



**MULTI-INNO TECHNOLOGY CO., LTD.**

# **LCD MODULE SPECIFICATION**

**Model : MI0350CT-4**

Revision	V0.1
Engineering	
Date	
Our Reference	

**Revision Record**

Date	Rev. No.	Page	Revision Items	Prepared
2008/02/02	0.0		Initial Release	Xiaorong Liu
2008/03/15	0.1		Modify Power Supply Mode,Add AVDD/VGH/VGL, Outside DC/DC Circuit And VCOM Circuit Is Needed To Driver This Module.	Xiaorong Liu



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## 1. Description

MI0350CT-4 is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver IC, FPC, a back light unit and TSP (Touch Screen Panel). The 3.5" display area contains 320 x (RGB) x 240 pixels and can display up to 16.7M colors. This product accords with RoHS environmental criterion.

## 2. Applications

- ◆ Portable Multimedia Player (PMP)
- ◆ Global Position System (GPS)

## 3. Features

- ◆ 8 bits color depth
- ◆ Using the 4-wires Touch Screen Panel
- ◆ Digital 24-bits RGB /S-RGB/ CCIR601/CCIR656 Interface supported

## 4. General Specifications

Item	Specification	Unit	Remark
Display Mode	Normally White	-	-
Display Technology	$\alpha$ -Si TFT active matrix	-	-
Outline Dimension	78.2(H)X65.0(V)X4.6(T)	mm	Note 4-1
Active Area	70.08(H)X52.56(V)	mm	-
Resolution	320X(RGB)X240	dots	-
Pixel Pitch	219X219	$\mu$ m	-
Pixel Configuration	RGB Stripe	-	-
Weight	(TBD)	g	-
Backlight	6*LED	-	-
Luminance	250(Typ.)	cd/m <sup>2</sup>	-
Surface Treatment	Anti-Glare	-	-
Signal Interface	Digital 24-bits RGB /S-RGB/ CCIR601/CCIR656	-	Note 4-2
Viewing Direction	12	o'clock	Note 4-3
Power consumption	TBD	mW	Note 4-4

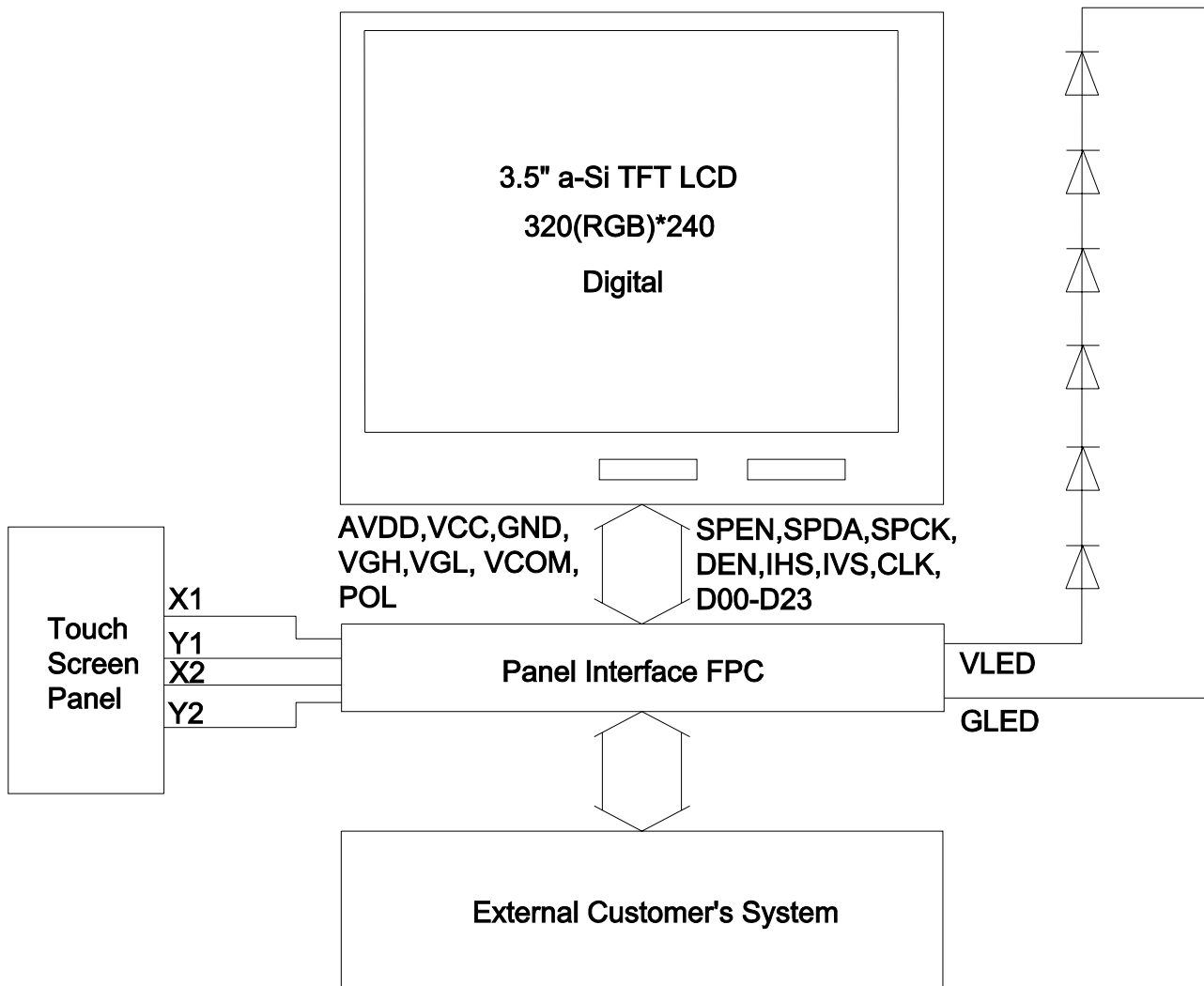
Note 4-1: Refer to the mechanical drawing on page 22.

Note 4-2: Signal Interface can be selected by Register R03 Bit [3:0].Refer to Note 6-2 for more details.

Note 4-3: Refer the definition of the viewing direction on page 19.

Note 4-4: The Power Consumption is a calculated reference value ( $P_{LCD}+P_{LED}$ ).

## 5. Block Diagram





## 6. Interface

(Recommended Connector: MOLEX 51296-6051)

Pin No.	Symbol	I/O	Description	Remark
1	GLED	I	Backlight LED Ground	-
2	GLED	I	Backlight LED Ground	-
3	VLED	I	Backlight LED Power	-
4	VLED	I	Backlight LED Power	-
5	GND	-	Ground	-
6	X1	I	X_Right	-
7	Y1	I	Y_Bottom	-
8	X2	I	X_Left	-
9	Y2	I	Y_Up	-
10	GND	-	Ground	-
11	NC	-	No Connection	-
12	NC	-	No Connection	-
13	POL	O	The signal to generate Vcom	-
14	RESET	I	Hardware Reset	-
15	SPENA	I	Chip Select	Note 6-1
16	SPCK	I	Serial Clock	Note 6-1
17	SPDA	I	Serial Data	Note 6-1
18	D00	I	Blue Data (LSB)	-
19	D01	I	Blue Data	-
20	D02	I	Blue Data	-
21	D03	I	Blue Data	-
22	D04	I	Blue Data	-
23	D05	I	Blue Data	-
24	D06	I	Blue Data	-
25	D07	I	Blue Data(MSB)	-
26	D08	I	Green Data(LSB)	-
27	D09	I	Green Data	-
28	D10	I	Green Data	-
29	D11	I	Green Data	-
30	D12	I	Green Data	-



31	D13	I	Green Data	-
32	D14	I	Green Data	-
33	D15	I	Green Data (MSB)	-
34	D16	I	Red Data (LSB)	-
35	D17	I	Red Data	-
36	D18	I	Red Data	-
37	D19	I	Red Data	-
38	D20	I	Red Data	-
39	D21	I	Red Data	-
40	D22	I	Red Data	-
41	D23	I	Red Data (MSB)	-
42	IHS	I	Horizontal Sync Input	-
43	IVS	I	Vertical Sync Input	-
44	CLK	I	Dot Data Clock	-
45	AVDD	I	Analog Power	-
46	AVDD	I	Analog Power	-
47	VCC	I	Digital Power	-
48	VCC	I	Digital Power	-
49	NC	-	No Connection	-
50	VGL	I	Gate off Power	-
51	VGL	I	Gate off Power	-
52	NC	-	No Connection	-
53	VGH	I	Gate on Power	-
54	NC	-	No Connection	-
55	NC	-	No Connection	-
56	VCOM	I	Driving Input	-
57	VCOM	I	Driving Input	-
58	DEN	I	Data Enable Input	-
59	GND	I	Ground	-
60	GND	I	Ground	-

Note 6-1: SPI Timing please refers to 10.3.

For S-RGB/CCIR601/CCIR656 interface, only D16~D23 is used. For unused pin, Please connect to GND. The interface is selected by the SPI initial code.

**SEL[3:0]: Data input mode**

SEL3	SEL2	SEL1	SEL0	Data input format	Operating frequency
0	0	0	0	CCIR601 YUV 1280 input format (YUV mode A)	24.54 MHz
0	0	0	1	CCIR601 YUV 1280 input format (YUV mode B)	24.54 MHz
0	0	1	0	CCIR601 YUV 1440 input format (YUV mode A)	27 MHz
0	0	1	1	CCIR601 YUV 1440 input format (YUV mode B)	27 MHz
0	1	0	0	CCIR656 YCbCr input format (YcbCr mode A)	27 MHz
0	1	0	1	CCIR656 YCbCr input format (YcbCr mode B)	27 MHz
0	1	1	0	-	-
0	1	1	1	-	-
1	0	0	0	8-bit digital RGB input format HV Mode (NTSC only)	27 MHz
1	0	0	1	8-bit digital RGB input format DE Mode (NTSC only)	27 MHz
1	0	1	0	8-bit digital RGB through mode input format HV Mode (NTSC only)	27 MHz
1	0	1	1	8-bit digital RGB through mode input format DE Mode (NTSC only)	27 MHz
1	1	0	0	24-bit digital RGB input format HV Mode (NTSC only)	6.4 MHz
1	1	0	1	24-bit digital RGB input format DE Mode (NTSC only)	6.4 MHz
1	1	1	0	-	-
1	1	1	1	-	-

Note : Hsync and Vsync will be floated in CCIR656 and DE mode

Remark:

YUV mode A: Data sequence are "Cb\_Y\_Cr\_Y..."

YUV mode B: Data sequence are "Cr\_Y\_Cb\_Y..."

RGB through mode will bypass 3-wire SWD[2:0] function; TCON will not arrange data color mapping.

## 7. Absolute Maximum Ratings

(GND=0V, Ta=25°C)

Item		Symbol	Min.	Max.	Unit	Remark
Supply Voltage for Source Driver	Analog	AVDD	-0.3	+7.0	V	-
	Digital	VCC	-0.3	+7.0		-
Supply Voltage for Gate Driver	Positive	VGH	-0.3	+32	V	-
	Negative	VGL	-22	+0.3		-
	-	VGH -VGL	-0.3	+45		-
Storage Temperature(Ambient)		T <sub>STG</sub>	-30	+80	°C	Note 7-1,2
Operation Temperature(Ambient)		T <sub>OPR</sub>	-20	+70	°C	Note 7-1,2,3,4

Note 7-1: No parameter is allowed to exceed to the temperature range.

Note 7-2: 95% RH Max. (40 °C ≥ Ta )

Maximum wet-bulb temperature at 39°C or less. (Ta >40 °C) No dew condensation.

Note 7-3: Only operation is guaranteed at operating temperature. Contrast, response time and another display quality are evaluated at +25°C.

Note 7-4: The ambient temperature, when backlight is on. (Reference)



## 8. Electrical Conditions

### 8.1 TFT- LCD Panel Driving Section

(Ta=25°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Digital Power Supply	VCC	3	3.3	3.6	V	-
Digital Operation Current	IVCC	-	TBD	-	mA	Note 8-1
Analog Power Supply	AVDD	3.8	5.0	5.5	V	-
Analog Operation Current	IAVDD	-	TBD	-	mA	Note 8-1
Gate on Power	VGH	-	15	-	V	-
Gate on Current	IVGH	-	TBD	-	mA	Note 8-1
Gate off Power	VGL	-	-10	-	V	-
Gate off Current	IVGL	-	TBD	-	mA	Note 8-1
VCOM	VCOMDC	1.0	-	2.26	V	Note 8-2
	VCOMAC	4.6	-	6.1	V	
Frame Frequency	f <sub>FRAME</sub>	-	60	-	Hz	-
Dot Data Clock	CLK	-	6.4	-	MHz	-
Power Consumption	P <sub>LCD</sub>	-	38	-	mW	Note 8-3

Note 8-1: IVCC, IAVDD, IVGH, IVGL were tested under the condition of VCC=3.3V&AVDD=5.0V, displaying a 8-grayscale graphic.

Note 8-2: VCOMDC VCOMAC: Adjust the color with gamma data.

Note 8-3: The P<sub>LCD</sub> is calculated by a reference value of  $VCC \times IVCC + AVDD \times IAVDD$ .

### 8.2 Backlight Driving Section



(Ta=25°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
LED Voltage	V <sub>L</sub>	-	19.8	-	V	-
LED Current	I <sub>L</sub>	-	20	-	mA	-
Power Consumption	P <sub>LED</sub>	-	384	-	mW	Note 8-4
Life Time	-	-	(50,000)	-	hrs	Note 8-5

Note 8-4: P<sub>LED</sub> is a calculated reference value (I<sub>L</sub> × V<sub>L</sub>);

Note 8-5: The "lamp life time" is defined as the module luminance decrease to 50% original luminance at Ta=25°C, I<sub>L</sub>=20 mA. (This is the reference value)

## 9. Touch Screen Panel Specifications

### 9.1 Electrical Characteristics

Item	Min.	Typ.	Max	Unit	Remark
Linearity	-1.5	-	1.5	%	Analog X and Y directions
Terminal resistance	160	-	640	$\Omega$	X(Film side)
	160	-	840	$\Omega$	Y(Film side)
Insulation resistance	25	-	-	M $\Omega$	DC 25V
Voltage	-	-	7	V	DC
Chattering	-	-	10	ms	100K $\Omega$ pull-up
Transparency	-	80	-	%	Non-glare

Caution: Do not operate it with a thing expect a polyacetal pen (tip R0.8mm or less) or a finger especially those with hard of sharp tips such as a ball point pen or a mechanical pencil.

### 9.2 Mechanical & Reliability Characteristics

Item	Min.	Typ.	Max.	Unit.	Remark
Activation force	-	-	80	G	Note 9-1
Durability-surface scratching	Write 100,000	-	-	Characters	Note 9-2
Durability-surface pitting	1000 ,000	-	-	Touches	Note 9-3
Surface Hardness	3	-	-	H	JIS K5400_ASTM D3363

Note 9-1: Styles pen Input: R0.8mm polyacetal pen or finger

Note 9-2: Measurement for surface area

- Scratch 100,000 times straight line on the film with a stylus change every 20,000 times
- Force: 250 gf
- Speed: 60mm/sec
- Stylus: R0.8mm polyacetal tip

Note 9-3: Pit 1,000,000 times on the film with a R0.8mm silicon rubber.

- Force: 250 gf
- Speed: 2times/sec

## 10. Timing Characteristics

### 10.1 Timing Conditions

#### 10.1.1 Parallel 24 Bit RGB Mode

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Remark
CLK	Frequency	Fclk	-	6.4	-	MHz	-
	CLK cycle time	Tclk	-	156		ns	-
	CLK pulse duty	Tcwh	40	50	60	ns	
DATA	Setup Time	Tds	12	-	-	ns	-
	Hold Time	Tdh	12	-	-	ns	-
IHS	Period	TH	-	408	-	CLK	-
	Pulse-Width	Thp	1	-	-	CLK	-
	Pulse Width +Back-Porch	Thp +Thb	-	70	-	CLK	-
	Display Period	Thd	-	320	-	CLK	-
	Front-Porch	Thf	-	18	-	CLK	-
IVS	Period	Tv	-	263	-	TH	
	Pulse-With	Tvp	1	-	-	TH	-
	Pulse-With +Back-Porch	Tvp +Tvb	-	13	-	TH	-
	Display Period	Tvd	-	240	-	TH	-
	Front-Porch	Tvf	-	10	-	TH	-

#### 10.1.2 S-RGB Mode(8 Bit RGB Mode)

Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK frequency	Fclk	-	27		MHz	-
CLK cycle time	Tclk	-	37		ns	-
CLK pulse duty	Tcwh	40	50	60	%	-

#### 10.1.3 CCIR601 Mode A/B

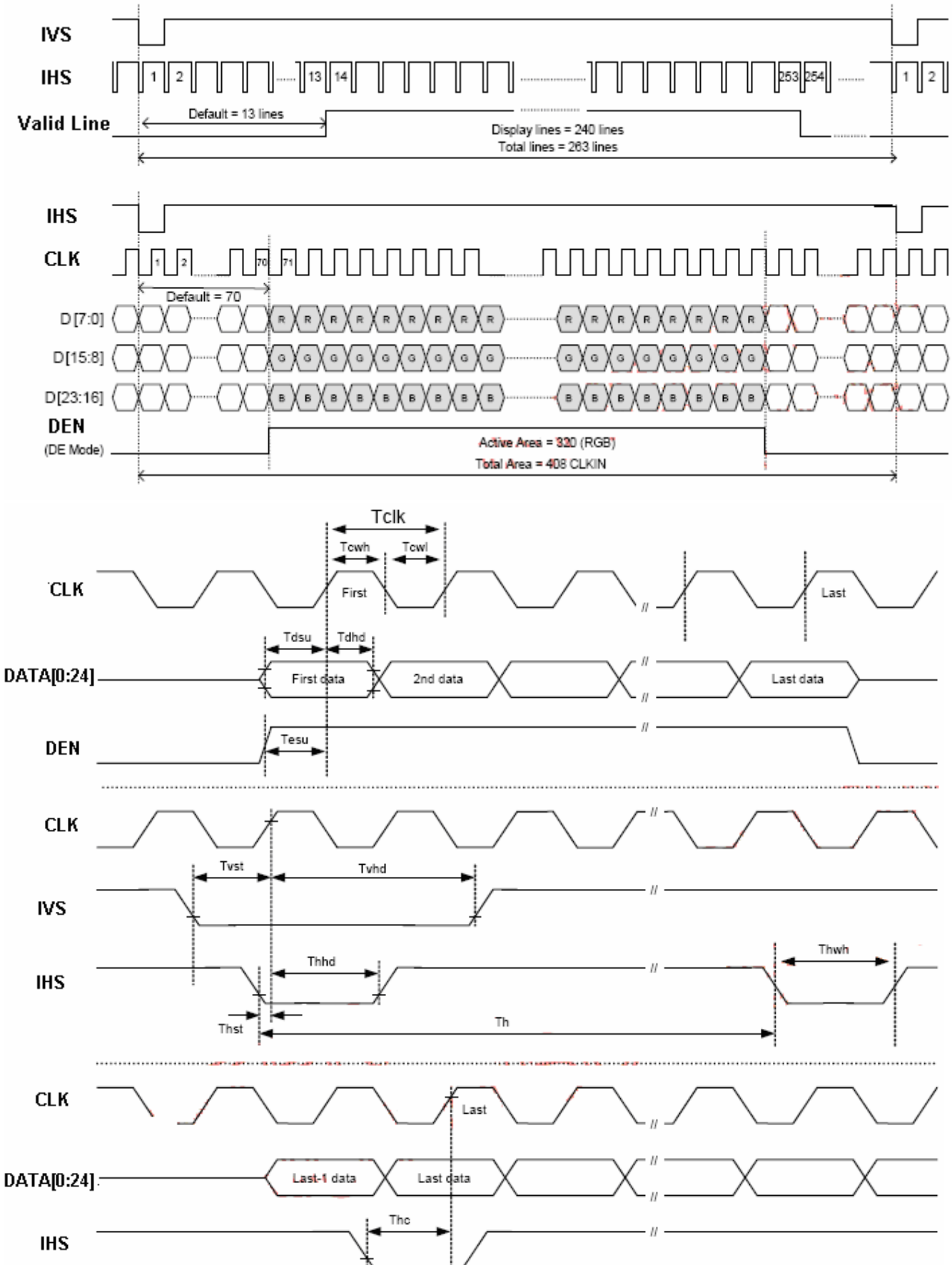
Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK frequency	Fclk	-	24.54/27		MHz	-
CLK cycle time	Tclk	-	40/37		ns	-
CLK pulse duty	Tcwh	40	50	60	%	-

#### 10.1.4 CCIR656 Mode A/B

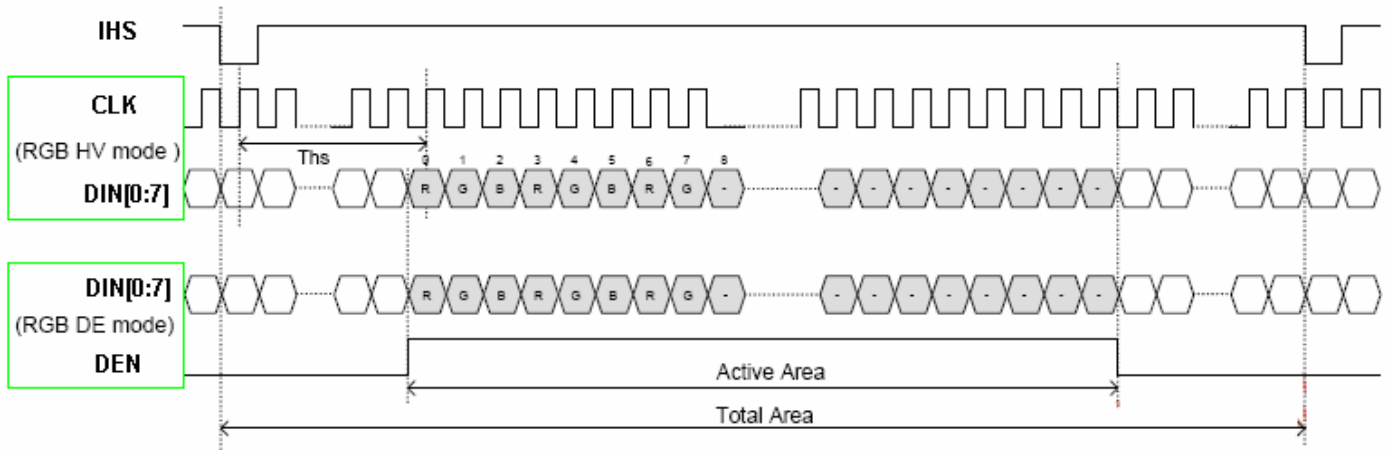
Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
CLK frequency	Fclk	-	27	-	MHz	-
CLK cycle time	Tclk	-	37	-	ns	-
CLK pulse duty	Tcwh	40	50	60	%	-

## 10.2 Timing Diagram

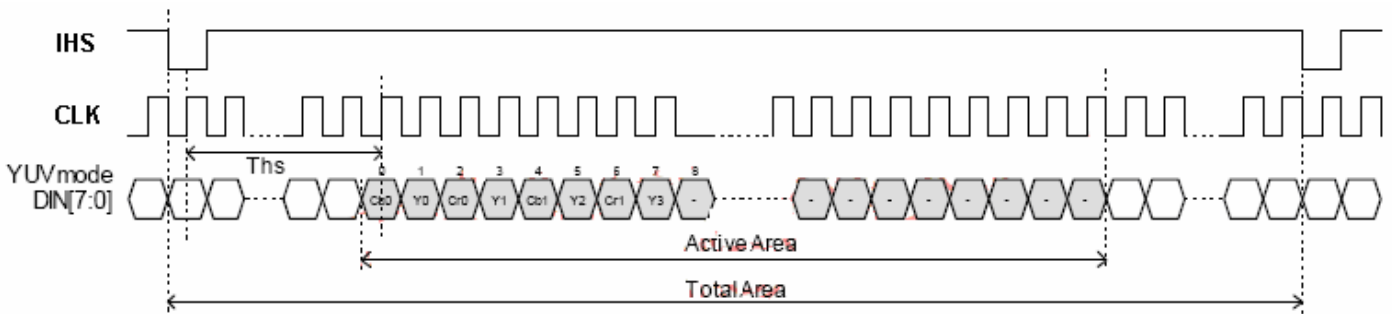
### 10.2.1 Parallel 24-bit RGB Interface



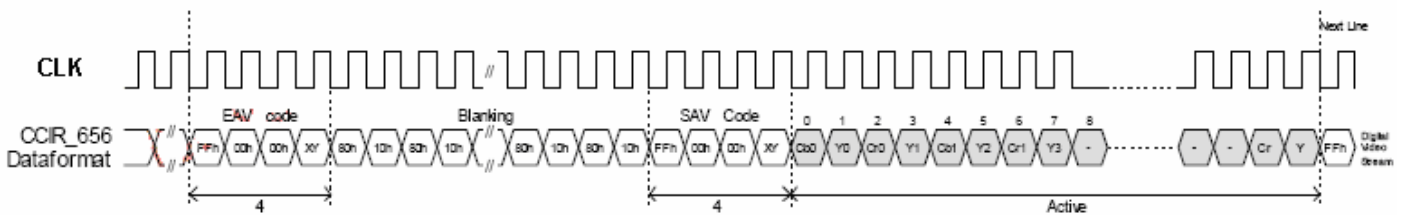
### 10.2.2 S-RGB Mode(8 Bit RGB Mode)



### 10.2.3 CCIR601 Mode A/B

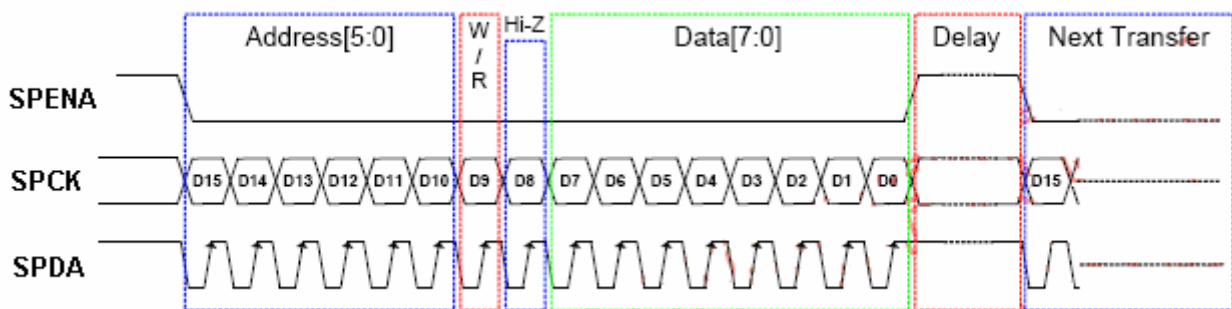


### 10.2.4 CCIR656 Mode A/B



## 10.3 SPI Interface

The SPI is available through the SPENA, SPCK, SPDA. The LCD driver recognizes the start of data transfer at the falling edge of SPENA input to initiate the transfer of start byte, and the end of data transfer at the rising edge of SPENA input.

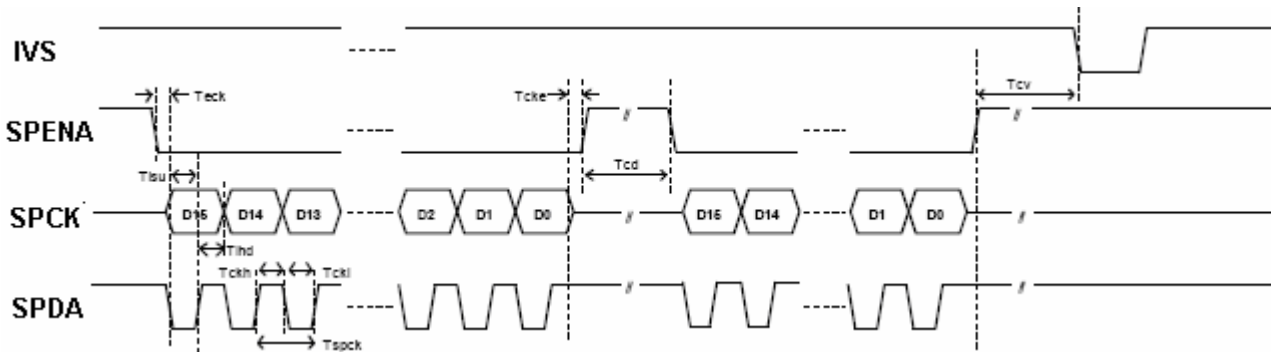


3-Wire Command Format:

Bit	Description
D15-D10	Register Address [5:0].
D9	W/R control bit. "1" for Write; "0" for Read
D8	Hi-Z bit during read mode. Any data within this bits will be ignored during write mode
D7-D0	Data for the W/R operation to the address indicated by Address phase

3-Wire Writer Format:

MSB										LSB					
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Register Address [5:0]						1	X	DATA (Issue by external controller)							

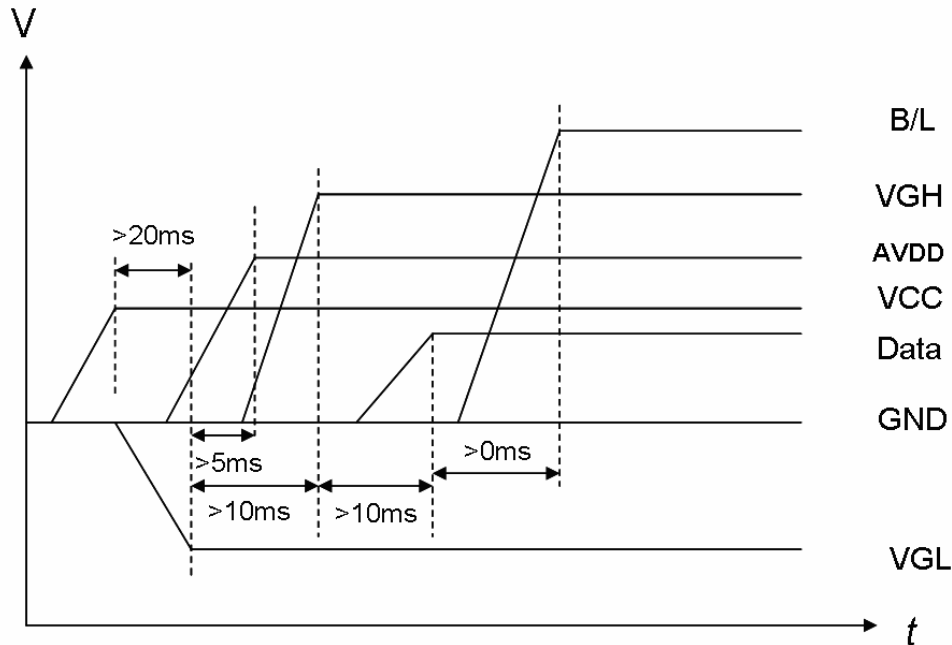


Item	Symbol	Min.	Typ.	Max.	Unit	Conditions
SPCK clock	Tspck	320	-	-	ns	-
SPCK pulse duty	Tscdut	40	50	60	%	-
Serial data setup time	Tisu	120	-	-	ns	-
Serial data hold time	Tihd	120	-	-	ns	-
Serial clock high/low	Tssw	120	-	-	ns	-
SPENA distinguish	Tcd	1	-	-	us	-
SPENA to IVS	Tcv	1	-	-	us	-

## 10.4 Power Sequence

The power on/off sequence is shown below. Please note that the initialization value is just for 24-bit parallel RGB mode, other modes or adjustment will be slightly different. More details please refer to the datasheet of the LCD driver IC.

### Power On Sequence

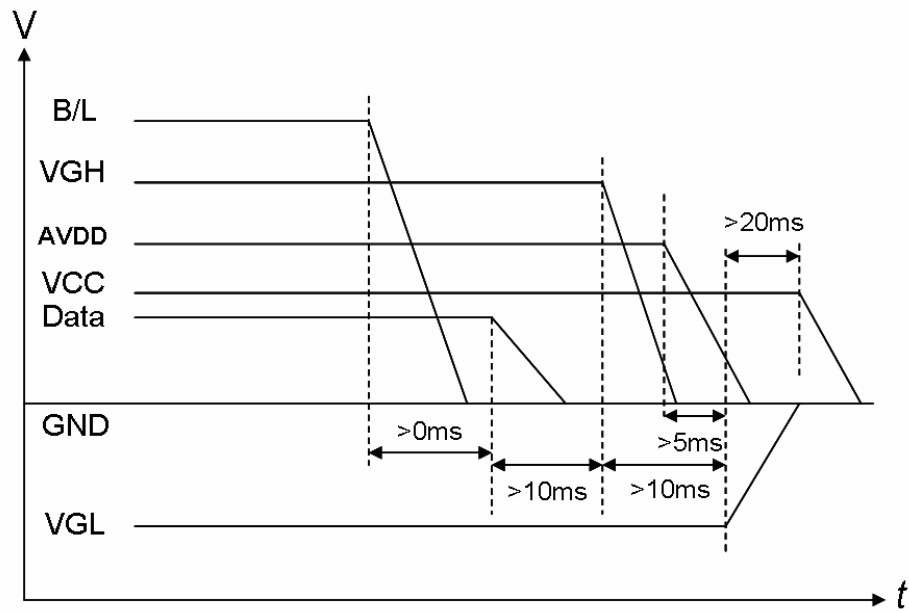


VCC → VGL → AVDD → VGH → Data → B/L

### 3-wire command Initialization

3-Wire Registers		Register Description		
D[15:10]	Name	Init.	R/W	Function Description
000000b	R00	07h	R/W	System control register
000001b	R01	00h	R/W	Timing Controller function register
000010b	R02	03h	R/W	Operation control register
000011b	R03	CCh	R/W	Input data Format control register
000100b	R04	46h	R/W	Source Timing delay control register
000101b	R05	0Dh	R/W	Gate Timing delay control register
000110b	R06	00h	R/W	Reserved
000111b	R07	00h	R/W	Internal function control register
001000b	R08	08h	R/W	RGB Contrast control register
001001b	R09	40h	R/W	RGB Brightness control register
001010b	R0A	88h	R/W	Hue / Saturation control register
001011b	R0B	88h	R/W	R / B Sub-Contrast control register
001100b	R0C	20h	R/W	R Sub-Brightness control register
001101b	R0D	20h	R/W	B Sub-Brightness control register
001110b	R0E	75h	R/W	VCOMDC Level Control Register
001111b	R0F	A4h	R/W	VCOMAC Level Control Register
010000b	R10	04h	R/W	VGAM2 level control register
010000b	R11	24h	R/W	VGAM3/4 level control register
010000b	R12	24h	R/W	VGAM5/6 level control register
010000b	R1E	00h	R/W	VCOMDC Trim function control register
100000b	R20	00h	R/W	Wide and narrow display mode control register

### Power Off Sequence



B/L → Data → VGH → AVDD → VGL → VCC

Note 10-1: Register R03 Bit [1] is STB, STB = "0", TCON, Source output will turn off and outputs are High-Z. STB = "1", Normal operation.

Note 10-2: Apply the LED voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the LEDs turns off, the display may momentarily become white.



## 11. Optical Characteristics

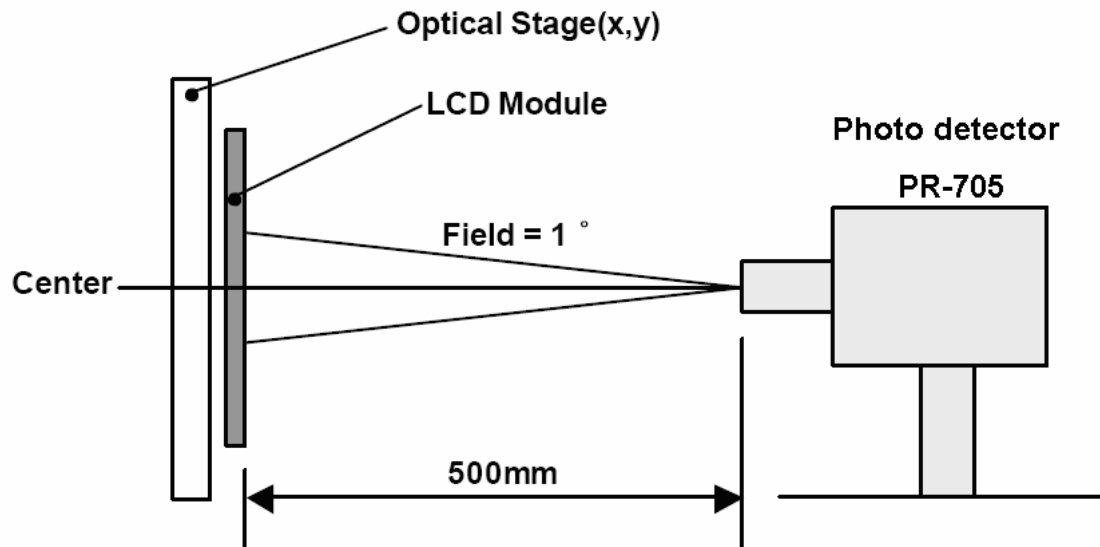
 (Ta = 25 °C, I<sub>f</sub> = 20 mA, V<sub>L</sub> = 19.8 V)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle	Horizontal	$\Theta_L$	Center CR≥10	50	60	-	Deg.	Note 11-2
		$\Theta_R$		50	60	-		
	Vertical	$\Theta_U$		40	50	-		
		$\Theta_D$		50	60	-		
Contrast Ratio		CR	At optimized View Angle	(250)	(300)	-	-	Note 11-1,4
Luminance		Y <sub>L</sub>	$\Theta=0^\circ$	(200)	(250)	-	cd/m <sup>2</sup>	Note 11-1,5
Uniformity		L <sub>U</sub>		(70)	(75)	-	%	Note11-1,6
Response Time		T <sub>r</sub>	$\Theta=0^\circ$	-	(10)	(20)	ms	Note 11-7
		T <sub>f</sub>		-	(15)	(30)	ms	
Color Chromaticity	White	X	$\Theta=0^\circ$	-	(0.32)	-	-	-
		Y		-	(0.33)	-		
	Red	X		-	(0.62)	-		
		Y		-	(0.36)	-		
	Green	X		-	(0.35)	-		
		Y		-	(0.55)	-		
	Blue	X		-	(0.14)	-		
		Y		-	(0.10)	-		

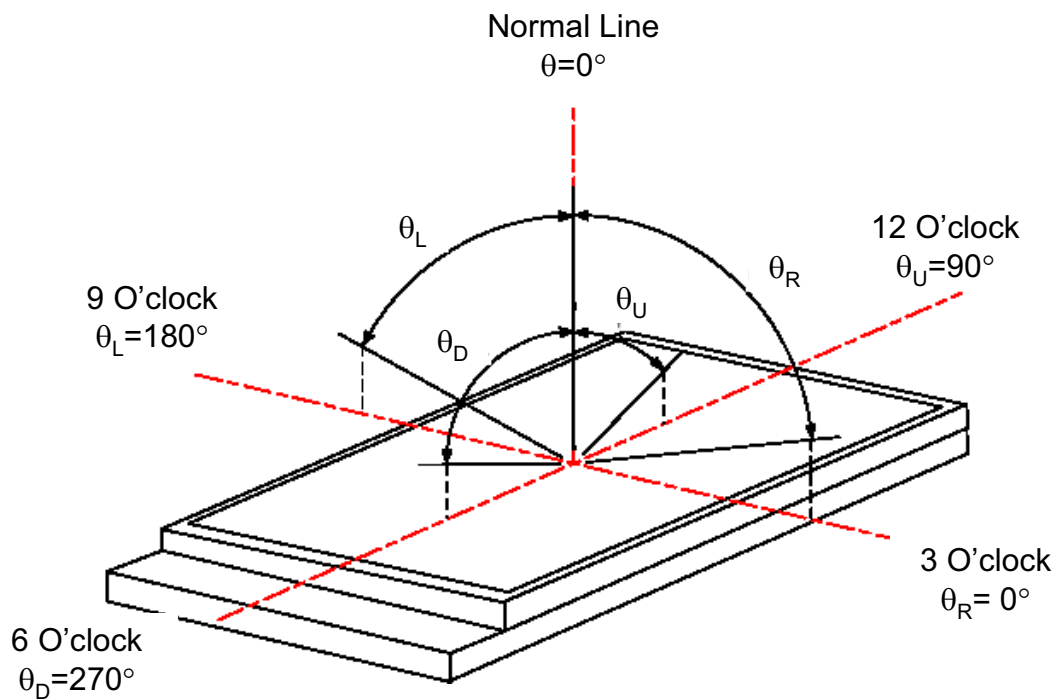
Note 11-1: Measuring equipments: DMS-501, PR-705.

Measuring condition:

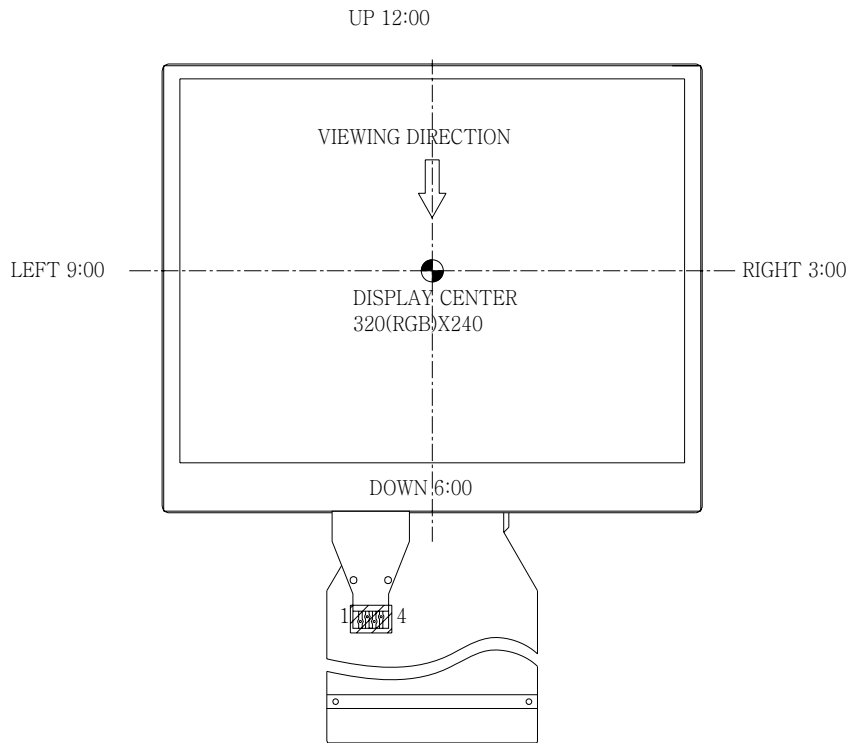
- After stabilizing and leaving the panel alone at a given temperature for 30 min, the measurement should be executed,
- Measuring surroundings: a stable, windless and dark room,
- Measuring temperature:  $T_a=25^{\circ}\text{C}$ ,
- 30 min after lighting the back-light.



Note 11-2: The definition of viewing angle:



Note 11-3: The definition of viewing direction:



\*\*\* The definition of viewing direction is for good image quality, which is 12 O'clock. View Direction for Largest Contrast Ratio is 6 O'clock.

Note 11-4: The contrast ratio (CR) is defined as follows:

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Measure the luminance at the center of the screen.

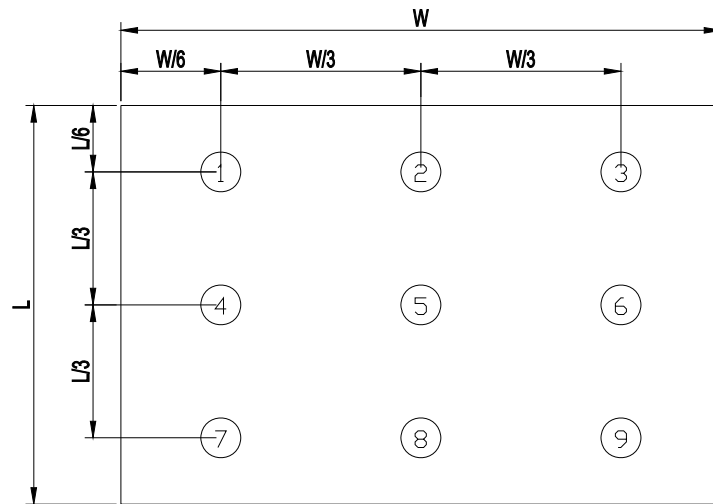
Note 11-5: Definition luminance of White: measure the luminance of White at the center of the screen.

Note 11-6: The definition of luminance uniformity:

The luminance uniformity is calculated by using following formula.

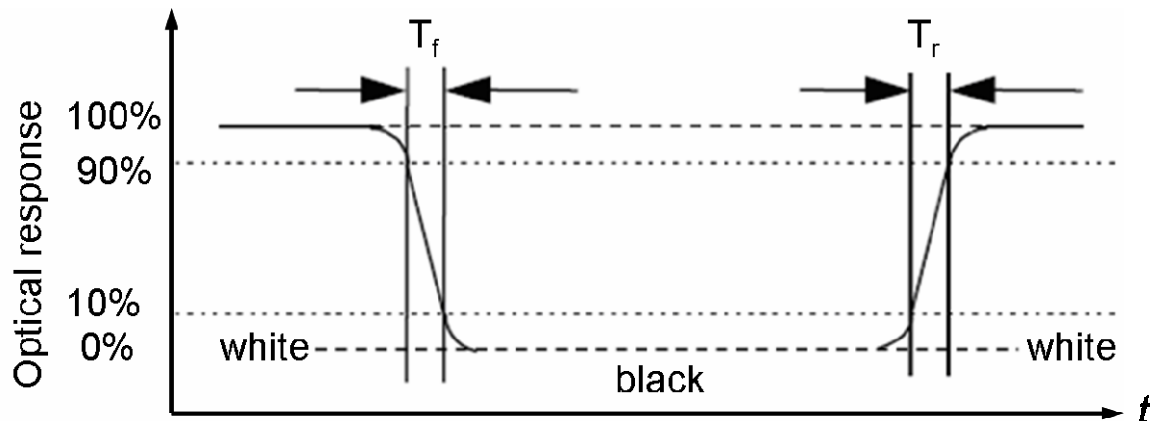
$$\text{Luminance uniformity (Lu)} = \frac{\text{Minimum luminance from ① to ⑨}}{\text{Maximum luminance from ① to ⑨}}$$

The luminance is measured at near the 9 points shown below.



Note 11-7: The definition of response time:

The output signals of photo detector are measured when the input signals are changed from “black” to “white” (falling time) and from “white” to “black” (rising time), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below:



## 12. Reliability Test

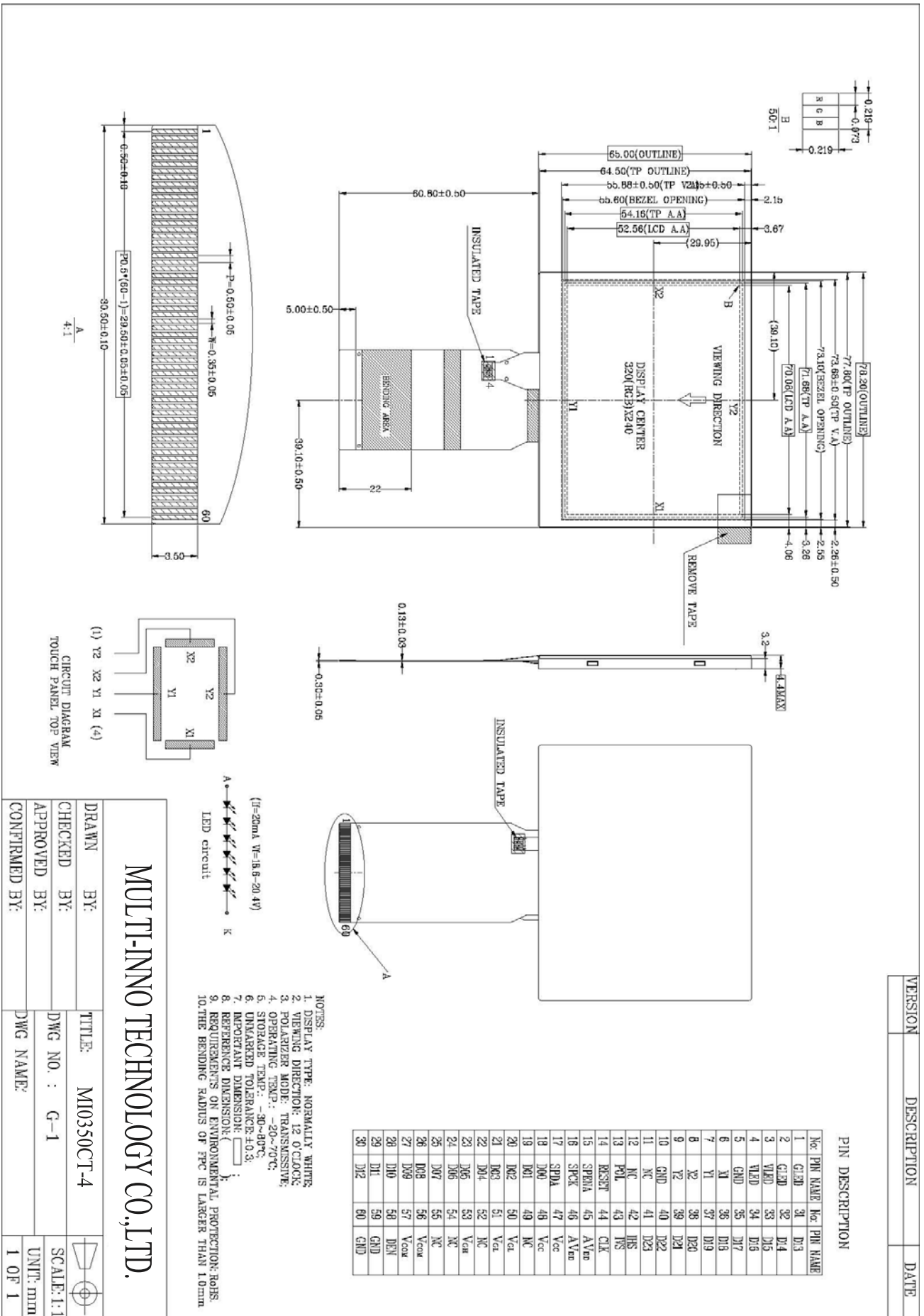
No.	Test Item	Test Condition
1	High Temperature Storage	Ta=+80 °C, 240 hrs
2	Low Temperature Storage	Ta=-30 °C, 240 hrs
3	High Temperature Operation Test	Ta=+70 °C, 240 hrs
4	Low Temperature Operation Test	Ta=-20 °C, 240 hrs
5	High Temperature & High Humidity Operation Test	Ta=+60 °C, 90% RH, 240 hrs
6	Temperature Cycle Test (Non-Operating)	-30 °C ↔ +25 °C ↔ +80 °C, 100 Cycles 30min 5min 30min
7	Vibration Test (Non-Operating)	Frequency: 10 ~150 Hz, Stroke: 1.5mm Sweep time: 11 min Test Period: 6 Cycles for each direction of X,Y,Z, 120 min every direction
8	Shock Test (Non-Operating)	Waveform : Half Sinusoidal Wave Shock Level: 50 G, Pulse Width: 11 ms, Direction: ±X, ±Y, ±Z, Cycle: 3 times
9	Electrical Static Discharge HBM (Operating)	Air : ± 8 kV, 150 pF/ 330 Ω (10 times/point )
		Contact : ± 4 kV, 150 pF/ 330 Ω (10 times/point )

Note 12-1: Ta=Ambient Temperature.

Note 12-2: The tested samples have recovery time for 2hrs at room temperature before estimating these appearance and display effect.

Note 12-3: Under the display quality test conditions with normal operation state, there should be no change which may affect practical display function.

### 13. Mechanical Drawing





## 14. Package

TBD

## 15. Indication of Model number

**MI 0350 C T -4**

**MI MULTI-INNO standard module**

**0350: Display Size is 3.5inch**

**C: Serial Number**

**T: TFT Module**

**-4: Sub-series Number**

## 16. Precautions for Use of LCD Modules

### 16.1 Handling Precautions

**16.1.1.** The display panel is made of glass. **Do not** subject it to a mechanical shock by dropping it from a high place, etc.

**16.1.2.** If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

**16.1.3. Do not** apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

**16.1.4.** The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

**16.1.5.** If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, **do not** use the following:

- Water
- Ketone
- Aromatic solvents

**16.1.6. Do not** attempt to disassemble the LCD Module.

**16.1.7.** If the logic circuit power is off, do not apply the input signals.

**16.1.8.** To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- a. Be sure to ground the body when handling the LCD Modules.
- b. Tools required for assembly, such as soldering irons, must be properly ground.
- c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
- d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

### 16.2 Storage precautions

**16.2.1.** When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

**16.2.2.** The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature :        0°C ~ 40°C  
Relatively humidity: ≤80%

**16.2.3.** The LCD modules should be stored in the room without acid, alkali and harmful gas.

### 16.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.