LIQUID CRYSTAL DISPLAY MODULE

Product Specification

CUSTOMER	**Standard**	
PRODUCT NUMBER	**TSR40823**	
CUSTOMER APPROVAL		**Date**

INTERNAL APPROVALS		
Product Mgr	Doc. Control	Electr. Eng
Bruno Recaldini	**Anthony Perkins**	**Bazile Peter**
Date: 21 Jun. 06	Date: 18 Jun 06	Date:18 Jun 06

☐ **Approval for Specification only**

☐ **Approval for Specification and Sample**

TABLE OF CONTENTS

REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECR no.
A	12 June 06			Production Release	

1 MAIN FEATURES

ITEM	CONTENTS
Screen Size	3.5” (diagonal)
Display Format	640x(RGB)x480 dots
Colours	262,144
Overall Dimensions	84.25(W) x 65.40(H) x 4.45(D) (Typ) mm
Viewing Area	75.2(W) x 55.56(H) mm
LCD type	TFT a-Si
Pixel Configuration	Stripe
Mode	Transmissive
Viewing Angle	6 o’clock
Backlight type	LED, White
Surface treatment	AG
Touch Panel surface Treatment	3H
Interface	TTL 18-bit
Operating temperature	-20 to +70 °C
Storage temperature	-20 to +70 °C

2 MECHANICAL SPECIFICATION

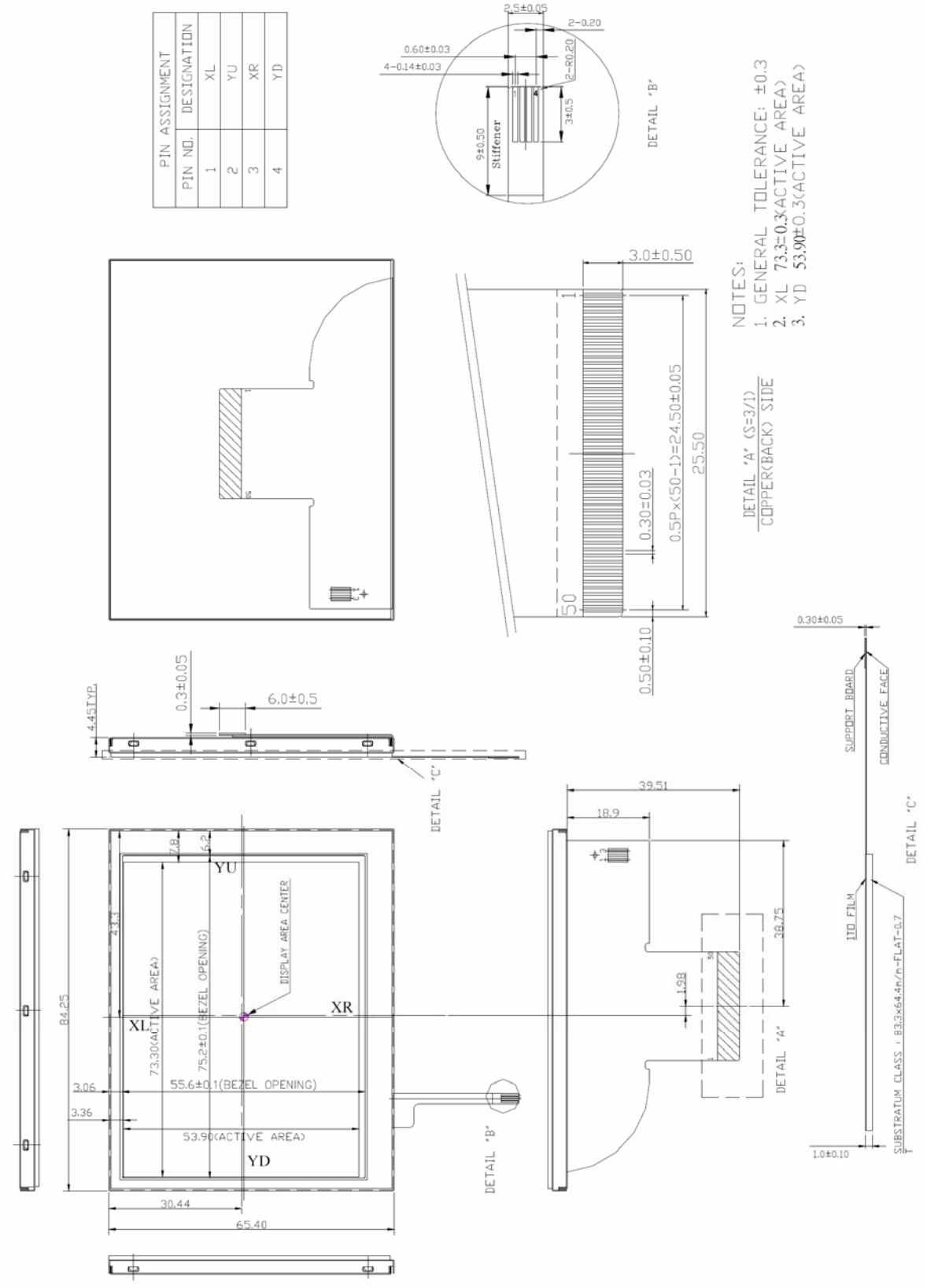
2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Screen Size	3.5 (diagonal)	inch
Display Format	640x(RGB)x480	dot
Overall Dimensions	84.25(W) x 65.40(H) x 4.45(D) (Typ)	mm
Viewing Area	75.2(W) x 55.56(H)	mm
Active Area	72(W) x 52.56(H)	mm
Dot Pitch	0.1125(W) x 0.1095(H)	mm
Weight	40 ±5 (Typ)	g

2.2 LABELLING & MARKING

DENSITRON
TSR40823
TW YYMM

2.3 MECHANICAL DRAWING



3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Min	Max	Unit	Note
Supply Voltage	V_{DD1}	-0.3	2	V	
	V_{CC}	-0.3	5		
	V_{DD2}	-0.5	12		
	V_{GG}	-0.3	40		
	V_{GG} V_{EE}	-0.3	40		
	V_{EE}	-20	0.3		
Operating Temperature	Top	-20	70	°C	Note 1
Storage Temperature	Tst	-20	70	°C	Note 2
Static Electricity	Be sure that you are grounded when handling displays.				

Note 1: Background colour changes slightly depending on ambient temperature. This phenomenon is reversible. Ta≤70 °C: 75% RH max

Note 2: Ta≤70 °C: 75% RH max

3.2 ELECTRICAL CHARACTERISTICS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit
Source Driver Supply Voltage	V_{DD1}	Ta = 25 °C	3.0	3.3	3.6	V
	V_{DD2}		9.5	10.0	10.5	
Gate Driver Supply Voltage	V_{GG}	Ta = 25 °C	-	17.0	-	V
	V_{EE}		-	-10.0	-	
	V_{CC}		3.0	3.3	3.6	
Input Voltage	V_{IL}	Ta = 25 °C	0	-	0.2 V_{DD1}	V
	V_{IH}	Ta = 25 °C	0.8 V_{DD1}	-	V_{DD1}	V
Gate Driver Supply Current (HI level)	I_{GG}	V_{GG} = 17.0V	-	0.12	0.15	mA
Gate Driver Supply Current (LOW level)	I_{EE}	V_{EE} = -10.0V	-	0.15	0.19	mA
Source Driver Supply Current (digital)	I_{DD1}	V_{DD1} = 3.3V	-	4.8	8.0	mA
Source Driver Supply Current (analogue)	I_{DD2}	V_{DD2} = 10.0V	-	16.0	30.0	mA
Gate Driver Supply Current (digital)	I_{CC}	V_{CC} = 3.3V	-	0.17	0.21	mA
LCD Panel Power Consumption	P_{LCD}		-	180	332	mW
Backlight Power Consumption	P_{LED}		-	384	456	mW
Total Power Consumption	P_{TOT}		-	564	788	mW

3.3 INTERFACE PIN ASSIGNMENT

No.	Symbol	I/O	Function	Note
1	DIO1	I/O	Horizontal Start Pulse Signal Input or Output 1	Note 1
2	VSS2	I	Ground	
3	VDD1	I	Power Supply	
4	CLK	I	Horizontal Shift Clock	
5	R/L	I	Left/Right Selection	Note 1
6	R0	I	Red Data (LSB)	
7	R1	I	Red Data	
8	R2	I	Red Data	
9	R3	I	Red Data	
10	R4	I	Red Data	
11	R5	I	Red Data (MSB)	
12	VSS2	I	Ground	
13	G0	I	Green Data (LSB)	
14	G1	I	Green Data	
15	G2	I	Green Data	
16	G3	I	Green Data	
17	G4	I	Green Data	
18	G5	I	Green Data (MSB)	
19	B0	I	Blue Data (LSB)	
20	B1	I	Blue Data	
21	B2	I	Blue Data	
22	B3	I	Blue Data	
23	B4	I	Blue Data	
24	B5	I	Blue Data (MSB)	
25	LD	I	Load output signal	Note 2

INTERFACE PIN ASSIGNMENT CONTINUED

No.	Symbol	I/O	Function	Note
26	REV	I	Data invert control	Note 3
27	POL	I	Polarity selection	Note 4
28	DIO2	I/O	Horizontal Start Pulse Signal Input or Output	Note 1
29	VSS2	I	Ground	
30	V3	I	Gamma Voltage 3	Note 5
31	V5	I	Gamma Voltage 5	Note 5
32	V7	I	Gamma Voltage 7	Note 5
33	V8	I	Gamma Voltage 8	Note 5
34	V10	I	Gamma Voltage 10	Note 5
35	V12	I	Gamma Voltage 12	Note 5
36	VSS2	I	Ground	
37	VDD2	I	Voltage for analogue circuit	Note 5
38	VCOM	I	Common Voltage	
39	OE	I	Output Enable	Note 6
40	U/D	I	Up/Down Selection	Note 7
41	CKV	I	Vertical Shift Clock	Note 8
42	STVU	I/O	Vertical Shift Pulse Signal Input or Output	Note 7
43	STVD	I/O	Vertical Shift Pulse Signal Input or Output	Note 7
44	VGG	I	Gate On Voltage	Note 9
45	VSS1	I	Ground	
46	VCC	I	Voltage for logic circuit	
47	VEE	I	Gate Off Voltage	Note 10
48	VLED	-	Supply voltage for LED backlight	Note 11
49	GLED2	-	Ground for LED backlight	
50	GLED1	-	Ground for LED backlight	

Note 1: Select left or right shift

R/L	DIO1	DIO2	Shift
1	Input	Hi-Z	Left to right
0	Hi-Z	Input	Right to left

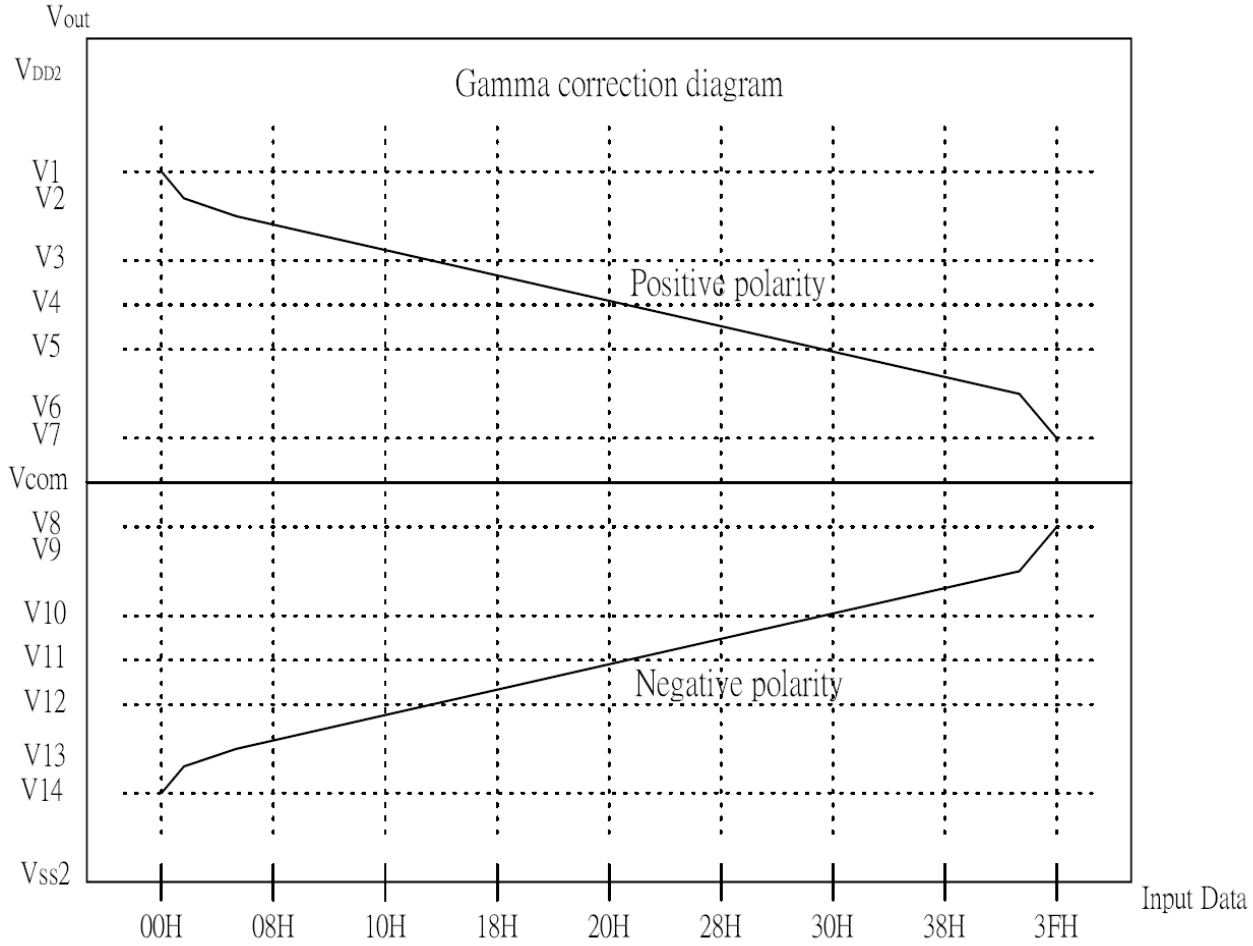
Note 2: Latch the polarity of outputs and switch the new data to outputs. At the rising edge (LD), latch the “POL” signal to control the polarity of the outputs.

Note 3: Control whether the Data R0~G5 are inverted or not (we suggests connecting to GND). When “REV=1”, these data will be inverted. EX: “00”→”3F”, “07” →”38”, “15” →”2A”

Note 4: Polarity selector for dot-inversion control. Available at the rising edge of LD. When POL=1: Even outputs range from V1~V7, and Odd outputs range from V8~V14; When POL=0: Even outputs range from V8~V14, and Odd outputs range from V1~V7.

Note 5:
1) Relationship between input data and output voltage

The figure below shows the relationship between the input data (x axis) and the output voltage with the polarity(y axis).
The range of V1~V7 is for positive polarity, and V8~V14 for negative polarity. Please refer to the following pages to get the related resister values and voltage calculation method.



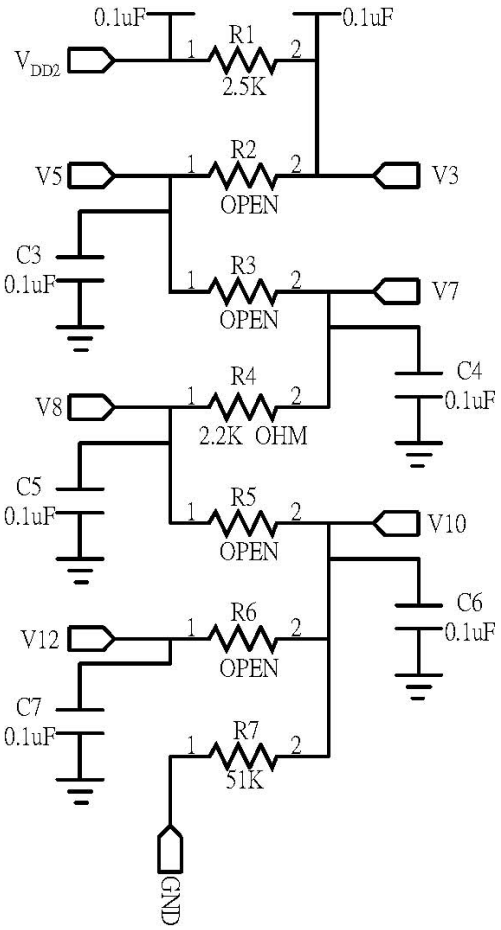
3.3.1 Output Voltage and Input Data

Data	Positive polarity Output Voltage	Negative polarity Output Voltage
00H	V1	V14
01H	V2=V3+(V1-V3) x 58 / 64.4	V13=V14+(V12-V14) x 6.4 / 64.4
02H	V3+(V1-V3) x 52 / 64.4	V14+(V12-V14) x 12.4 / 64.4
03H	V3+(V1-V3) x 46.4 / 64.4	V14+(V12-V14) x 18 / 64.4
04H	V3+(V1-V3) x 41.2 / 64.4	V14+(V12-V14) x 23.2 / 64.4
05H	V3+(V1-V3) x 36.4 / 64.4	V14+(V12-V14) x 28 / 64.4
06H	V3+(V1-V3) x 32 / 64.4	V14+(V12-V14) x 32.4 / 64.4
07H	V3+(V1-V3) x 27.6 / 64.4	V14+(V12-V14) x 36.8 / 64.4
08H	V3+(V1-V3) x 23.6 / 64.4	V14+(V12-V14) x 40.8 / 64.4
09H	V3+(V1-V3) x 19.6 / 64.4	V14+(V12-V14) x 44.8 / 64.4
0AH	V3+(V1-V3) x 16.4 / 64.4	V14+(V12-V14) x 48 / 64.4
0BH	V3+(V1-V3) x 13.2 / 64.4	V14+(V12-V14) x 51.2 / 64.4
0CH	V3+(V1-V3) x 10.4 / 64.4	V14+(V12-V14) x 54 / 64.4
0DH	V3+(V1-V3) x 7.6 / 64.4	V14+(V12-V14) x 56.8 / 64.4
0EH	V3+(V1-V3) x 4.8 / 64.4	V14+(V12-V14) x 59.6 / 64.4
0FH	V3+(V1-V3) x 2.4 / 64.4	V14+(V12-V14) x 62 / 64.4
10H	V3	V12
11H	V4+(V3-V4) x 19.6 / 22	V12+(V11-V12) x 2.4 / 22
12H	V4+(V3-V4) x 17.6 / 22	V12+(V11-V12) x 4.4 / 22
13H	V4+(V3-V4) x 15.6 / 22	V12+(V11-V12) x 6.4 / 22
14H	V4+(V3-V4) x 13.6 / 22	V12+(V11-V12) x 8.4 / 22
15H	V4+(V3-V4) x 12 / 22	V12+(V11-V12) x 10 / 22
16H	V4+(V3-V4) x 10.4 / 22	V12+(V11-V12) x 11.6 / 22
17H	V4+(V3-V4) x 8.8 / 22	V12+(V11-V12) x 13.2 / 22
18H	V4+(V3-V4) x 7.6 / 22	V12+(V11-V12) x 14.4 / 22
19H	V4+(V3-V4) x 6.4 / 22	V12+(V11-V12) x 15.6 / 22
1AH	V4+(V3-V4) x 5.2 / 22	V12+(V11-V12) x 16.8 / 22
1BH	V4+(V3-V4) x 4 / 22	V12+(V11-V12) x 18 / 22
1CH	V4+(V3-V4) x 3.2 / 22	V12+(V11-V12) x 18.8 / 22
1DH	V4+(V3-V4) x 2.4 / 22	V12+(V11-V12) x 19.6 / 22
1EH	V4+(V3-V4) x 1.6 / 22	V12+(V11-V12) x 20.4 / 22
1FH	V4+(V3-V4) x 0.8 / 22	V12+(V11-V12) x 21.2 / 22

OUTPUT VOLTAGE and INPUT DATA CONTINUED

Data	Positive polarity Output Voltage	Negative polarity Output Voltage
20H	V4	V11
21H	V5+(V4-V5) x 12 / 12.8	V11+(V10-V11) x 0.8 / 12.8
22H	V5+(V4-V5) x 11.2 / 12.8	V11+(V10-V11) x 1.6 / 12.8
23H	V5+(V4-V5) x 10.4 / 12.8	V11+(V10-V11) x 2.4 / 12.8
24H	V5+(V4-V5) x 9.6 / 12.8	V11+(V10-V11) x 3.2 / 12.8
25H	V5+(V4-V5) x 8.8 / 12.8	V11+(V10-V11) x 4 / 12.8
26H	V5+(V4-V5) x 8 / 12.8	V11+(V10-V11) x 4.8 / 12.8
27H	V5+(V4-V5) x 7.2 / 12.8	V11+(V10-V11) x 5.6 / 12.8
28H	V5+(V4-V5) x 6.4 / 12.8	V11+(V10-V11) x 6.4 / 12.8
29H	V5+(V4-V5) x 5.6 / 12.8	V11+(V10-V11) x 7.2 / 12.8
2AH	V5+(V4-V5) x 4.8 / 12.8	V11+(V10-V11) x 8 / 12.8
2BH	V5+(V4-V5) x 4 / 12.8	V11+(V10-V11) x 8.8 / 12.8
2CH	V5+(V4-V5) x 3.2 / 12.8	V11+(V10-V11) x 9.6 / 12.8
2DH	V5+(V4-V5) x 2.4 / 12.8	V11+(V10-V11) x 10.4 / 12.8
2EH	V5+(V4-V5) x 1.6 / 12.8	V11+(V10-V11) x 11.2 / 12.8
2FH	V5+(V4-V5) x 0.8 / 12.8	V11+(V10-V11) x 12 / 12.8
30H	V5	V10
31H	V7+(V5-V7) x 26.8 / 27.6	V10+(V8-V10) x 0.8 / 27.6
32H	V7+(V5-V7) x 26 / 27.6	V10+(V8-V10) x 1.6 / 27.6
33H	V7+(V5-V7) x 25.2 / 27.6	V10+(V8-V10) x 2.4 / 27.6
34H	V7+(V5-V7) x 24.4 / 27.6	V10+(V8-V10) x 3.2 / 27.6
35H	V7+(V5-V7) x 23.6 / 27.6	V10+(V8-V10) x 4 / 27.6
36H	V7+(V5-V7) x 22.4 / 27.6	V10+(V8-V10) x 5.2 / 27.6
37H	V7+(V5-V7) x 21.2 / 27.6	V10+(V8-V10) x 6.4 / 27.6
38H	V7+(V5-V7) x 20 / 27.6	V10+(V8-V10) x 7.6 / 27.6
39H	V7+(V5-V7) x 18.4 / 27.6	V10+(V8-V10) x 9.2 / 27.6
3AH	V7+(V5-V7) x 16.8 / 27.6	V10+(V8-V10) x 10.8 / 27.6
3BH	V7+(V5-V7) x 14.8 / 27.6	V10+(V8-V10) x 12.8 / 27.6
3CH	V7+(V5-V7) x 12.8 / 27.6	V10+(V8-V10) x 14.8 / 27.6
3DH	V7+(V5-V7) x 10.4 / 27.6	V10+(V8-V10) x 17.2 / 27.6
3EH	V7+(V5-V7) x 6.4 / 27.6	V10+(V8-V10) x 21.2 / 27.6
3FH	V7	V8

3.3.2 Typical Application Circuit



Note 6: When OE is connected to high "1", the driver outputs are disabled (Gate output = V_{EE}). Under this condition, the operation of registers will not be affected.

Note 7: Select up or down shift:

U/D	STVU	STVD	Shift
1	Hi-Z	Input	Down to Up
0	Input	Hi-Z	Up to Down

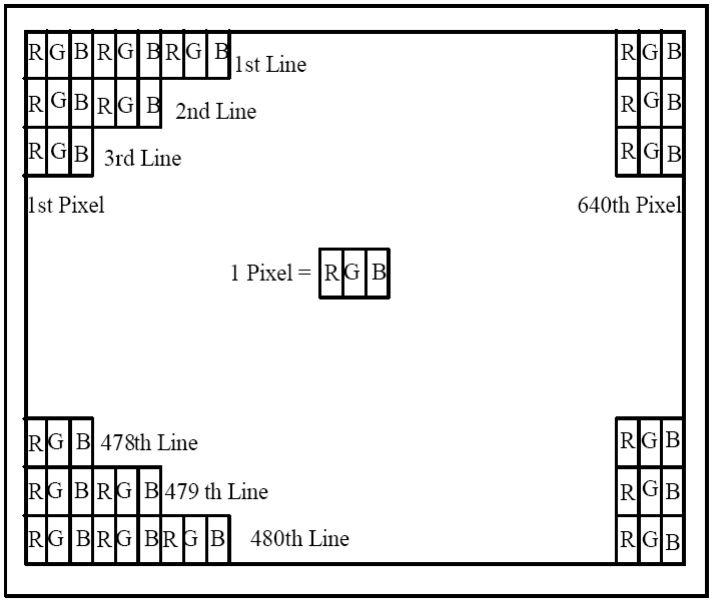
Note 8: Gate driver shift clock

Note 9: Gate on voltage, V_{GG} = +17V.

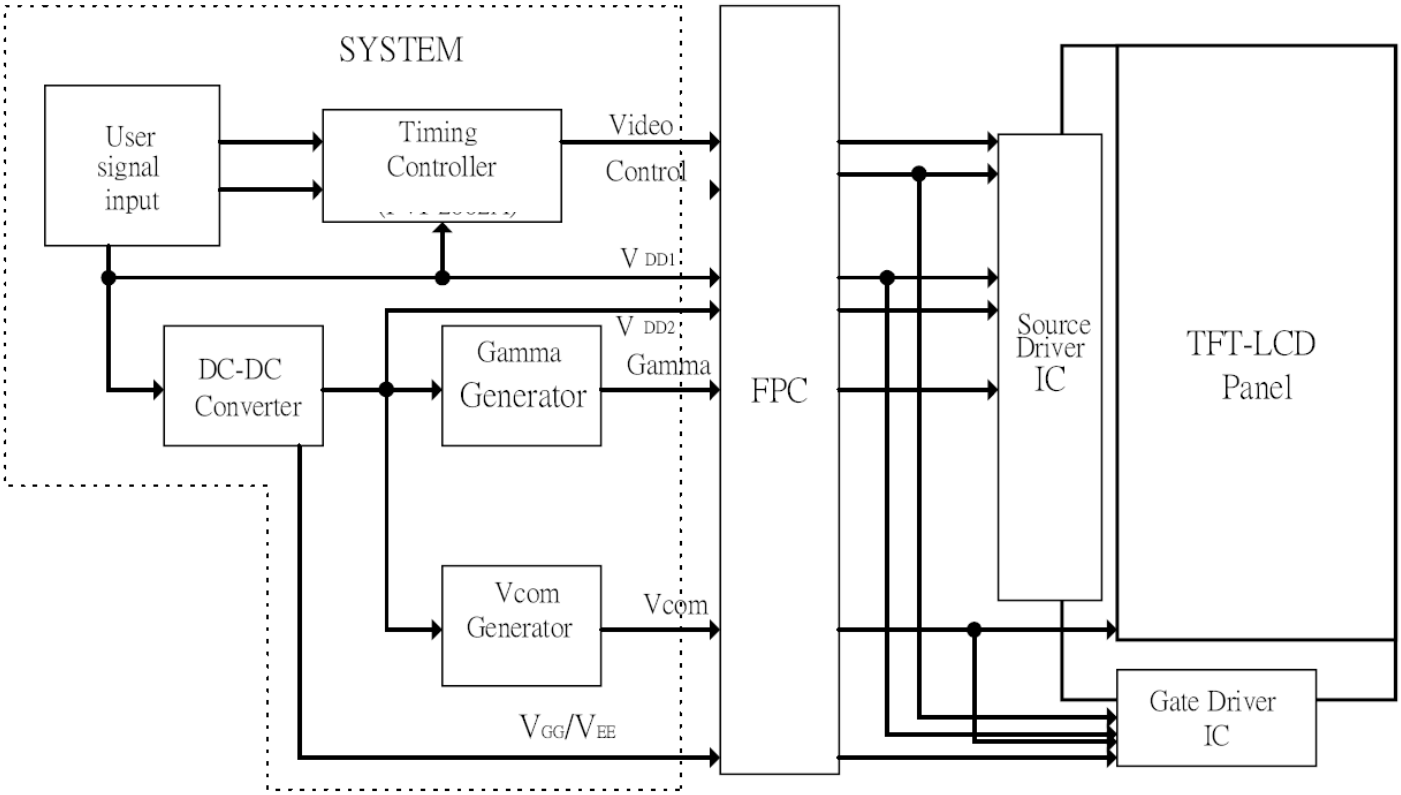
Note 10: Gate off voltage, V_{EE} = -10V.

Note 11: ILED .= 20mA.typ

3.4 PIXEL ARRANGEMENT – STRIPE



3.5 BLOCK DIAGRAM



3.6 COLOUR DATA INPUT ASSIGNMENT

Colour		Input Colour Data																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colours	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green (63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red	Red(00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(01)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(02)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker																		
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	Brighter																		
	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green	Green (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (01)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green (02)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Darker																		
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	Brighter																		
	Green (61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green (62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green (63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Blue	Blue (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue (01)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue (02)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Darker																		
	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	Brighter																		
	Blue (61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue (62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

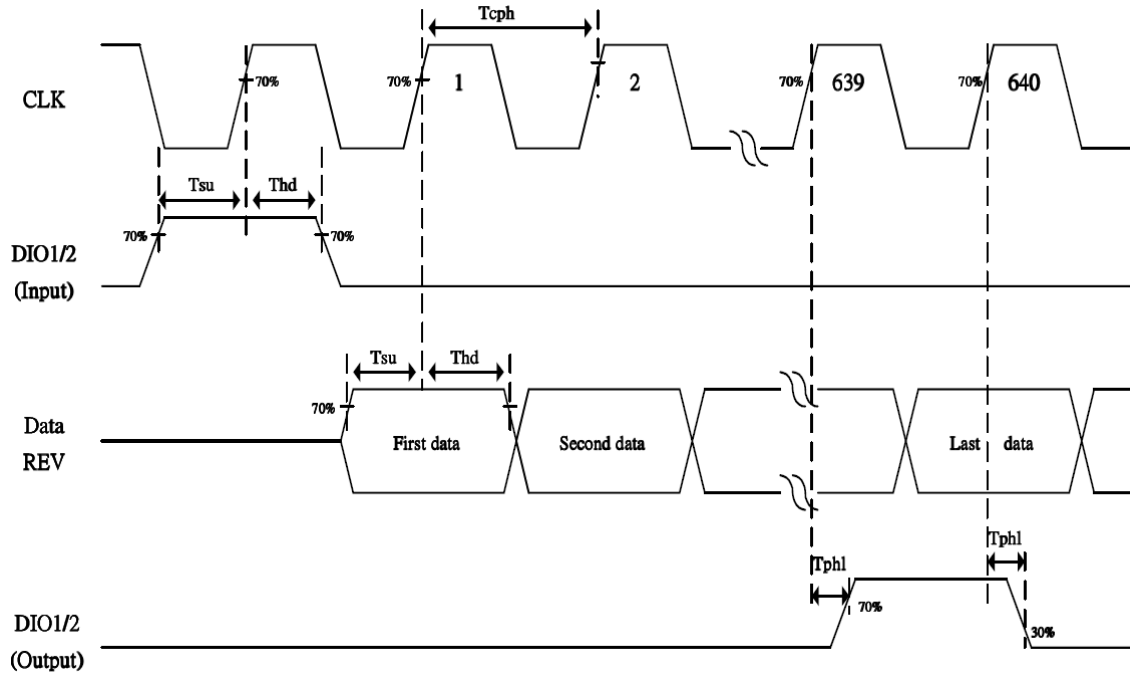
3.7 TIMING CHARACTERISTICS

3.7.1 AC Electrical Characteristics

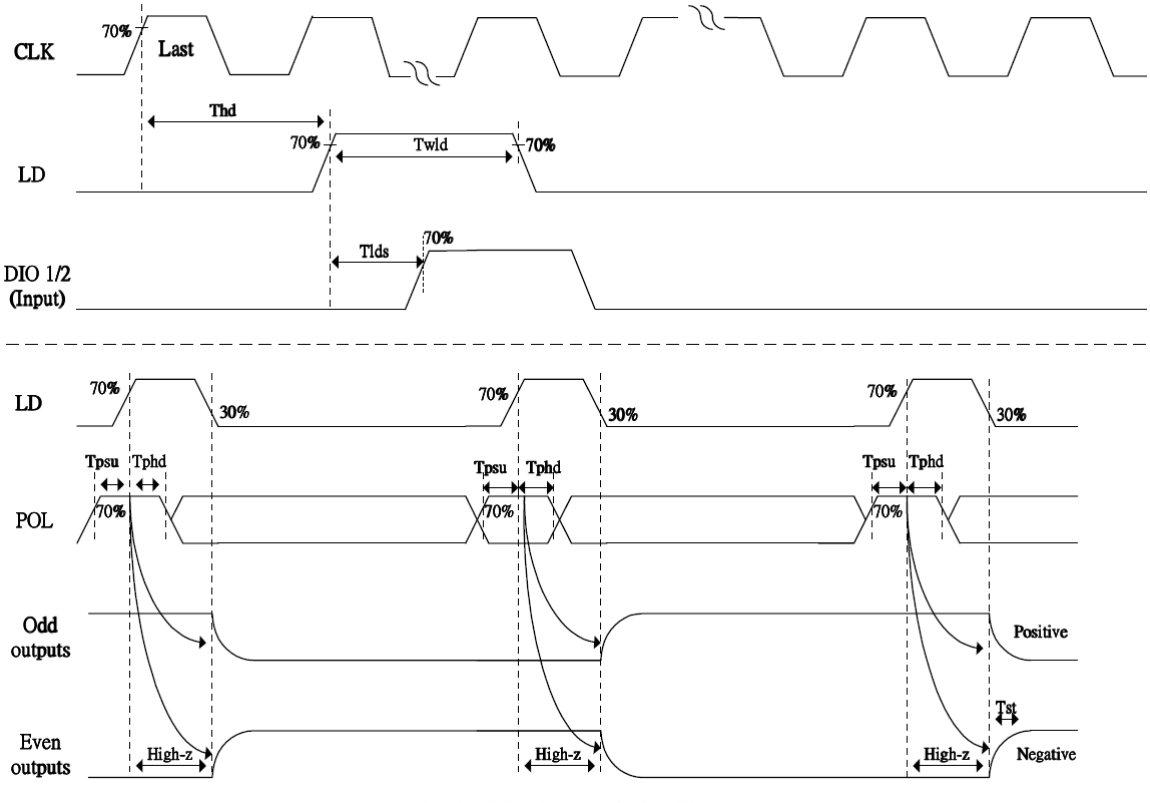
$V_{CC} = V_{DD1} = 3.3V$, $V_{DD2} = 10.0V$, $GND = V_{SS1} = V_{SS2} = 0V$; Ta = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit
CLK Frequency	Fclk	-	25	40	MHz
CLK Pulse Width	TCPH	25	-	-	ns
Data Set-up Time	Tsu	4	-	-	ns
Data Hold Time	Thd	2	-	-	ns
Propagation Delay of DIO2/1	Tphl	6	10	15	ns
Time That The Last Data to LD	Tld	1	-	-	TCPH
Pulse width of LD	Twld	2	-	-	TCPH
Time That LD to DIO1/2	Tlds	5	-	-	TCPH
POL Set-up Time	Tpsu	6	-	-	ns
POL Hold Time	Tphd	6	-	-	ns
OE Pulse Width	TOEV	1	-	-	s
CKV Pulse Width	TCKV	500	-	-	ns
STV Set-up Time	TSUV	400	-	-	ns
STV Hold Time	THDV	400	-	-	ns
Horizontal Display Period	THDP	-	640	-	TCPH
Horizontal Period Timing Range	THP	-	800	-	TCPH
Horizontal Lines Per Field	TV	520	525	640	THP
Vertical Display Timing Range	TDV	-	480	-	THP

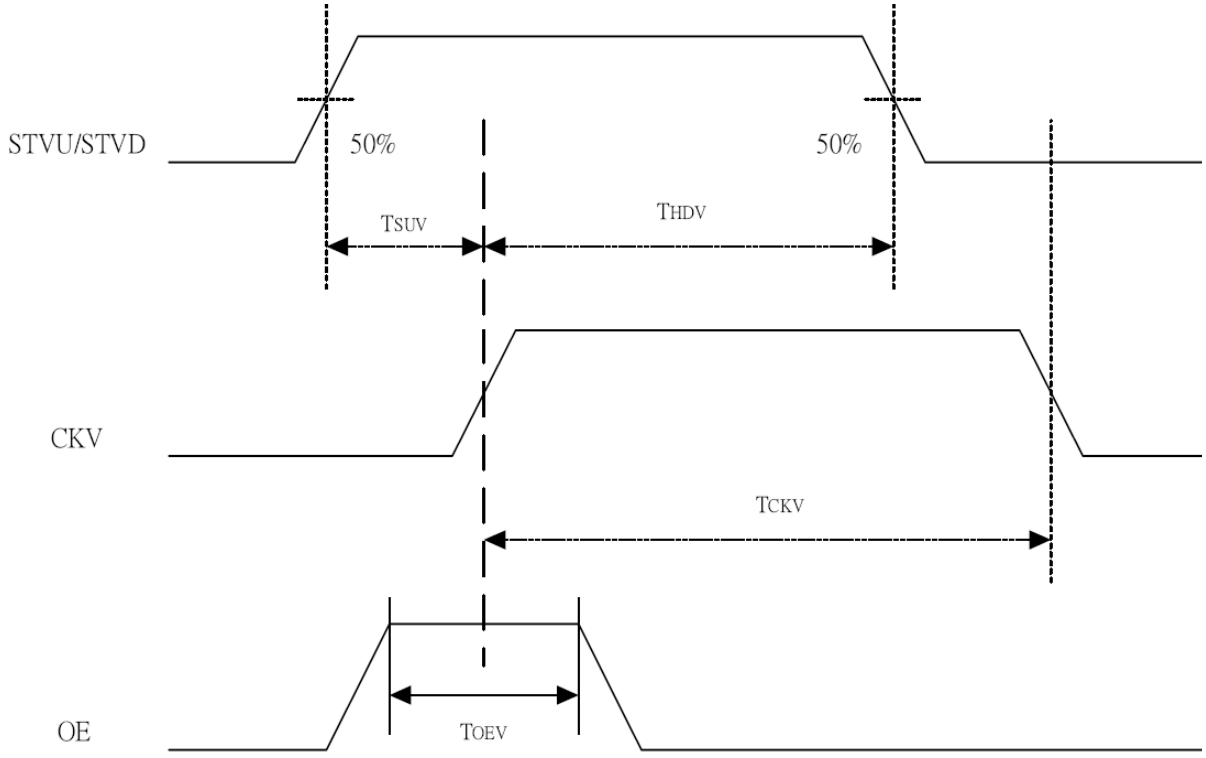
3.7.2 Timing Diagram



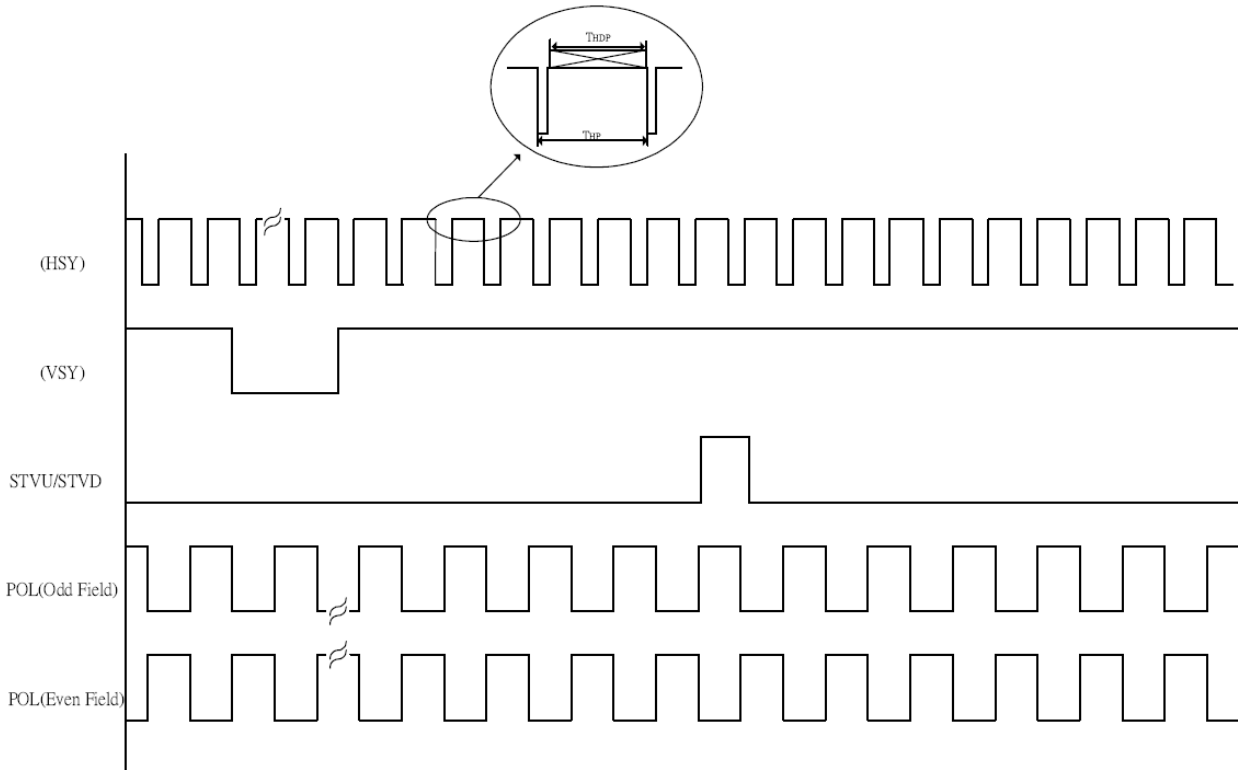
Horizontal Timing (1)



Horizontal Timing (2)

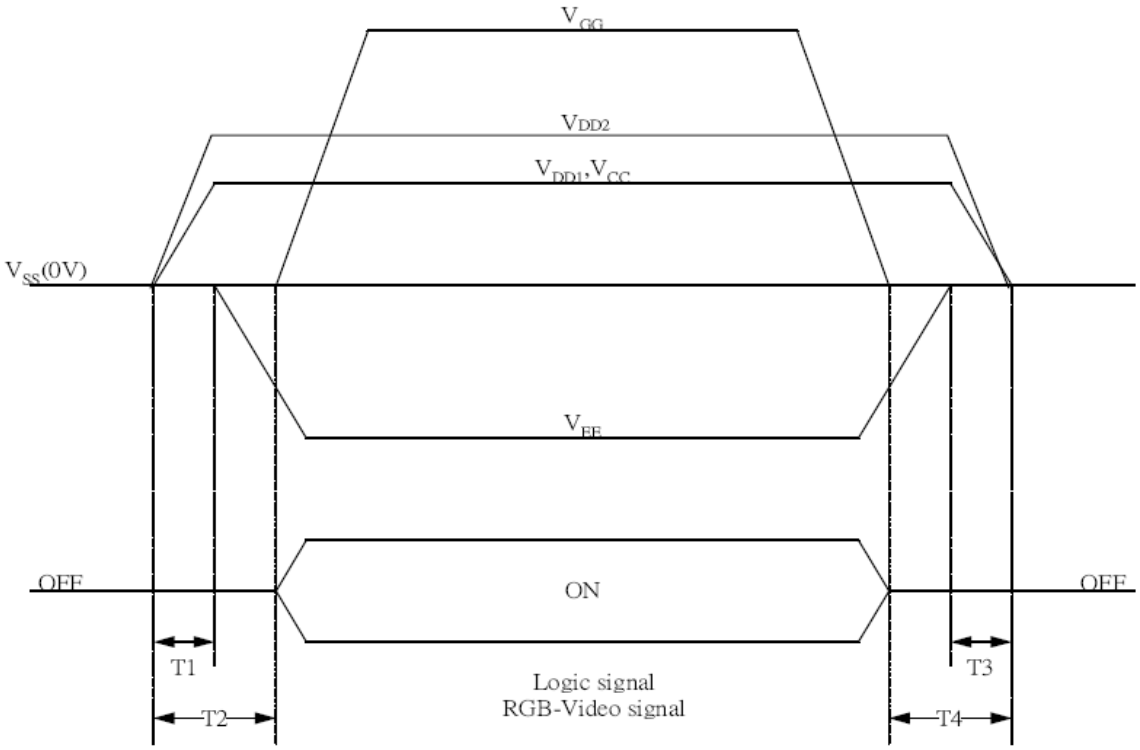


Vertical shift clock timing



Vertical timing

3.8 POWER ON SEQUENCE



Notes:

- 10 ms ≤ T1 < T2
- 0 ms < T3 ≤ T4 ≤ 10 ms

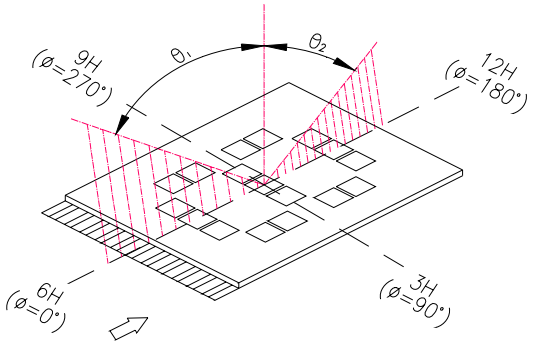
4 OPTICAL SPECIFICATION

4.1 OPTICAL CHARACTERISTICS

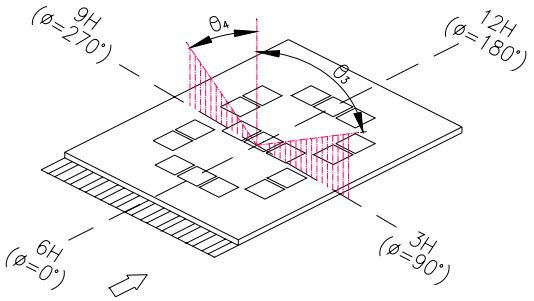
Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle	θ1 (6H)	CR≥10	30	35	-	deg	1
	θ2 (12H)	CR≥10	10	15	-	deg	1
	θ3 (3H)	CR≥10	45	50	-	deg	2
	θ4 (9H)	CR≥10	45	50	-	deg	2
Contrast Ratio	CR	Ta = 25 °C	200	400	-	-	3
Response Time	Tr	Ta = 25 °C; θ=0°	-	15	30	ms	4
	Tf		-	25	50		
Brightness	B	Ta = 25 °C; θ=0°	200	250	-	cd/m²	5
Cross Talk		Ta = 25 °C; θ=0°	-	-	3	%	6
Viewing Direction	6 O'CLOCK						

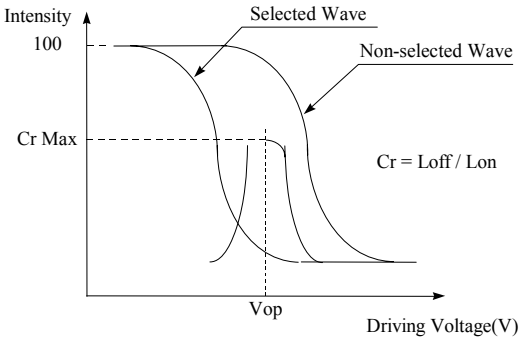
Note 1: definition of viewing angle θ1 & θ2



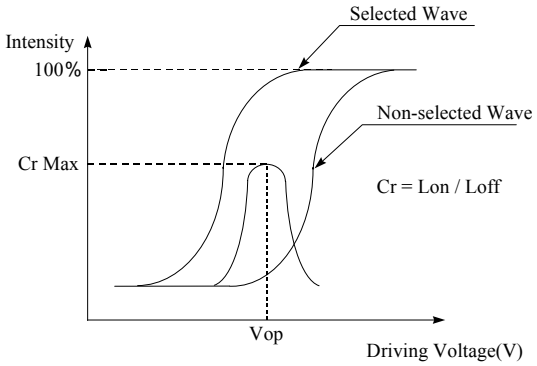
Note 2: definition of viewing angle θ3 & θ4



Note 3: definition of contrast ratio (CR)

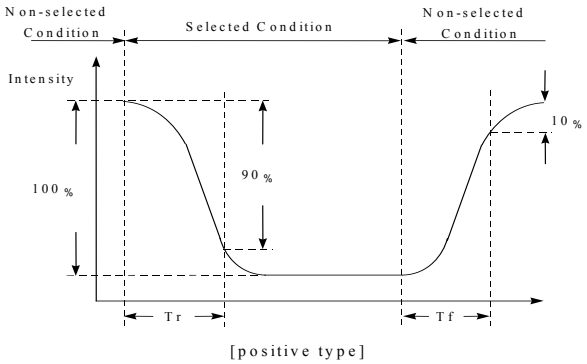


[positive type]

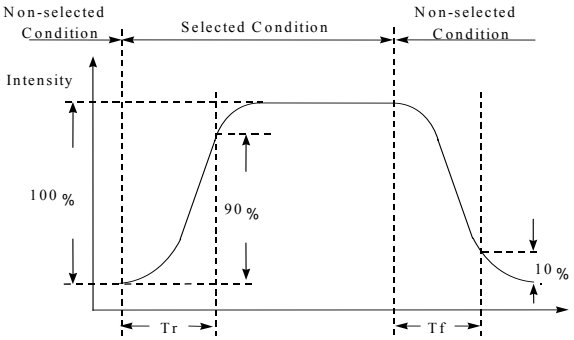


[Negative type]

Note 4: definition of response time

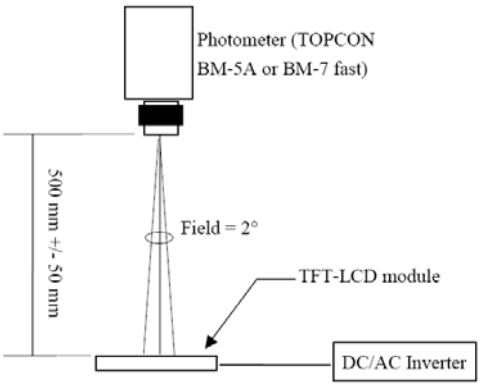


[positive type]



[Negative type]

Note 5: the brightness is measured with Topcon BM-5A or BM-7 fast luminance meter. 1° field of view is used (after 1 minute operation).

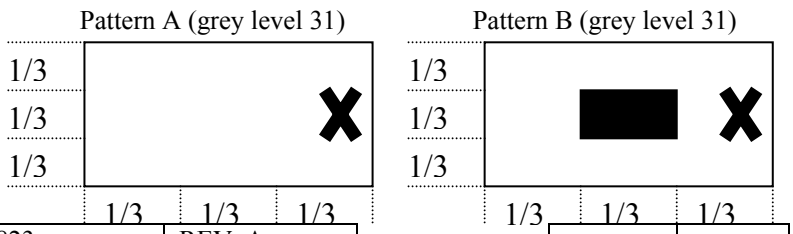


Optical characteristics measuring configuration

Note 6: Cross Talk = (BA-BB)/(BB) x 100

BA = Brightness of pattern A
BB = Brightness of pattern B

X = Testing point



5 TOUCH PANEL CHARACTERISTICS

5.1 Pin Assignment

PIN	Symbol	Function
1	XL	Upper Electrode X (Left Side)
2	YU	Lower Electrode X (Upper Side)
3	XR	Upper Electrode X (Right Side)
4	YD	Lower Electrode X (Down Side)

5.2 Electrical Characteristics

Parameters	Symbol	Min	Typ	Max	Unit	Remarks
Terminal Resistance	X	120	240	370		
	Y	280	570	860		
Input Voltage	V_T		5	7	V	
Linearity(X, Y directly)				±1.5	%	
Insulation Impedance		20			M	DC 25V
Response Time				5	ms	
Operation Force				35	g	Note 1

Note 1: Input through 0.8R stylus or finger

5.3 Durability Performance

Hitting Durability
At least 1,000,000 times with R8.0 mm silicon rubber, 200g, 3times/sec

Sliding Durability
At least 1,000,000 times with R8.0 mm polyacetal Stylus, 200g, 3times/sec

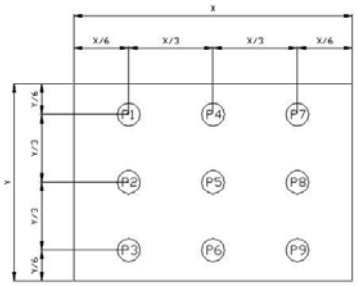
6 BACKLIGHT SPECIFICATION

6.1 BACKLIGHT CHARACTERISTICS

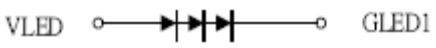
Item	Symbol	Condition	Min	Typ	Max	Unit	Note
LED Input Voltage	V_{LED}	I_{LED} = 20 mA	9.0	9.6	11.4	V	
LED Input Current	I_{LED1} / I_{LED2}		-	20.0	-	mA	
Backlight Power consumption	P_{LED}		360	384	456	mW	4
Brightness	B	Ta = 25 °C; θ=0°	200	250	-	cd/m²	1 (on LCD)
Brightness Uniformity		Ta = 25 °C; θ=0°	70	75		%	2
White Chromaticity	x		0.28	0.31	0.34		
	y		0.30	0.33	0.36		
Life time		I_{LED} = 20 mA		10000		hrs	3

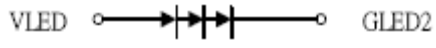
Note:

1. Average luminous intensity of 9 points
2. Brightness uniformity =Min / MAX x 100
3. Half of the original brightness
4. $P_{LED} = V_{LED} \times I_{LED1} + V_{LED} \times I_{LED2}$

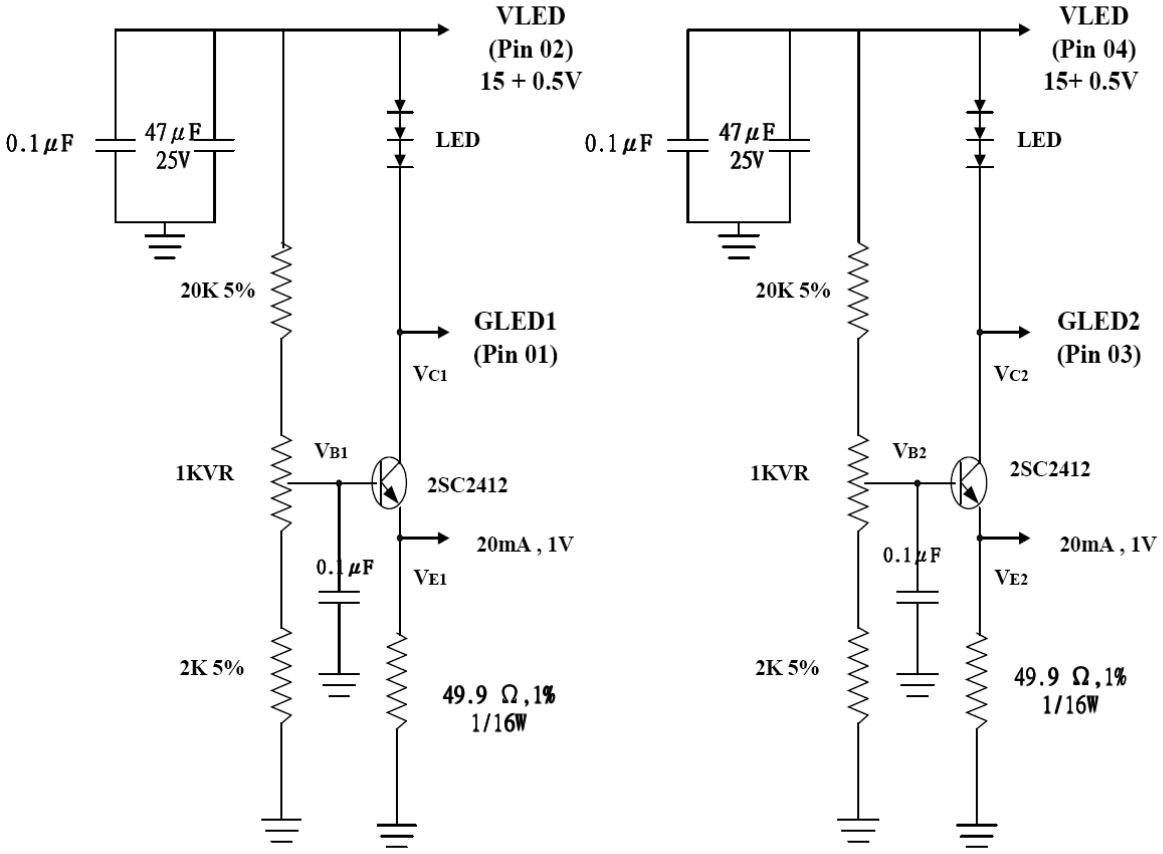


6.2 INTERNAL CIRCUIT DIAGRAM





6.3 LED BACKLIGHT APPLICATION NOTE



7 QUALITY ASSURANCE SPECIFICATION

7.1 CONFORMITY

The performance, function and reliability of the shipped products conform to the Product Specification.

7.2 DELIVERY ASSURANCE

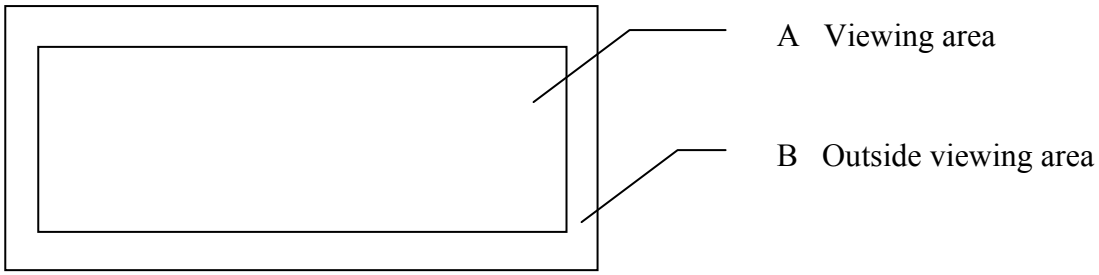
7.2.1 Delivery inspection standards

- MIL-STD-105E, general inspection level II, single sampling level;
- IPC-AA610 rev. C, class 2 electronic assemblies standard

The quality assurance levels are shown below:

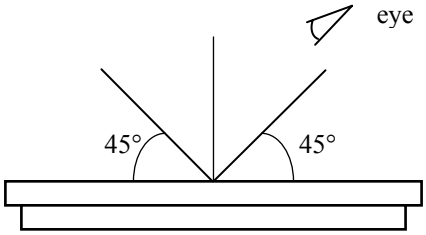
Class	**AQL (%)**
Critical defect	0.5%
Major defect	1.0%
Minor defect	2.5%
TOTAL	2.5%

7.2.2 Zone definition



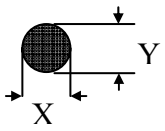
7.2.3 Visual inspection

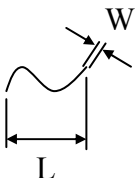
- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk on screen).
- Inspect the module at 45° right and left, top and bottom.
- Use the optimum viewing angle during the contrast inspection.

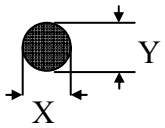


7.2.3.1 Standard of appearance inspection

Units: mm

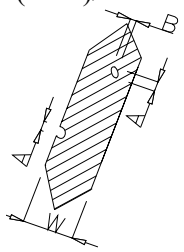
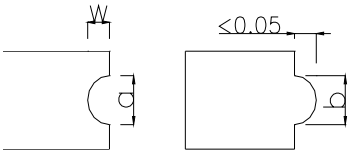
<table>
<tr><th>Class</th><th>Item</th><th>Criteria</th></tr>
<tr><td>Minor</td><td rowspan="2">Packing & Label</td><td>Outside & inside package | Presence of product no., lot no., quantity</td></tr>
<tr><td>Critical</td><td>Product must not be mixed with others and quantity must not be different from that indicated on the label</td></tr>
<tr><td>Major</td><td>Dimension</td><td>Product dimensions must be according to specification and drawing</td></tr>
<tr><td>Major</td><td>Electrical</td><td>Product electrical characteristics must be according to specification</td></tr>
<tr><td>Critical</td><td>LCD Display</td><td>Missing lines or wrong patterns on LCD display are not allowed</td></tr>
<tr><td>Minor</td><td>Black spot, white spot, dust</td><td>Round type: as per following drawing
∅ = (X+Y)/2
 

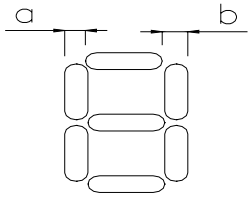
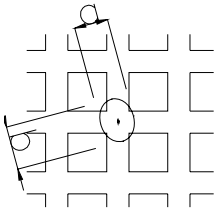
<table><tr><th colspan="3">Acceptable quantity</th></tr><tr><th>Size</th><th>Zone A</th><th>Zone B</th></tr><tr><td>∅<0.1</td><td>Any number</td><td rowspan="4">Any number</td></tr><tr><td>0.1<∅<0.2</td><td>2</td></tr><tr><td>0.2<∅<0.25</td><td>1</td></tr><tr><td>0.25<∅</td><td>0</td></tr></table>
Line type: as per following drawing
 

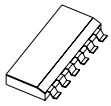
<table><tr><th colspan="4">Acceptable quantity</th></tr><tr><th>Length</th><th>Width</th><th>Zone A</th><th>Zone B</th></tr><tr><td>- -</td><td>W≤0.02</td><td>Any number</td><td rowspan="4">Any number</td></tr><tr><td>L≤3.0</td><td>0.02<W≤0.03</td><td rowspan="2">2</td></tr><tr><td>L≤2.5</td><td>0.03<W≤0.05</td></tr><tr><td>- -</td><td>0.05<W</td><td>As round type</td></tr></table>
Total acceptable quantity: 3</td></tr>
<tr><td>Minor</td><td>Polariser scratch</td><td>Scratch on protective film is permitted
Scratch on polariser: same as No. 1</td></tr>
<tr><td>Minor</td><td>Polariser bubble</td><td>∅ = (X+Y)/2
 

<table><tr><th colspan="3">Acceptable quantity</th></tr><tr><th>Size</th><th>Zone A</th><th>Zone B</th></tr><tr><td>∅<0.2</td><td>Any number</td><td rowspan="4">Any number</td></tr><tr><td>0.2<∅<0.5</td><td>2</td></tr><tr><td>0.5<∅<1.0</td><td>1</td></tr><tr><td>1.0<∅</td><td>0</td></tr></table>
Total acceptable quantity: 3</td></tr>
</table>

<table>
<tr><th>Class</th><th>Item</th><th>Criteria</th></tr>
<tr><td>Minor</td><td>Segment deformation</td><td>1.a. Pin hole on segmented display

W: segment width
∅ = (A+B)/2
 
<table><tr><td colspan="2">Acceptable quantity</td></tr><tr><td>Width</td><td>∅</td></tr><tr><td>W≤0.4</td><td>∅≤0.2 and ∅≤1/2W</td></tr><tr><td>W>0.4</td><td>∅≤0.25 and ∅≤1/3W</td></tr></table>Total acceptable quantity: 1 defect per segment
Pin holes with ∅ under 0.10 mm are acceptable</td></tr>
<tr><td>Minor</td><td>Segment deformation</td><td>1b. Pin hole on dot matrix display
 
<table><tr><td colspan="2">Acceptable quantity</td></tr><tr><td>Size</td><td></td></tr><tr><td>a,b<0.1</td><td>Any number</td></tr><tr><td>(a+b)/2≤0.1</td><td>Any number</td></tr><tr><td>0.5<∅<1.0</td><td>3</td></tr></table>Total acceptable quantity: 7

2. Segments / dots with different width
 
<table><tr><td colspan="2">Acceptable</td></tr><tr><td>a≥b</td><td>a/b≤4/3</td></tr><tr><td>a<b</td><td>a/b>4/3</td></tr></table>
3. Alignment layer defect
∅ = (a+b)/2
 
<table><tr><td colspan="2">Acceptable quantity</td></tr><tr><td>Size</td><td></td></tr><tr><td>∅≤0.4</td><td>Any number</td></tr><tr><td>0.4<∅≤1.0</td><td>5</td></tr><tr><td>1.0<∅≤1.5</td><td>3</td></tr><tr><td>1.5<∅≤2.0</td><td>2</td></tr></table>Total acceptable quantity: 7</td></tr>
<tr><td>Minor</td><td>Colour uniformity</td><td>Level of sample for approval set as limit sample</td></tr>
<tr><td>Critical</td><td rowspan="3">Backlight</td><td>The backlight colour should correspond to the product specification</td></tr>
<tr><td>Critical</td><td>Flashing and or unlit backlight is not allowed</td></tr>
<tr><td>Minor</td><td>Dust larger than 0.25 mm is not allowed</td></tr>
<tr><td>Major</td><td rowspan="3">COB</td><td>Exposed wire bond pad is not allowed</td></tr>
<tr><td>Major</td><td>Insufficient covering with resin is not allowed (wire bond line exposed)</td></tr>
<tr><td>Minor</td><td>Dust or bubble on the resin are not allowed</td></tr>
</table>

<table>
<tr><th>Class</th><th>Item</th><th>Criteria</th></tr>
<tr><td>Major</td><td rowspan="4">PCB
  </td><td>No unmelted solder paste should be present on PCB</td></tr>
<tr><td>Critical</td><td>Cold solder joints, missing solder connections, or oxidation are not allowed</td></tr>
<tr><td>Minor</td><td>No residue or solder balls on PCB are allowed</td></tr>
<tr><td>Critical</td><td>Short circuits on components are not allowed</td></tr>
<tr><td>Minor</td><td>Tray particles</td><td>
<table>
<tr><th></th><th>Size</th><th>Quantity</th></tr>
<tr><td rowspan="2">On tray</td><td>∅<0.2</td><td>Any number</td></tr>
<tr><td>∅>0.25</td><td>4</td></tr>
<tr><td rowspan="2">On display</td><td>∅≥0.25</td><td>2</td></tr>
<tr><td>L = 3</td><td>1</td></tr>
</table>
</td></tr>
</table>

7.3 DEALING WITH CUSTOMER COMPLAINTS

7.3.1 Non-conforming analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.
After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.
If the analysis cannot be completed on time, Densitron must inform the purchaser.

7.3.2 Handling of non-conforming displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.
Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.
Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

8 RELIABILITY SPECIFICATION

8.1 RELIABILITY TESTS

Test Item	Test Condition	Evaluation and assessment
High Temperature Operation	70°C for 240 hours	No abnormalities in function* and appearance
Low Temperature Operation	-20°C for 240 hours	No abnormalities in function* and appearance
High Temperature Storage	70°C for 240 hours	No abnormalities in function* and appearance
Low Temperature Storage	-20°C for 240 hours	No abnormalities in function* and appearance
High Temperature & High Humidity Storage	60°C, 90%RH for 240 hours	No abnormalities in function* and appearance
Thermal Shock Storage	-20°C to 70 °C for 200 cycles, left at each temperature for 30 min	No abnormalities in function* and appearance
Vibration (storage)	Sweep for 11 min at 10~55Hz, amplitude 1.0 mm, 6 cycles each in the X, Y and Z direction	No abnormalities in function* and appearance
ESD	200pF, 0Ω, ±200V, 1 time each terminal	No abnormalities in function* and appearance
Shock	100G, 6ms, 3 times each in the X, Y and Z direction	No abnormalities in function* and appearance
Electrostatic Discharge test (non operation)	200pF, 0Ω ±200V 1 time/each terminal	
Hitting Durability	At least 1,000,000 times with R8.0 mm silicon rubber, 200g, 3times/sec	
Sliding Durability	At least 1,000,000 times with R8.0 mm polyacetal Stylus, 200g, 3times/sec	

* Current consumption < 2 times initial value

* Contrast > ½ initial value

8.2 LIFE TIME

Item	Description
1	Function, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions of room temperature (25±10 °C), normal humidity (45±20% RH), and in area not exposed to direct sunlight.
2	Function, performance, appearance, etc. shall be free from remarkable deterioration within 5,000 hours under ordinary operating and storage conditions of 70 °C temperature, normal humidity (45±20% RH), and in area not exposed to direct sunlight.

9 PART NUMBER DESCRIPTIONS FOR AVAILABLE OPTIONS

TSR40823①②480G640③④

① **POLARIZER TYPE**
E = Transmissive

② **BACKLIGHT COLOUR**
W = White

③ **FLUID TYPE AND TEMPERATURE RANGE**
H = Wide Temperature Range; negative supply voltage required

④ **FLUID TYPE AND TEMPERATURE COMPENSATION**
R = TFT

10 HANDLING PRECAUTIONS

Safety
If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Mounting and Design
Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.
When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean.
Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD cleaning
Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotriflorothane.
Do not wipe the display surface with dry or hard materials that will damage the polariser surface.
Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against static charge
As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on.
Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

Packaging
Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height.
To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

Caution during operation
It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.
Direct current causes an electrochemical reaction with remarkable deterioration of the display quality.
Give careful consideration to prevent direct current during ON/OFF timing and during operation.
Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged.
If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once.
Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage
Store the display in a dark place where the temperature is 25°C ± 10°C and the humidity below 50%RH.
Store the display in a clean environment, free from dust, organic solvents and corrosive gases.
Do not crash, shake or jolt the display (including accessories).