

SPECIFICATION

OF

LIQUID CRYSTAL DISPLAY MODULE



CUSTOMER : URT-STD

Model No. : UMNH-9577MD-T

Model version : 3

Document Revision : 3

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**

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Revision record

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1. BASIC SPECIFICATION

1.1 Mechanical specifications

Items	Nominal Dimension	Unit
Active screen size	2.4" diagonal	-
Dot Matrix	240*RGB*320	Pixel
Module Size (W x H x T)	42.7 x 59.45 x 3.0	mm.
Active Area (W x H)	36.72 x 48.96	mm.
Pixel Size (W x H)	0.153 x 0.153	mm.
Interface	8/9/16/18-bit MPU parallel	-
Driving IC Package	COG	-
Module weight	14±10%	g

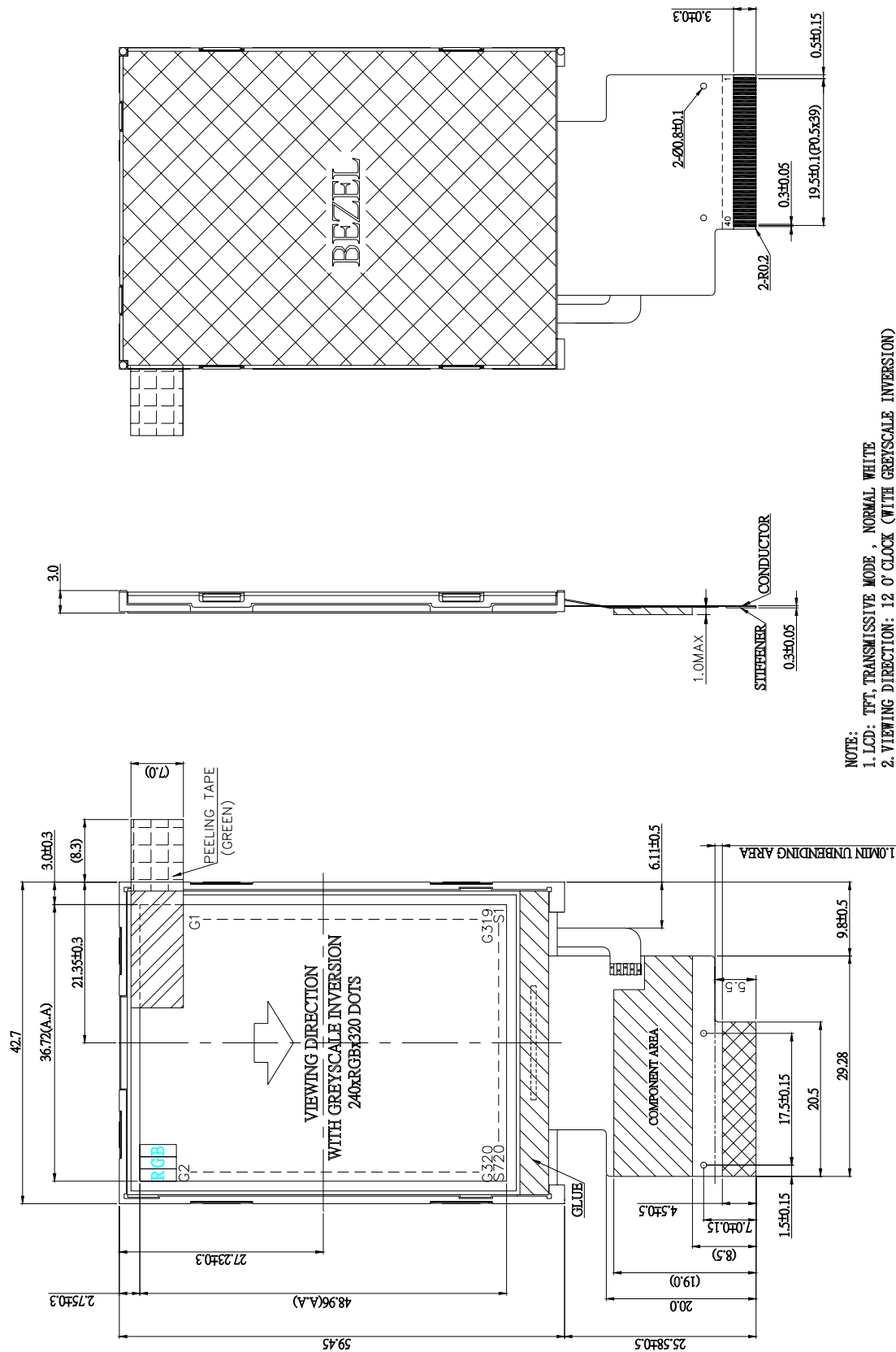
1.2 Display specification

Display	Descriptions	Note
LCD Type	a-Si TFT	-
LCD Mode	TN/Normal White	-
Polarizer Mode	Transmissive	-
Polarizer Surface	Normal	-
Pixel arrangement	RGB-stripe	-
Backlight Type	LED	-
Gray Scale Inversion Direction	12 O'clock Direction	1

* Color tone is slightly changed by temperature and driving voltage.

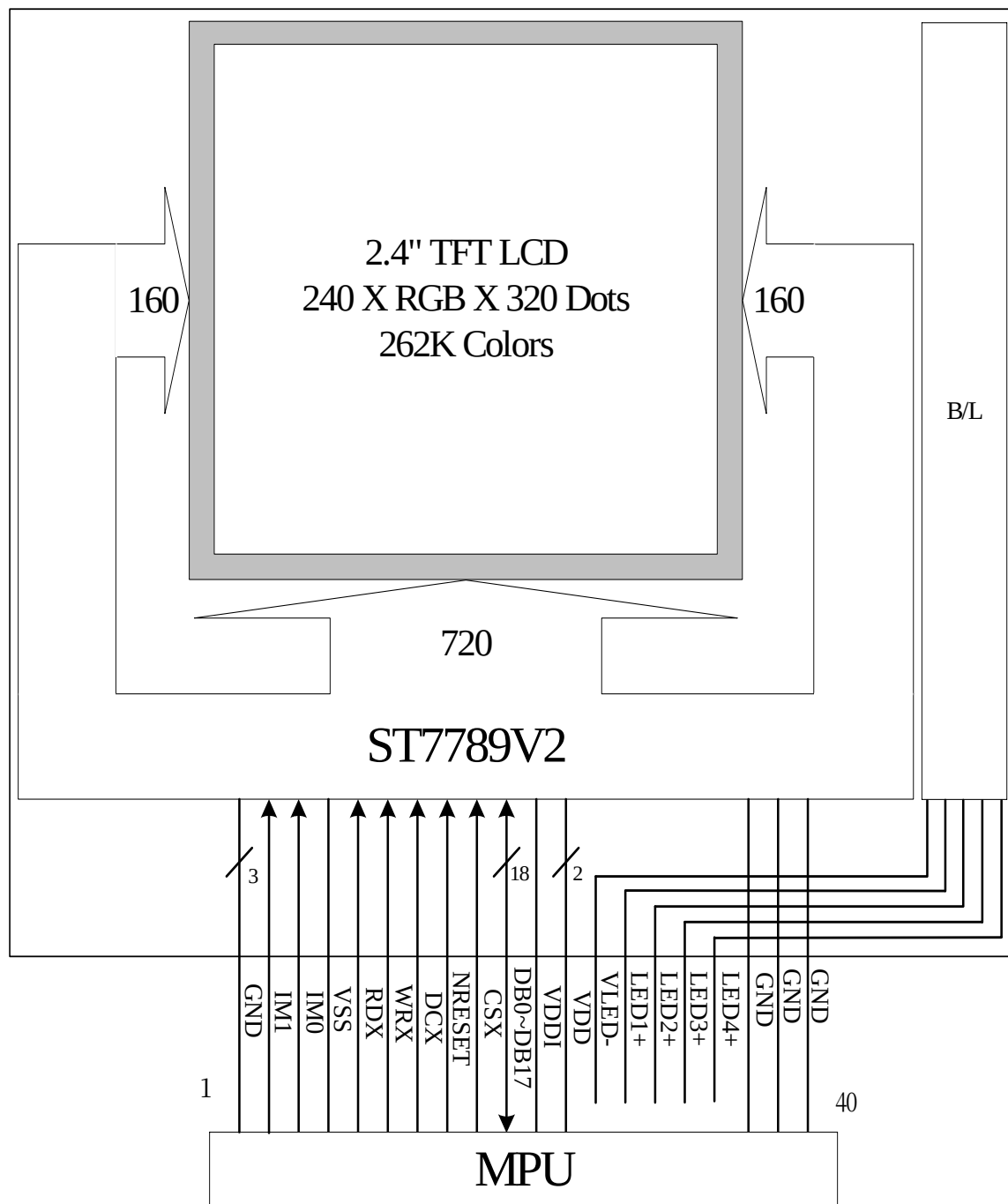
Note 1 : The viewing direction defined in this specification is according to the rubbing direction of its TFT surface treatment by the TFT glass manufacturer. The grayscale inversion is at this direction as well. However, the optimal viewing direction for human view is normally where the color does NOT change to grayscale inversion, and this would be the opposite site of the specified viewing direction in this specification. In any case we advise customers to judge by themselves, and be aware of this phenomenon.

1.3 Outline dimension



- NOTE:
1. LCD: TFT, TRANSMISSIVE MODE, NORMAL WHITE
 2. VIEWING DIRECTION: 12 O'CLOCK (WITH GREYSCALE INVERSION)
 3. TOP: -20°C-70°C ; TST: -30°C-80°C
 4. LED COLOR: WHITE, 4 PCS; IF=80.0mA, VLED=3.3 V(TYP)(Parallel Type, Constant Current)
 5. DRIVER IC: ST7789V2
 6. TOLERANCE FOR NOT ASSIGNED :±0.2 mm
 7. TFT PIXEL SIZE : 0.153 x 0.153 mm
 8. THE MINIMUM BENDABLE RADIUS(INNER) OF THE FPC IS 0.5 mm
 9. IF THE CUSTOMER BEND THE FPC INSIDE OF THE UNBENDING AREA, URT WON'T BE RESPONSIBLE FOR ANY DAMAGE

1.4 Block diagram:



1.5 Interface pin :

Pin No.	Pin Symbol	I/O	Description			
1~3	GND	P	Power Supply for Ground (0V).			
4	IM1	I	Selects the MPU interface mode.			
			IM1	IM0	MPU Interface Mode	Data pin
			0	0	80-8bit parallel I/F	DB[7:0]
			0	1	80-16bit parallel I/F	DB[15:0]
5	IM0		1	0	80-9bit parallel I/F	DB[8:0]
			1	1	80-18bit parallel I/F	DB[17:0].
6	GND	P	Power Supply for Ground (0V).			
7	RDX	I	Read enable in 8080 MCU parallel interface. If not used, please fix this pin at VDDI or GND.			
8	WRX	I	Write enable in MCU parallel interface			
9	DCX	I	Display data/command selection pin in parallel interface DCX='1': display data or parameter. DCX='0': command data..			
10	RESX	I	This signal will reset the device and it must be applied to properly initialize the chip.-Signal is active low.			
11	CSX	I	Chip selection pin Low enable. High disable.			
12~29	DB0~DB17	I/O	18-bit bi-directional data bus. -If not used, please fix this pin at VDDI or GND.			
30	VDDI	P	Power Supply for I/O System			
31~32	VDD	P	Power Supply for Analog, Digital System and Booster Circuit.			
33	VLED-	P	Cathode of the LED Backlight (0V).			
34	LED1+	P	Anode1 of the LED Backlight.			
35	LED2+	P	Anode2 of the LED Backlight.			
36	LED3+	P	Anode3 of the LED Backlight.			
37	LED4+	P	Anode4 of the LED Backlight.			
38~40	GND	P	Power Supply for Ground (0V).			

2. ELECTRICAL CHARACTERISTICS

2.1 Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit
Logic Supply Voltage	VDDI	-0.3	+4.6	V
Analog Supply Voltage	VDD	-0.3	+4.6	V
Input voltage	V _{in}	-0.3	VDDI+0.5	V
Operating temperature range	T _{OP}	-20	+70	°C
Storage temperature range	T _{ST}	-30	+80	°C

2.2 DC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Interface Operation Voltage	VDDI	1.65	1.8	3.3	V	
System Voltage	VDD	2.4	2.8	3.3	V	
Input high level voltage	V _{IH}	0.7VDDI	-	VDDI	V	-
Input low level voltage	V _{IL}	GND	-	0.3 VDDI	V	-
Output high level voltage	V _{OH}	0.8 VDDI	-	VDDI	V	-
Output low level voltage	V _{OL}	GND	-	0.2VDDI	V	-
Power supply current	I _{VCI}	-	-	13	mA	NOTE

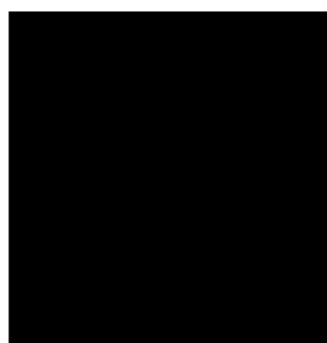
NOTE :

Measuring Condition :

Standard Value MAX.

T_a = 25°C

VDDI=VDD-GND = +2.8V



0 gray black pattern

2.3 Command Sequence (Recommend by U.R.T.)

LCD_Initial_ ST7789V2:

Driving ability Setting:

COMMAND	CODE	DESCRIPTION
--	POWER_ON LCD_RESET=0 delay 120ms LCD_RESET=1 delay 120ms	VDD & VDDI ON Delay LCD HW RST Enable Delay LCD HW RST Disable Delay
11H		Sleep Out
delay 120ms		
36H	00H	Memory Data Access Control
3AH	05H	Interface Pixel Format
B2H	0CH	Porch Setting
	0CH	
	00H	
	33H	
	33H	
B7H	75H	Gate Control
BBH	38H	VCOM Setting
C0H	2CH	LCM Control
C2H	01H	VDV and VRH Command Enable
	FFH	
C3H	13H	VRH Set
C4H	20H	VDV Set
C6H	0FH	Frame Rate Control in Normal Mode
D0H	A4H	Power Control 1
	A1H	

2.3 Command Sequence (Recommend by U.R.T.)

LCD_Initial_ ST7789V2:

Driving ability Setting:

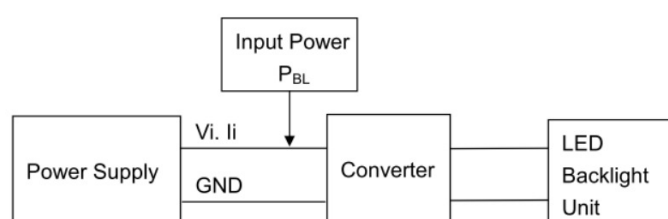
COMMAND	CODE	DESCRIPTION
E0H	70H	Positive Voltage Gamma Control
	0DH	
	14H	
	0CH	
	0CH	
	38H	
	37H	
	43H	
	47H	
	0BH	
	18H	
	17H	
	18H	
	1CH	
E1H	70H	Negative Voltage Gamma Control
	0EH	
	15H	
	0CH	
	0CH	
	08H	
	38H	
	44H	
	48H	
	3BH	
	18H	
	17H	
	18H	
	1CH	
29H		Display On

2.4 Back-light only Specification :

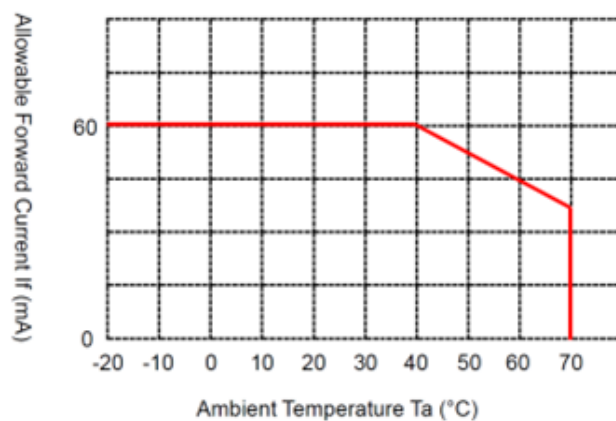
PARAMETER	SYMBOL	MIN	TYP	MAX	Unit	Test Condition	NOTE
Supply Current	I_f	-	80	-	mA	$T_a=25^{\circ}\text{C}$	1
Supply Voltage	V_f	2.6	3.3	3.4	V	$T_a=25^{\circ}\text{C}$ $I_f=80\text{mA}$	
Life Time	L_f	-	50000	-	Hr	$T_a=25^{\circ}\text{C}$ $I_f=80\text{mA}$	2

Note 1: The LED Supply Voltage is defined by d by the number of LED at $T_a=25^{\circ}\text{C}$ and $I_f=80\text{mA}$.

Note 2: LED current is measured by utilizing a high frequency current meter as shown below:



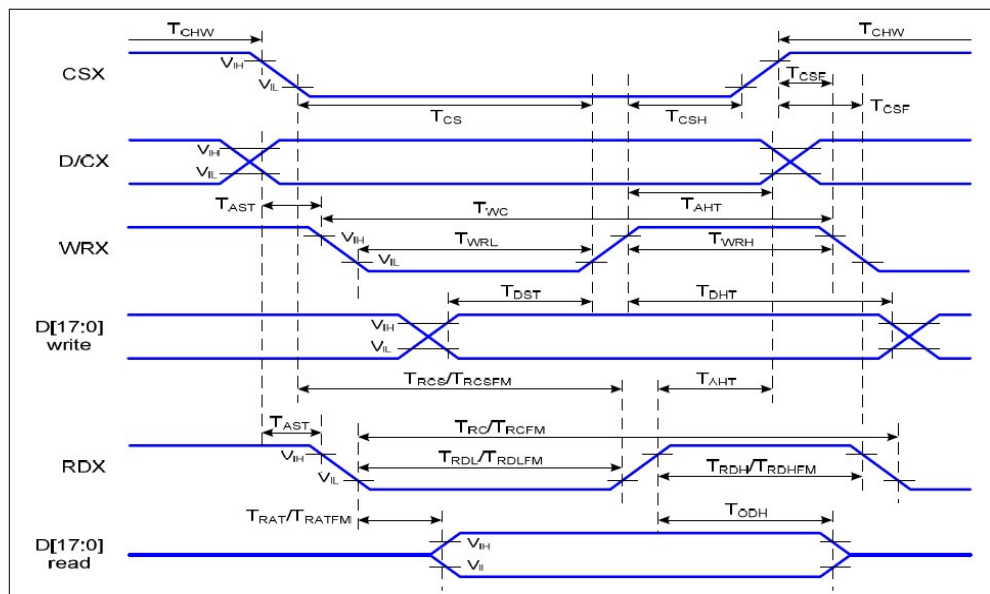
Note 3: The "LED life time" is defined as the module brightness decrease to 50% original brightness at $T_a=25^{\circ}\text{C}$ and $I_f=80\text{mA}$. The LED lifetime could be decreased if operating I_f is larger than 80mA .



2.5 AC Characteristics

2.5.1 8080-System Interface Timing Characteristics(8/9/16/18bit)

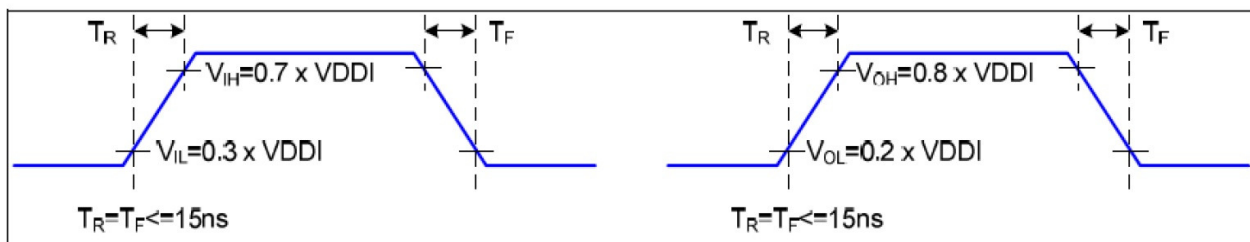
8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus



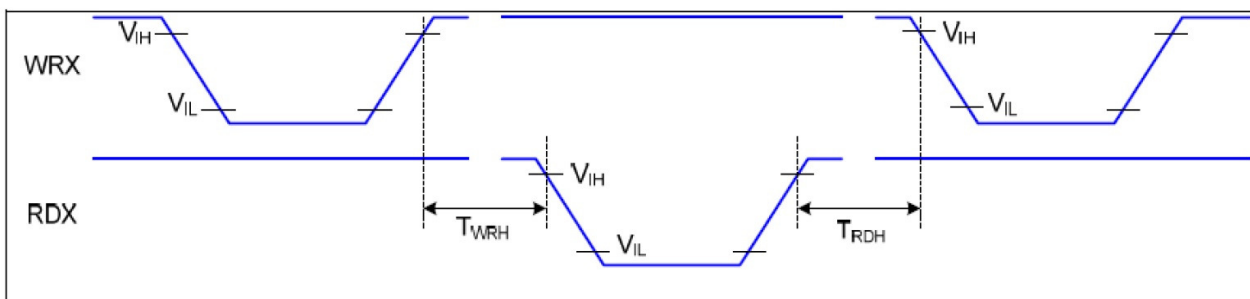
Parallel Interface Timing Characteristics (8080-Series MCU Interface)

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25°C

Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T _{AST}	Address setup time	0		ns	-
	T _{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T _{CHW}	Chip select "H" pulse width	0		ns	-
	T _{CS}	Chip select setup time (Write)	15		ns	
	T _{RCS}	Chip select setup time (Read ID)	45		ns	
	T _{RCSFM}	Chip select setup time (Read FM)	355		ns	
	T _{CSF}	Chip select wait time (Write/Read)	10		ns	
	T _{CSH}	Chip select hold time	10		ns	
WRX	T _{WC}	Write cycle	66		ns	
	T _{WRH}	Control pulse "H" duration	15		ns	
	T _{WRL}	Control pulse "L" duration	15		ns	
RDX (ID)	T _{RC}	Read cycle (ID)	160		ns	When read ID data
	T _{RDH}	Control pulse "H" duration (ID)	90		ns	
	T _{RDL}	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T _{RCFM}	Read cycle (FM)	450		ns	When read from frame memory
	T _{RDHFM}	Control pulse "H" duration (FM)	90		ns	
	T _{RDLFM}	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T _{DST}	Data setup time	10		ns	For CL=30pF
	T _{DHT}	Data hold time	10		ns	
	T _{RAT}	Read access time (ID)		40	ns	
	T _{RATFM}	Read access time (FM)		340	ns	
	T _{ODH}	Output disable time	20	80	ns	



Rising and Falling Timing for I/O Signal

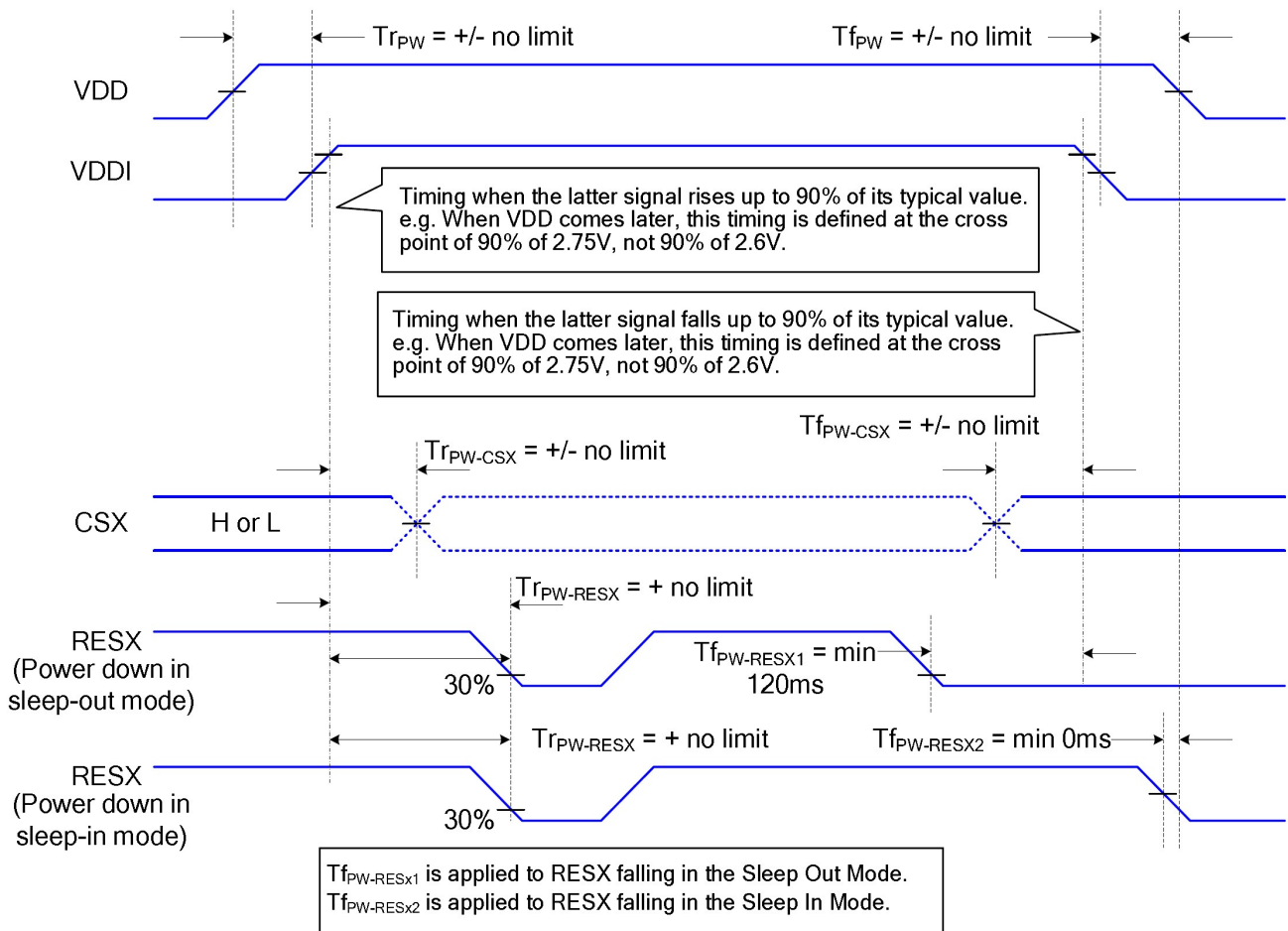


Write-to-Read and Read-to-Write Timing

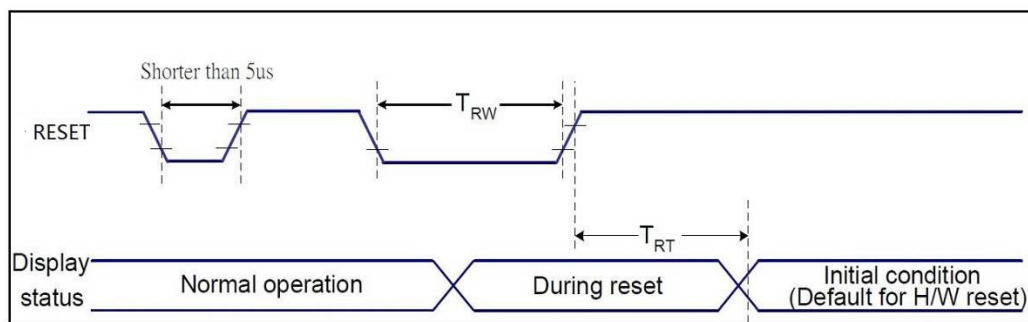
Note: The rising time and falling time (T_r , T_f) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

2.5.2 Power ON/OFF Sequence

The power on/off sequence is illustrated below



2.5.3 Reset Timing



Reset Timing

$IOVCC=1.65$ to $3.3V$, $VCI=2.4$ to $3.3V$, $GND=0V$, $T_a=25^{\circ}C$

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESET	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel	-	5 (Note 1, 5)	ms
				120 (Note 1, 6, 7)	ms

Reset Timing

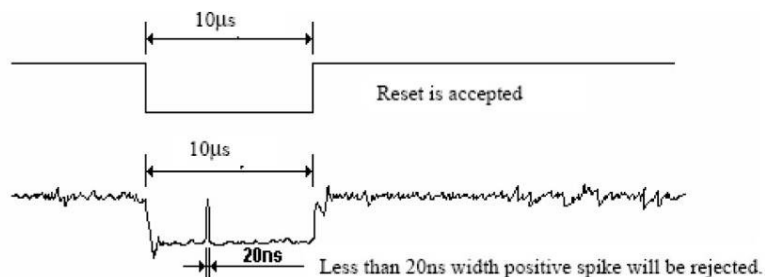
Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (t_{RT}) within 5 ms after a rising edge of RESET.
2. Spike due to an electrostatic discharge on RESET line does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.

4. Spike Rejection also applies during a valid reset pulse as shown below:



5. When Reset applied during Sleep In Mode.
6. When Reset applied during Sleep Out Mode.
7. It is necessary to wait 5msec after releasing RESET before sending commands. Also Sleep Out command cannot be sent for 120msec.

3. OPTICAL CHARACTERISTICS

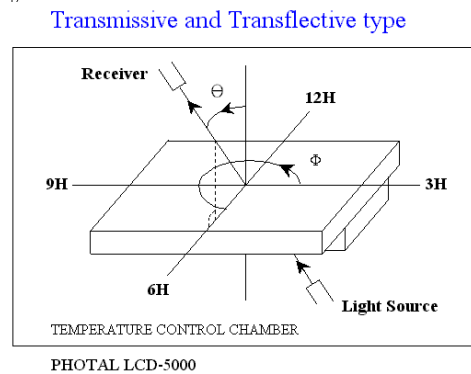
3.1 Characteristics

Electrical and Optical Characteristics

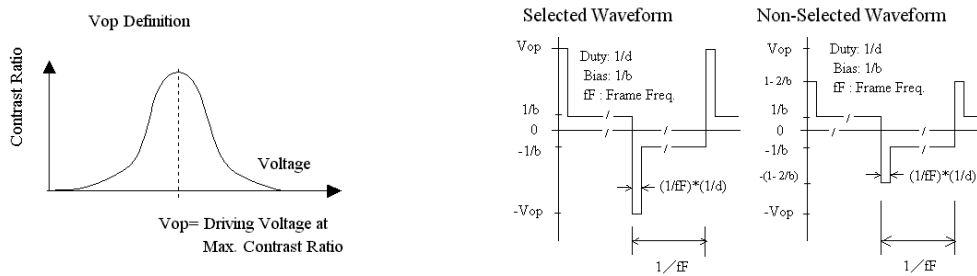
No.	Item			symbol / temp.		Min.	Typ.	Max.	Unit	Note
1	Response Time			Tr+Tf	25 °C	-	30	-	ms	2
2	Viewing Angle	Hor.	CR>10	θ_{2+}	$\Phi = 180^{\circ}$	60	80	-	degree	3
				θ_{2-}	$\Phi = 0^{\circ}$	60	80	-		
		Ver.		θ_{1+}	$\Phi = 90^{\circ}$	60	80	-		
				θ_{1-}	$\Phi = 270^{\circ}$	60	70	-		
3	Contrast Ratio			Cr	25 °C	800	1000	-	-	4
4	Red x-code			Rx	25 °C	0.543	0.593	0.643	-	5
	Red y-code			Ry		0.288	0.338	0.388		
	Green x-code			Gx		0.470	0.520	0.570		
	Green y-code			Gy		0.549	0.599	0.649		
	Blue x-code			Bx		0.098	0.148	0.198		
	Blue y-code			By		0.020	0.070	0.120		
	White x-code			Wx		0.252	0.302	0.352		
	White y-code			Wy		0.268	0.318	0.368		
	Brightness			Y		250	300	-	cd/m ²	
5	Brightness Uniformity				25 °C	80	-	-	%	6

3.2 Definition of optical characteristics

Measurement condition :

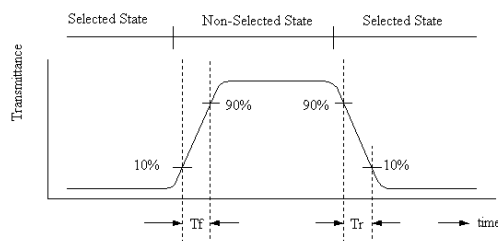


[Note 1] Definition of LCD Driving Vop and Waveform :



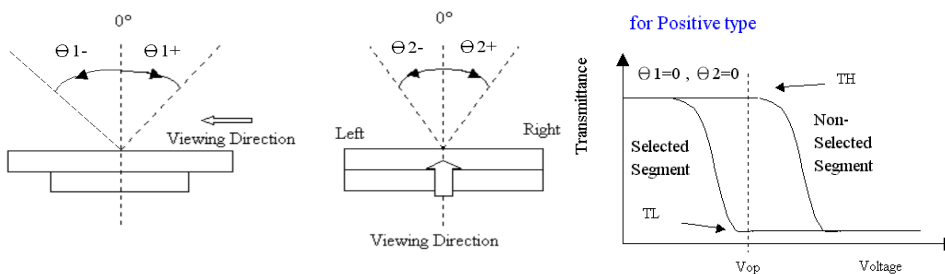
[Note 2] Definition of Response Time

for Positive type :



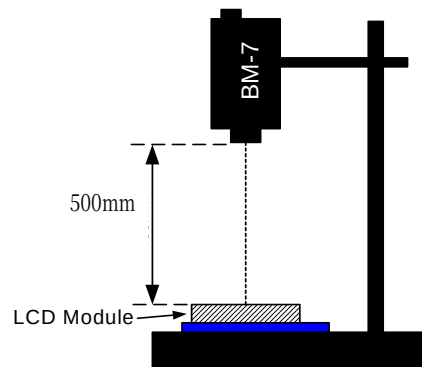
[Note 3] Definition of Viewing Angle :

[Note 4] Definition of Contrast Ratio :

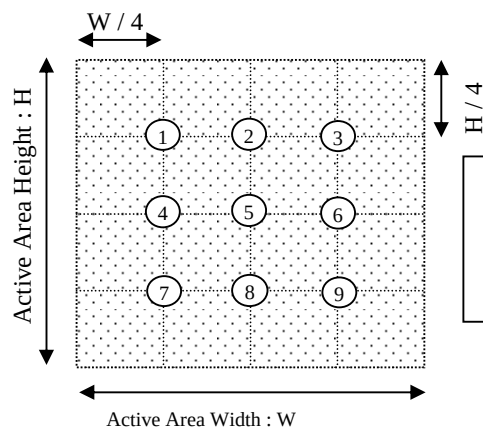


$$\text{Contrast Ratio} = \frac{TH}{TL}$$

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

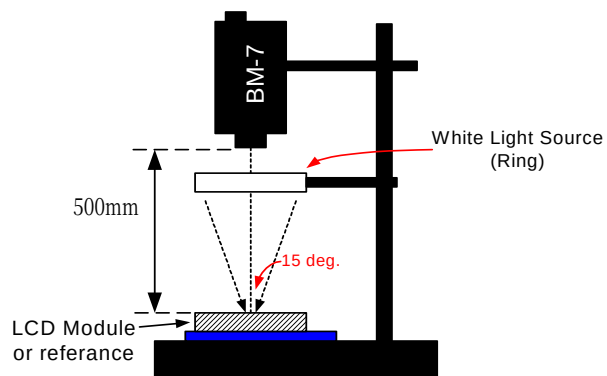


[Note 6] Definition of Brightness Uniformity



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

[Note 7] Definition of Measurement of Reflectance



4. RELIABILITY :

Item No	Items	Condition	Remark
1	High temperature operating	70 °C , 200 hours	1
2	Low temperature operating	-20 °C , 200 hours	1
3	High temperature storage	80 °C , 200 hours	1
4	Low temperature storage	-30 °C , 200 hours	1
5	High temperature & humidity storage	60°C, 90%RH, 100 hours	2
6	Thermal Shock storage	-30°C, 30min.<=> 80°C, 30min. 10 Cycles	1
7	Vibration test	10 => 55 =>10 => 55 => 10 Hz , within 1 minute Amplitude : 1.5mm. 15 minutes for each Direction (X,Y,Z)	
8	Drop test	Packed, 100CM free fall, 6 sides, 1 corner, 3edges	

Note 1 : The product move into the room temperature for at least 2 hours with no condensation.

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

* 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

☐ 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.
- Pay attention to the humidity of the work shop, 50~60%RH is satisfactory.
- Use a non-leak iron for soldering LCM.
- Do not touch the display surface or connection terminals area with bare hands. Smudges on the display surface reduce the insulation between terminals.
- Cautions for soldering to LCM:
Condition for soldering I/O terminals:
Temperature at iron tip : $350^{\circ}\text{C} \pm 15^{\circ}\text{C}$.
Soldering time : 3~4sec./ terminals.
Type of solder : Eutectic solder (rosin flux filled).

☐ PRECAUTION IN USE OF LCM

- Do not contact or scratch the front surface and the contact pads of a LCM with hard materials such as metal or glass or with one's nail.
- To clean the surface, wipe it gently with soft cloth dampened by alcohol.
- Do not attempt to wipe off the contact pads.
- Keep LCM away from direct sunlight, also avoid them in high-temperature & high humidity environment for a long period.
- Do not drive LCM by DC voltage.
- Do not expose LCM to organic solvent.
- 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.

☐ PRECAUTION FOR STORING AND USE OF LCM

- To avoid degradation of the device, do not store the module under the conditions of direct sunlight, high temperature or high humidity. Keep the module in bags designed to prevent static electricity charging under low temperature / normal humidity conditions (avoid high temperature / high humidity and low temperature below 0°C)
- Never use the LCD, LCM under 45 Hz, the liquid crystal will decomposition and cause permanently damage on display !!

☐ 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**

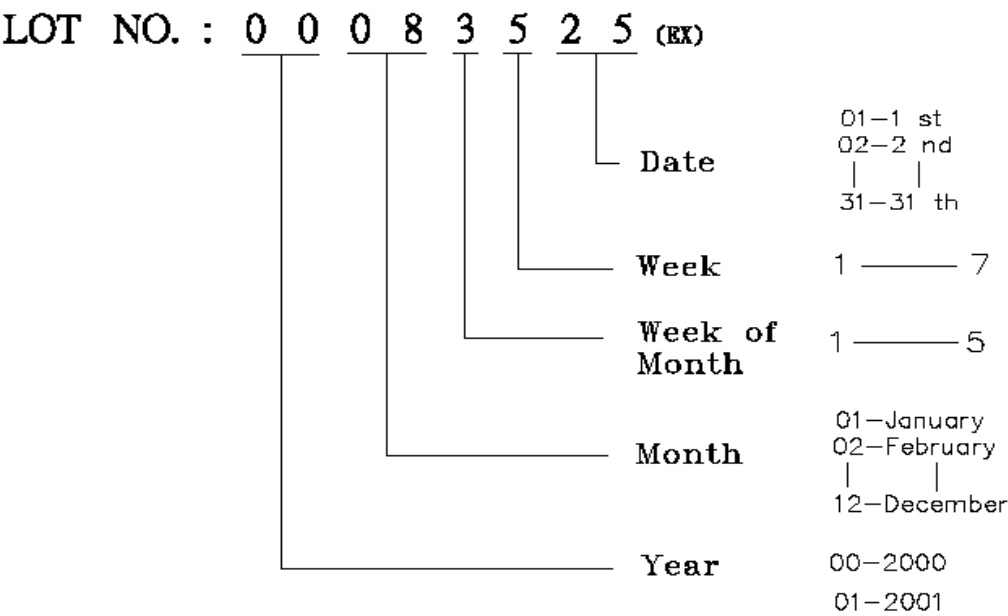
| | | |
Year Month Day - Serial No.

- Example: 121108 - 0003 ==> Year 2012, November,8th , Serial No.0003

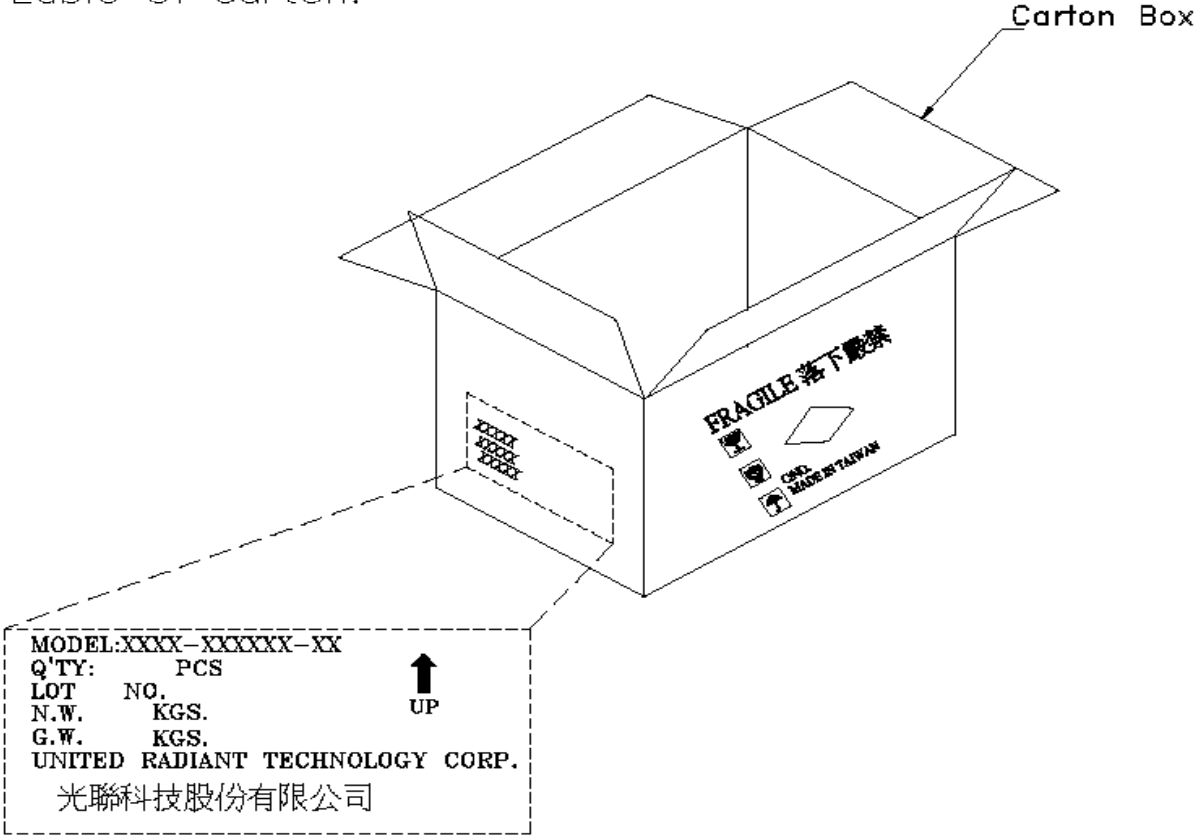
Note : The lot no. attached on the packing box will be used for tracking once the part is too small to print the date code.

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 °C 40 °C ,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.

CLASS	AQL(%)
CRITICAL	0.4 %
MAJOR	0.65 %
MINOR	1.5 %

EVERY ITEM SHALL BE INSPECTED ACCORDING TO THE CLASS.

(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 NEW PRODUCTS FOR THESE DEFECT PRODUCT WHICH UNDER WARRANTY PERIOD AND BELONG TO THE RESPONSIBILITY OF U.R.T.

8.2. CHECKING CONDITION

8.2.1. VIEWING DISTANCE IS APPROXIMATELY : 30 ± 5 CM.

8.2.2. VIEWING ANGLE IS NORMAL TO THE LCD PANEL WITH 45°.

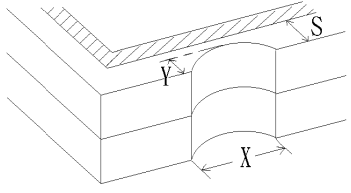
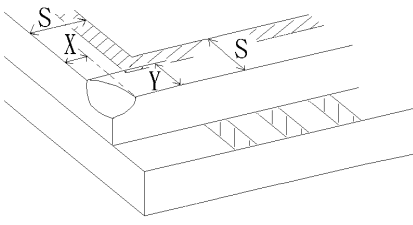
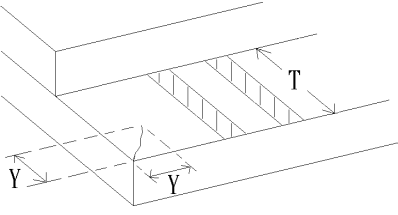
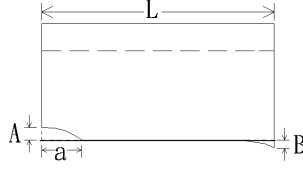
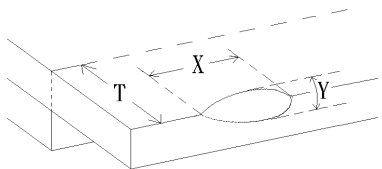
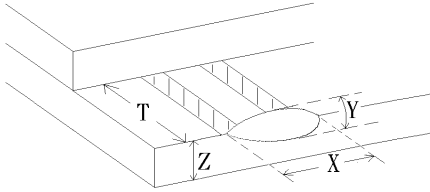
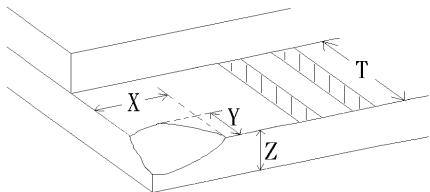
8.2.3. AMBIENT ILLUMINANCE : 2 PCS OF 20W FLUORESCENT LAMPS(DISTANCE TO THE SAMPLE >100CM)
OR 1000 ± 200 LUX.

8.3. INSPECTION PLAN :

CLASS	ITEM	JUDGEMENT	CLASS
PACKING & INDICATE	1. OUTSIDE AND INSIDE PACKAGE	"MODEL NO." , "LOT NO." AND "QUANTITY" SHOULD INDICATE ON THE PACKAGE.	Minor
	2. MODEL MIXED AND QUANTITY	OTHER MODEL MIXED.....REJECTED QUANTITY SHORT OR OVER.....REJECTED	Critical
	3. PRODUCT INDICATION	"MODEL NO." SHOULD INDICATE ON THE PRODUCT	Major
ASSEMBLY	4. DIMENSION, LCD GLASS SCRATCH AND SCRIBE DEFECT.	ACCORDING TO SPECIFICATION OR DRAWING.	Major
APPEARANCE	5. VIEWING AREA	POLARIZER EDGE OR LCD'S SEALING LINE IS VISABLE IN THE VIEWING AREAREJECTED	Minor
	6. CANNOT BE REMOVED, BLEMISH BLACK SPOTS, WHITE SPOTS, ON THE LCD AND LCD GLASS CRACKS.	ACCORDING TO STANDARD OF VISUAL INSPECTION (INSIDE VIEWING AREA)	Minor
	7. BLEMISH, BLACK SPOT WHITE SPOT AND SCRATCH ON THE POLARIZER	ACCORDING TO STANDARD OF VISUAL INSPECTION (INSIDE VIEWING AREA)	Minor
	8. BUBBLE IN POLARIZER	ACCORDING TO STANDARD OF VISUAL INSPECTION (INSIDE VIEWING AREA)	Minor
	9. LCD'S RAINBOW COLOR	STRONG DEVIATION COLOR (OR NEWTON RING) OF LCD.....REJECTED. OR ACCORDING TO LIMITED SAMPLE (IF NEEDED, AND INSIDE VIEWING AREA)	Minor
ELECTRICAL	10. ELECTRICAL AND OPTICAL CHARACTERISTICS (CONTRAST, VOP, CHROMATICITY ... ETC)	ACCORDING TO SPECIFICATION OR DRAWING . (INSIDE VIEWING AREA)	Critical
	11.MISSING LINE	MISSING DOT, LINE, CHARACTERREJECTED	Critical
	12.SHORT CIRCUIT, WRONG PATTERN DISPLAY	NON DISPLAY, WRONG PATTERN DISPLAY, CURRENT CONSUMPTION OUT OF SPECIFICATION..... REJECTED	Critical
	13. PIN HOLE, PATTERN DEFORMITY	ACCORDING TO STANDARD OF VISUAL INSPECTION	Minor

8.4. STANDARD OF VISUAL INSPECTION

NO.	CLASS	ITEM	JUDGEMENT																				
8.4.1	MINOR	BLACK AND WHITE SPOT FOREIGN MATERIEL DUST IN THE CELL BLEMISH SCRATCH	(A) ROUND TYPE: unit : mm.<table><tr><th>DIAMETER (mm.)</th><th>ACCEPTABLE Q'TY</th></tr><tr><td>$\Phi \leq 0.1$</td><td>DISREGARD</td></tr><tr><td>$0.1 < \Phi \leq 0.25$</td><td>3 (Distance>5mm)</td></tr><tr><td>$0.25 < \Phi$</td><td>0</td></tr></table> NOTE: $\Phi=(\text{LENGTH}+\text{WIDTH})/2$ (B) LINEAR TYPE: unit : mm.<table><tr><th>LENGTH</th><th>WIDTH</th><th>ACCEPTABLE Q'TY</th></tr><tr><td>-----</td><td>$W \leq 0.03$</td><td>DISREGARD</td></tr><tr><td>$L \leq 5.0$</td><td>$0.03 < W \leq 0.07$</td><td>3 (Distance>5mm)</td></tr><tr><td>-----</td><td>$0.07 < W$</td><td>FOLLOW ROUND TYPE</td></tr></table>	DIAMETER (mm.)	ACCEPTABLE Q'TY	$\Phi \leq 0.1$	DISREGARD	$0.1 < \Phi \leq 0.25$	3 (Distance>5mm)	$0.25 < \Phi$	0	LENGTH	WIDTH	ACCEPTABLE Q'TY	-----	$W \leq 0.03$	DISREGARD	$L \leq 5.0$	$0.03 < W \leq 0.07$	3 (Distance>5mm)	-----	$0.07 < W$	FOLLOW ROUND TYPE
DIAMETER (mm.)	ACCEPTABLE Q'TY																						
$\Phi \leq 0.1$	DISREGARD																						
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LENGTH	WIDTH	ACCEPTABLE Q'TY																					
-----	$W \leq 0.03$	DISREGARD																					
$L \leq 5.0$	$0.03 < W \leq 0.07$	3 (Distance>5mm)																					
-----	$0.07 < W$	FOLLOW ROUND TYPE																					
8.4.2	MINOR	BUBBLE IN POLARIZER DENT ON POLARIZER	unit : mm.<table><tr><th>DIAMETER</th><th>ACCEPTABLE Q'TY</th></tr><tr><td>$\Phi \leq 0.2$</td><td>DISREGARD</td></tr><tr><td>$0.2 < \Phi \leq 0.5$</td><td>2 (Distance>5mm)</td></tr><tr><td>$0.5 < \Phi$</td><td>0</td></tr></table>	DIAMETER	ACCEPTABLE Q'TY	$\Phi \leq 0.2$	DISREGARD	$0.2 < \Phi \leq 0.5$	2 (Distance>5mm)	$0.5 < \Phi$	0												
DIAMETER	ACCEPTABLE Q'TY																						
$\Phi \leq 0.2$	DISREGARD																						
$0.2 < \Phi \leq 0.5$	2 (Distance>5mm)																						
$0.5 < \Phi$	0																						
8.4.3	MINOR	Dot Defect	<table><tr><th>Items</th><th>ACC. Q'TY</th></tr><tr><td>Bright dot</td><td>$N \leq 4$ (Distance>5mm)</td></tr><tr><td>Dark dot</td><td>$N \leq 4$ (Distance>5mm)</td></tr></table> Pixel Define Pixel R G B Dot Dot Dot Not 1: The definition of dot: The size of a defective dot over 1/2 of whole dot is regarded as one defective dot. Not 2: Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern. Not 3: Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green ,blue pattern.	Items	ACC. Q'TY	Bright dot	$N \leq 4$ (Distance>5mm)	Dark dot	$N \leq 4$ (Distance>5mm)														
Items	ACC. Q'TY																						
Bright dot	$N \leq 4$ (Distance>5mm)																						
Dark dot	$N \leq 4$ (Distance>5mm)																						

NO.	CLASS	ITEM	JUDGEMENT
8.4.4	MINOR	CHIPPING	 $Y > S$ REJ.
8.4.5	MINOR	CHIPPING	 $X \text{ or } Y > S$ REJ.
8.4.6	MAJOR	GLASS CRACK	 $Y > (1/2) T$ REJ.
8.4.7	MAJOR	SCRIBE DEFECT	 $a > L/3$, $A > 1.5\text{mm}$. REJ. - B : ACCORDING TO DIMENSION
8.4.8	MINOR	CHIPPING (ON THE TERMINAL AREA)	 $\Phi = (x+y)/2 > 2.5 \text{ mm}$ REJ.
8.4.9	MINOR	CHIPPING (ON THE TERMINAL SURFACE)	 $Y > (1/3) T$ REJ.
8.4.10	MINOR	CHIPPING	 $Y > T$ REJ.