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MDT020003R	240 x 320	SPI Interface	TFT Module

Specification

Version: 1	Date: 30/05/2024

Revision

1	28/05/2024	First issue
2	29/10/2026	Updated the operating temperature from 20 to -20 to 70C, pin-out table has been corrected on the interface pin function page, and the drawing has been corrected from 2.4” to 2.0” TFT.

Display Features	
Display Size	2.0”
Resolution	240 x 320
Orientation	Portrait
Appearance	RGB
Logic Voltage	2.8V
Interface	SPI
Brightness	320 cd/m^2
Touchscreen	RTP
Module Size	37.88 x 51.50 x 2.50 mm
Operating Temperature	-20°C ~ +70°C
Pinout	13 way FFC
Pitch	0.5 mm

RoHS compliant

Created By	Checked By
RV	WE
Box Quantity	Weight / Display
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* - For full design functionality, please use this specification in conjunction with the ST7789T3-G4-1 display driver specification.(Provided Separately)

Display Accessories

Part Number	Description
MDIB-CC1	Interconnect board for standard pitch pinouts to fine pitch wires. Providing pinouts for 2.54 pinout. 1.27, 1, 0.845, 0.8, 0.7, 0.65, 0.62, 0.6, 0.5 & 0.3 pads.

Optional Variants

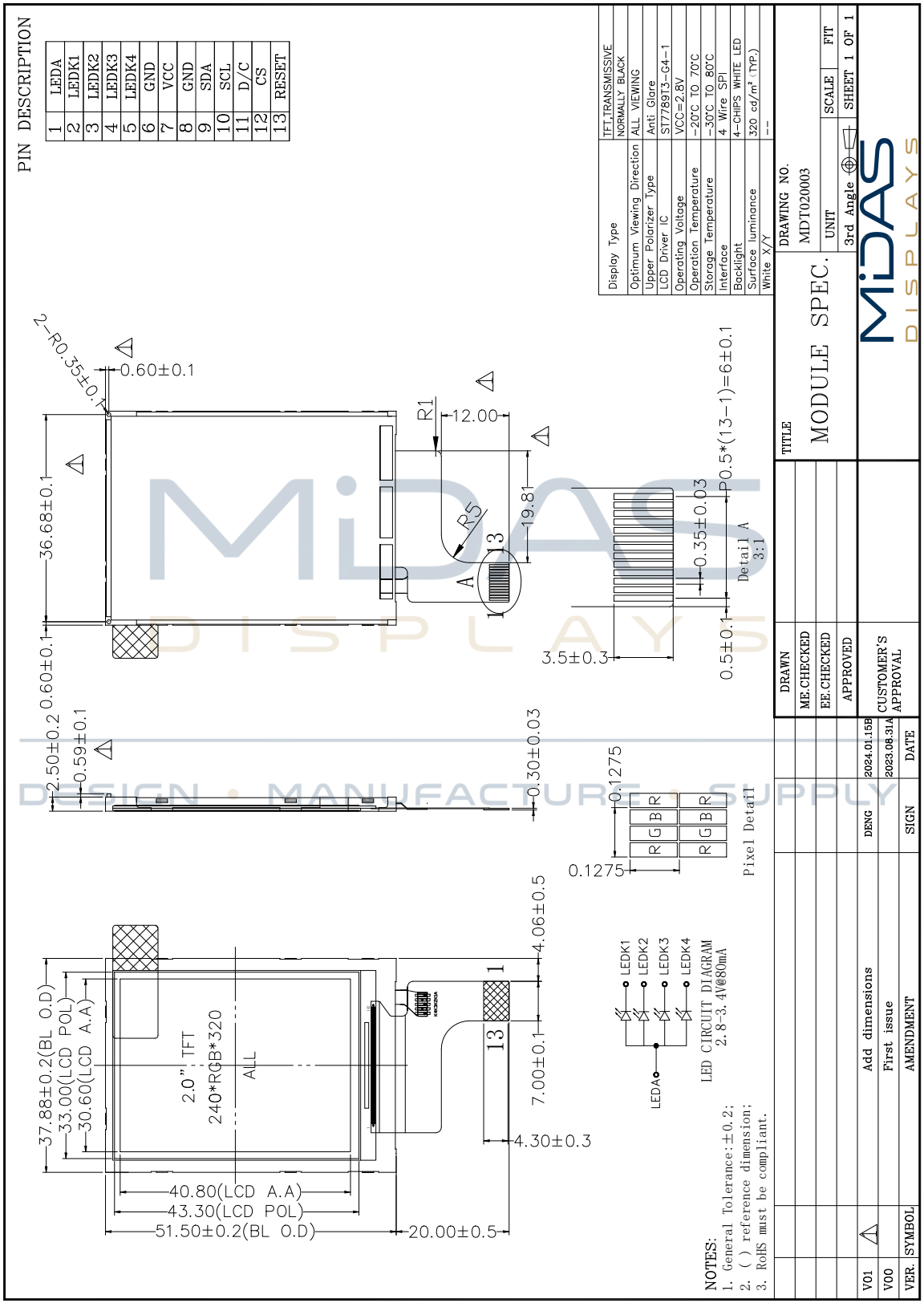
Appearances	Voltage

1. General Specification

Item	Contents	Unit
LCD type	TFT/Transmissive	
Module size (W*H*T)	37.88*51.50*2.50	mm
Active size (W*H)	30.6*40.80	mm
Pixel pitch (W*H)	0.1275*0.1275	mm
Number of dots	240(H)*RGB*320(V)	
Driver IC	ST7789T3-G4-1	
Interface type	4 WIRE SPI	
Top polarizer type	Anti-Glare	
Recommend viewing direction	All	O'clock
Gary scale inversion direction	--	O'clock
Backlight type	4-Dies white LED	
Touch panel type	Resistive	

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2.Mechanical Drawing



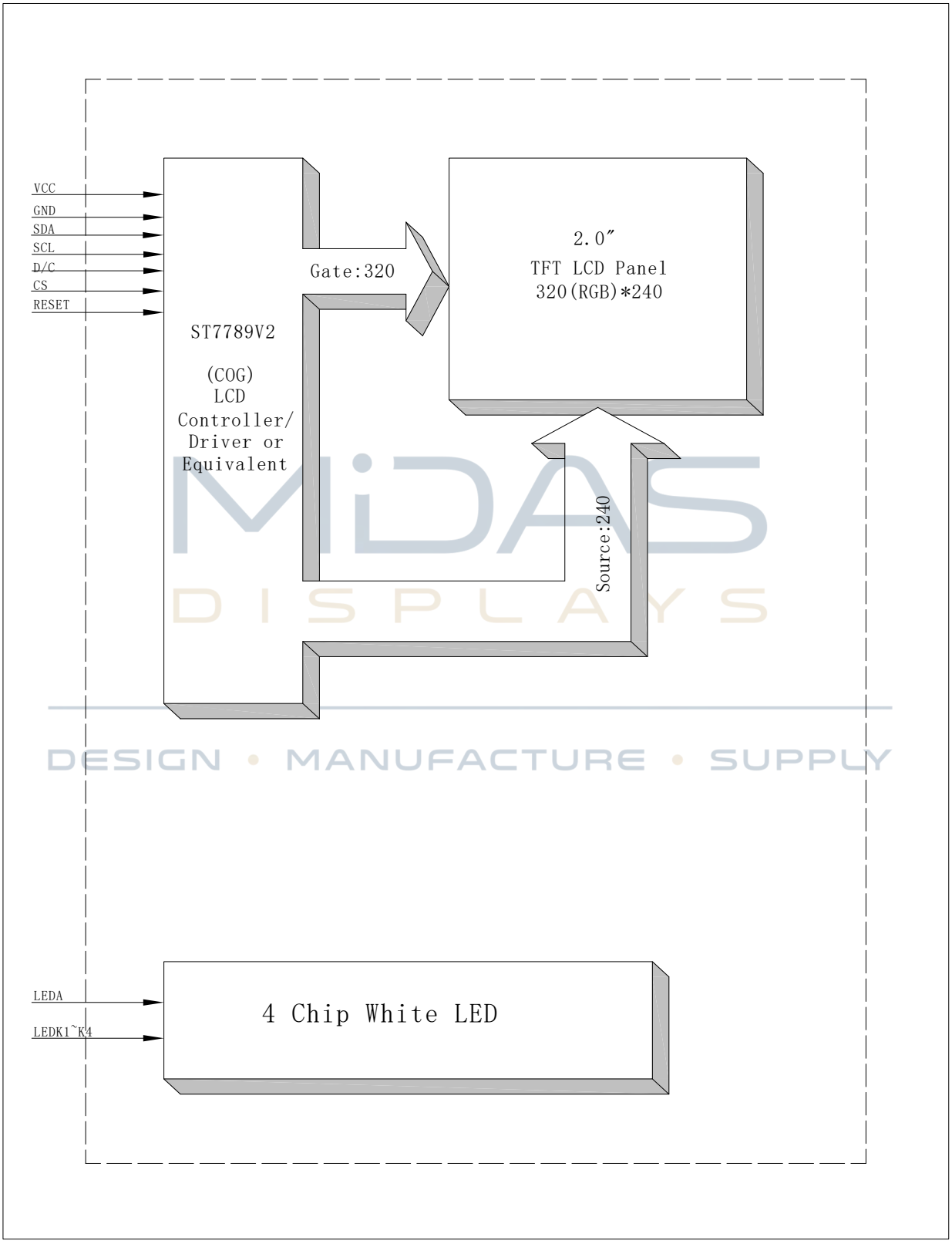
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Email:tech@midasdisplays.com
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Touch Panel Drawing available on request, please contact sales@midasdisplays.com

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3.Block Diagram



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4.Interface Pin Function

Pin No.	Symbol	Description
1	LEDA	Anode of LED backlight
2	LEDK1	Cathode of LED backlight
3	LEDK2	Cathode of LED backlight
4	LEDK3	Cathode of LED backlight
5	LEDK4	Cathode of LED backlight
6	GND	Power ground
7	VCC	Supply Voltage
8	GND	Power ground
9	SDA	SPI interface input/output pin.
10	CS	Chip selection pin ,Low enable.
11	SCL	Serial interface clock.
12	D/C	Display data/command selection pin.
13	RESET	This signal will reset the device and it must be applied to properly initialize the chip.

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5.Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply voltage for analog	VCC	-0.3	4.6	V
Supply voltage for logic	VCC	-0.3	4.6	V
Supply current (One LED)	I_{LED}		30	mA
Operating temperature	T_{OP}	-20	+70	°C
Storage temperature	T_{ST}	-30	+80	°C

Note: The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

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6. Electrical Characteristics

6.1 Input Power

Item	Symbol	Min	Typ.	Max	Unit	Applicable terminal
Supply Voltage for Analog	VCC	2.5	2.8	3.3	V	
Supply Voltage for Logic	VCC	2.5	2.8	3.3	V	
Input Voltage	V_{IL}	GND	-	0.3VCI	V	
	V_{IH}	0.7 VCI	-	VCI		
Input leakage Current	I_{LKG}	-1		1	μA	

6.2 Backlight Driving Conditions

Item	Symbol	Value			Unit	Remark
		Min.	Typ.	Max.		
Voltage for LED Backlight	V_F	2.8	3.2	3.4	V	I_L =80mA
Current for LED Backlight	I_L		80		mA	
Power Consumption	P		0.256		W	
LED Life Time		30,000	50,000		Hr	Note

Note: Brightness to be decreased to 50% of the initial value at ambient temperature TA=25℃

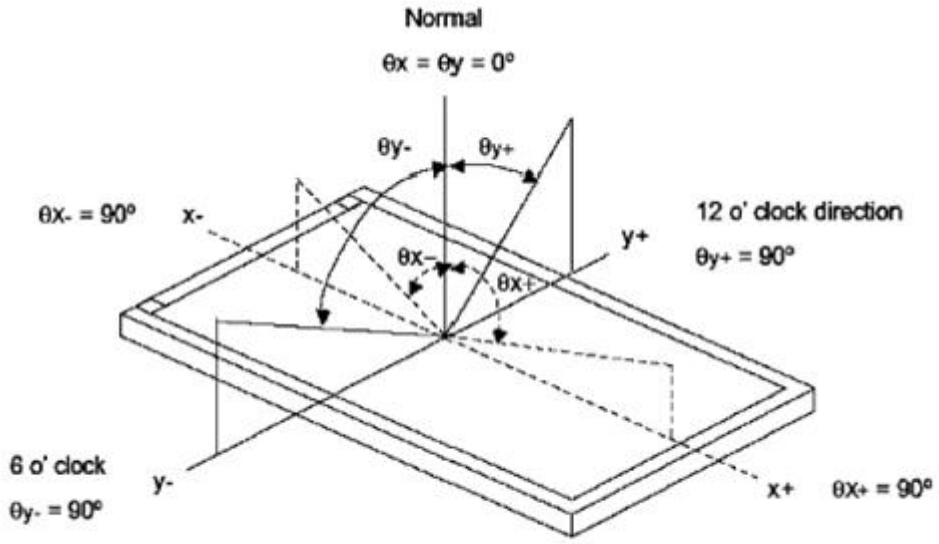
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7.Optical Characteristics

ITEM		SYMBOL	CONDITIONS	SPECIFICATIONS			UNIT	NOTE
				MIN	TYP.	MAX		
Luminance		L	I_L =80mA	250	320	450	Cd/m^2	
Contrast Ratio		CR	θ=0°	800	1000	-		
Response Time		T_{ON}	25℃		30	35	ms	
		T_{OFF}						
CIE Color Coordinate	Red	X_R	Viewing normal angle	0.5911	0.6311	0.6711		
		Y_R		0.3018	0.3418	0.3818		
	Green	X_G		0.2857	0.3257	0.3657		
		Y_G		0.5501	0.5901	0.6301		
	Blue	X_B		0.0846	0.1246	0.1646		
		Y_B		0.0348	0.0748	0.1148		
	White	X_W		0.2426	0.2826	0.3226		
		Y_W		0.2647	0.3047	0.3447		
Viewing Angle	Hor.	θ_{X+}	CR≥10	80	85		Degree	
		θ_{X-}		80	85			
	Ver.	θ_{Y+}		80	85			
		θ_{Y-}		80	85			
Uniformity	Un			80			%	

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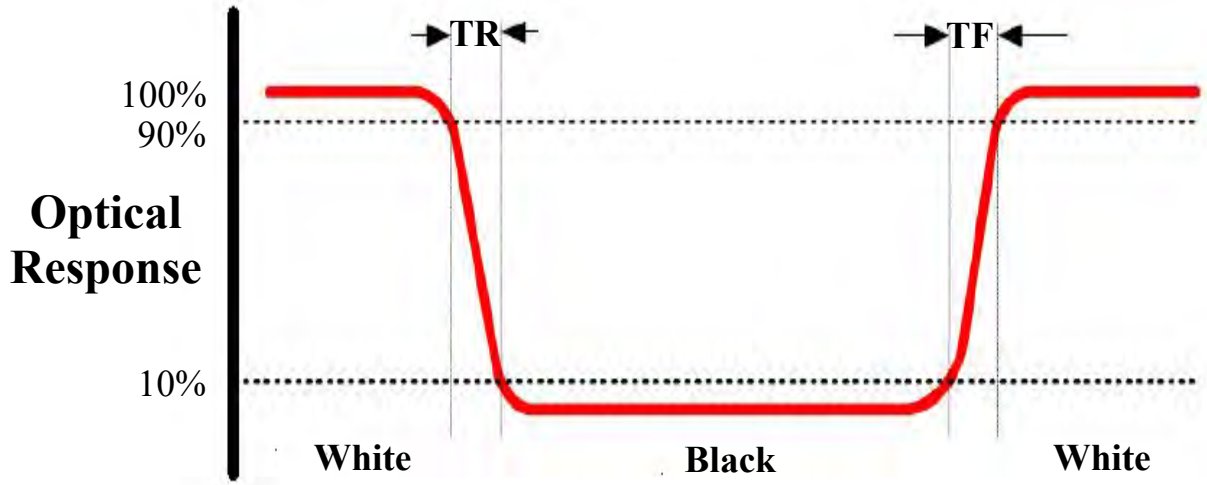
Note 1: Definition of Viewing Angle θx and θy:



Note 2: Definition of contrast ratio CR:

$$CR = \frac{\text{Luminance of white state}}{\text{Luminance of black state}}$$

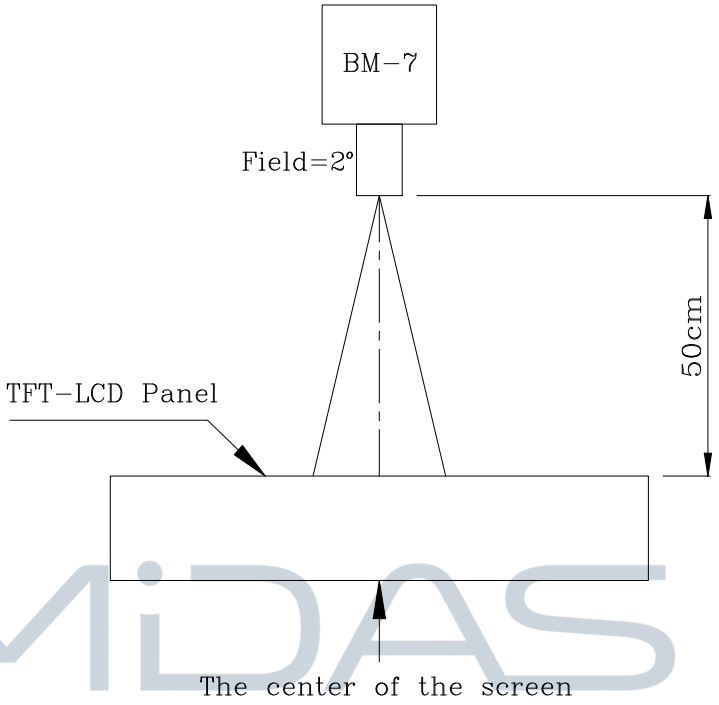
Note 3: Definition of Response Time(Tr,Tf)



Note 4: Definition of Luminance

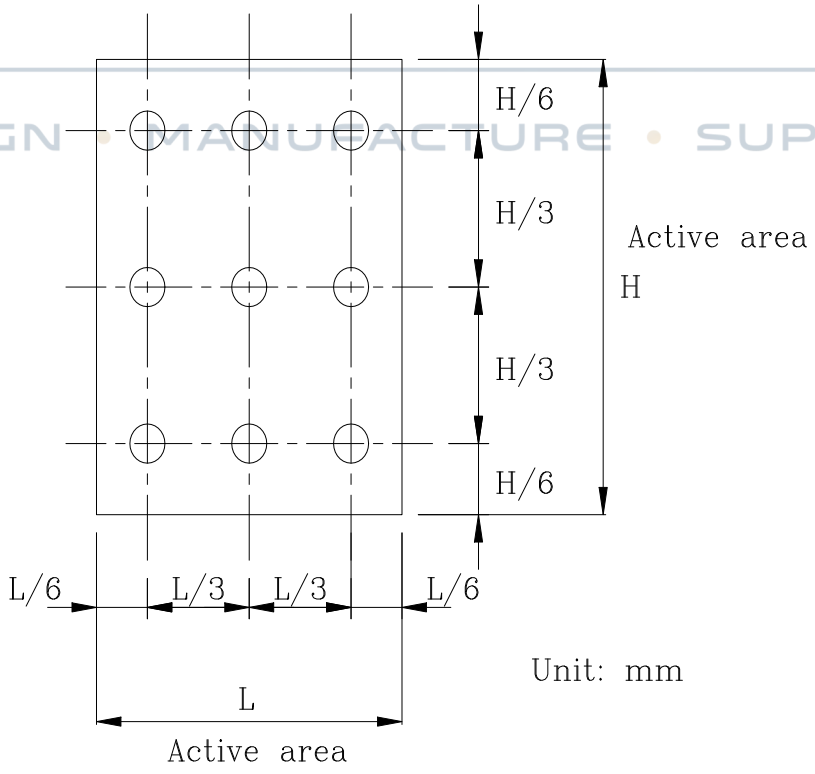
①The Brightness Test Equipment Setup

Field=2° (As measuring "black" image, field=2° is the best testing condition)



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②The Brightness Test Point Setup



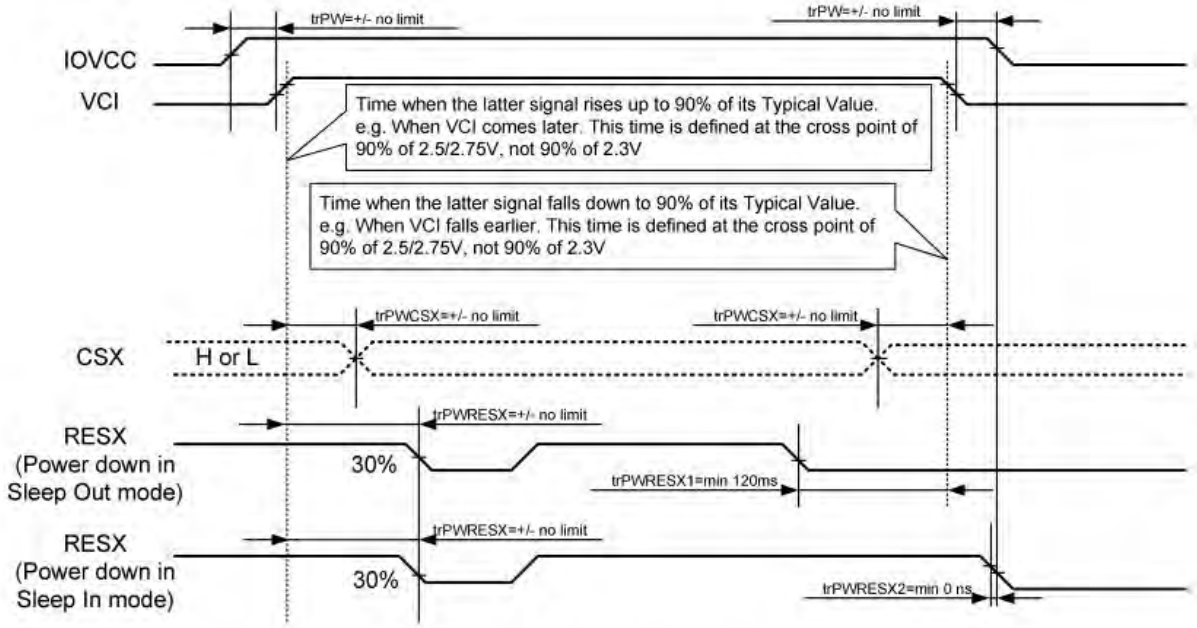
8.Timing Characteristics

8.1Power On/Off Sequence

IOVCC and VCI can be applied in any order.
VCI and IOVCC can be powered down in any order.
During power off, if LCD is in the Sleep Out mode, VCI and IOVCC must be powered down minimum120msec after RESX has been released.
During power off, if LCD is in the Sleep In mode, IOVCC or VCI can be powered down minimum 0msec after RESX has been released.
CSX can be applied at any timing or can be permanently grounded. RESX has priority over CSX.
Note 1: There will be no damage to the display module if the power sequences are not met.
Note 2: There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.
Note 3: There will be no abnormal visible effects on the display between end of Power On Sequence and before receiving Sleep Out command. Also between receiving Sleep In command and Power Off Sequence.
Note 4: If RESX line is not held stable by host during Power On Sequence as defined in Case1 and Case 2,then it will be necessary to apply a Hardware Reset (RESX) after Host Power On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed.

Case 1 – RESX line is held High or Unstable by Host at Power ON

If RESX line is held High or unstable by the host during Power On, then a Hardware Reset must be applied after both VCI and IOVCC have been applied – otherwise correct functionality is not guaranteed. There is no timing restriction upon this hardware reset.

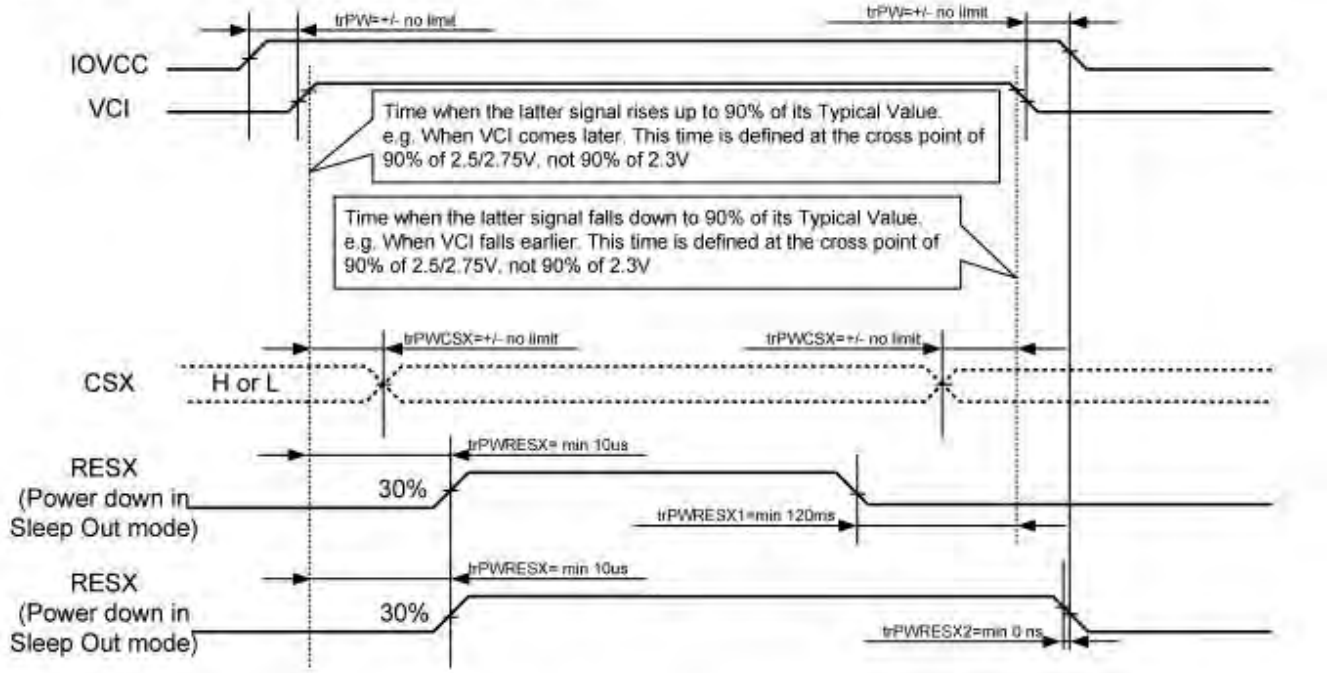


trPWRESX1 is applied to RESX falling in the Sleep Out Mode
trPWRESX2 is applied to RESX falling in the Sleep In Mode

Note 1: Unless otherwise specified, timings herein show cross point at 50% of signal power level.

Case 2 – RESX line is held Low by Host at Power ON

If RESX line is held Low (and stable) by the host during Power On, then the RESX must be held low for minimum 10µsec after both VCI and IOVCC have been applied.

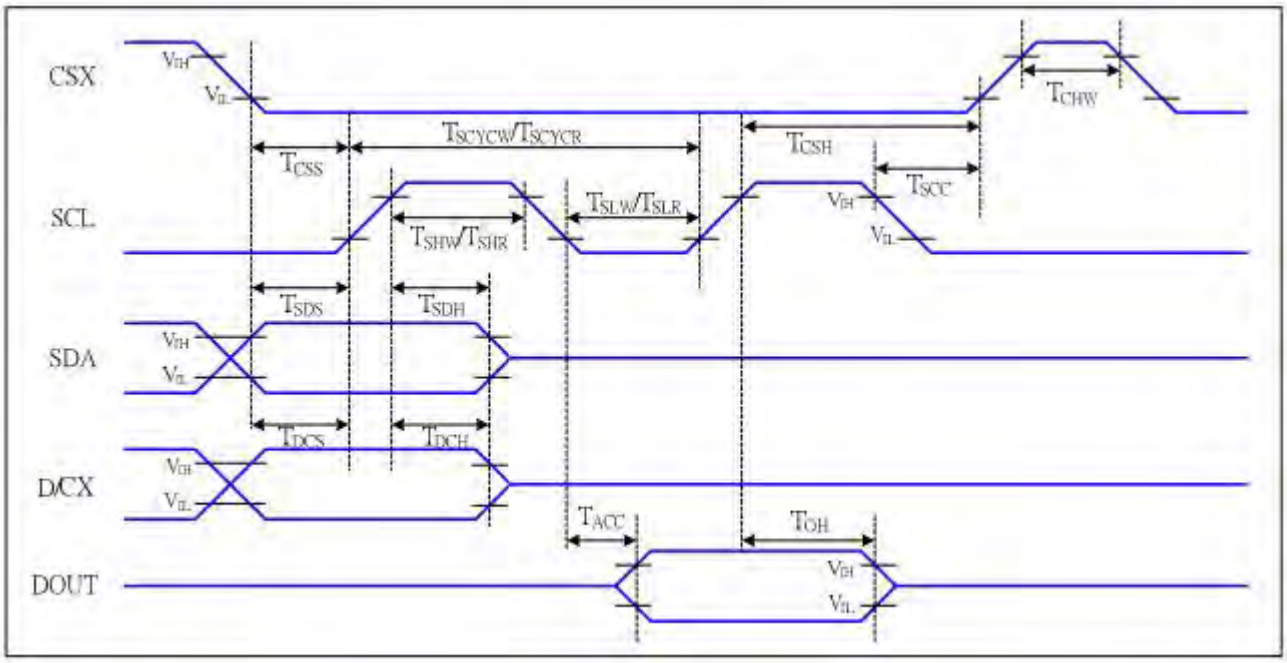


trPWRESX1 is applied to RESX falling in the Sleep Out Mode
trPWRESX2 is applied to RESX falling in the Sleep In Mode

Note 1: Unless otherwise specified, timings herein show cross point at 50% of signal power level.

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8.2 Serial Interface Characteristics (4-line serial)



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

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	Tcss	Chip select setup time (write)	15		ns	
	Tcsh	Chip select hold time (write)	15		ns	
	Tcss	Chip select setup time (read)	60		ns	
	Tscc	Chip select hold time (read)	65		ns	
	Tchw	Chip select "H" pulse width	40		ns	
SCL	Tscycw	Serial clock cycle (Write)	16		ns	-write command & data ram
	Tshw	SCL "H" pulse width (Write)	7		ns	
	Tslw	SCL "L" pulse width (Write)	7		ns	
	Tscycr	Serial clock cycle (Read)	150		ns	-read command & data ram
	Tshr	SCL "H" pulse width (Read)	60		ns	
	Tslr	SCL "L" pulse width (Read)	60		ns	
D/CX	Tdcs	D/CX setup time	10		ns	
	Tdch	D/CX hold time	10		ns	
SDA (DIN)	Tsds	Data setup time	7		ns	
	Tsdh	Data hold time	7		ns	
DOUT	Tacc	Access time	10	50	ns	For maximum CL=30pF
	Toh	Output disable time	15	50	ns	For minimum CL=8pF

9.Standard Specification for Reliability

9.1Standard Specification for Reliability of LCD Module

No.	Item	Description	Remarks
01	High temperature operation	Ts=+70℃, 240hrs.	Note1, IEC60068-2-2,GB2423.2—89
02	Low temperature operation	Ta=-20℃, 240hrs	Note2, IEC60068-2-1,GB2423.1—89
03	High temperature storage	Ta=+80℃, 240hrs	IEC 60068-2-2, GB2423.2-89
04	Low temperature storage	Ta=-30℃, 240hrs	IEC 60068-2-1, GB2423.1-89
05	High Temperature & High Humidity（NonOperation）	+60℃, 90% RH max,240 hours	IEC60068-2-3, GB/T2423.3—2006
06	Thermal Shock (Nonoperation)	-20℃ 30 min~+60℃ 30 min, Change time:5min, 30 Cycle	Start with cold temperature, end with high temperature IEC60068214,GB2423.22—87
07	Electro Static Discharge (Operation)	C=150pF, R=330Ω，5points/panel Air:±8KV，5times;Contact:±4KV，5 times; （Environment: 15℃～35℃， 30%～60%，86Kpa～106Kpa）	IEC 61000-4-2 GB/T17626.2-1998
08	Package Drop Test	Height:80 cm ， 1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8—1995

Note1: Ts is the temperature of panel's surface.
Note2: Ta is the ambient temperature of sample.

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9.2 Testing Conditions and Inspection Criteria

For the final test, the testing sample must be stored at room temperature for 24 hours. After the tests listed in Table 9.2, standard specifications for reliability will be executed in order to ensure stability.

No.	Item	Test Model	In section Criteria
01	Current Consumption	Refer To Specification	The current consumption should conform to the product specification.
02	Contrast	Refer To Specification	After the tests have been executed, the contrast must be larger than half of its initial value prior to the tests.
03	Appearance	Visual inspection	Defect free.

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9.3 MTBF

MTBF	Functions, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (25±5℃), normal humidity (50±10% RH), and in area not exposed to direct sun light.

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10. General Precautions

10.1. Safety

- Liquid crystal is poisonous. Do not put it in your mouth. If liquid crystal touches your skin or clothes, wash it off immediately by using soap and water.

10.2. Handling

- The LCD panel is plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.
- The polarizer attached to the display is easily damaged. Please handle it carefully to avoid scratch or other damages.
- To avoid contamination on the display surface, do not touch the module surface with bare hands.
- Keep a space so that the LCD panels do not touch other components.
- Put cover board such as acrylic board on the surface of LCD panel to protect panel from damages.
- Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where the condensation of dew occurs.
- Do not leave module in direct sunlight to avoid malfunction of the ICs.

10.3. Static Electricity

- Be sure to ground module before turning on power or operating module.
- Do not apply voltage which exceeds the absolute maximum rating value.

10.4. Storage

- Store the module in a dark room where recommend to 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.

10.5. Cleaning

- Do not wipe the polarizer with dry cloth. It might cause scratch.
- Only use a soft sloth with IPA to wipe the polarizer, other chemicals might permanent damage to the polarizer.

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11.Specification of Quality Assurance

This standard of Quality Assurance confirms to the quality of LCD module products supplied by Midas.

11.1 Quality Test

Before delivering, the supplier should conduct the following tests to confirm the quality of products.

- Electrical-Optical Characteristics: According to the individual specification to test the product.
- Appearance Characteristics: According to the individual specification to test the product.
- Reliability Characteristics: According to the definition of reliability on the specification for testing products.

11.2 Delivery Test

Before delivering, the supplier should conduct the delivery test.

- Test method: According to MIL-STD105E.General Inspection Level II take a single Time.
- The defects classify of AQL as following:
  Major defect: AQL = 0.65
  Minor defect: AQL = 1.5
  Total defects: AQL = 1.5

11.3 Non-conforming Analysis & Deal With Manners

11.3.1 Non-conforming Analysis

- Purchaser should provide the data detail of non-conforming sample and the non-conforming.
- After receiving the data detail from purchaser, the analysis of non-conforming should be finished within two weeks.
- If the analysis can't be finished on time, supplier must notice purchaser 3 days in advance.

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11.3.2 Disposition of non-conforming

- If any product defect be found during assembling, supplier must change the good for every defect after confirmation.
- Both supplier and customer should analyze the reason and discuss the disposition of non-conforming when the reason of nonconforming is not sure.

11.4 Agreement items

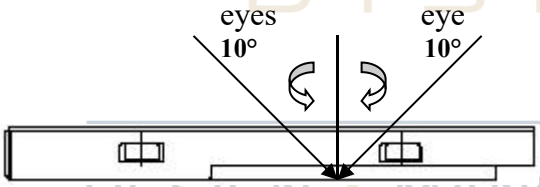
Both parties should negotiate together when the following problems happen.

- There is any problem of standard of quality assurance, and both sides should agree that it must be modified.
- There is a disagreement with the product that is not recorded in the standards of quality assurance.
- Any other special problem.

11.5 Standard of The Product Appearance Test

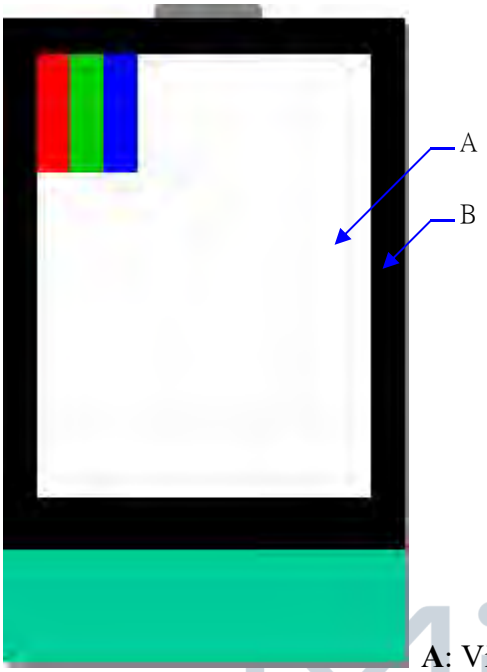
11.5.1 Manner of appearance test

- The test must be under 20W × 2 or 40W fluorescent light, and the distance of view must be at 30±5cm.
- When test the model of transmissive product must add the reflective plate.
- The test direction is base on around 10° of vertical line.
- Temperature: 25±5℃ Humidity: 60±10%RH



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- Definition of area:



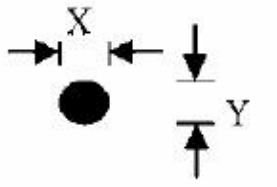
A: Viewing area B: Outside viewing area

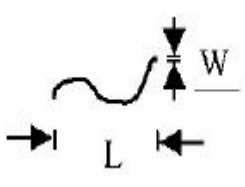
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11.5.2 Basic principle

- When the standard can not be described, AQL will be applied.
- The sample of the lowest acceptable quality level must be negotiated by both supplier and customer when any dispute happened.
- New item must be added on time when it is necessary.

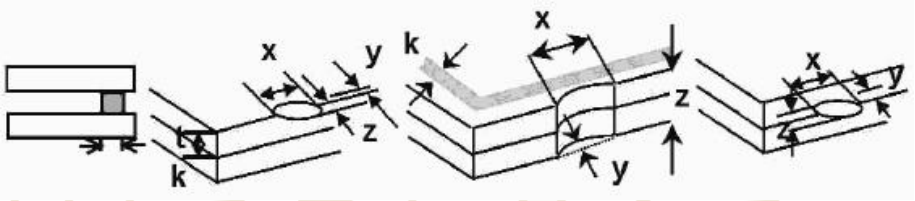
11.6 Inspection Specification

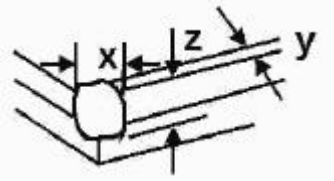
<table>
<tr><th>NO.</th><th>Item</th><th>Criterion</th><th>AQL</th></tr>
<tr><td>01</td><td>Electrical Testing</td><td>1.1 Missing vertical, horizontal segment, segment contrast defect.
1.2 Missing character, dot or icon.
1.3 Display malfunction.
1.4 No function or no display.
1.5 Current consumption exceeds product specifications.
1.6 LCD viewing angle defect.
1.7 Mixed product types.
1.8 Flicker</td><td>0.65</td></tr>
<tr><td>02</td><td>Black or White spots or Bright spots or Color spots on LCD (Display only)</td><td>2.1 White and black or color spots on display ≦ 0.25mm, no more than Five spots.
2.2 Densely spaced: No more than three spots within 3mm.</td><td>1.5</td></tr>
<tr><td rowspan="2">03</td><td rowspan="2">LCD and Touch Panel black spots, white spots, contamination (non – display)</td><td>3.1 Round type: As following drawing
Φ = (X+Y) / 2


<table><tr><th>Size(mm)</th><th>Acceptable Q'ty</th></tr><tr><td>Φ≦0.10</td><td>Accept no dense</td></tr><tr><td>0.10< Φ≦0.20</td><td>2</td></tr><tr><td>0.20< Φ≦0.25</td><td>2</td></tr><tr><td>0.25< Φ≦0.30</td><td>1</td></tr><tr><td>0.30< Φ</td><td>0</td></tr></table>* Densely spaced: No more than two spots within 3mm.</td><td>1.5</td></tr>
<tr><td>3.2 Line type: (As following drawing)


<table><tr><th>Length(mm)</th><th>Width(mm)</th><th>Acceptable Q'ty</th></tr><tr><td>---</td><td>W≦0.02</td><td>Accept no dense</td></tr><tr><td>L≦3.0</td><td>0.02<W≦0.05</td><td rowspan="2">2</td></tr><tr><td>L≦2.5</td><td>0.03<W≦0.08</td></tr><tr><td>---</td><td>0.08<W</td><td>Rejection</td></tr></table>* Densely spaced: No more than two lines within 3mm.</td><td>1.5</td></tr>
</table>

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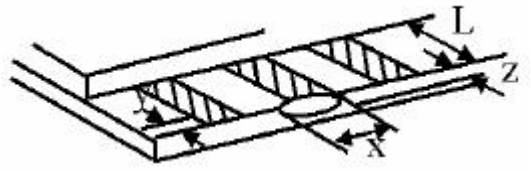
<table>
<tr><th>NO.</th><th>Item</th><th>Criterion</th><th>AQL</th></tr>
<tr><td>04</td><td>Polarizer bubbles</td><td>If bubbles are visible, judge using black spot specifications, not easy to find, must check in specify direction
<table>
<tr><td>Size Φ(mm)</td><td>Acceptable Q'ty</td></tr>
<tr><td>Φ≦0.20</td><td>Accept no dense</td></tr>
<tr><td>0.20< Φ≦0.50</td><td>3</td></tr>
<tr><td>0.50< Φ≦1.00</td><td>2</td></tr>
<tr><td>1.00< Φ</td><td>0</td></tr>
<tr><td>Total Q’ty</td><td>3</td></tr>
</table></td><td>1.5</td></tr>
<tr><td>05</td><td>Scratches</td><td>Follow NO.3 -2 Line Type.</td><td></td></tr>
<tr><td>06</td><td>Chipped glass</td><td>Symbols:
x: Chip length y: Chip width z: Chip thickness
k: Seal width t: Glass thickness
a: LCD side length（There is a broken side）
L: Electrode pad length
6.1 General glass chip:
6.1.1 Chip on panel surface and crack between panels:


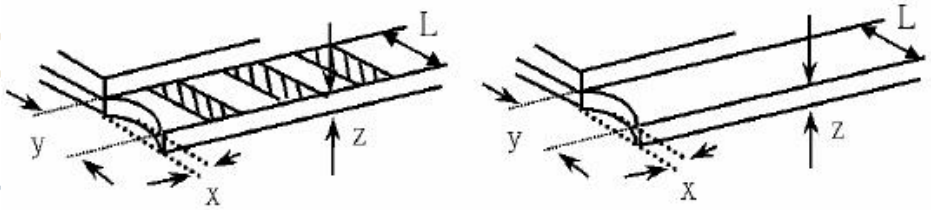
<table>
<tr><td>z: Chip thickness</td><td>y: Chip width</td><td>x: Chip length</td></tr>
<tr><td>Z≦1/2t</td><td>Not over viewing area</td><td>x≦1/8a</td></tr>
<tr><td>1/2t< z≦2t</td><td>Not exceed 1/3k</td><td>x≦1/8a</td></tr>
</table>
⊙ Unit: mm
⊙ If there are 2 or more chips, x is the total length of each chip
6.1.2 Corner crack:


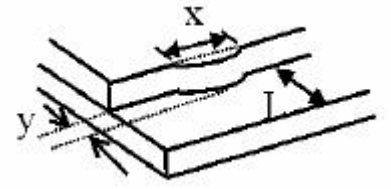
<table>
<tr><td>z: Chip thickness</td><td>y: Chip width</td><td>x: Chip length</td></tr>
<tr><td>Z≦1/2t</td><td>Not over viewing area</td><td>x≦1/8a</td></tr>
<tr><td>1/2t< z≦2t</td><td>Not exceed 1/3k</td><td>x≦1/8a</td></tr>
</table>
⊙ Unit: mm
⊙ If there are 2 or more chips, x is the total length of each chip</td><td>1.5</td></tr>
</table>

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<table>
<tr><th>NO.</th><th>Item</th><th>Criterion</th><th>AQL</th></tr>
<tr><td>07</td><td>Glass crack</td><td>
Symbols:
x: Chip length y: Chip width z: Chip thickness
k: Seal width t: Glass thickness
a: LCD side length（There is a broken side）

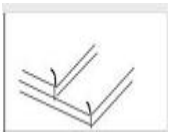
L: Electrode pad length
7.2 Protrusion over terminal:
7.2.1 Chip on electrode pad:


<table>
<tr><th>y: Chip width</th><th>x: Chip length</th><th>z: Chip thickness</th></tr>
<tr><td>y≦0.5mm</td><td>x≦1/8a</td><td>0< z≦t</td></tr>
</table>
7.2.2
Non-conductive portion:


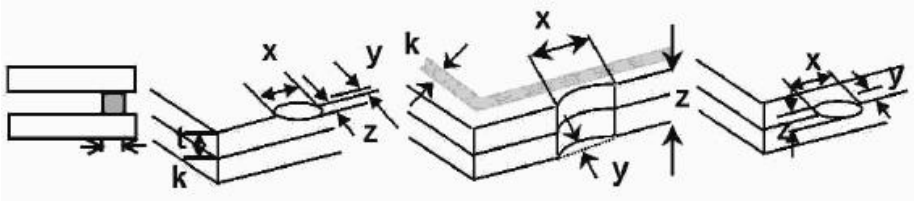
<table>
<tr><th>y: Chip width</th><th>x: Chip length</th><th>z: Chip thickness</th></tr>
<tr><td>y≦L</td><td>x≦1/8a</td><td>0< z≦t</td></tr>
</table>
⊙ If there chipped area touches the ITO terminal, over 2/3 of the ITO must remain and be inspected according to electrode terminal specifications.
⊙ If the product will be heat sealed by the customer, the alignment mark must mot be damaged.
7.2.3 Substrate protuberance and internal crack


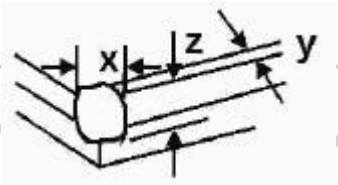
<table>
<tr><th>y: width</th><th>x: length</th></tr>
<tr><td>y≦1/3L</td><td>X≦a</td></tr>
</table>
</td><td>1.5</td></tr>
</table>

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NO.	Item	Criterion	AQL
08	Cracked glass	The LCD with any extensive crack is not acceptable. 	1.5
09	Backlight elements	9.1 Illumination source flickers when lit. 9.2 Spots or scratches that appear when lit must be judged. Using LCD spot, lines and contamination standards. 9.3 Backlight doesn't light or color is wrong.	1.5 1.5 0.65
10	Bezel	Bezel must comply with product specifications.	1.5
11	PCB、COB	11.1 COB seal may not have pinholes larger than 0.2mm or contamination. 11.2 COB seal surface may not have pinholes through to the IC. 11.3 The height of the COB should not exceed the height indicated in the assembly diagram. 11.4 There may not be more than 2mm of sealant outside the seal area on PCB. And there should be no more than three places. 11.5 Parts on PCB must be the same as on the production characteristic chart, There should be no wrong parts, missing parts or excess parts. 11.6 The jumper on the PCB should conform to the product characteristic chart.	1.5 1.5 1.5 1.5 0.65 0.65
12	FPC	12.1 FPC terminal damage ≦ 1/2 FPC terminal width and can not affect the function , we judge accept. 12.2 FPC alignment hole damage ≦ 1/2 alignment area and can not affect the function , we judge accept.	1.5 1.5
13	Soldering	13.1 No cold solder joints, missing solder connections, oxidation or icicle. 13.2 No short circuits in components on PCB or FPC.	1.5 0.65

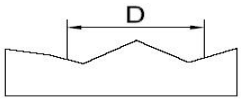
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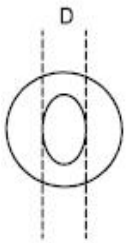
<table>
<tr><th>NO.</th><th>Item</th><th>Criterion</th><th>AQL</th></tr>
<tr><td>14</td><td>Touch Panel Chipped glass</td><td>
Symbols:
x: Chip length y: Chip width z: Chip thickness
k: Seal width t: Touch Panel Total thickness
a: LCD side length（There is a broken side）
L: Electrode pad length
14.1 General glass chip:
14.1.1 Chip on panel surface and crack between panels:


<table>
<tr><td>z: Chip thickness</td><td>y: Chip width</td><td>x: Chip length</td></tr>
<tr><td>Z≦t</td><td>≦1/2 k and not over viewing area</td><td>x≦1/8a</td></tr>
</table>
⊙ Unit: mm
⊙ If there are 2 or more chips, x is the total length of each chip
14.1.2 Corner crack:


<table>
<tr><td>z: Chip thickness</td><td>y: Chip width</td><td>x: Chip length</td></tr>
<tr><td>z≦t</td><td>≦1/2 k and not over viewing area</td><td>x≦1/8a</td></tr>
</table>
⊙ Unit: mm
⊙ If there are 2 or more chips, x is the total length of each chip
</td><td>1.5</td></tr>
</table>

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<table>
<tr><th>NO.</th><th>Item</th><th>Criterion</th><th>AQL</th></tr>
<tr><td>15</td><td>Touch Panel(Fish eye、dent and bubble on film)</td><td>
<table>
<tr><td>SIZE(mm)</td><td>Acceptable Q’ty</td></tr>
<tr><td>Φ≦0.2</td><td>Accept no dense</td></tr>
<tr><td>0.2< D ≦0.4</td><td>5</td></tr>
<tr><td>0.4< D ≦0.5</td><td>2</td></tr>
<tr><td>0.5< D</td><td>0</td></tr>
</table>




</td><td>1.5</td></tr>
<tr><td>16</td><td>Touch Panel Newton ring</td><td>Newton ring dimension ≦ 1/4 touch panel area and not affect font and line distortion(≦2.5%) , it is acceptable.</td><td>1.5</td></tr>
<tr><td>17</td><td>Touch Panel Linearity</td><td>Less than 1.5% is acceptable.</td><td>1.5</td></tr>
<tr><td>18</td><td>LCD Ripple</td><td>Touch the touch panel , can not see the LCD ripple.
Pen: R 1.0mm silicon rubber.
Operation Force: 80g</td><td>1.5</td></tr>
<tr><td>19</td><td>General appearance</td><td>19.1 Pin type must match type in specification sheet.
19.2 LCD pin loose or missing pins.
19.3 Product packaging must the same as specified on packaging specification sheet.
19.4 Product dimension and structure must conform to product specification sheet.</td><td>0.65
0.65
0.65
0.65</td></tr>
</table>

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