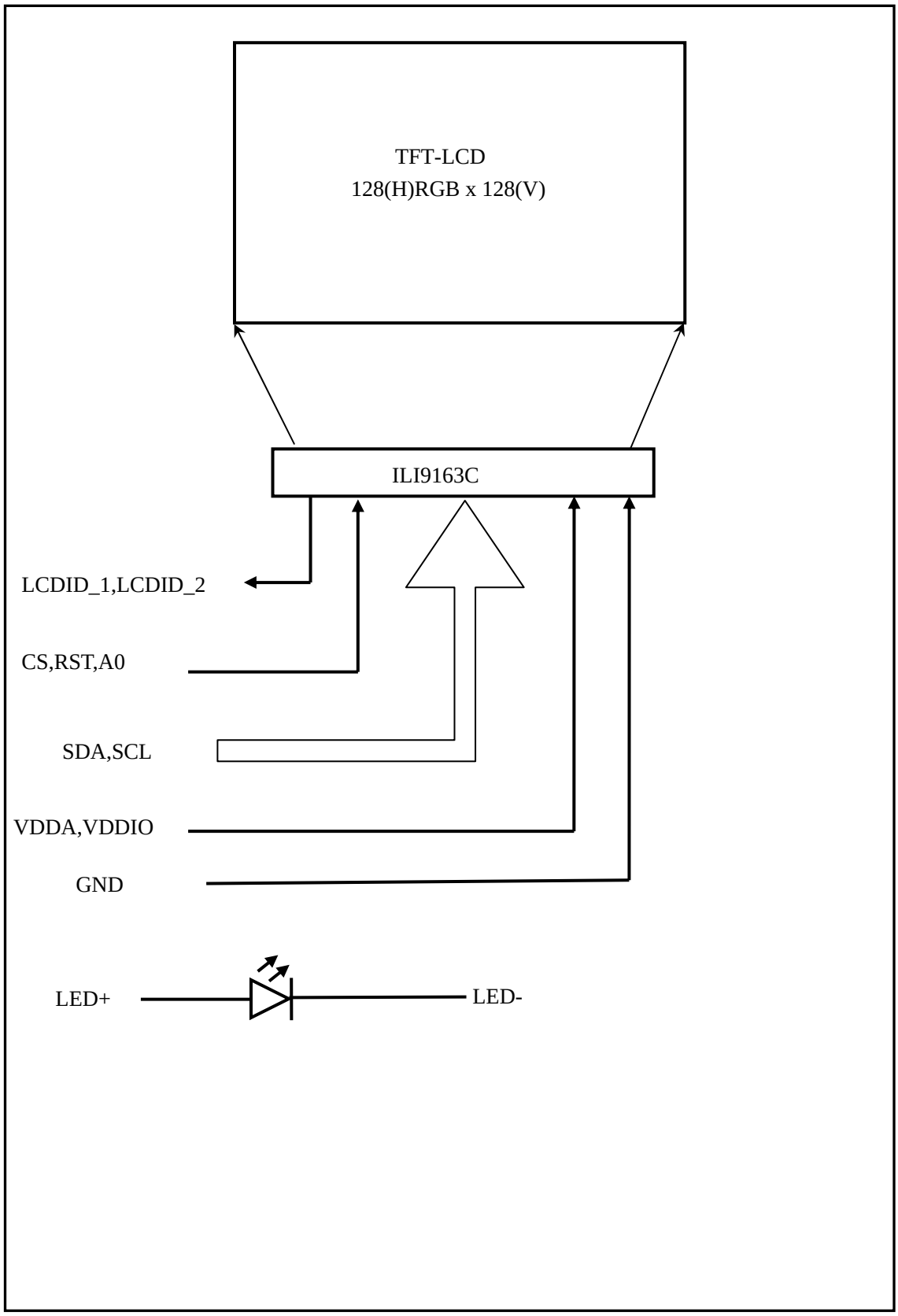


FIG.4 The definition of Viewing Angle

11. <Outline dimension>



12. <Block diagram>



13. <Table of Pin Assignment >

PinNo.	Signal	I/O	Discription
1	VDDIO	P	Power Supply for Logic Circuit (TYP1.8/ 2.8V)
2	VDDA	P	Power Supply for Analog Circuit (TYP 2.8V)
3	SDA	I	Data input in SPI mode
4	A0	I	Register Select Signal（Low:command, High:data）
5	CS	I	Chip Select Signal (Low Active)
6	SCL	I	Synchronizing clock signal in SPI mode
7	GND	P	Ground
8	LCD_ID1	-	Connected to VDD
9	RST	I	Reset Signal (Low Active)
10	GND	P	Ground
11	LED+	P	Power Supply for LED(Anode)
12	LED-	P	Power Supply for LED(Cathode)
13	LCD_ID2	-	Connected to GND

14. <Command/AC Timing>

Detail technical information of "command/data", or "AC timing" can be available with following documents:
-IC specification of driver IC: ILI9163C

17.3.2.2 4-pin Serial Interface

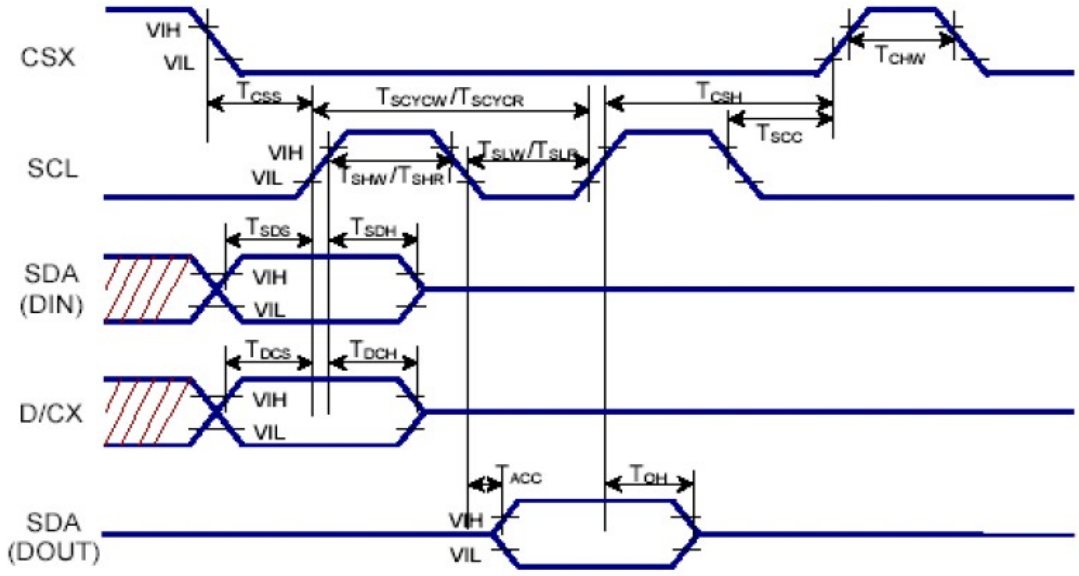


Table 17.3.2.2: 4 pin Serial Interface Characteristics

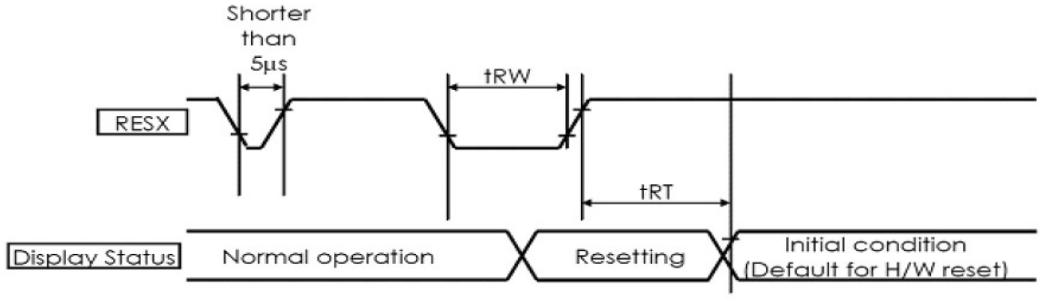
Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	TCSS	Chip select setup time	10		ns	
	TCSH	Chip select hold time	30		ns	
	TCHW	Chip select "H" pulse width	30		ns	
SCL	TSCYCW	Serial clock cycle(Write)	66		ns	
	TSHW	S"L""H" pulse width(Write)	15		ns	
	TSLW	S"L""L" pulse width(Write)	15		ns	
	TSCYCR	Serial clock cycle(Read)	150		ns	
	TSHR	S"L""H" pulse width(Read)	60		ns	
	TSLR	S"L""L" pulse width(Read)	60		ns	
D/CX	TDCS	D/CX setup time	5		ns	
	TDCH	D/CX hold time	5		ns	
SDA(DIN) (DOUT)	TSDS	Data setup time	5		ns	
	TSDH	Data hold time	5		ns	
	TACC	Access time	5	50	ns	For maximum CL = 30pF
	TOH	Output disable time	10		ns	For minimum CL = 8pF

Note 1: VDDI=1.65 to 3.3V, VCI=2.6 to 3.3V, AGND=GND=0V. Ta=-30 to 70℃ (to +85℃ no damage)

Note 2 : The input signal rise time and fall time(tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 10% and 90% of VDDI for Input signals.

12.3 Reset Timing



(VSS=0V, VDDI=1.65V to 1.95V, VCI=2.6V to 2.9V, Ta = -30 to 70℃)

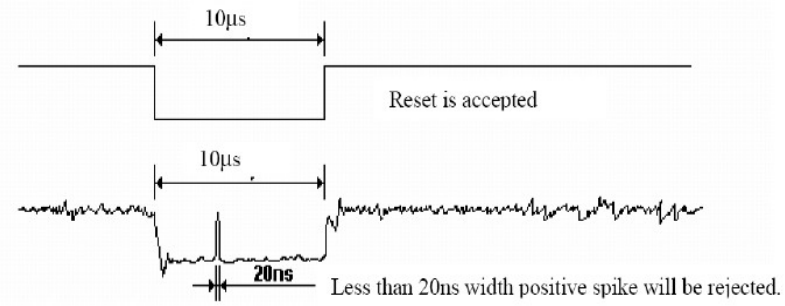
Symbol	Parameter	Related Pins	MIN	TYP	MAX	Note	Unit
tRESW	*1) Reset low pulse width	RESX	10	-	-	-	µs
tREST	*2) Reset complete width	-	-	-	5	When reset applied during Sleep in mode	ms
		-	-	-	120	When reset applied during Sleep out mode	ms

Note

1. Spike due to an electrostatic discharge on RESX line does not cause system reset according to the table below.

RESX Pulse	Action
Shorten than 5µs	Reset Rejected
Longer than 10µs	Reset
Between 5µs and 10µs	Reset starts (It depends on voltage and temperature condtion.)

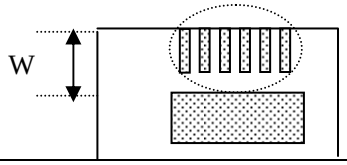
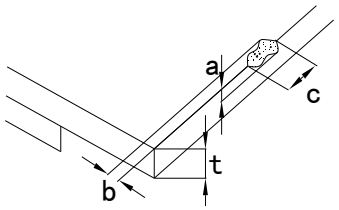
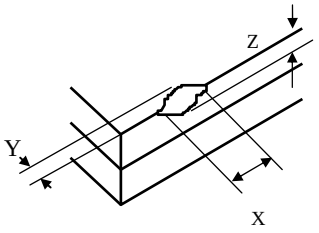
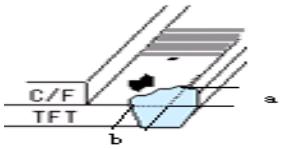
2. During the resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode) and then return to Default condition for Hardware Reset.
3. During Reset Complete Time, ID2 and VCOMOF value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 5ms after a rising edge of RESX.
4. Spike Rejection also applies during a valid reset pulse as shown below:



5. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

15. Inspection Criteria

Item NO.	Inspection Item	Inspection Standard			Classification of defects
1	Electrical fuction Testing	1) No display 2) Missing line 3) No backlight 4) shadow 5) black/blue display 6) Irregular operating 7) visual angle is wrong			Major
2	Outline dimension	All outline dimension beyond the drawing is not allowed			Major
3	White/Black spot (in LCD or Backlight)	Φ(mm)	acceptable		Minor
		Φ≤0.10	ignore		
		0.10 ＜Φ≤0.2	2		
		Φ＞0.2	0		
4	Dirt in POL	as same as White/Black spot			Minor
5	Dent at POL	as same as White/Black spot			Minor
6	Bubble in POL	Φ(mm)	acceptable		Minor
		Φ≤0.20	3		
		0.20 ＜Φ≤0.3	2		
		0.30 ＜Φ≤0.5	1		
		Φ＞0.5	0		
7	Color/bright/dark dot	as same as White/Black spot			Minor
8	Scratch / lines (in LCD)	Width	Length	acceptable	Minor
		W≤0.03	L＜2.0	1	
		0.03 ＜W≤0.05	L≤1.0	1	
		W＞0.08	ignore	0	
		ignore	L＞3.0	0	
9	Scratch / lines in POL	as same as White/Black spot			Minor
10	Scratch / lines in BLU	as same as White/Black spot			Minor

11	LCD defect	Crack	Unallowed	Major
		Pad break	W＞0.5mm， unallowed 。 	Major
		Con-Pad break	When a＜1/2T（T=the thickness of single LCD）: b≥1/2 PAD NG or c≥5mm NG When a≥1/2T: as same as PAD break 	Minor
		Break not in PAD	X≤1/8A; Y into the inspect area is unallawed; X≤1/8A, if Y not into the frame,Z ignore; X≤1/8A,Y≤1/2 Seal,Z≤1/2T is allawed X≤1/8A,Y＞1/2 Seal, Z≤1/4T is allawed 	Minor
		Corner break	1)'a'> 1MM unallowed 2)'b'> 1/4E unallowed (E = PAD long of short side) 	Minor

If the acceptable number is ≥ 2 ,the interval between dots or lines must be ≥ 10mm .

16. Reliability

Item NO.	TEST Item	Condition	Criterion
1	Humidity operating	60℃±3℃, 95%RH, 96 hrs	· Placed 2 hours in normal temperature, then inspect the function and cosmetic after test. · After testing, cosmetic defects should not happen. · Polarizers may fail in humidity test, but only this failure is allowable.
2	Thermal shock test	25℃±3℃ (5min) → -40℃±3℃ (120min) → 25℃±3℃ (5min) → 70℃±3℃ (120min) 24cycle	

17.  For Safety

LCD module is generally designed with precise parts to achieve light weighted thin mechanical dimensions.

In using our Modules, make certain that you fully understand and put into practice the warnings and safety precautions detailed in Engineering Information No.EE-N001 , "CAUTIONS AND INATRUCTIONNS FOR TCL DISPLAY TECHNOLOGY CO., LTD. LCD MODULES".

Refer to individual specifications and TECHNICAL DATA sheets (hereinafter called "TD") for more detailed technical information.

1) SPECIAL PURPOSES

a) TCL Display Technology's Standard LCD modules have not been customized for operation in extreme environments or for use in applications where performance failures could be life-threatening or otherwise catastrophic.

b) Since TCL Display Technology's Standard LCD modules have not been designed for operation in extreme environments, they must never be used in devices that will be exposed to abnormally high levels of vibration or shock which exceed TCL Display Technology's published specification limits.

c) In addition, since TCL Display Technology's Standard LCD modules have not been designed for use in applications where performance failures could be life-threatening or catastrophic, they must never be installed in aircraft navigation control systems (such as, but not limited to Traffic Collision Avoidance System and Air Traffic Indicator), in military defense or weapons systems, in critical industrial process-control systems (e.g., those involved in the production of nuclear energy), or in critical medical device or patient life-support systems.

2) DISASSEMBLING OR MODIFICATION

DO NOT DISASSEMBLE OR MODIFY the modules. It may damage sensitive parts inside LCD module, and may cause scratches or dust on the display. TCL Display Technology does not warrant the modules, if customer disassembled or modified it.

3) BREAKAGE OF LCD PANEL

DO NOT INGEST liquid crystal material, DO NOT INHALE this material, and DO NOT PERMIT this material with skin, if LCD panel is broken and liquid crystal material spills out.

If liquid crystal material comes into mouth or eyes, rinse mouth or eyes out with water immediately.

If this material contact with skin or cloths, wash it off immediately with alcohol and rinse thoroughly with water.

4) GLASS OF LCD PANEL

BE CAREFUL WITH CHIPS OF GRASS that may cause injuring fingers or skin, when the glass is broken.

5) ELECTRIC SHOCK

DISCONNECT POWER SUPPLY before handing LCD module.

6) ABSOLUTE MAXIMUM RATINGS AND POWER PROTECTION CIRCUIT

DO NOT EXCEED the absolute maximum rating values under the worst probable conditions caused by the supply voltage variation, input voltage variation, variation in parts' constants, environmental temperature, etc., otherwise LCD module may be damaged.

Employ protection circuit for power supply, whenever the specification or TD specifies it.

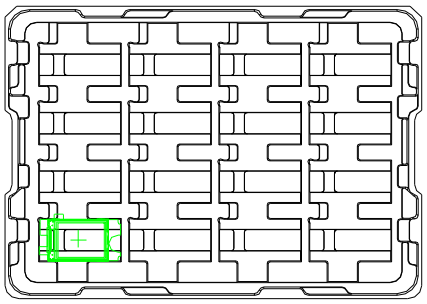
Suitable protection circuit should be applied for each system design.

7) DISPOSAL

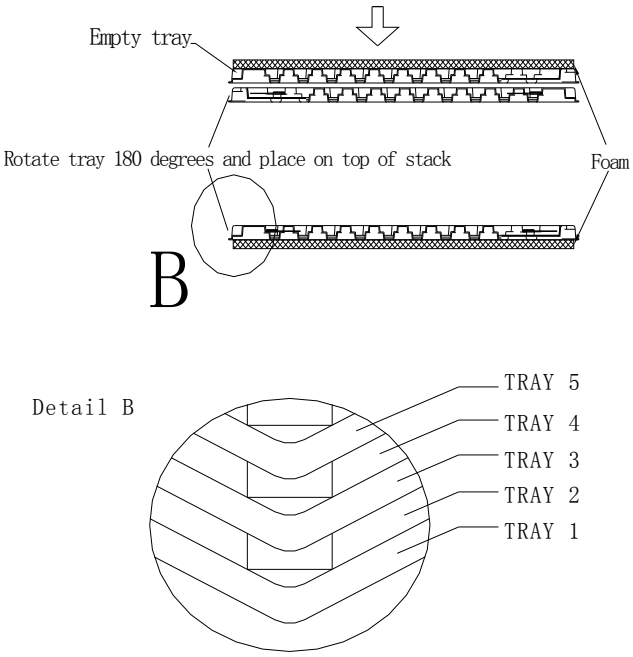
When disposing of the LCD module, obey to the applicable environmental regulations.

18. Packaging

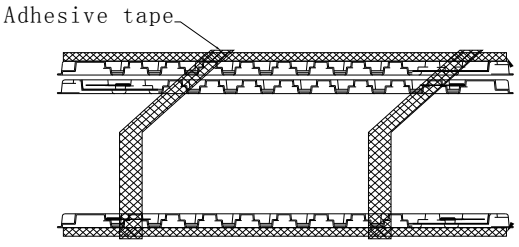
Step 1: Put LCM into tray



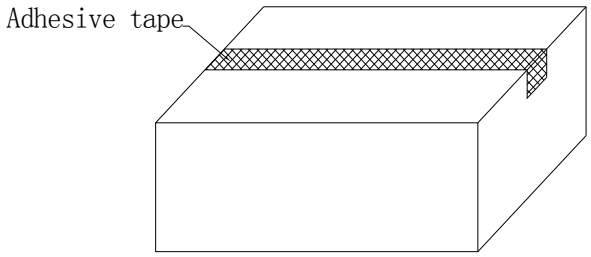
Strep 2: Tray stacking



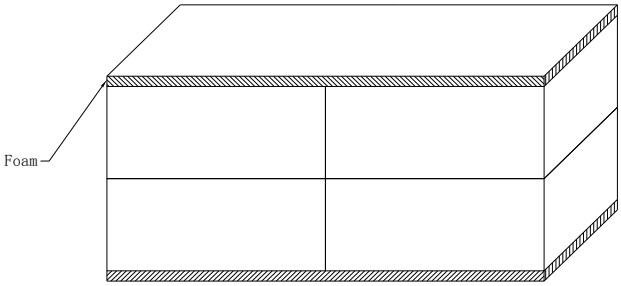
Step3: use adhesive tape to seal, with desiccant put into the shield pag for defending ESD



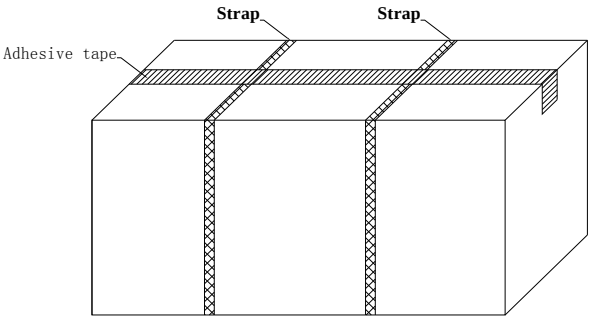
Step4: put into inner package carton ,and use adhesive tape to seal



Step5:Put four inner package carton into one outer package carton



Step6: use adhesive tape to seal,and strap.



Step7: attach a ticket to carton

现品票			
供应商名称		出厂日期	
物料名称		出厂检验结果	
物料编码			
规格		预收单号	
本批送货数量		LOT NO	
		TCL验收结果	