MULTI-INNO TECHNOLOGY CO., LTD.

LCD MODULE SPECIFICATION

Model : MI0200NT

Revision	
Engineering	
Date	
Our Reference	

DOCUMENT REVISION HISTORY

DOCUMENT REVISION FROM TO	DATE	DESCRIPTION	CHANGED BY	CHECKED BY
A	2007.11.23	First Release.	ZHANG	

CONTENTS

		Page No.
1.	GENERAL DESCRIPTION	4
2.	MECHANICAL SPECIFICATIONS	4
3.	INTERFACE SIGNALS	7
4.	ABSOLUTE MAXIMUM RATINGS	8
4.1	ELECTRICAL MAXIMUM RATINGS - FOR IC ONLY	8
4.2	ENVIRONMENTAL CONDITION	8
5.	ELECTRICAL SPECIFICATIONS	9
5.1	TYPICAL ELECTRICAL CHARACTERISTICS	9
5.2	TIMING SPECIFICATIONS	9
5.3	CONFIGURATION OF POWER SUPPLY CIRCUIT	11
5.4	INSTRUCTION SETTING	12
5.5	POWER SUPPLY SETTING	14
6.	OPTICAL CHARACTERISTICS	15
7.	TFT PANEL INSPECTION SPECIFICATIONS	17
8.	REMARK	19

Preliminary Specification
of
LCD Module Type
Model No.: MI0200NT

1. General Description

- 2.0”, 176 x RGB x 220 dots, 262k colors, transmissive, positive, TFT LCD module.
- Viewing angle: 12 o’clock direction.
- Driving IC: ‘LG’ LGDP4524 TFT controller & driver or equivalent.
- Data interface: 8080 system 16-bits parallel interface.
- White LED backlight.
- FPC connection.
- “RoHS” compliance.

2. Mechanical Specifications

The mechanical detail is shown in Fig. 1 and summarized in Table 1 below.

Table 1

Parameter		Specifications	Unit
Outline dimensions		37.68(W) x 51.3(H) x 3.05(D) (Exclude bending area, component area, cable of backlight and FPC)	mm
TFT 176xRGBx220	Active area	31.68(W) x 39.6(H)	mm
	Display format	176 x RGB x 220	dots
	Color configuration	RGB stripe	-
	Dot pitch	0.18(RGB)(W) x 0.18(H)	mm
Weight		TBD	gram

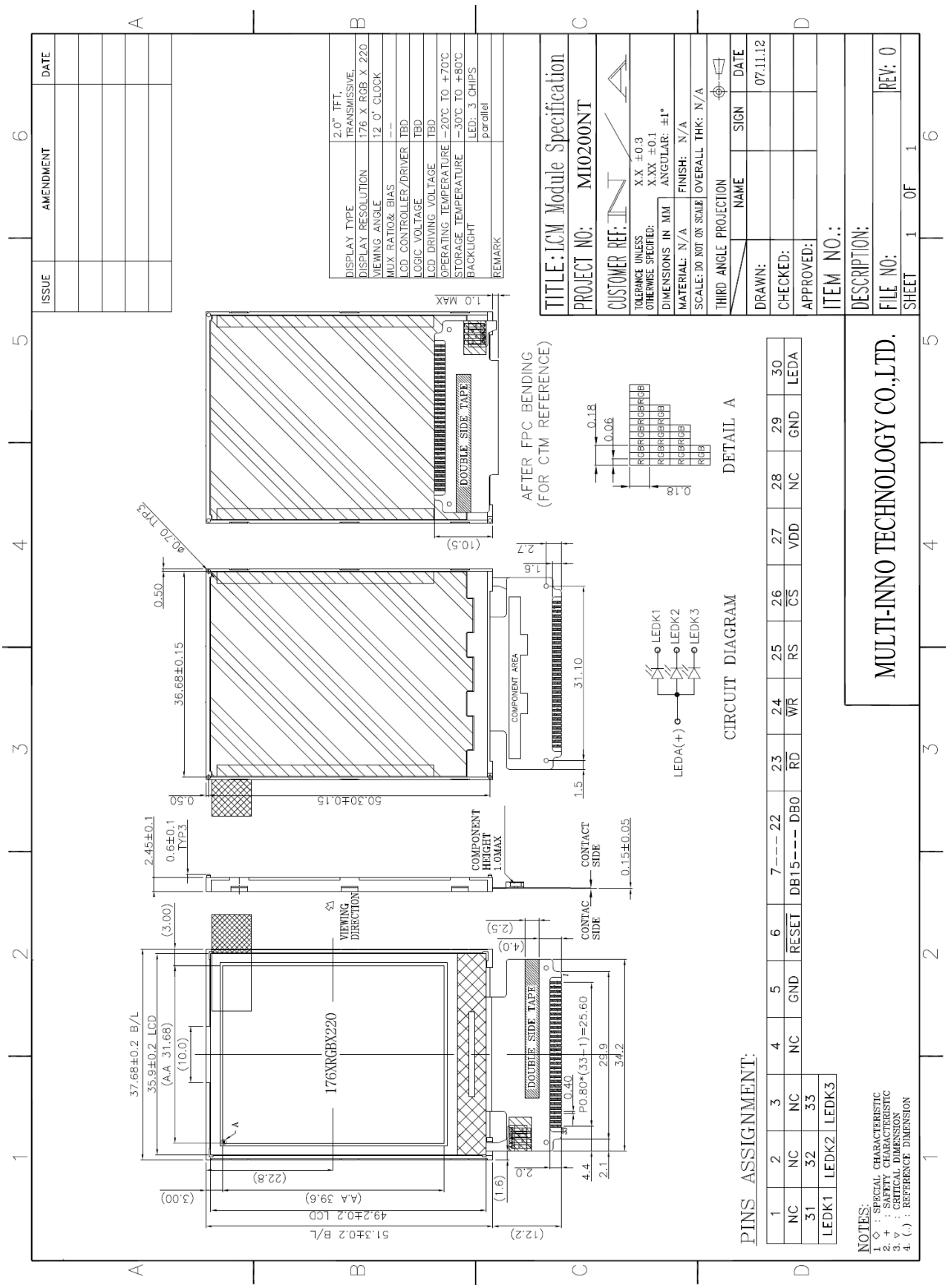


Figure 1: Module Specification

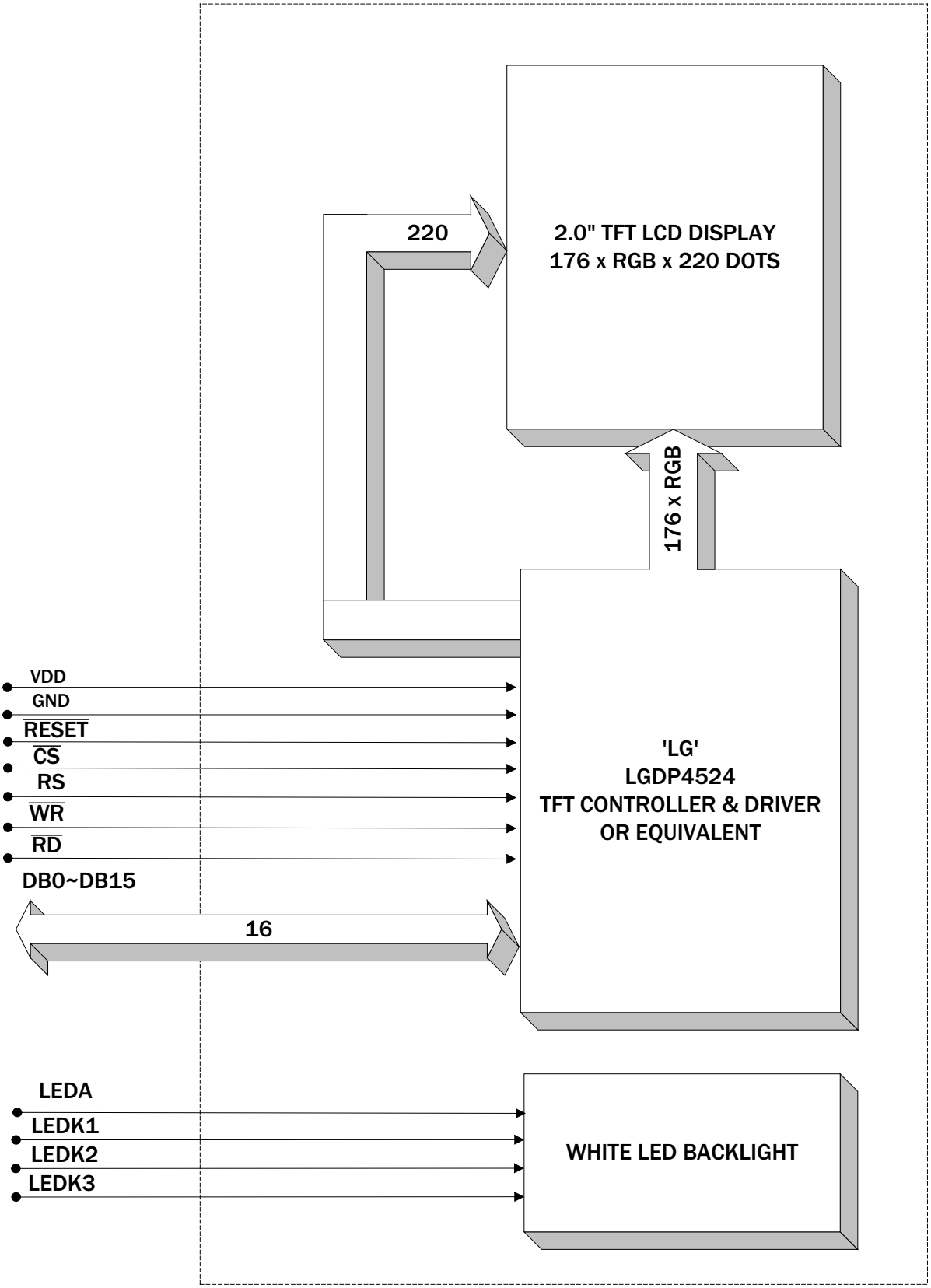


Figure 2: Block Diagram

3. Interface signals

Table 2: Pin assignment

Pin No.	Symbol	Description
1~4	NC	No connection.
5	GND	Ground.
6	$\overline{\text{RESET}}$	Hardware reset (active low). Be sure to execute a power-on reset after supplying power.
7	DB15	Parallel bi directional data bus.
8	DB14	
9	DB13	
10	DB12	
11	DB11	
12	DB10	
13	DB9	
14	DB8	
15	DB7	
16	DB6	
17	DB5	
18	DB4	
19	DB3	
20	DB2	
21	DB1	
22	DB0	
23	$\overline{\text{RD}}$	Read strobe (active low) in 80-system bus interface mode.
24	$\overline{\text{WR}}$	Write strobe (active low) in 80-system bus interface mode.
25	RS	Register select signal. Low: selects the index/status register. High: selects a control register.
26	$\overline{\text{CS}}$	Chip select signal (active low). Low: LGDP4524 is selected and accessible. High: LGDP4524 is not selected and not accessible.
27	VDD	Power supply.
28	ID	No connection.
29	GND	Ground.
30	LEDA	Anode of LED backlight input.
31	LEDK1	Cathode of LED backlight input.
32	LEDK2	Cathode of LED backlight input.
33	LEDK3	Cathode of LED backlight input.

4. Absolute Maximum Ratings

4.1 Electrical Maximum Ratings – for IC Only

Table 3

Parameter	Symbol	Min.	Max.	Unit	Notes
Power Supply Voltage (1)	VCC,IOVCC	-0.3	4.2	V	1,2
Power Supply Voltage (2)	VCI-GND	-0.3	4.2	V	1,3
Power Supply Voltage (3)	DDVDH-GND	-0.3	7.7	V	1,4
Power Supply Voltage (4)	GND-VCL	-0.3	4.2	V	1
Power Supply Voltage (5)	VCI-VCL	-0.3	7.7	V	1,5
Power Supply Voltage (6)	VGH-GND	-0.3	18	V	1,6
Power Supply Voltage (7)	GND-VGL	-0.3	18	V	1,7
Input voltage	Vt	-0.3	4.2	V	1

Notes: 1. If used beyond the absolute maximum ratings, the LSI may permanently be damaged. It is strongly recommended to use the LSI at a condition within the electrical characteristics for normal operation. Exposure to a condition not within the electrical characteristics may affect device reliability.
2. Make sure (High) Vcc ≥ GND (Low), (High) IOVcc ≥ GND (Low).
3. Make sure (High) Vci ≥ GND (Low).
4. Make sure (High) DDVDH ≥ GND (Low).
5. Make sure (High) Vci ≥ VCL (Low).
6. Make sure (High) VGH ≥ GND (Low).
7. Make sure (High) GND ≥ VGL (Low).

4.2 Environmental Condition

Table 4

Item	Operating temperature (Topr)		Storage temperature (Tstg) (Note 1)		Remark
	Min.	Max.	Min.	Max.	
Ambient temperature	-20°C	+70°C	-30°C	+80°C	Dry
Humidity (note 1)	90% max. RH for Ta ≤ 40°C < 50% RH for 40°C < Ta ≤ Maximum operating temperature				No condensation
Vibration (IEC 68-2-6) cells must be mounted on a suitable connector	Frequency: 10 ~ 55 Hz Amplitude: 0.75 mm Duration: 20 cycles in each direction.				3 directions
Shock (IEC 68-2-27) Half-sine pulse shape	Pulse duration: 11 ms Peak acceleration: 981 m/s^2 = 100g Number of shocks: 3 shocks in 3 mutually perpendicular axes.				3 directions

Note 1: Product cannot sustain at extreme storage conditions for long time.

5. Electrical Specifications

5.1 Typical Electrical Characteristics

At Ta = 25 °C, VDD= 2.8V, GND=0V.

Table 5

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power supply voltage	VDD		2.5	2.8	3.3	V
TFT gate ON voltage	VGH(Note 1)		12	-	18	V
TFT gate OFF voltage	VGL(Note 2)		-11	-	-7	V
TFT common electrode voltage	Vcom (Note 3)		-2	-	5	V
Input signal voltage	V_{IH}	"H" level	0.8IOVCC	-	IOVCC	V
	V_{IL}	" L" level	-0.3	-	0.2IOVCC	V
Supply current (Logic)	IDD	VDD=2.8V	-	TBD	-	mA
Supply voltage of white LED backlight	VLED	Forward current =15mA x 3 =45mA Number of LED dies = 3	3.0	3.2	3.4	V
Luminance (on the backlight surface)			3200	-	-	cd/m^2

Note (1): VGH is TFT Gate operating voltage.
Note (2): VGL is TFT Gate operating voltage.
The low voltage level VGL signal must be fluctuates with same phase as Vcom in case of Cadd (Storage on Gate) structure.
Note (3): Vcom must be adjusted to optimize display quality.

5.2 Timing Characteristics

5.2.1 Reset Operation

Table 6: Reset Timing Characteristics

Item	Symbol	Unit	Min	Typ	Max
Reset "Low" level width	t_{RES}	ms	1	-	-
Reset rise time	t_{rRES}	us	-	-	10

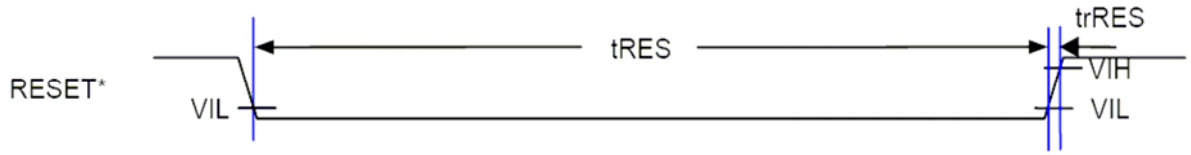
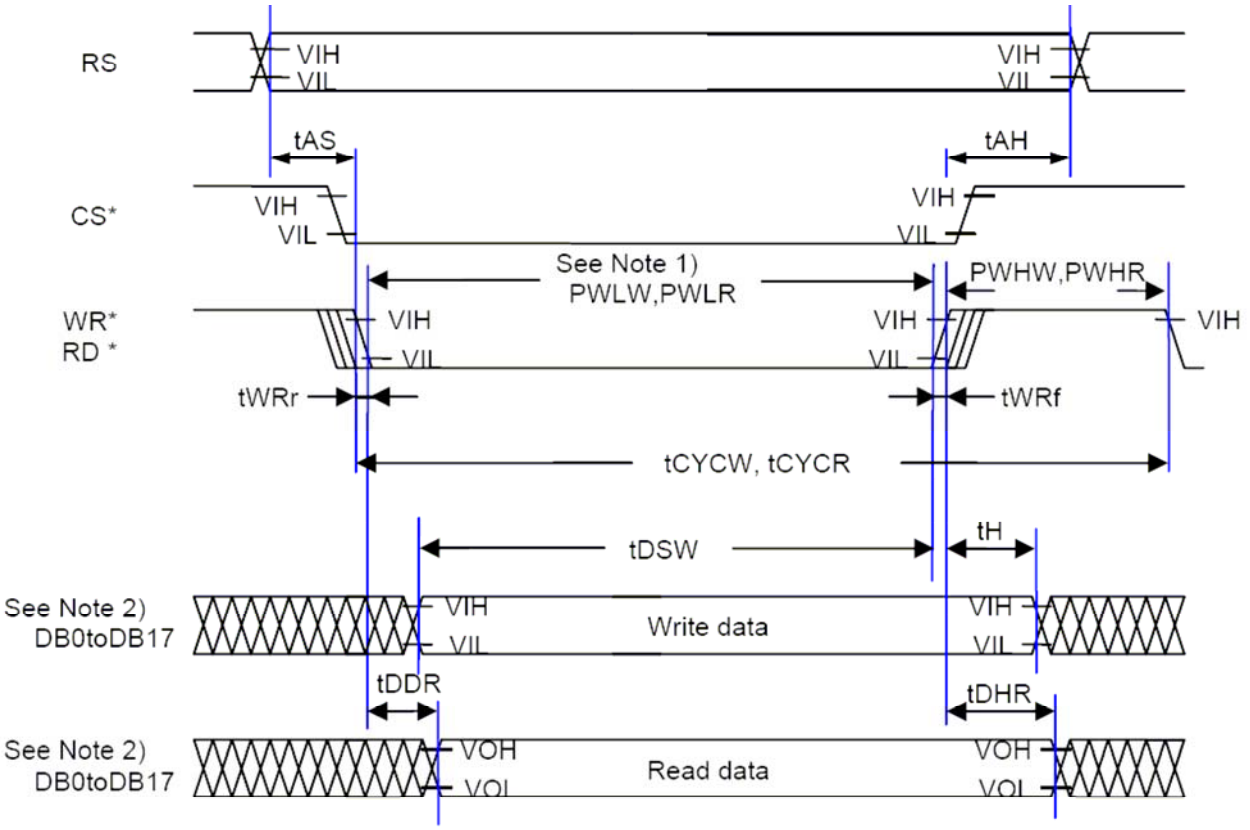


Figure 3: Reset operation

5.2.2 80-System Bus Interface Timing Characteristics

Table7

Item		Symbol	Unit	Min	Typ	Max
Bus cycle time	Write	t_{CYCW}	ns	100	-	-
	Read	t_{CYCR}		250	-	-
Write "Low" level pulse width	Write	PW_{LW}	ns	40	-	-
Read "Low" level pulse width	Read	PW_{LR}		150	-	-
Write "High" level pulse width	Write	PW_{HW}	ns	30	-	-
Read "High" level pulse width	Read	PW_{HR}		100	-	-
Write/Read rise/fall time		t_{WRr}, t_{WRf}	ns	-	-	25
Setup time	Write (RS to CS*/WR*)	t_{AS}	ns	0	-	-
	Read (RS to CS*/RD*)			10	-	-
Address hold time		t_{AH}	ns	2	-	-
Write data setup time		t_{DSW}	ns	25	-	-
Write data hold time		t_H	ns	2	-	-
Read data delay time		t_{DDR}	ns	-	-	100
Read data hold time		t_{DHR}	ns	5	-	-

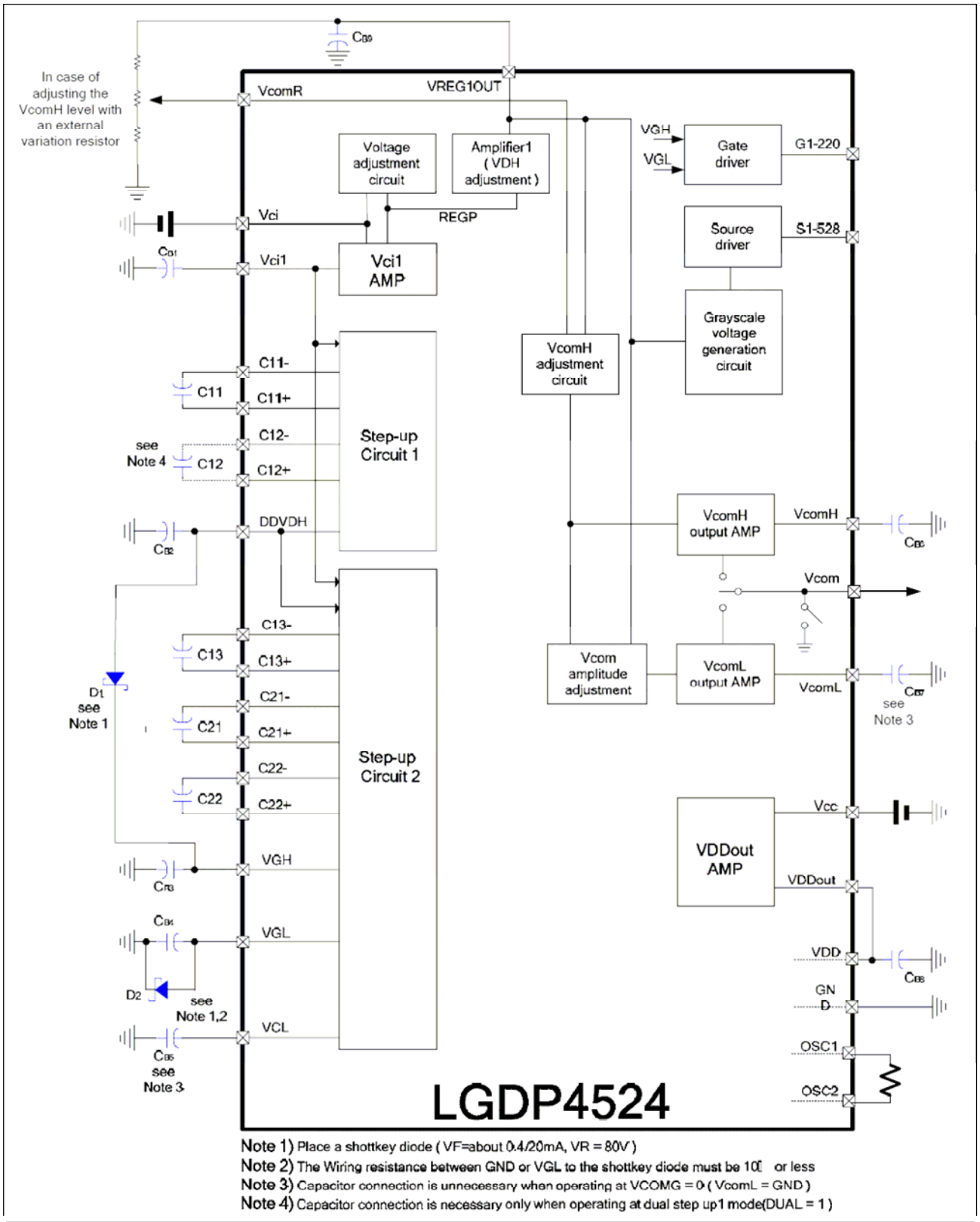


Note 1) PWLW and PWLR are defined by the overlap period when CS* is "Low" and WR* or RD* is "Low".
Note 2) Unused DB pins must be fixed at "Vcc" or "GND".

Figure 4: 80-system bus interface operation

5.3 Configuration of Power Supply Circuit

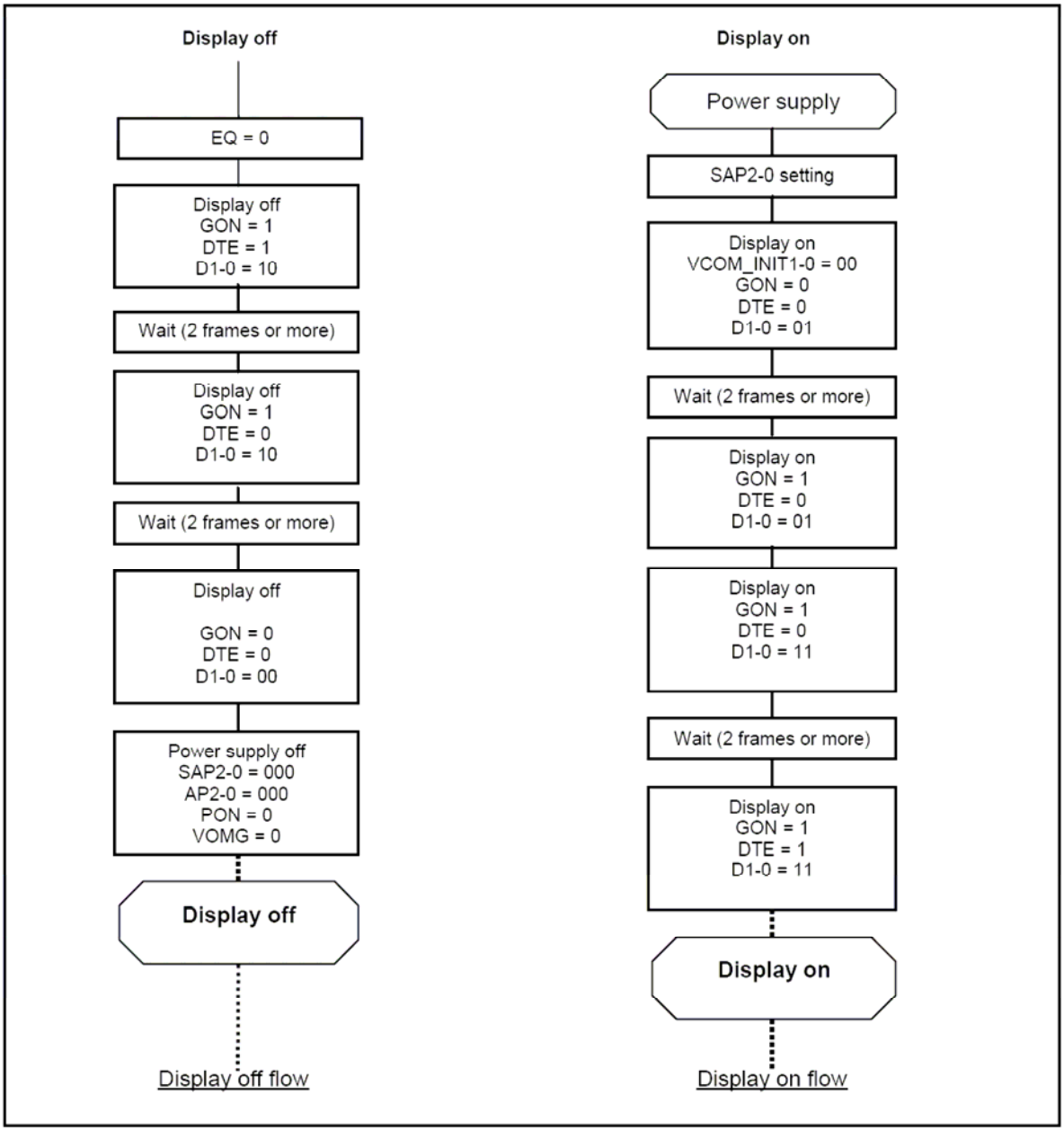
The follow are the configuration of power supply circuit to generate liquid crystal panel drive levels.



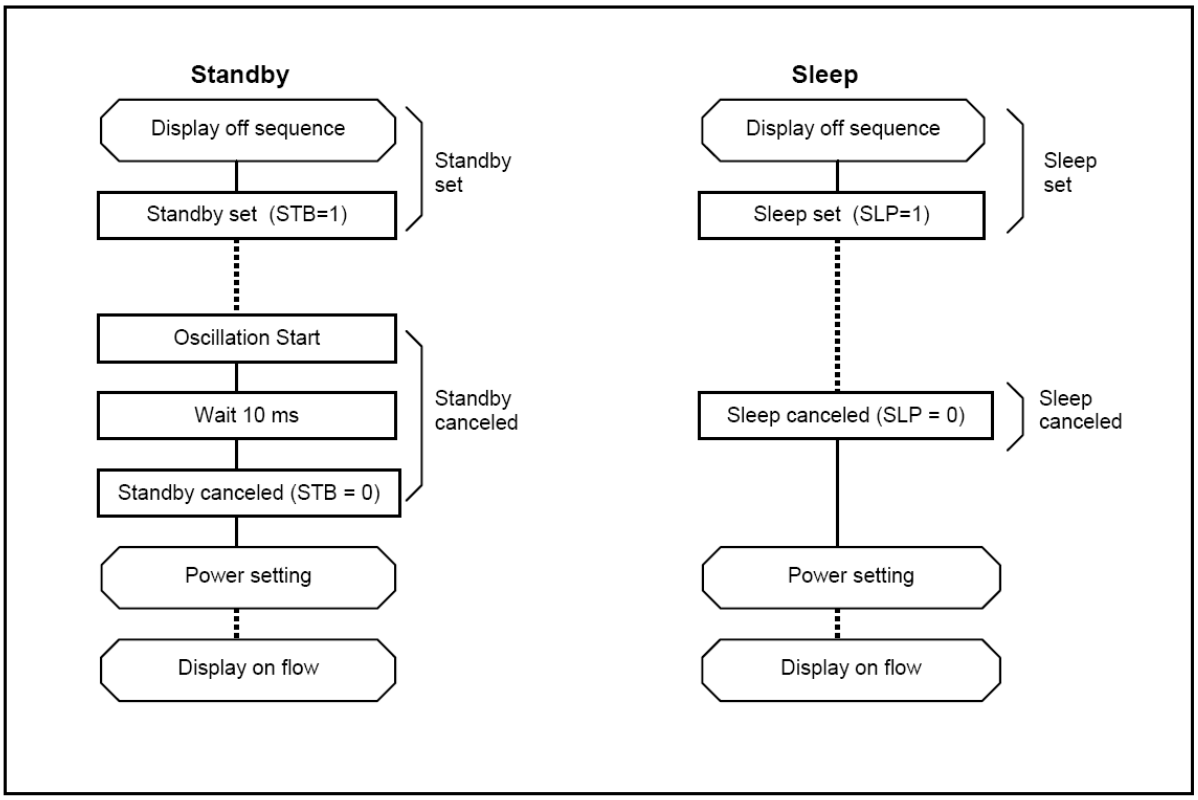
5.4 Instruction Setting

When setting the following instructions, follow respective sequences below.

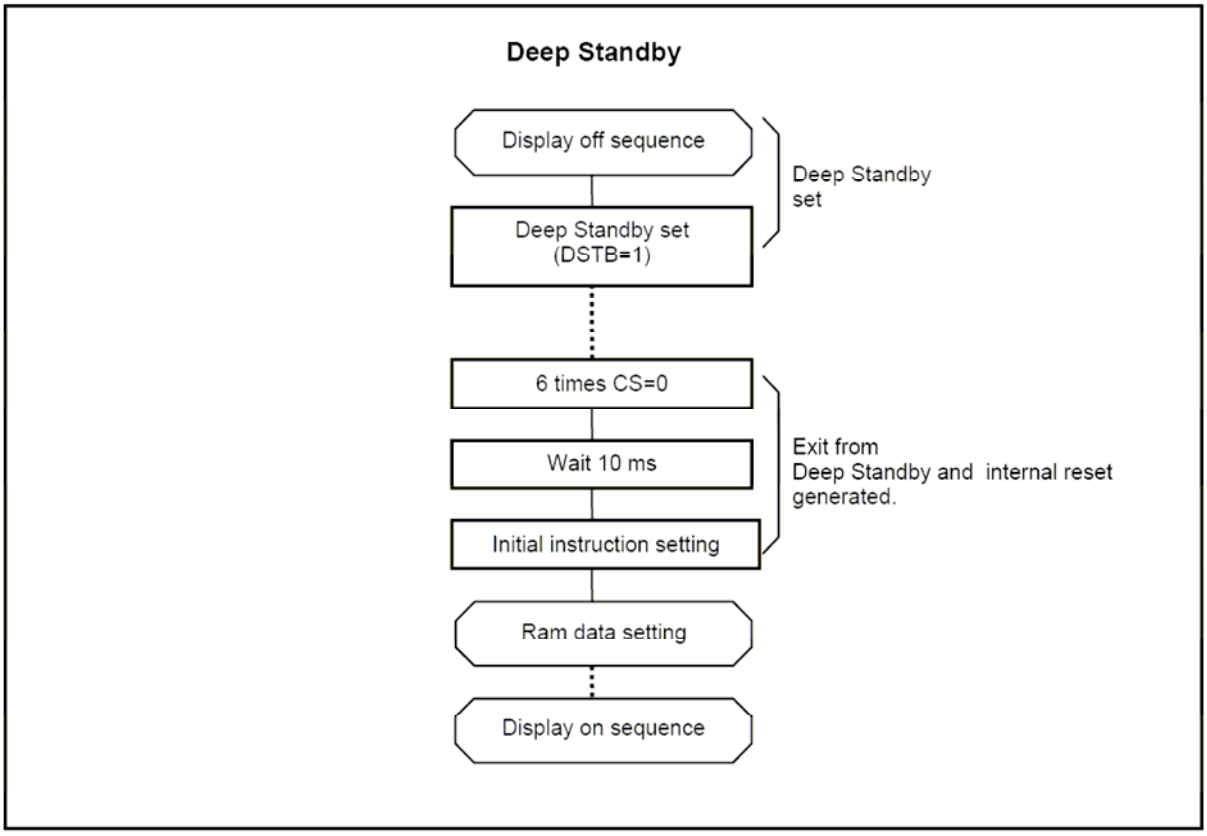
Display On/Off



Standby and Sleep Modes



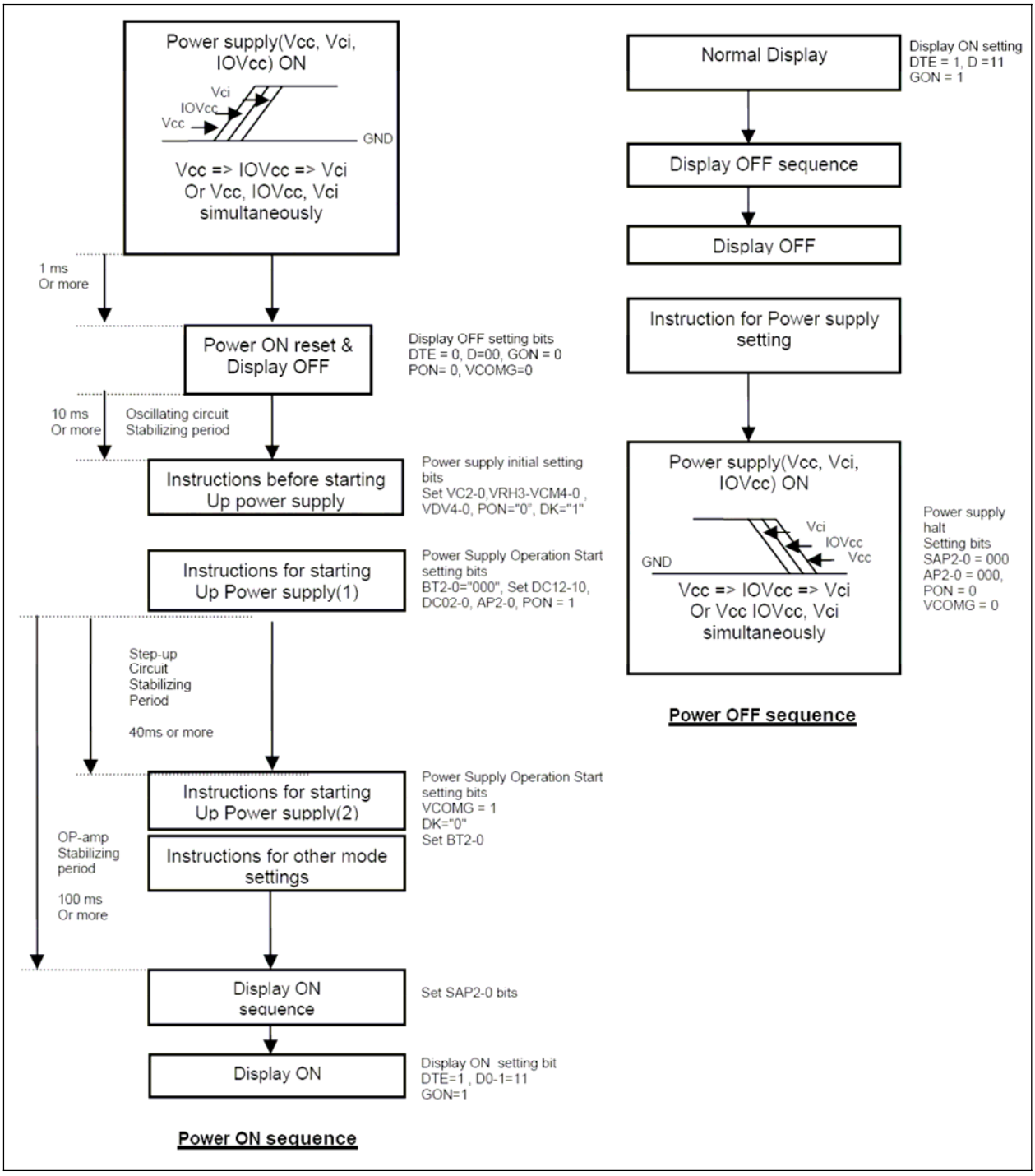
Deep Standby Mode



5.5 Power Supply Setting

When supplying and cutting off power, follow the sequence below.

The setting time for oscillators, step-up circuits and operational amplifiers depends on external resistance and capacitance.



6. Optical Characteristics (for reference only)

Table 8: Optical specifications (With TN LC + Polarizer,Note 1, Note 2, Note 3)

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Threshold voltage		Vsat		2.2	2.3	2.4	V	Fig. 5
		Vth		1.3	1.4	1.5	V	
Viewing Angle range	Horizontal	Θ_3	CR > 10		45		Deg.	Note 1
		Θ_9			45		Deg.	
	Vertical	Θ_{12}			50		Deg.	
		Θ_6			20		Deg.	
Contrast ratio		CR	Θ = 0°		300			Note 2
Transmittance		T(%)	Θ = 0°		6.4 (15)			Note 3
White Chromaticity		x_w	Θ = 0°	0.287	0.307	0.327		Note 4 *Color Filter Glass
		y_w		0.315	0.335	0.355		
Reproduction Of color	Red	x_R	Θ = 0°	0.624	0.644	0664		
		y_R		0326	0.346	0.366		
	Green	x_G		0.285	0.305	0.325		
		y_G		0.561	0.581	0.601		
	Blue	x_B		0.115	0.135	0.155		
		y_B		0.116	0.136	0.156		
Response Time		Tr+Tf	Θ = 0°		25		msec	Note 5

Note: 1. Viewing angle is the angle at which the contrast ratio is greater than 10.
The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface (see figure 6 shown in Appendix).

2. Contrast measurements shall be made at viewing angle of Θ= 0°and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See figure 6 shown in Appendix) Luminance Contrast Ratio (CR) is defined mathematicallv.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3.Transmittance is the value with Polarizer(Without Polarizer).

4.The color chromaticity coordinates specified in Table 8shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the C/F. Measurement condition is C -light source & Halogen Lamp

.5.The electro-optical response time measurements shall be made as figure 7 shown in Appendix by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is Tr, and 90% to 10% is Td.

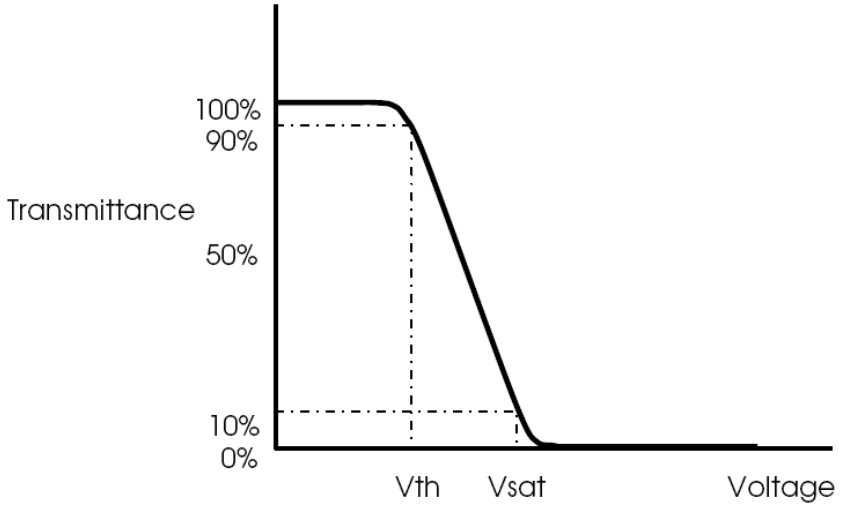


Figure 5: The definition of Vth & Vsat

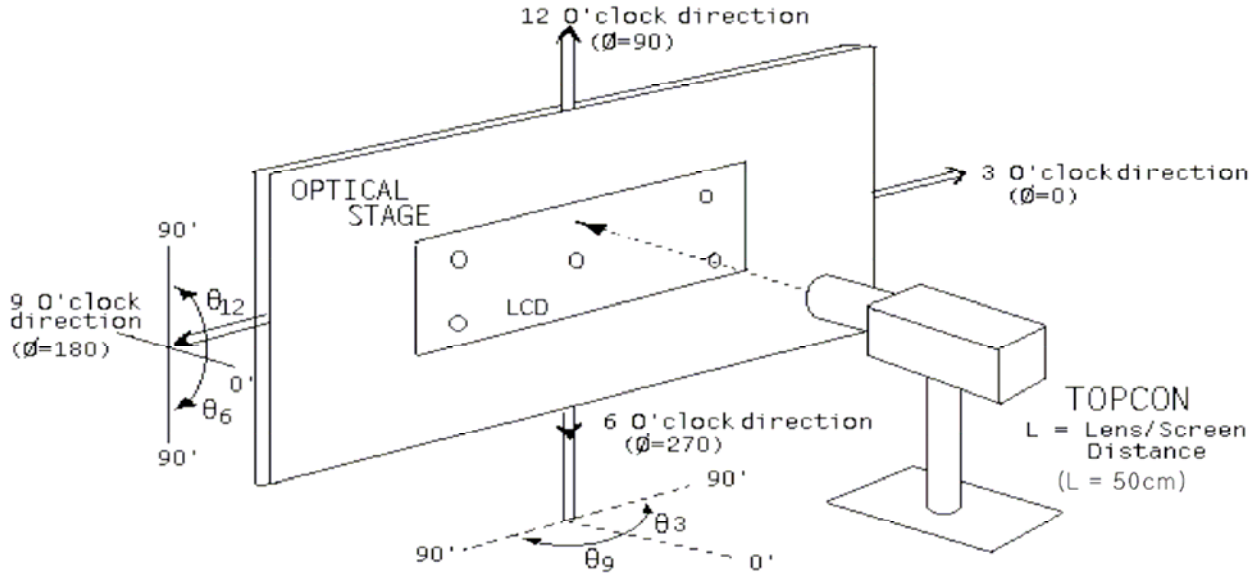


Figure 6: Measurement Set Up

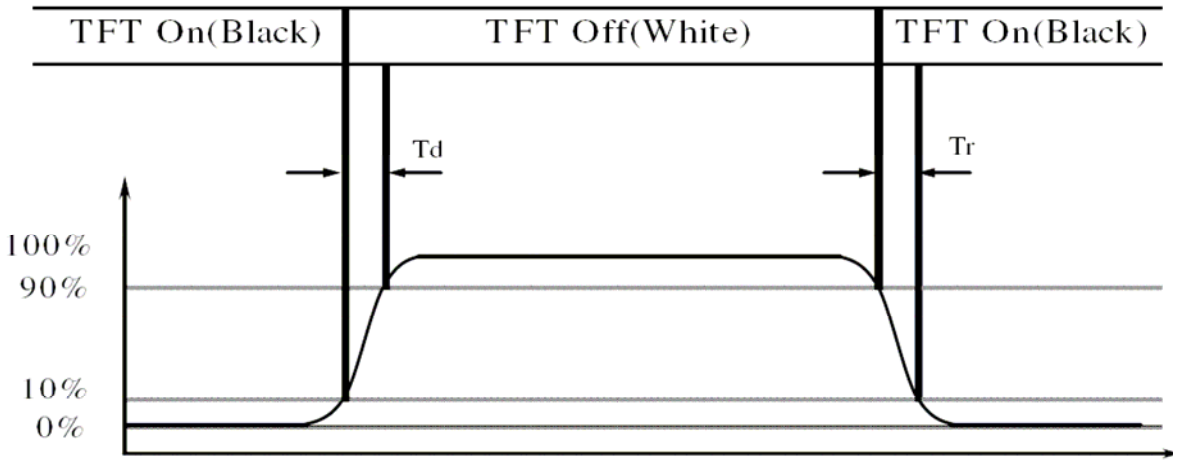
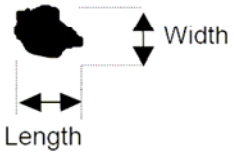
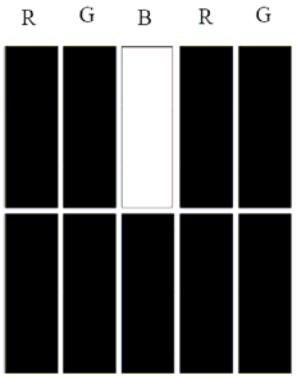
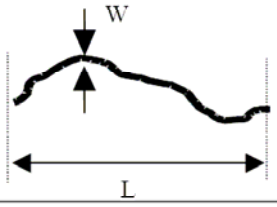
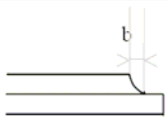
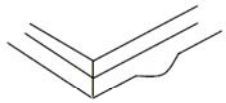
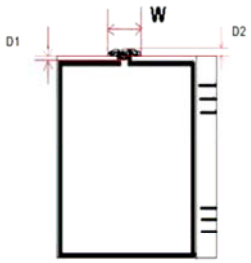
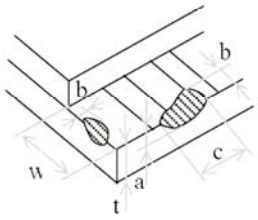
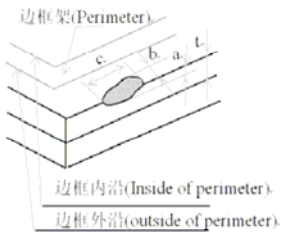
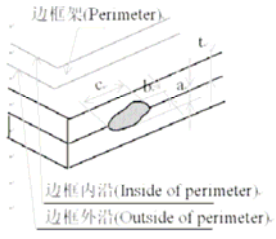
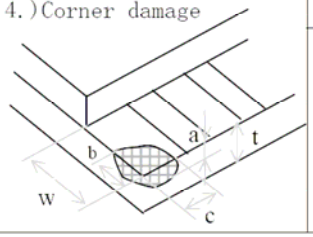


Figure 7: Response Time Testing

7. TFT Panel Inspection Specifications

Failure mode	Illustration	Category (Unit: mm)		Acceptable count	
				Viewing area	Non-Viewing area
Black spot White spot	 Φ= (Length+width)/2	A	Φ≦0.10	Not count	Not count
		B	0.10<Φ≦0.15	The gap between the two spots should be 5 mm and above.After divided the display into 9 zones with equal area, only 2 spots are acceptable in each zone.	
		C	0.15<Φ≦0.25	2	
		D	0.25<Φ	0	
Bright spot (Red spot, green spot and blue spot caused by damaged colour filter)		A	Area≦1 sub-pixel	The gap between the two spots should 5 mm and above.	N/A
Black line White line		A	W≦0.05	Not count	Not count
		B	0.05<W≦0.08, L≦8.0	2	
		C	0.08<W or L>8.0	Judged by spot spec	

Below are cosmetic inspection specifications

<table>
<tr><td rowspan="2">Excess glass</td><td> 
</td><td>b≦1.0, this defect shall not affect the outline dimension or assembly process.(Remarks: For COG process, the defect size is decided by the dimension of LCD panel.)</td></tr>
<tr><td>  </td><td>This defect shall not affect the outline dimension or assembly process.</td></tr>
<tr><td>The depth of UV glue entered in LCD cell</td><td> 
</td><td>a. D1≥0.2，not enter into viewing area
b. D2≦0.8,
c. W=End mouth width + (2~6 mm)</td></tr>
<tr><td rowspan="4">Glass defect (scratch, damage)</td><td>1.) LCD ledge damage
 
</td><td colspan="2">Category
A: The defect shall not affect the outline dimension or assembly process at non ITO zone.
B: b≦1/4w, a & c not count (at ITO zone)
C: Alignment mark on LCD ledge shall not be damaged.</td></tr>
<tr><td>2.) Outside of perimeter damage
 
</td><td colspan="2">b can't reach inside of perimeter.</td></tr>
<tr><td>3.) Joint glass damage
 
</td><td colspan="2">b can't reach outside of perimeter or ITO layout.</td></tr>
<tr><td>4.)Corner damage
 
</td><td>A</td><td>a ≦ t， b ≦ 3.0， c ≦ 3.0
B. Alignment mark on LCD ledge shall not be damaged.</td></tr>
<tr><td colspan="3">Remark: A stands for thickness of damage, b for width, c for length and t for glass thickness. (Unit: mm)</td></tr>
</table>

8. Remark

HANDLING LCD AND LCD MODULES

1. Liquid Crystal Display (LCD)

LCD is made up of glass, organic sealant, organic fluid and polymer based polarizers. The following precautions should be taken when handling:

(1) Keep the temperature within range for use and storage. Excessive temperature and humidity could cause polarization degredation, polarizer peel-off or bubble generation. When storage for a long period over 40° C is required, the relative humidity should be kept below 60%.
(2) Do not contact the exposed polarizers with anything harder than an HB pencil lead. To clean dust off the display surface, wipe gently with cotton, chamois or other soft material soaked in petroleum benzin. Never scrub hard.
(3) Varitronix does not responsible for any polarizer defect after the protective film has been removed from the display
(4) Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or color fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.
(5) PETROLEUM BENZIN is recommended to remove adhesives used to attach front/rear polarizers and reflectors, while chemicals like acetone, toluene, ethanol and isopropyl alcohol will cause damage to the polarizer. Avoid oil and fats. Avoid lacquer and epoxies which might contain solvents and hardeners to cause electrode errosion. Some solvents will also soften the epoxy covering the DIL pins and thereby weakening the adhesion of the epoxy on glass. This will cause the exposed electrodes to erode electrochemically when operating in high humidity and condensing environment.
(6) Glass can be easily chipped or cracked from rough handling, especially at corners and edges.
(7) Do not drive LCD with DC voltage.
(8) When soldering DIL pins, avoid excessive heat and keep soldering temperature between 260°C to 300°C for no more than 5 seconds. Never use wave or reflow soldering.

2. Liquid Crystal Display Modules (MDL)

2.1 Mechanical Considerations

MDL's are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.
(1) Do not tamper in any way with the tabs on the metal frame.
(2) Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.
(3) Do not touch the elastomer connector (conductive rubber), especially when inserting an EL panel.
(4) When mounting a MDL make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
(5) Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.
(6) If FPCA need to be bent, please refer the suggested bending area on the specification. The stiffener and component area on FPC/FFC/COF must not be bent during or after assembly (Note: for those models with FPC/FFC/COF +stiffener).
(7) Sharp bending should be avoided on FPC to prevent track cracking.

2.2 Static Electricity

MDL contains CMOS LSI's and the same precaution for such devices should apply, namely:

(1) The operator should be grounded whenever he comes into contact with the module. Never touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any part of the human body.
(2) The modules should be kept in antistatic bags or other containers resistant to static for storage.
(3) Only properly grounded soldering irons should be used.
(4) If an electric screwdriver is used it should be well grounded and shielded from commutator sparks.
(5) The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended.
(6) Since dry air is inducive to statics, a relative humidity of 50 - 60% is recommended.

2.3 Soldering

(1) Solder only to the I/O terminals.
(2) Use only soldering irons with proper grounding and no leakage.
(3) Soldering temperature is 280°C ± 10°C .
(4) Soldering time: 3 to 4 seconds.
(5) Use eutectic solder with resin flux fill.
(6) If flux is used. the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.
(7) Use proper de-soldering methods (e.g. suction type desoldering irons) to remove lead wires from the I/O terminals when necessary. Do not repeat the soldering/ desoldering process more than three times as the pads and plated through holes may be damaged.

2.4 Label

Identification labels will be stuck on the module without obstructing the viewing area of display.

3. Operation

(1) The viewing angle can be adjusted by varying the LCD driving voltage Vo.
(2) Driving voltage should be kept within specified range, excess voltage shortens display life.
(3) Response time increases with decrease in temperature.
(4) Display may turn black or dark Blue at temperatures above its operational range; this is however not destructive and the display will return to normal once the temperature falls back to range.
(5) Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured". They will recover once the display is turned off.
(6) Condensation at terminals will cause malfunction and possible electrochemical reaction. Relative humidity of the environment should therefore be kept below 60%.
(7) Display performance may vary out of viewing area. If there is any special requirement on performance out of viewing area, please consult Varitronix.

4. Storage and Reliability

(1) LCD's should be kept in sealed polyethylene bags while MDL's should use antistatic ones. If properly sealed, there is no need for desiccant.
(2) Store in dark places and do not expose to sunlight or fluorescent light. Keep the temperature between 0°C and 35°C and the relative humidity low. Please consult MULTI-INNO for other storage requirements.
(3) Water condensation will affect reliability performance of the display and is not allowed.
(4) Semi-conductor device on the display is sensitive to light and should be protected properly.
(5) Power up/down sequence.
   a) Power Up: in general, LCD supply voltage, Vo must be supplied after logic voltage, VDD becomes steady. Please refer to related IC data sheet for details.
   b) Power Down: in general, LCD supply voltage, Vo must be removed before logic voltage, VDD turns off. Please refer to related IC data sheet for details.

5. Safety

If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all times.

LIMITED WARRANTY

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

1. The liability of MULTI-INNO is limited to repair or replacement on the terms set forth below. MULTI-INNO will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user.

   Unless otherwise agreed in writing between MULTI-INNO and the customer, MULTI-INNO will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with MULTI-INNO LCD Acceptance Standards (copies available on request), for a period of one year from the date of shipment. Confirmation of such date shall be based on freight documents.

2. No warranty can be granted if any of the precautions stated in HANDLING LCD and LCD Modules above have been disregarded. Broken glass, scratches on polarizers, mechanical damages as well as defects that are caused by accelerated environmental tests are excluded from warranty.
3. In returning the LCD and Modules, they must be properly packaged and there should be detailed description of the failures or defects.

IMPORTANT NOTICE

The information presented in this document has been carefully checked and is believed to be accurate, however, no responsibility is assumed for inaccuracies. MULTI-INNO reserves the right to make changes to any specifications without further notice for performance, reliability, production technique and other considerations, MULTI-INNO does not assume any liability arising out of the application or use of products herein. Please see Limited Warranty in the previous section.

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