SPECIFICATION FOR LCM MODULE

MODULE NO.:TFT-0161
DOC. REVISION01

Customer Approval:

	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)		
PREPARED BY (QA ENGINEER)		
CHECKED BY		
APPROVED BY		

WRITTEN BY	CHECKED BY	APPROVED BY

Notes:

1、Please contact GTK before assigning your product based on this module specification.

2、To improve the quality of product, and this product specification is subject to change without any notice.

REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
V0.1	2014-12-03	First release	Preliminary

CONTENTS

■ GENERAL INFORMATION

Item of general information	Contents	Unit
LCD size	10.4 inch	/
LCD type	TFT/TRANSMISSIVE normal white	
View direction	80/80/70/70	
Resolution	800*(RGB)*600	
Module size (W× H×T)	243(W)×184(H)×8.5(T)	mm^3
Active area (W×H)	211.2(W)×158.4(H)	mm^2
Pixel pitch (W × H)	0.264(W)×0.264(H)	mm^2
Interface Type	LVDS interface	/
Input voltage	3.3V	V
Module Power consumption	4.1(TYP)	w
Backlight Type	LED	/

■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Power supply voltage	VCC	-0.3	7	V
Converter voltage	Vi	-0.3	18	V
Enable voltage(For LED)	EN	-	5.5	V
Backlight Adjust	ADJ	-	5.5	V
Operating temperature	Top	-30	85	(C
Storage temperature	TST	-30	85	(C
Humidity	RH	-	90%(Max60 °C)	RH

■ ELECTRICAL CHARACTERISTICS
DC CHARACTERISTICS

Parameter		Symbol	Min	Typ	Max	Unit
Supply Voltage		VDD	3.0	3.3	3.6	V
Rush current		Irush	-		1.5	A
Power Supply Current	White	-	-	310	375	mA
	Black	-	-	410	495	mA
Power consumption		PL	-	1.35	1.63	W
LVDS differential input valtage		|VID|	100	-	600	mV
LVDS common input valtage		VICM	0.7	-	1.6	V

■ BACKLIGHT CHARACTERISTICS

Item of backlight characteristics		Symbol	Min.	Typ.	Max.	Unit	Condition
Converter power supply voltage		Vi	7	12	17	V	
Converter power supply current		Ii	-	0.25	0.3	mA	Vi=12v Duty 100%
LED power consumption		Pled		3.0	3.6	W	Vi=12v Duty 100%
EN control level	Bacnlight on	-	2.0	3.3	5.0	V	
	Bacnlight off		0	-	0.8	V	
PWM control level	PWM high	-	2.0	3.3	5.0	V	
	PWM low		0	-	0.15	V	
PWM control duty ratio		-	2	-	100	%	Note3
PWM control frequency		fpwm	190	200	20000	HZ	Note1
LED life time		LI	50,000	-	-	Hour	Note2

Note1:The lifetime of LED is defined as the when it continues to operate under the conditions at Ta=25±2°C and Duty 100% until the brightness becomes ≤50% of original value.Operating LED under high temperature environment will reduce life time and lead to color shift.

Note2:At 190 ~1KHz PWM control frequency, duty ratio range is restricted from 2% to 100%.

1K ~20KHz PWM control frequency，minimum duty on-time ≧ 20 us

■ EXTERNAL DIMENSIONS
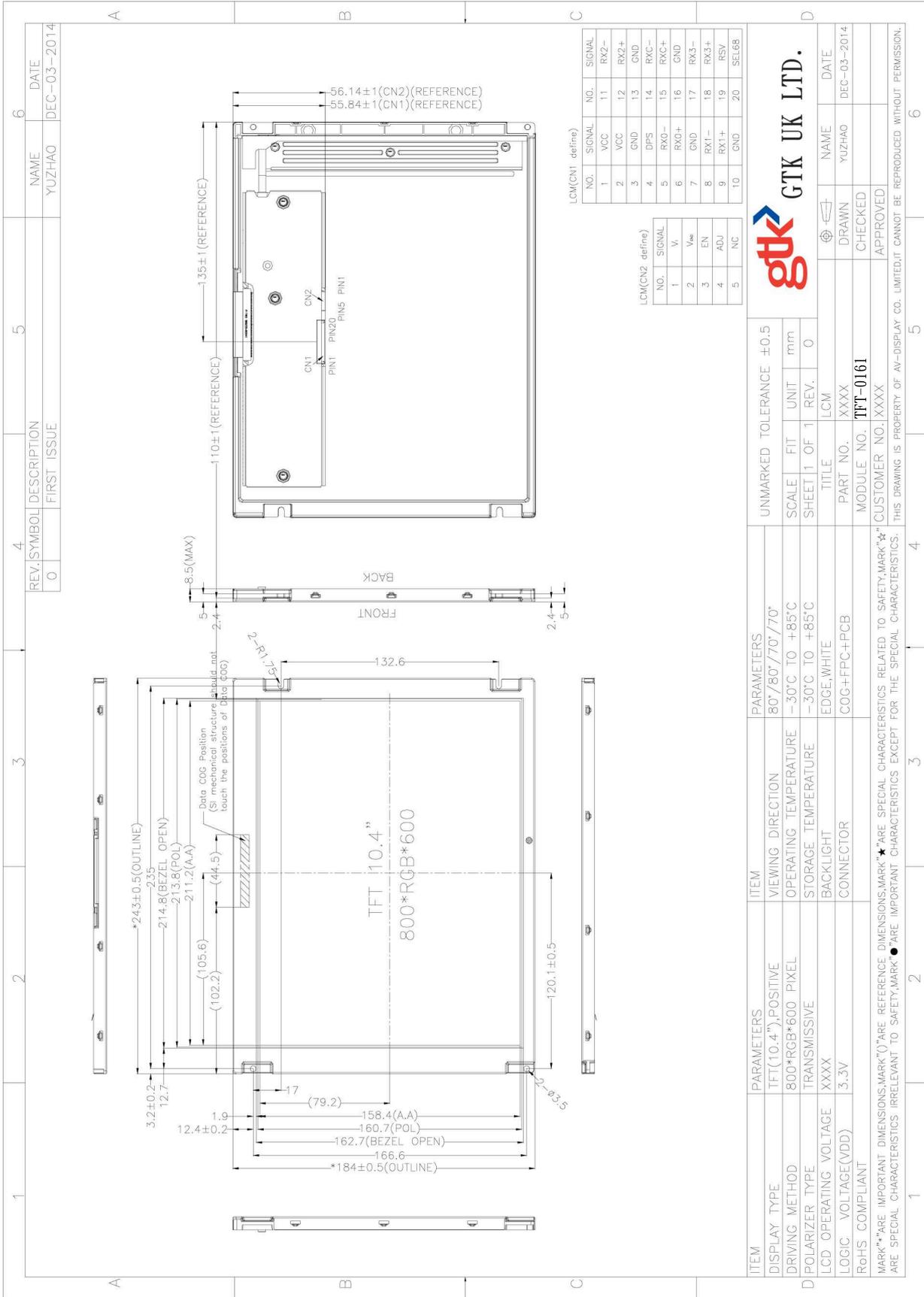
■ ELECTRO-OPTICAL CHARACTERISTICS

Item of electro-optical characteristics	Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time	Tr+ Tf		–	16	26	ms	Fig.1	4
Contrast ratio	Cr		500	700	–	---	FIG 2.	1
Surface Luminance	Lv		300	400	–	cd/m2	FIG 2.	2
Viewing angle range	θ	$\varnothing$ = 90	60	70	–	deg	FIG 3.	6
		$\varnothing$ = 270	60	70	–	deg	FIG 3.	
		$\varnothing$ = 0	70	80	–	deg	FIG 3.	
		$\varnothing$ = 180	70	80	–	deg	FIG 3.	
CIE (x, y) chromaticity	Red x	θ=0° $\varnothing$=0° Ta=25℃	TYP-0.05	0.609	TYP+0.05	-	FIG 2.	5
	Red y			0.339		-		
	Green x			0.333		-		
	Green y			0.590		-		
	Blue x			0.154		-		
	Blue y			0.146		-		
	White x			0.303		-		
	White y			0.344		-		

Note1. Contrast Ratio(CR) is defined mathematically by the following formula. For more information see FIG 2.:

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P3, P4, P5)}}$$

Note2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see FIG 2.

Lv = Average Surface Luminance with all white pixels (P1, P2, P 3,P4, P5)

Note3. The uniformity in surface luminance （δ WHITE） is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information see FIG 2.

$$\delta \text{ WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}$$

Note4. Response time is the time required for the display to transition from White to black(Rise Time, Tr) and from black to white(Decay Time, Tf). For additional information see FIG 1..

Note5. CIE (x, y) chromaticity ,The x,y value is determined by screen active area position NO.5 For more information see FIG 2.

Note6. Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the conrast 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 3.

Note7. For Viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope. Series Instruments. For contrast ratio, Surface Luminance, Luminance uniformity and CIE，the testing data is base on TOPCON's BM-5 photo detector or compatible.

Note8. For TFT module, Gray scale reverse occurs in the direction of panel viewing angle

FIG.1. The definition of Response Time
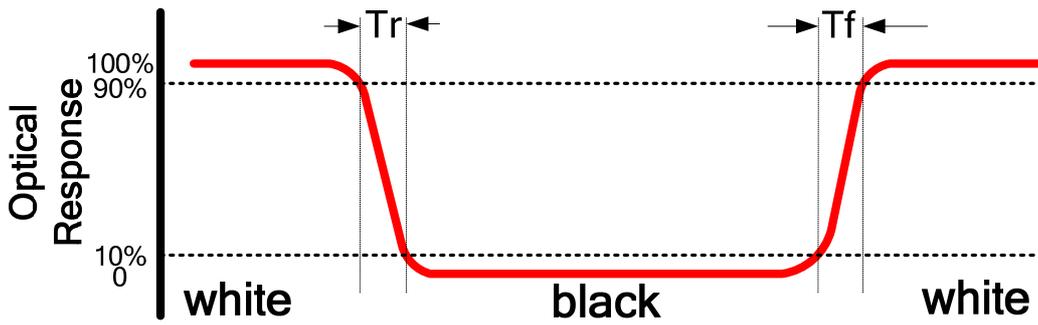
FIG.2. Measuring method for Contrast ratio,surface luminance, Luminance uniformity,CIE (x, y) chromaticity

FIG.1. A : 5 mm
FIG.2. B : 5 mm
FIG.3. H,V : Active Area
FIG.4. Light spot size (=5mm, 500mm distance from the LCD surface to detector lens
**FIG.5. measurement instrument is TOPCON's luminance meter BM-5**
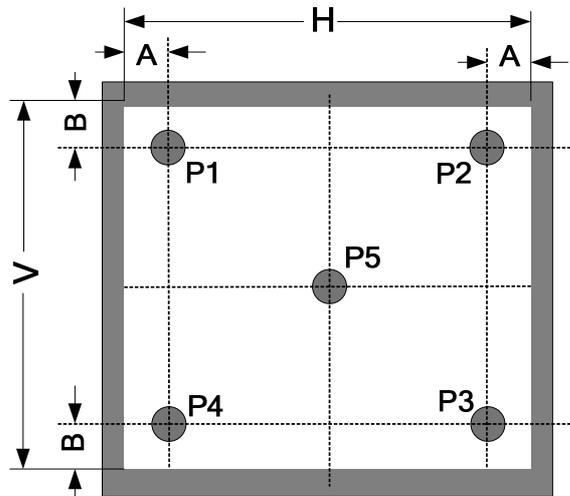
FIG.3. The definition of viewing angle
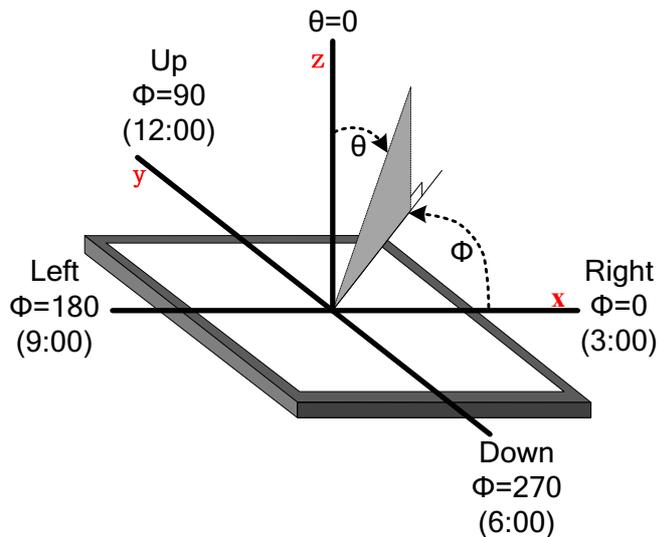
■ INTERFACE DESCRIPTION
CN1_INTERFACE

Interface NO.	NAME	I/O or connect to	DESCRIPTION
1	VCC	P	Power Supply
2	VCC	P	Power Supply
3	GND	P	Ground
4	DPS	I	Reverse Scan Function High : Enable , Low : Disable]
5	RX0-	I	Differential Data Input, CH0 (Negative)
6	RX0+	I	Differential Data Input, CH0 (Positive)
7	GND	P	Ground
8	RX1-	I	Differential Data Input, CH1 (Negative)
9	RX1+	I	Differential Data Input , CH1 (Positive)
10	GND	P	Ground
11	RX2-	I	Differential Data Input , CH2 (Negative)
12	RX2+	I	Differential Data Input , CH2 (Positive)
13	GND	P	Ground
14	RXC-	I	Differential Clock Input (Negative)
15	RXC+	I	Differential Clock Input (Positive)
16	GND	P	Ground
17	RX3-	I	Differential Data Input, CH3 (Negative)
18	RX3+	I	Differential Data Input, CH3 (Positive)
19	RSV	/	Reserved for internal test. Please treat it as NC.
20	SEL68	I	LVDS 6/8 bit select function control, Low or NC 6 bit Input Mode High 8bit Input Mode

CN2_INTERFACE

Interface NO.	NAME	I/O or connect to	DESCRIPTION
1	Vi	P	Converter input voltage(12V)
2	VGND	P	Converter ground
3	EN	I	Backlight Enable (LED on/off)
4	ADJ	I	Backlight Adjust(PWM Dimming)
5	NC	/	/

■ AC CHARACTERISTICS
INPUT SIGNAL TIMING SPECIFICATION

The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	Fc	30	40	50	MHz	
Vertical Active Display Term	Total	Tv	608	628	1024	Th	Tv=Tvd+Tvb
	Display	Tvd	-	600	-	Th	-
	Blank	Tvb	8	28	424	Th	-
Horizontal Active Display Term	Total	Th	960	1056	1060	Tc	Th=Thd+Thb
	Display	Thd	-	800	-	Tc	-
	Blank	Thb	160	256	260	Tc	-

Note (1) Since this assembly is operated in DE only mode, Hsync and Vsync input signals should be set to low logic level. Otherwise, this assembly would operate abnormally.

(2) Frame rate is 60Hz

INPUT SIGNAL TIMING DIAGRAM
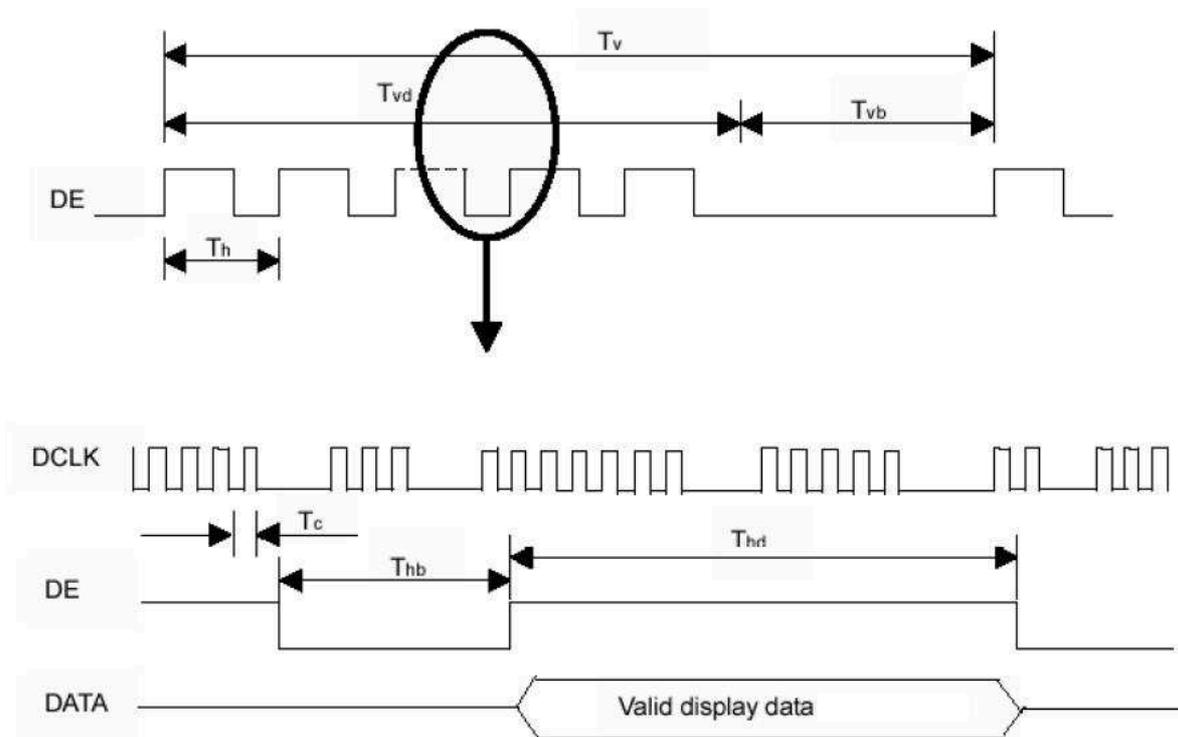
The Input Data Format

SEL68 = "Low" or "NC" for 6 bits LVDS Input

RXC							
RX0	G0	R5	R4	R3	R2	R1	R0
RX1	B1	B0	G5	G4	G3	G2	G1
RX2	DE	VS	HS	B5	B4	B3	B2
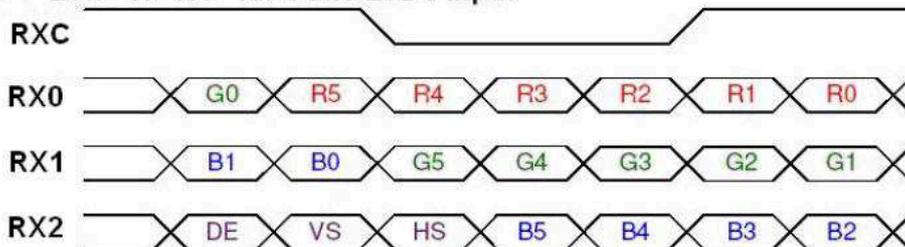
SEL68 = "High" for 8 bits LVDS Input

RXC							
RX0	G0	R5	R4	R3	R2	R1	R0
RX1	B1	B0	G5	G4	G3	G2	G1
RX2	DE	VS	HS	B5	B4	B3	B2
RX3	RSV	B7	B6	G7	G6	R7	R6
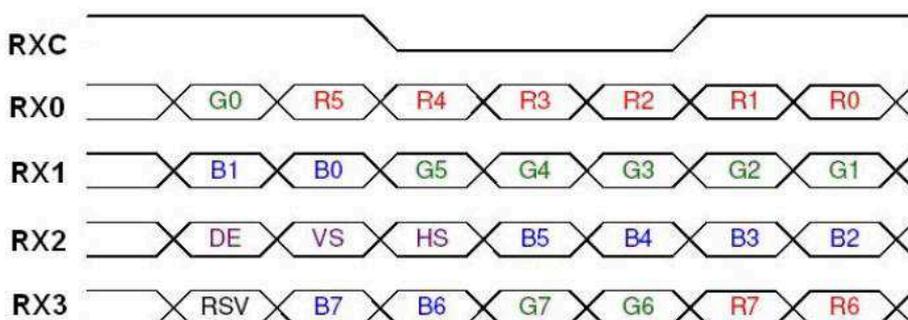
Note (1) R/G/B data 7: MSB, R/G/B data 0: LSB

Note (2) Please follow PSWG

Signal Name	Description	Remark
R7	Red Data 7 (MSB)	Red-pixel Data
R6	Red Data 6	Each red pixel's brightness data consists of these
R5	Red Data 5	8 bits pixel data.
R4	Red Data 4	
R3	Red Data 3	
R2	Red Data 2	
R1	Red Data 1	
R0	Red Data 0 (LSB)	
G7	Green Data 7 (MSB)	Green-pixel Data
G6	GreenData 6	Each green pixel's brightness data consists of these
G5	GreenData 5	8 bits pixel data.
G4	GreenData 4	
G3	GreenData 3	
G2	GreenData 2	
G1	GreenData 1	
G0	GreenData 0 (LSB)	
B7	Blue Data 7 (MSB)	Blue-pixel Data
B6	Blue Data 6	Each blue pixel's brightness data consists of these
B5	Blue Data 5	8 bits pixel data.
B4	Blue Data 4	
B3	Blue Data 3	
B2	Blue Data 2	
B1	Blue Data 1	
B0	Blue Data 0 (LSB)	
RXCLKIN+ RXCLKIN-	LVDS Clock Input	
DE	Display Enable	
VS	Vertical Sync	
HS	Horizontal Sync	

Note (3) Output signals from any system shall be low or Hi-Z state when VCC is off.

■ POWER SEQUENCE

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as the diagram below.
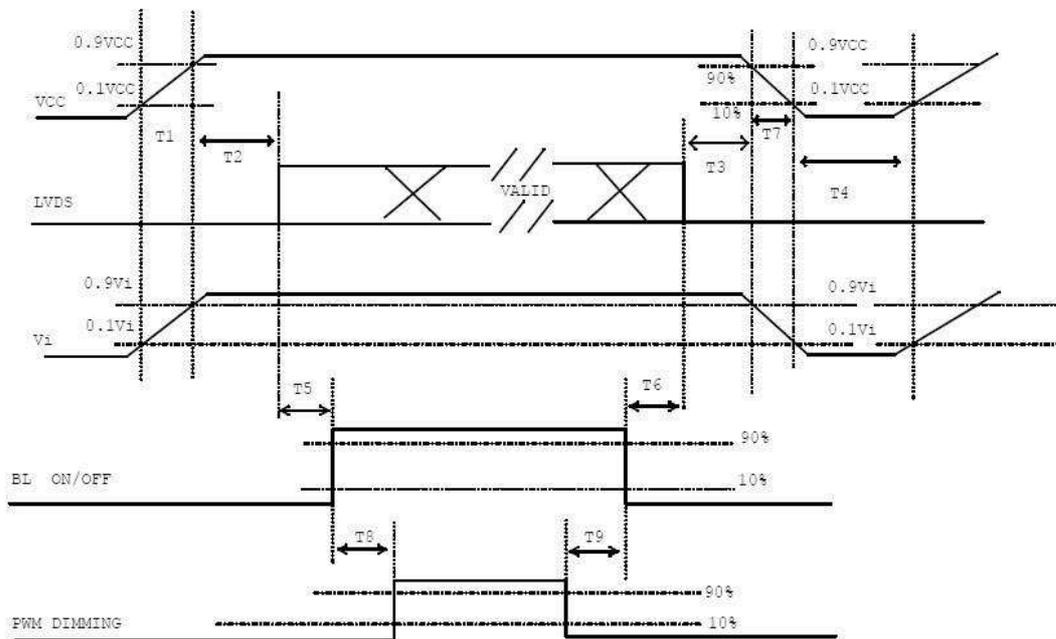
Power ON/OFF sequence

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	200	-	-	ms
T6	200	-	-	ms
T7	5	-	300	ms
T8	10	-	-	ms
T9	10	-	-	ms

■ REFERENCE APPLICATION CIRCUIT

Please consult our technical department for detail information.

■ RELIABILITY TEST CONDITIONS

No.	Test Item	Test Condition	Inspection after test
1	High Temperature Storage	80±2℃/240 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Sealleak; 3.Non-display; 4.missing segments; 5.Glass crack; 6.Current Idd is twice higher than initial value.
2	Low Temperature Storage	-30±2℃/240 hours	
3	High Temperature Operating	70±2℃/120 hours	
4	Low Temperature Operating	-20±2℃/120 hours	
5	Temperature Cycle	-20±2℃~25~70±2℃×10cycles (30min.) (5min.) (30min.)	
6	Damp Proof Test	50℃±5℃×90%RH/120 hours	
7	Vibration Test	Frequency：10Hz~55Hz~10Hz Amplitude：1.5mm, X, Y, Z direction for total 3hours (Packing condition)	
8	Dropping test	Drop to the ground from 1m height, one time, every side of carton. (Packing condition)	
9	ESD test	Voltage:±8KV R: 330Ω C: 150pF Air discharge, 10time	

Remark:
1.The test samples should be applied to only one test item.
2.Sample size for each test item is 5~10pcs.
3.For Damp Proof Test, Pure water(Resistance＞10MΩ) should be used.
4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.
5.EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
6.Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

■ INSPECTION CRITERION

This specification is made to be used as the standard acceptance/rejection criteria for Normal LCM Product.

1 Sample plan

   Sampling plan according to GB/T2828.1-2003/ISO 2859-1：1999 and ANSI/ASQC Z1.4-1993, normal level 2 and based on:

   Major defect: AQL 0.65

   Minor defect: AQL 1.5

2. Inspection condition

   ● Viewing distance for cosmetic inspection is about 30cm with bare eyes, and under an environment of 20~40W light intensity, all directions for inspecting the sample should be within 45°against perpendicular line. (Normal temperature $20\sim25°C$ and normal humidity $60\pm15\%$RH).

   ● Driving voltage

   The Vop value from which the most optimal contrast can be obtained near the specified Vop in the specification (Within ±0.5V of the typical value at 25°C.).

3. Definition of inspection zone in LCD.
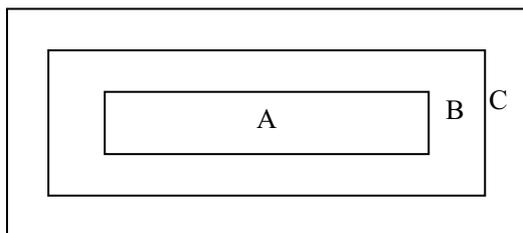
Zone A: character/Digit area

Zone B: viewing area except Zone A (ZoneA+ZoneB=minimum Viewing area)

Zone C: Outside viewing area (invisible area after assembly in customer's product)

Fig.1 Inspection zones in an LCD.

Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

4.Inspection Standard

4.1 Major Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects
4.1.1	a. All functional defects b.	c. 1) No display d. 2) Display abnormally e. 3) Missing vertical，horizontal segment f. 4) Short circuit g. 5) Back-light no lighting, flickering and abnormal lighting.	h. i. j. k. Major l. m.
4.1.2	n. Missing g	o. Missing component	
4.1.3	p. q. Outline dimension	r. s. Overall outline dimension beyond the drawing is not allowed. t.	

4.2 Cosmetic Defect
4.2.1 Module Cosmetic Criteria

No.	Item	Judgement Criterion	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Minor
4	Resist flaw on Printed Circuit Boards	visible copper foil ((0.5mm or more) on substrate pattern	Minor
5	Accretion of metallic Foreign matter	No accretion of metallic foreign matters (Not exceed (0.2mm)	Minor Minor
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate discoloring	No plate fading, rusting and discoloring	Minor
8	Solder amount 1. Lead parts	a. Soldering side of PCB Solder to form a 'Filet' all around the lead. Solder should not hide the lead form perfectly. (too much) b. Components side (In case of 'Through Hole PCB') Solder to reach the Components side of PCB.	Minor
	2. Flat packages	Either 'Toe' (A) or 'Seal' (B) of the lead to be covered by 'Filet'. A B Lead form to be assume over solder.	Minor
	3. Chips	(3(2) H (h ((1(2) H h H	Minor

9	Solder ball/Solder splash	u. The spacing between solder ball and the conductor or solder pad h (0.15 mm) The diameter of solder ball d (0.15mm)	Minor
		v. The quantity of solder balls or solder Splashes isn't beyond 5 in 600 mm^2.	Minor
		c. Solder balls/Solder splashes do not violate minimum electrical clearance.	Major
		d. Solder balls/Solder splashes must be entrapped/encapsulated Or attached to the metal surface . NOTE: Entrapped/encapsulated/attached is intended to mean that normal service environment of the product will not cause a solder ball to become dislodged.	Minor

4.2.2 Cosmetic Criteria (Non-Operating)

No.	Defect	Judgment Criterion	Partition
1	Spots	In accordance with Screen Cosmetic Criteria (Operating) No.1.	Minor
2	Lines	In accordance with Screen Cosmetic Criteria (Operating) No.2.	Minor
3	Bubbles in polarizer	Size : d mm — Acceptable Qty in active area: d (0.3 → Disregard; 0.3 (d (1.0 → 3; 1.0 (d (1.5 → 1; 1.5 (d → 0	Minor
4	Scratch	In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor
5	Allowable density	Above defects should be separated more than 30mm each other.	Minor
6	Coloration	Not to be noticeable coloration in the viewing area of the LCD panels. Back-lit type should be judged with back-lit on state only.	Minor
7	Contamination	Not to be noticeable.	Minor

For item 3, the embedded table is:

Size : d mm	Acceptable Qty in active area
d (0.3	Disregard
0.3 (d (1.0	3
1.0 (d (1.5	1
1.5 (d	0

4.2.3 Cosmetic Criteria (Operating)

No.	Defect	Judgment Criterion	Partition
1	Spots	A) Clear	Minor

A) Clear

Lcd size	Size : mm d	Acceptable Qty in active area
Lcd size≤8.0'	d≤0.1	Disregard
	0.1＜d≤0.2	6
	0.2＜d≤0.3	2
	0.3 (d	0
Lcd size＞8.0'	d ≤0.1	Disregard
	0.1＜d≤0.3	10
	0.3＜d≤0.5	5
	0.5 (d	0

Note :   Including pin holes and defective dots which must be within one pixel size; Total defective point shall not exceed 6 pcs no more than 8 inch LCD and 10PCS for more than 8 inch LCD.

B) Unclear

Lcd size	Size : mm d	Acceptable Qty in active area
Lcd size≤8.0'	d≤0.2	Disregard
	0.2＜d≤0.5	6
	0.5＜d≤0.7	2
	0.7＜d	0
Lcd size ＞8.0'	d≤0.2	Disregard
	0.2＜d≤0.5	10
	0.5＜d≤0.7	3
	0.7＜d≤1.0	1
	1.0(d	0

Note :   Total defective point shall not exceed 6 pcs for no more than 8 inch LCD and 10PCS for more than 8 inch LCD.

| 2 | Lines | A) Clear | Minor |

A) Clear

L
∞   (0)
2.0   (6)   See No. 1
                              W
0.02   0.05   0.1

Note :   ( ) - Acceptable Qty in active area
L   - Length (mm)
W   - Width (mm)
(- Disregard

B) Unclear

L
∞   (0)
          (6)
2.0   See No. 1
                              W
0.05   0.3   0.5
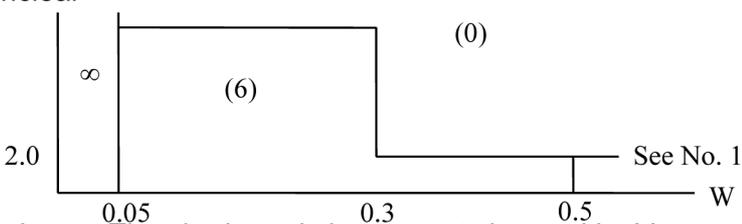
'Clear'   = The shade and size are not changed by Vop.
'Unclear' = The shade and size are changed by Vop.

3	Rubbing line	Not to be noticeable.	Minor
4	Allowable density	Above defects should be separated more than 10mm each other.	Minor
5	Rainbow	Not to be noticeable.	Minor
6	Dot size	To be 95((105(of the dot size (Typ.) in drawing. Partial defects of each dot (ex. pin-hole) should be treated as 'Spot'. (see Screen Cosmetic Criteria (Operating) No.1)	Minor
7	Uneven brightness (only back-lit type module)	Uneven brightness must be BMAX (BMIN (2 - BMAX : Max. value by measure in 5 points - BMIN : Min. value by measure in 5 points Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure. ○ : Measuring points	Minor
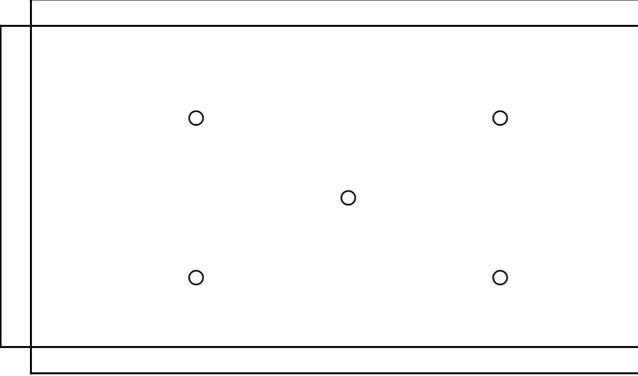
Note :
    (1) Size : d = (long length (short length) (2
    (2) The limit samples for each item have priority.
    (3) Complex defects are defined item by item, but if the numbers of defects are defined in above table, the total number should not exceed 10.
    (4) In case of 'concentration', even the spots or the lines of 'disregarded' size should not allowed. Following three situations should be treated as 'concentration'.
        - 7 or over defects in circle of (5mm.
        - 10 or over defects in circle of (10mm.
        - 20 or over defects in circle of (20mm.

■ PACKING SPECIFICATION

Please consult our technical department for detail information.