CONFIDENTIAL(A)

SPECIFICATION

OF

LIQUID CRYSTAL DISPLAY MODULE

UNITED RADIANT TECHNOLOGY CORP. 光聯科技 Jun-04-2025 品管部 QC DEPT.

CUSTOMER : URT-STD

Model No. : UMOH-9728FD-T

Model version : 0

Document Revision : 2

CUSTOMER APPROVED SIGNATURE			

This specification need to be signed by purchaser or customer as a specification of products production and delivery from URT. Without signature of this specification , any purchase order for this model no. will be treated and considered that this specification is automatically acknowledged and accepted by purchaser or customer.

U.R.T. UNITED RADIANT TECHNOLOGY CORPORATION

Joe Wu	Ashin Chiu	Ashin Chiu	Jun-04-2025
APPROVED	CHECKED	PREPARED	Date

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Revision record

Document Revision	Model No. Version No.	Description	Revision by
0	UMOH-9728MD-T Version No. 0	4.3” TFT LCD. 480*272 dots	H.F. Kuo Y.C. Lin 04-Jan-2024
1	UMOH-9728MD-T Version No. 1	Update SPEC.	H.F. Kuo Eric Wang 03-Jun-2025
2	UMOH-9728FD-T Version No. 0	Modify Module Number from UMOH-9728MD-T to UMOH-9728FD-T.	H.F. Kuo Eric Wang 04-Jun-2025

CONTENTS:

1. BASIC SPECIFICATION

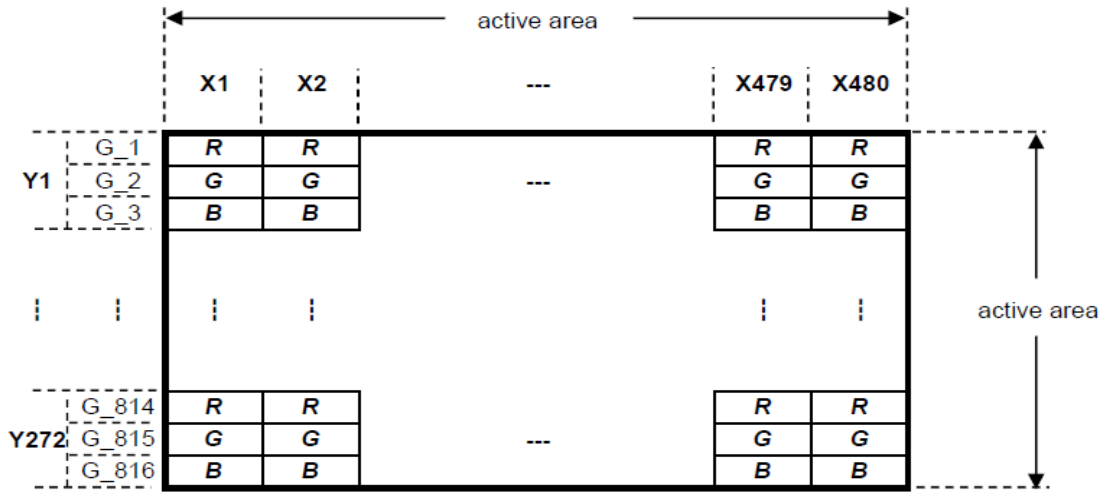
1.1 Mechanical specifications

Items	Nominal Dimension	Unit
Active screen size	4.3” diagonal	-
Dot Matrix	480 x 272RGB	Pixel
Module Size (W x H x T)	105.50 x 67.20 x 5.2	mm.
Active Area (W x H)	95.04 x 53.856	mm.
Pixel Size (W x H)	0.198 x 0.066	mm.
Color depth	16.7M	color
Interface	Parallel 24-bit RGB	-
Module weight	62±10%	g

1.2 Display specification

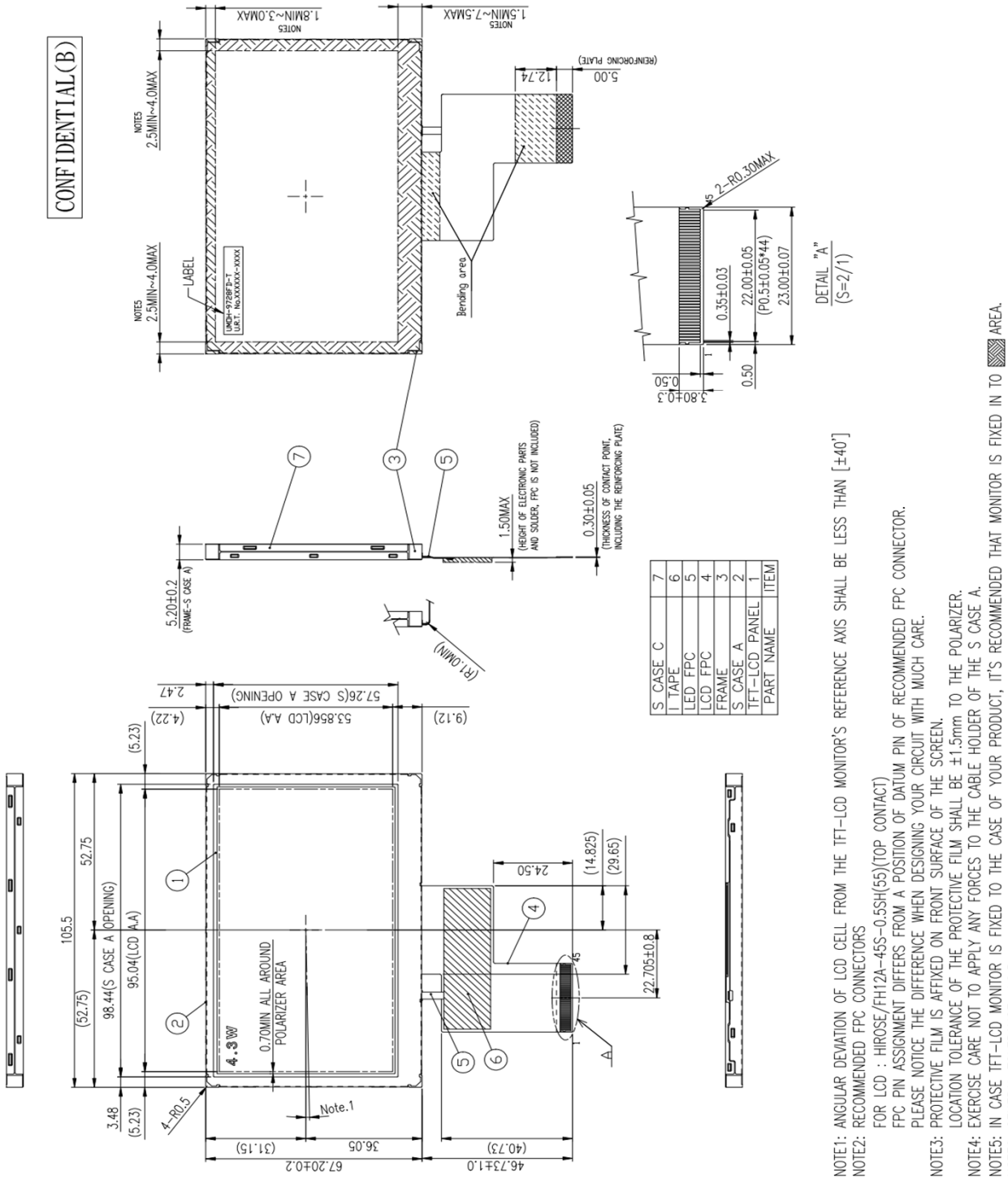
Display	Descriptions	Note
LCD Type	TFT transflective (Micro Reflective)	-
Display Mode	Normal Black	-
Pixel arrangement	RGB horizontal stripe	1
Backlight Type	LED	-
Viewing Direction	All Viewing	-

Note1:



Dot arrangement (FPC cable placed downside)

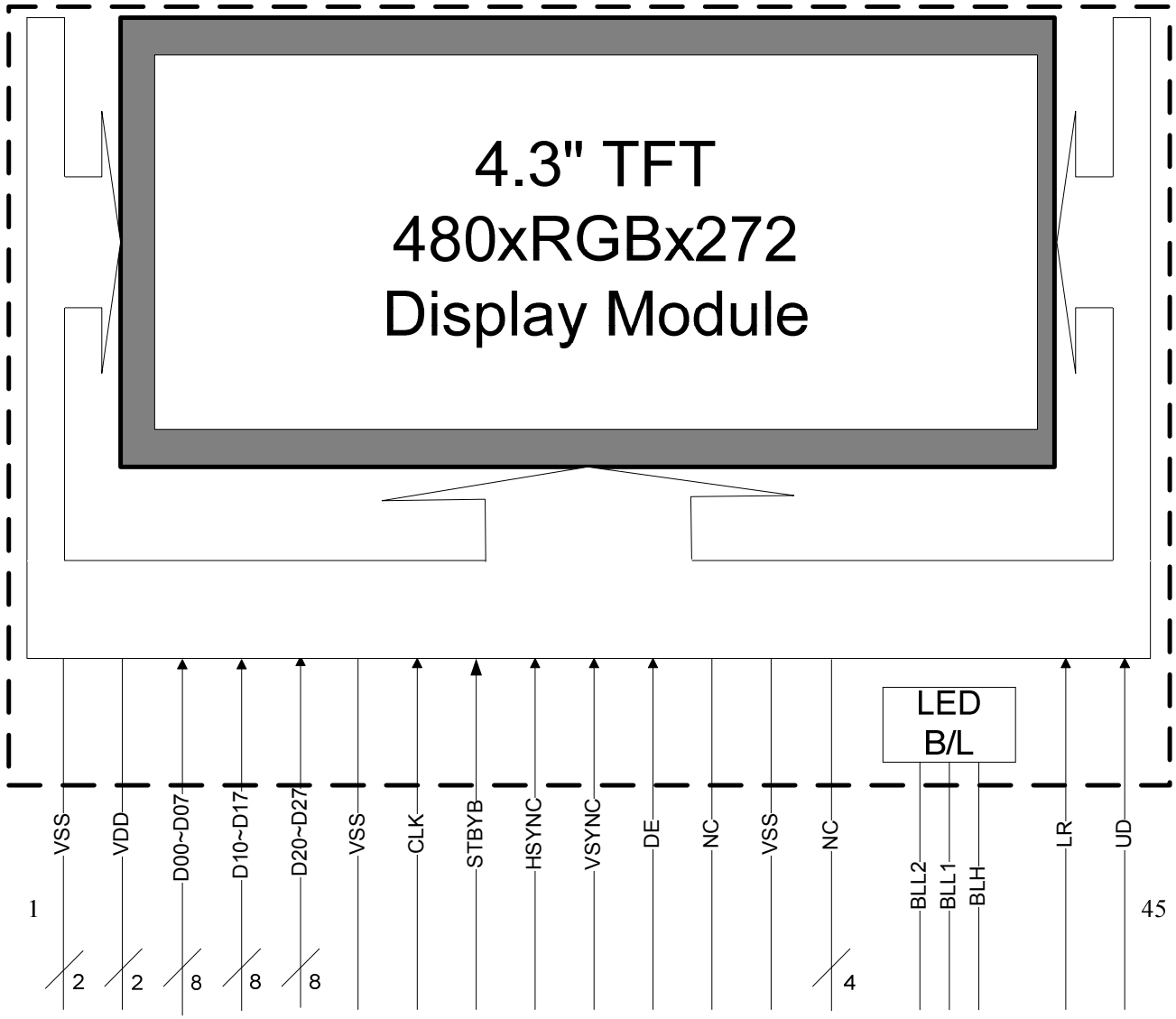
1.3 Outline dimension：



NOTE1: ANGULAR DEVIATION OF LCD CELL FROM THE TFT-LCD MONITOR'S REFERENCE AXIS SHALL BE LESS THAN [±40']
NOTE2: RECOMMENDED FPC CONNECTORS
FOR LCD : HIROSE/FH12A-45S-0.5SH(55)(TOP CONTACT)
FPC PIN ASSIGNMENT DIFFERS FROM A POSITION OF DATUM PIN OF RECOMMENDED FPC CONNECTOR.
PLEASE NOTICE THE DIFFERENCE WHEN DESIGNING YOUR CIRCUIT WITH MUCH CARE.
NOTE3: PROTECTIVE FILM IS AFFIXED ON FRONT SURFACE OF THE SCREEN.
LOCATION TOLERANCE OF THE PROTECTIVE FILM SHALL BE ±1.5mm TO THE POLARIZER.
NOTE4: EXERCISE CARE NOT TO APPLY ANY FORCES TO THE CABLE HOLDER OF THE S CASE A.
NOTE5: IN CASE TFT-LCD MONITOR IS FIXED TO THE CASE OF YOUR PRODUCT, IT'S RECOMMENDED THAT MONITOR IS FIXED IN TO ▨ AREA.
NOTE6: GENERAL TOLERANCE: ±0.5mm

LCD TYPE: TFT transflective(Micro Reflective)

1.4 Block diagram:



1.5 Interface Pin Connection :

Pin No.	Pin Symbol	I/O	Description
1~2	VSS	P	Ground.
3~4	VDD	P	Power Supply. (Typ. +3.3V)
5~12	D00 ~ D07	I	Red data input. Connect unused pins to VSS. D00: LSB, D07: MSB.
13~20	D10 ~ D17	I	Green data input. Connect unused pins to VSS. D10: LSB,D17:MSB.
21~28	D20 ~ D27	I	Blue data input. Connect unused pins to VSS. D20: LSB, D27: MSB.
29	VSS	P	Ground.
30	CLK	I	Clock signal. Latching data at the falling edge.
31	STBYB	I	Standby signal input. "Hi" : Normal display, "Lo" : standby mode.
32	HSYNC	I	Horizontal sync signal.(Low active)
33	VSYNC	I	Vertical sync signal. (Low active)
34	DE	I	Data input Enable. Active high to enable the data input.
35	NC	-	Open.
36	VSS	P	Ground.
37 ~ 40	NC	-	Open.
41	BLL2	P	Power supply for LED backlight cathode.
42	BLL1	P	Power supply for LED backlight cathode.
43	BLH	P	Power supply for LED backlight anode.
44	LR	I	Left/Right display reverse.(Hi or Open: Normal display)
45	UD	I	Up/Down display reverse. .(Hi or Open: Normal display)

2. ELECTRICAL CHARACTERISTICS

2.1 Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit
Power supply voltage	VDD	-0.3	+5.0	V
Logic input/output voltage	VIO	-0.3	VDD+0.3	V
LED direction current of order	IL	-	70	mA
Operate temperature range	TOP	-30	85	℃
Storage temperature range	TST	-40	95	℃

*Note1 :

The operating temperature is for product's functionality, please pay attention to human injury when using the product under extreme temperature.

2.2 DC Characteristics:

T_a= 25℃

Items	Symbol	Min.	Typ.	Max.	Unit	Condition
Supply Voltage	VDD	3.0	3.3	3.6	V	-
Input Voltage	V_{IL}	0	-	0.3VDD	V	L level
	V_{IH}	0.7VDD	-	VDD	V	H level
Current Consumption	I_{VDD}	-	30	60	mA	Note1

*Note1 :

Measuring Condition:

Standard Value Max.

Ta = 25℃

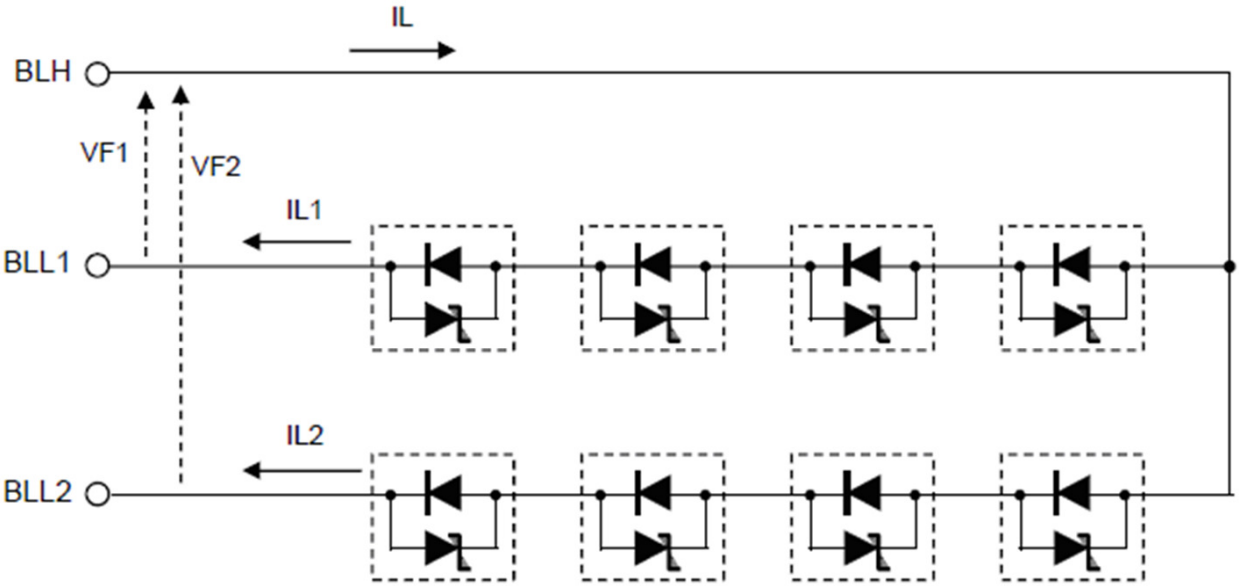
f_{CLK}= 9MHz

VDD -GND = 3.3V

2.3 Back-light only Specification :

PARAMETER	SYMBOL	Min.	Typ.	Max.	Unit	Test Condition	NOTE
Forward Current	IL1	-	20	50	mA	Ta=25℃	-
	IL2		20	50	mA	Ta=25℃	
Forward Voltage	VF1		10.6	11.4	V	Ta=25℃	@ 20mA
	VF2		10.6	11.4	V	Ta=25℃	@ 20mA
Half-Life Time	Lf	-	50000	-	hrs	Ta=25℃	1

Note 1 : The "Half-Life Time" is defined as the LED chip brightness decreases to 50% than original brightness, based on Ta 25±2℃,60±10% RH condition.



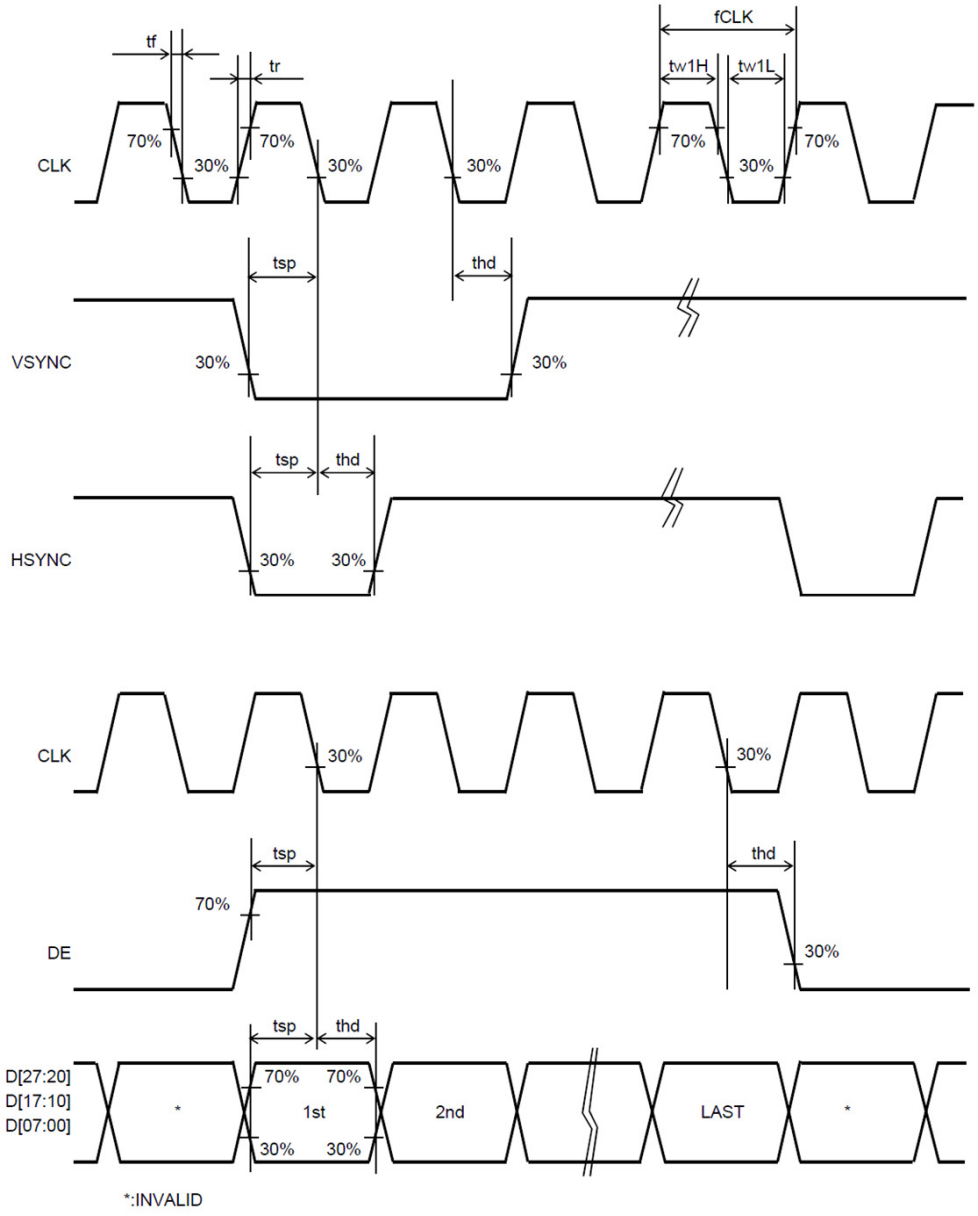
* It is recommended to control currents of BLL1 / BLL2 to equal current values (IL1 = IL2).

2.4 AC Characteristics

(Unless otherwise noted, Ta=25°C,VDD=3.3V,VSS=0V)

Item	Symbol	Condition	Rating			Unit	Applicable terminal
			MIN	TYP	MAX		
CLK frequency	fCLK		7.2	9.0	12.0	MHz	CLK
CLK rising time	tr		--	--	10	ns	
CLK falling time	tf		--	--	10	ns	
CLK Low period	tw1L	0.3×VDD or less.	26.4	--	--	ns	
CLK High period	tw1H	0.7×VDD or more.	26.4	--	--	ns	
Setup time	tsp		10.0	--	--	ns	CLK,VSYNC,HSYNC,
Hold time	thd		16.0	--	--	ns	DE,D[27:20],D[17:10], D[07:00]

Switching Waveform Characteristics



2.5 Parallel RGB Input Timing Requirement

(Unless otherwise noted, Ta=25°C,VDD=3.3V,VSS=0V)

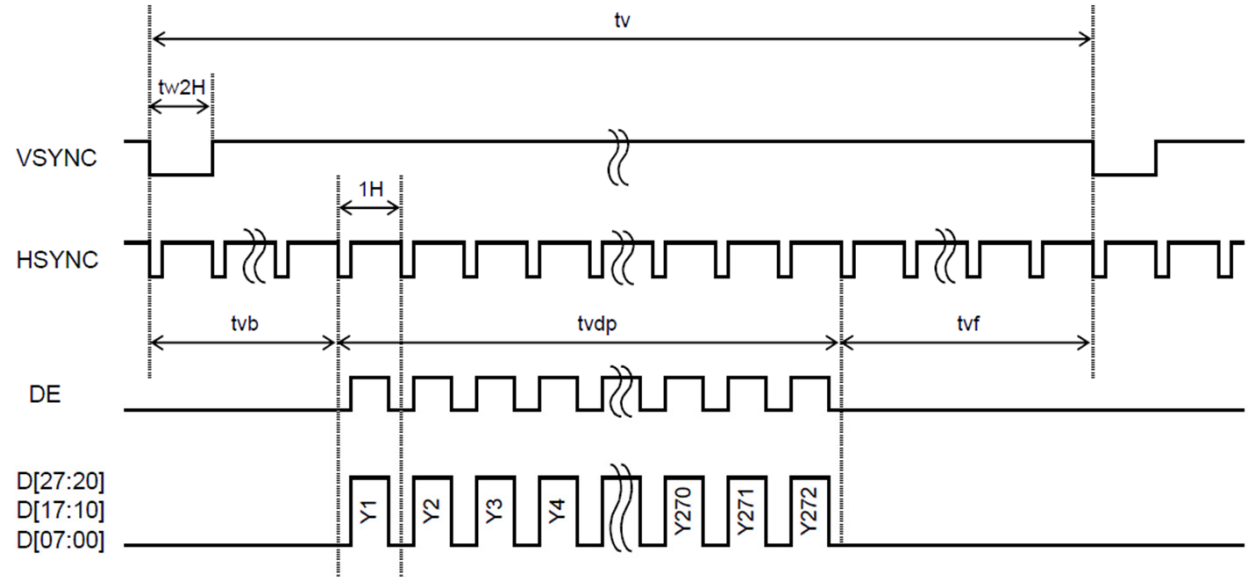
Item	Symbol	Rating			Unit	Applicable terminal
		MIN	TYP	MAX		
CLK frequency	fCLK	7.2	9.0	12.0	MHz	CLK
VSYNC frequency Note	fVSYNC	54	60	66	Hz	VSYNC
VSYNC signal cycle time	tv	277	288	396	H	VSYNC,HSYNC
VSYNC pulse width	tw2H	1	--	--	H	
Vertical back porch	tvb	tw2H + 2	8	31	H	
Vertical front porch	tvf	2	8	93	H	
Vertical display period	tvdp	--	272	--	H	VSYNC,HSYNC,DE,D[27:20], D[17:10],D[07:00]
HSYNC frequency	fHSYNC	15.38	16.67	18.18	Khz	HSYNC
HSYNC signal cycle time	th	521	525	734	CLK	HSYNC,CLK
HSYNC pulse width	tw3H	1	--	--	CLK	
Horizontal back porch	thb	tw3H + 1	40	127	CLK	HSYNC,DE,CLK
Horizontal front porch	thf	1	5	127	CLK	
Horizontal display period	thdp	--	480	--	CLK	DE,D[27:20],D[17:10],D[07:00], CLK
DE pulse width	tw4H	--	480	--	CLK	DE,CLK

Note: The characteristics and values in the chart indicate recommended specifications.
In the the case that the product might be used NOT in compliant with the specifications,
it is highly recommended to use the product after adequate
verifications could be implemented and at your own risk.

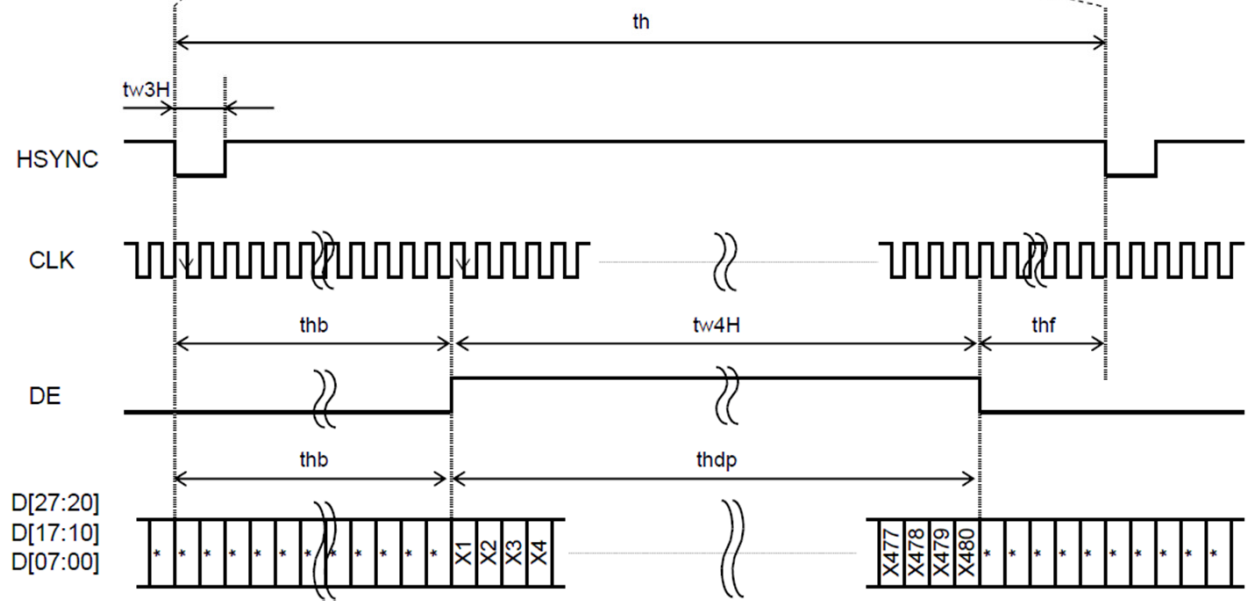
2.6 Interface Timing Chart

2.6.1 Driving Timing Chart

-Vertical Timing

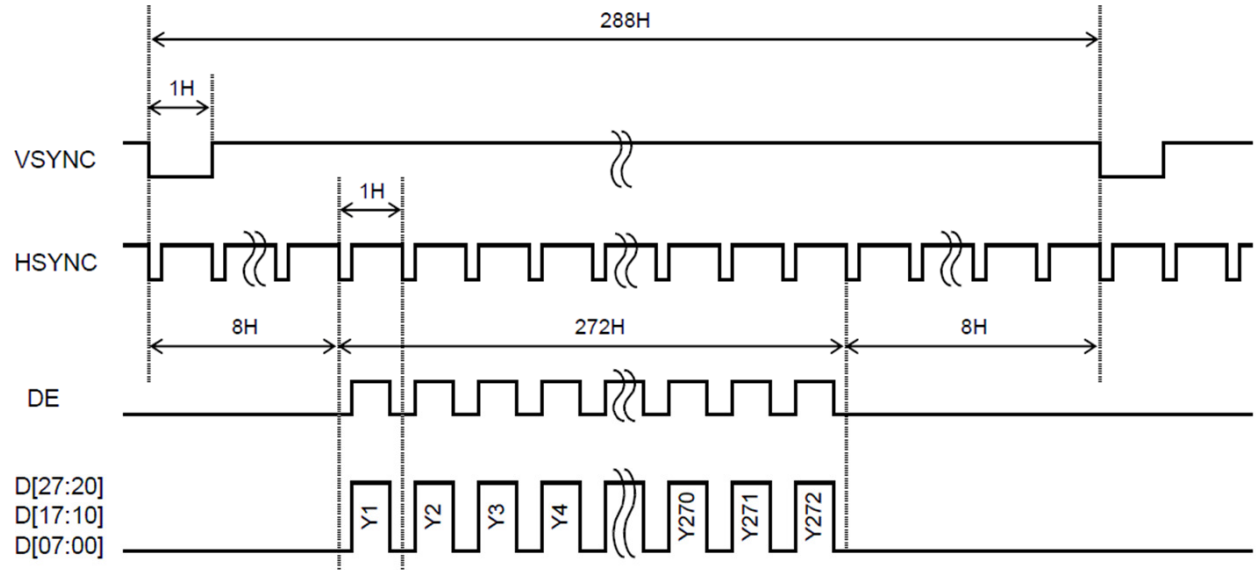


-Horizontal Timing

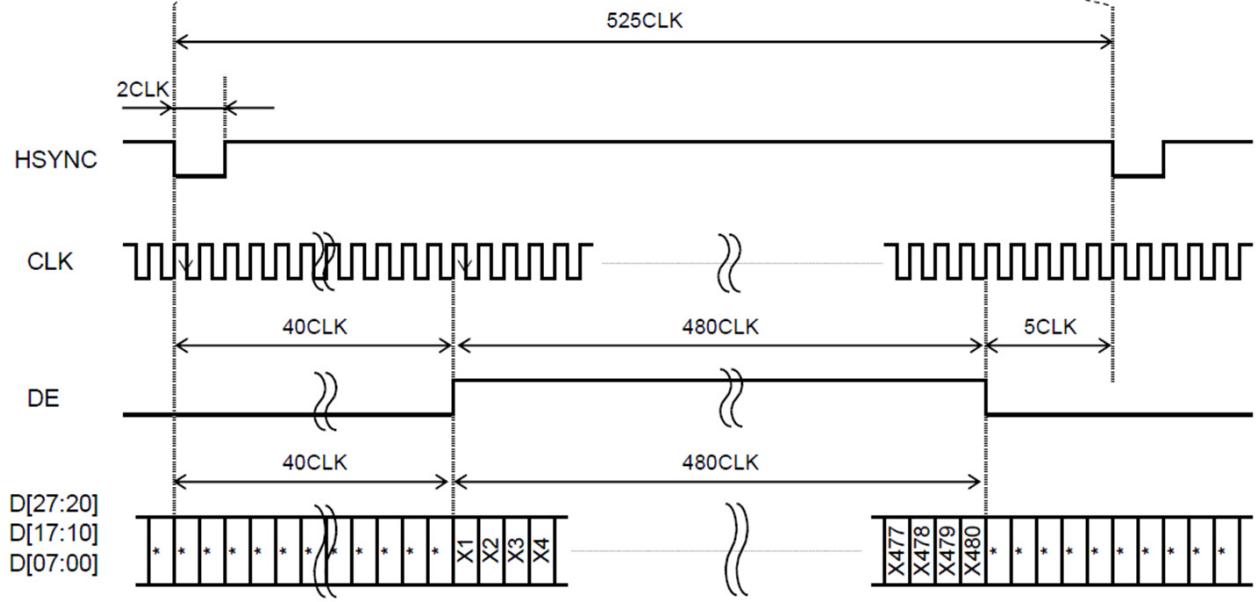


2.6.2 Example of Driving Timing Chart (fCLK=9MHz)

-Vertical Timing

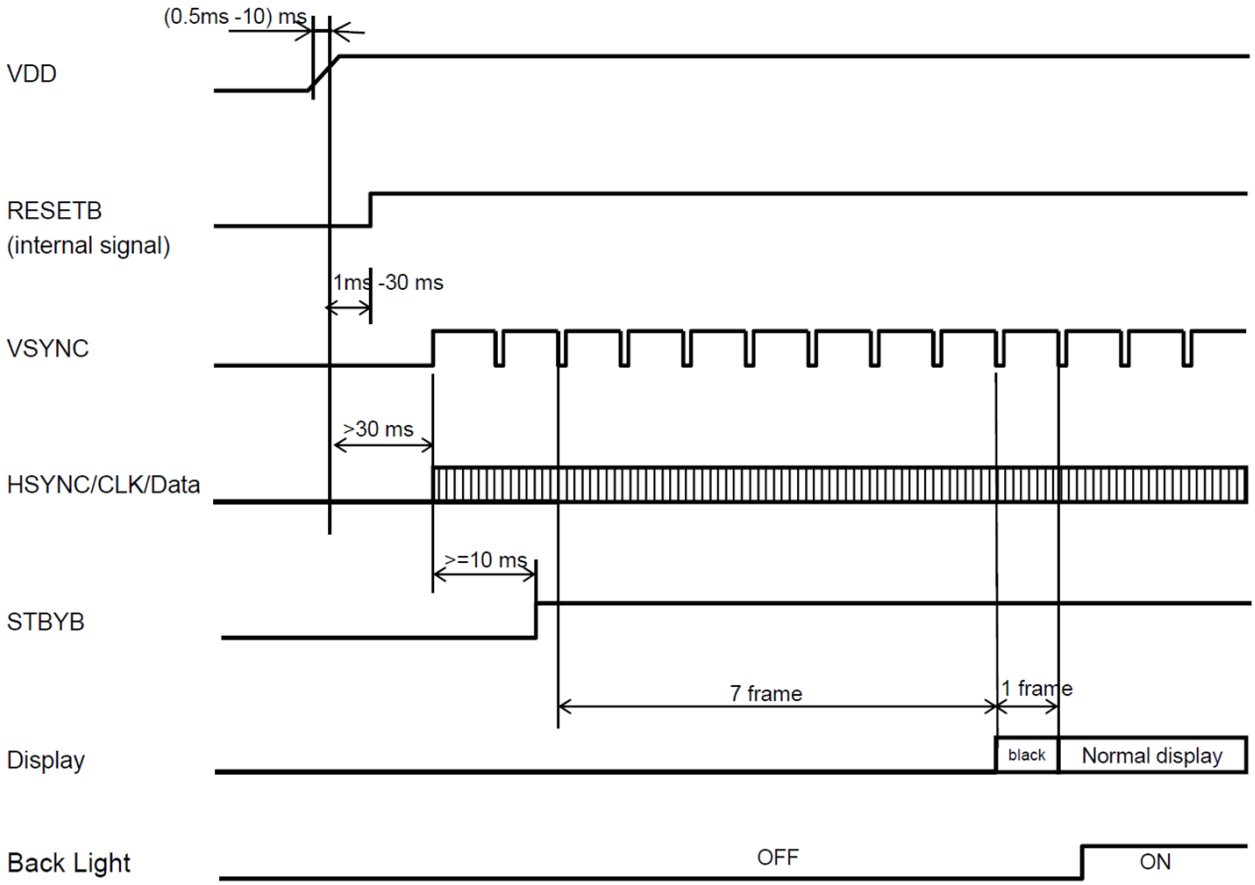


-Horizontal Timing

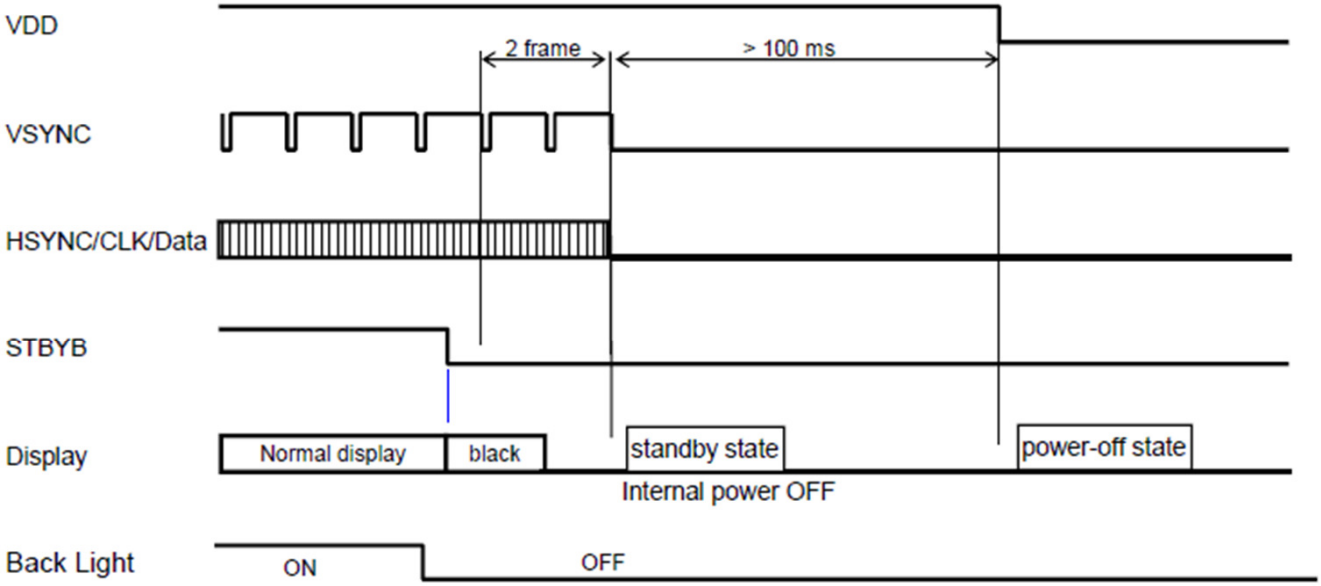


2.7 Power ON/OFF Sequence Timing

2.7.1 Power ON Sequence



2.7.2 Power OFF Sequence



If CLK and VSYNC signals are stopped or the power supply is turned off to a regulated frame or less, the afterimage might remain.

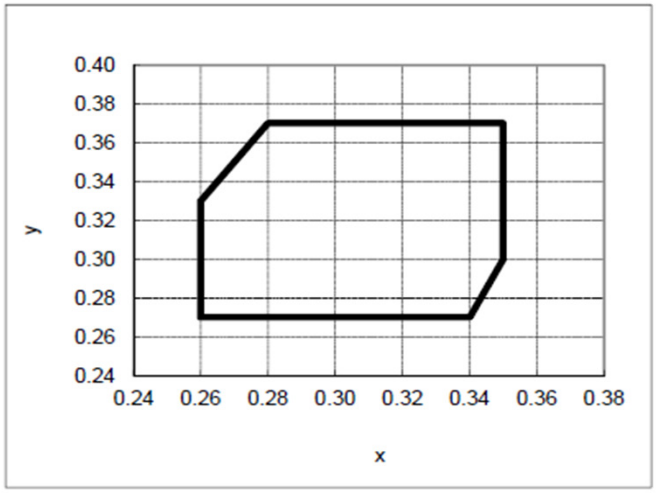
3. OPTICAL CHARACTERISTICS

3.1 Characteristics

Electrical and Optical Characteristics

Measured temperature: Ta=25° C

No.	Item			symbol / temp.		Min.	Typ.	Max.	Unit	Note
1	Response Time			Tr+Tf	25 ℃	-	50	100	ms	2
2	Viewing Angle	Hor.	Cr≧10	θ_{2+}	Φ = 0°	80	-	-	degree	3
				θ_{2-}	Φ = 180°	80	-	-		
		Ver.		θ_{1+}	Φ = 270°	80	-	-		
				θ_{1-}	Φ = 90°	80	-	-		
3	Contrast Ratio			Cr	25 ℃	400	800	-	-	4
4	White x-code			Wx	25 ℃	White Chromaticity Range			-	5
	White y-code			Wy						
	Brightness			Y		390	600	-	cd/m^2	
5	Brightness Uniformity				25 ℃	75	-	-	%	6



White Chromaticity Range

【White Chromaticity Range】

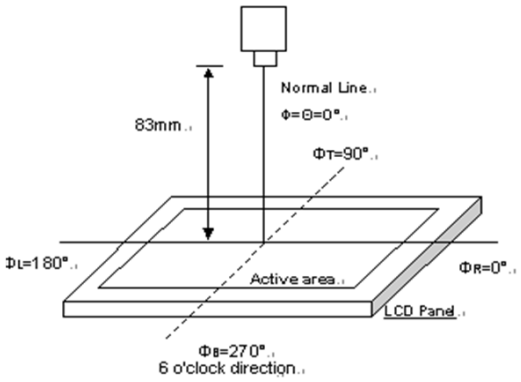
x	y
0.26	0.33
0.26	0.27
0.34	0.27
0.35	0.30
0.35	0.37
0.28	0.37
0.26	0.33

3.2 Temperature Characteristics

Item		Symbol	Specification			Remark
			MIN	TYP	MAX	
Contrast ratio		CR	200	—	—	Ta=-30℃ Backlight ON
			200	—	—	Ta=85℃ Backlight ON
Response time	Rise time + Fall time	TON + TOFF	—	980ms	1500ms	Ta=-30℃
			—	40ms	80ms	Ta=85℃
Display Quality			Display Quality and display defect and/or non-uniformity (Mura) will NOT become noticeably visible.			

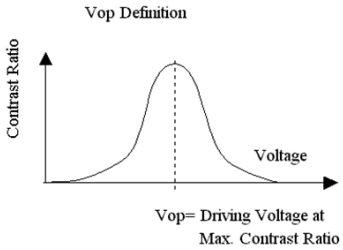
3.2 Definition of optical characteristics

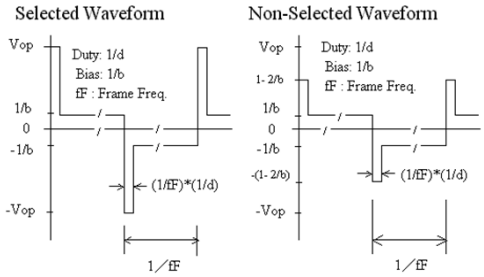
Measurement condition : Transmissive mode optical measurement system



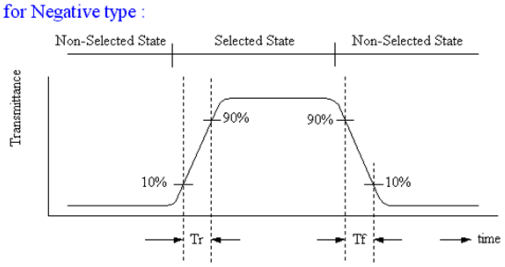
LCD Evaluation System : DMS-803
Light Source : Halogen Lamp.

[Note 1] Definition of LCD Driving Vop and Waveform :

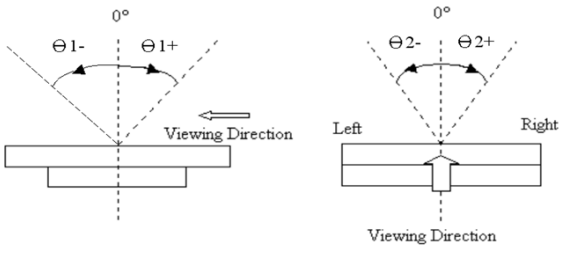




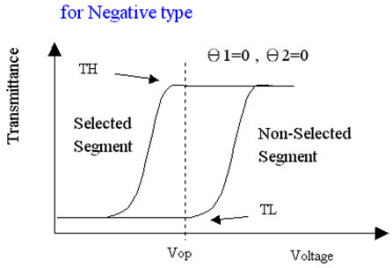
[Note 2] Definition of Response Time



[Note 3] Definition of Viewing Angle :

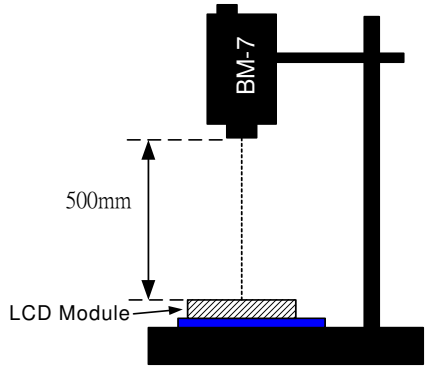


[Note 4] Definition of Contrast Ratio :

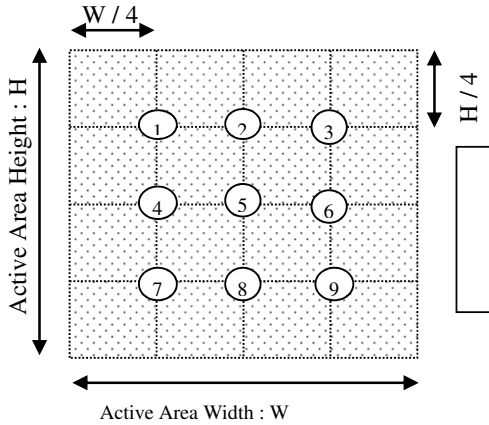


$$\text{Contrast Ratio} = \frac{TH}{TL}$$

[Note 5] Definition of measurement of Color Chromaticity and Brightness



[Note 6] Definition of Brightness Uniformity



$$\text{Brightness Uniformity} = \frac{\text{Minimum Brightness of Point 1~9}}{\text{Maximum Brightness of Point 1~9}}$$

4. RELIABILITY :

Item No	Items	Condition	Note
1	High temperature operating	85 ℃ , 240 hours	1
2	Low temperature operating	-30 ℃ , 240 hours	1
3	High temperature storage	95 ℃ , 240 hours	1
4	Low temperature storage	-40 ℃ , 240 hours	1
5	High temperature & humidity storage	60℃, 90%RH, 240 hours	2
6	Thermal Shock storage	-40℃, 30min.<=> 95℃, 30min. 10 Cycles	
7	Vibration test	Total amplitude 1.5mm，f：10~55Hz X，Y，Z directions for each 30mins.	
8	Electrostatic discharge test (Non operation)	C：200pF，R：0Ω，V：±200V Each 3 times of discharge on and power supply and other terminals.	
9	Surface discharge test (Non operation)	C：250pF，R：100Ω，V：±12KV Each 5 times of discharge in both polarities on the center of screen with the case grounded.	
10	Packing drop test	Drop from 75cm high 1 time to each 6 surfaces，3 edges，1 corner.	
11	Image Sticking Test	25 ± 2°C Operation with test pattern sustained for 2 hrs, then change to gray pattern immediately. After 5 mins, the mura must be disappeared completely  Image Sticking -pattern Mid-Gray pattern	

Note 2：The product move into the room temperature for at least 24 hours with no condensation.

Note 3 : Please change the display picture (autorun) during operating mode. Avoid displaying static images to avoid image sticking , and the image sticking is accelerated by temperature.

Note 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.

* One single product test for only one item.

* Judgment after test : keep in room temperature for more than 2 hours.

- Current consumption < 2 times of initial value
- Function : work normally

5. PRODUCT HANDLING AND APPLICATION

5.1 PRECAUTION FOR HANDLING LCM

- The LCD module contains a C-MOS LSI. People who operate the LCM should wear ESD protection equipment to prevent ESD hurt on products.
- Do not input any signal before power is turned on.
- Do not take LCM from its packaging bag until it is assembled.
- Peel off the LCM protective film slowly since static electricity may be generated.
- Hand Soldering : Soldering temperature less than 260℃,within 5 sec, at 5 mm. Away from pin connection.
- Do not touch the display surface or connection terminals area with bare hands. Smudges on the display surface reduce the insulation between terminals.
- Do not twist or bend the modules and also avoid any inappropriate external force on display surface during assembly.
- Do not expose LCM to organic solvent. IF clean the surface , wipe it gently with soft cloth dampened by alcohol.
- Do not attempt to wiped off the contact pads.
- Keep LCM panels away from direct sunlight or fluorescent light, , also avoid them in high-temperature & high humidity environment for a long period.
- It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life.
- Do not drive LCM by DC voltage & avoid displaying at certain pattern for a long time otherwise it might cause image sticking.
- Response time will be extremely delayed at lower temperature then the operating temperature range and on the other hand at higher temperature LCD's how dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, which will come back in the specified operation temperature.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- Never use the LCD , LCM under 45 Hz , the liquid crystal will decomposition and cause perfectly damage on display !!
- Liquid in LCM is hazardous substance. In case a contact with liquid crystal material is occurred, be sure to immediately wash such material away by soap and water.
- The polarizer is easily damaged and should be handle with special care. Don't press or rub it with hard objects.

5.2 PRECAUTION FOR STORING

- Store the module in a dark room where must keep at 25±10℃ and 65%RH or less.
- Do not store the module in surroundings containing organic solvent or corrosive gas
- Store the module in an anti-electrostatic container or bag.

5.3 USING ON MEDICAL CARE , SAFETY OR HAZARDOUS APPLICATION OR SYSTEM

- For the application in medical care, safety and hazardous products or systems, an authorization from URT is required. URT will not responsible for any damage or loss which caused by the products without any authorization given by URT.
- This product is not allowed to be designed and used for military application and/or purpose.
- The delivery of this product to the countries and/or regions where the embargoes are imposed by U.N. is prohibited.
- The application and delivery of this product must comply with Strategic High-Tech Commodities (SHTC) export control and the sales to the embargoed and/or sanctioned countries or regions are strictly prohibited.

6. DATE CODE OF PRODUCTS

- Date code will be shown on each product :

- **YY MM DD - XXXX**

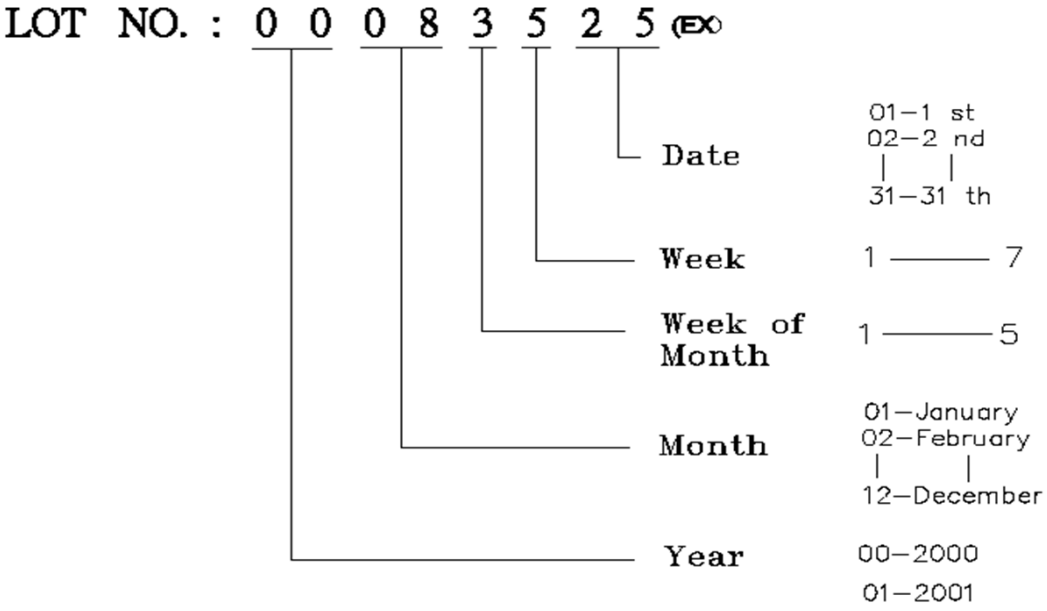
  Year Month Day - Production lots no.

- Example: 241108 - 0003 ==> Year 2024, November,8th ,
  Production lots no. 0003

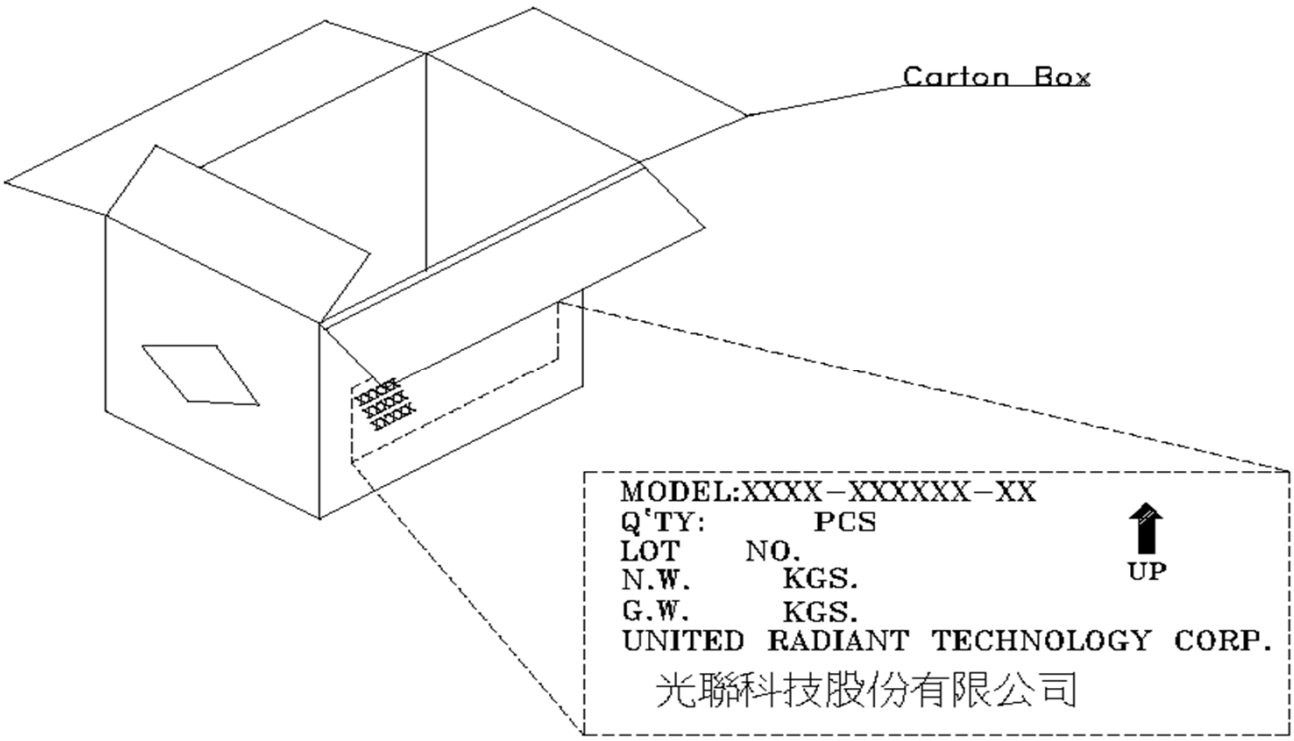
Note ： The lot no. attached on the packing box will be used for tracking once the part is too small to print the date code.

7. LOT NO.

Instruction of lot number:



Lable of carton:



8. INSPECTION STANDARD

8.1. QUALITY :

THE QUALITY OF GOODS SUPPLIED TO PURCHASER SHALL COME UP TO THE FOLLOWING STANDARD.

8.1.1. THE METHOD OF PRESERVING GOODS

AFTER DELIVERY OF GOODS FROM U.R.T. TO PURCHASER. PURCHASER SHALL CONTROL THE LCM AT -10 ℃ ~40 ℃ ,AND IT MIGHT BE DESIRABLE TO KEEP AT THE NORMAL ROOM TEMPERATURE AND HUMIDITY UNTIL INCOMING INSPECTION OR THROWING INTO PROCESS LINE.

8.1.2. INCOMING INSPECTION

(A) THE METHOD OF INSPECTION

IF PURCHASER MAKE AN INCOMING INSPECTION , A SAMPLING PLAN SHALL BE APPLIED ON THE CONDITION THAT QUALITY OF ONE DELIVERY SHALL BE REGARDED AS ONE LOT.

(B) THE STANDARD OF QUALITY

ISO-2859-1 (SAME AS MIL-STD-105E) , LEVEL Ⅱ SINGLE PLAN.

(C) MEASURE

IF AS THE RESULT OF ABOVE RECEIVING INSPECTION , A LOT OUT IS DISCOVERED. PURCHASER SHALL BE INFORM SELLER OF IT WITHIN SEVEN DAYS. BUT FIRST SHIPMENT WITHIN FOURTEEN DAYS.

8.1.3. WARRANTY POLICY

U.R.T. WILL PROVIDE ONE-YEAR WARRANTY FOR THE PRODUCTS ONLY IF UNDER SPECIFICATION OPERATING CONDITIONS. U.R.T. WILL REPLACE GOOD PRODUCTS FOR THESE DEFECT PRODUCT WHICH UNDER WARRANTY PERIOD AND BELONG TO THE RESPONSIBILITY OF U.R.T.

8.1.4 Illustrate of The Inspection

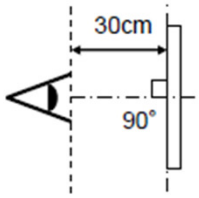
Samples are used to assist and verify compliance with specifications, not as inspection standards.
If a physical sample is required as the inspection standard, both parties shall jointly determine and sign "Inspection sample or Limited sample (with upper limit and lower limit) " .

8.2 Standard of Visual Inspection：

8.2.1 Defective Display and Screen Quailty

Test Condition: Observed TFT-LCD monitor from front during operation with the following conditions
Driving Signal: Raster Patter (RGB, white, black)

Observation distance: 30 cm
Illuminance: 200 to 350 lx



Defect item		Defect content		Criteria
Display Quality	Line defect	Black, white or color line, 3 or more neighboring defective dots		Not exists
	Dot defect	Uneven brightness on dot-by-dot base due to defective TFT or CF, or dust is counted as dot defect (brighter dot, darker dot) Dark dot: Appear dark through white display		Refer to table 1 *To be discussed and determined by both parties if any matters related to this item occurred.
Screen Quality	Dirt	Uneven brightness (white stain, black stain etc)		Invisible through 5% ND filter at Black screen. Invisible through 1% ND filter at other screen.
	Foreign particle	Point-like	0.25mm< φ	N=0
			0.20mm< φ ≦0.25mm	N≦2
			φ ≦0.20mm	Acceptable
		Liner	3.0mm<length and 0.08mm<width	N=0
			length≦3.0mm or width≦0.08mm	Acceptable
	Others			Use boundary sample for judgment when necessary

φ(mm): Average diameter = (major axis + minor axis)/2
Permissible number: N

Table 1

Judgment screen	black	gray	red	green	blue	Total
Bright dot	○	don't judge	○	○	○	0
Dark dot	don't judge	○	○	○	○	1 or less

Definition of bright dot and dark dot

List of screens	R	G	B
black	00h	00h	00h
gray	94h	94h	94h
red	94h	00h	00h
green	00h	94h	00h
blue	00h	00h	94h

8.2.2 Screen and Other Appearance

Testing conditions

Observation distance	30cm
Illuminance	1200～2000 lx

Item		Criteria	Remark
Polarizer	Flaw Stain Bubble Dust Dent	Ignore invisible defect when the backlight is on.	Applicable area: Active area only (Refer to the section 1.3 "Outward form")
S-case		No functional defect occurs	
FPC cable		No functional defect occurs	