



# Riverdi

Intelligent Display Solutions

## RiTFT-35 series

### 3.5" EVE3 SERIES LCD TFT

Rev.1.0

2018-10-22

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally white	/
Size	3.5	Inch
Viewing Direction	12:00 (without image inversion)	O' Clock
Gray Scale Inversion Direction	6:00	O' Clock
Number of Dots	320 x (RGB) x 240	/
Driver IC	BT81x	/
Interface Type	SPI/QSPI	/
Module Memory Size	1 MB (BT81x) + 64 Mb (external flash)	/
Color Depth	16.7M	/
Pixel Arrangement	RGB Vertical Stripe	/
Surface Treatment	Anti-glare / Clear (for CTP)	/
Input Voltage	3.3	V

**Note 1:** RoHS, REACH SVHC compliant

**Note 2:** LCM weight tolerance:  $\pm 5\%$ .

## REVISION RECORD

REVNO.	REVDATE	CONTENTS	REMARKS
1.0	2018-10-22	Initial Release	

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## 1 MODULE CLASSIFICATION INFORMATION

<b>RV</b>	<b>T</b>	<b>35</b>	<b>A</b>	<b>H</b>	<b>B</b>	<b>X</b>	<b>W</b>	<b>X</b>	<b>00</b>
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.

1.	<b>BRAND</b>	<b>RV – Riverdi</b>
2.	<b>PRODUCT TYPE</b>	<b>T – TFT Standard</b> F – TFT Custom
3.	<b>DISPLAY SIZE</b>	<b>35 – 3.5”</b>
4.	<b>MODEL SERIAL NO.</b>	A (A-Z)
5.	<b>RESOLUTION</b>	<b>H– 320x240 px</b>
6.	<b>INTERFACE</b>	<b>B – TFT + Controller BT81x</b>
7.	<b>FRAME</b>	N – No Frame F – Mounting Frame
8.	<b>BACKLIGHT TYPE</b>	<b>W – LED White</b>
9.	<b>TOUCH PANEL</b>	N – No Touch Panel R – Resistive Touch Panel C – Capacitive Touch Panel
10.	<b>VERSION</b>	00 (00-99)

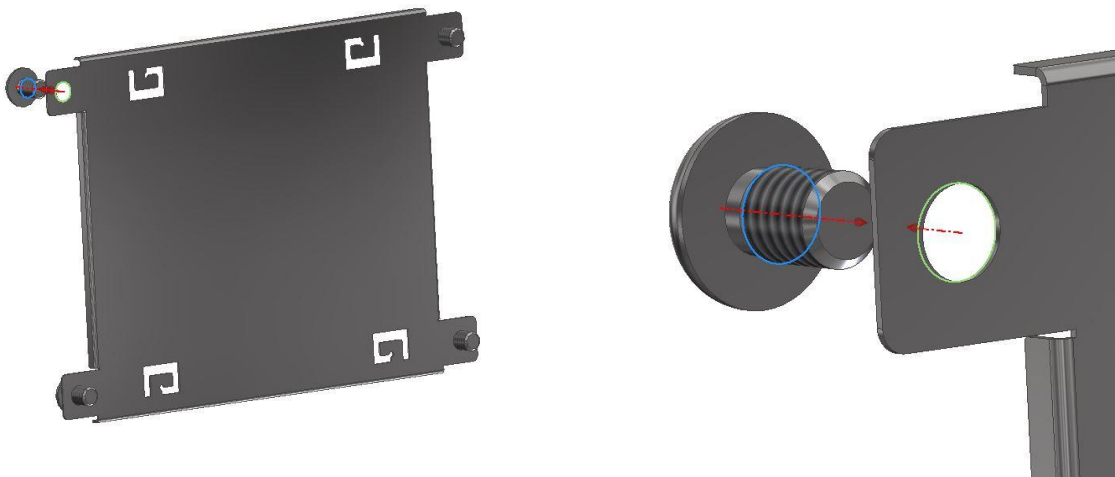
## 2 ASSEMBLY GUIDE - INTEGRATION

NAME OF THE PRODUCT	PART NUMBER	DESCRIPTION
<b>RiTFT-35</b>	RVT35AHBNWN00	BT816, no touch panel
<b>RiTFT-35-RES</b>	RVT35AHBNWR00	BT816, resistive touch panel
<b>RiTFT-35-CAP</b>	RVT35AHBNWC00	BT815, capacitive touch panel
<b>RiTFT-35-FR</b>	RVT35AHBFWN00	BT816, no touch panel, mounting frame
<b>RiTFT-35-RES-FR</b>	RVT35AHBFWR00	BT816, resistive touch panel, mounting frame
<b>RiTFT-35-CAP-FR</b>	RVT35AHBFWC00	BT815, capacitive touch panel, mounting frame

## 2.1 Mounting frame

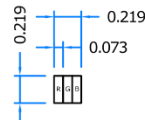
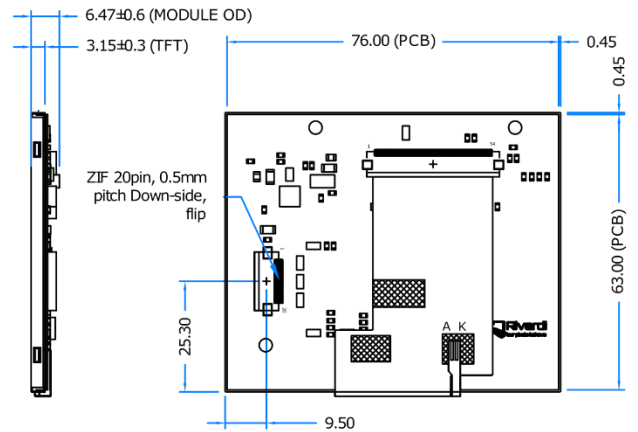
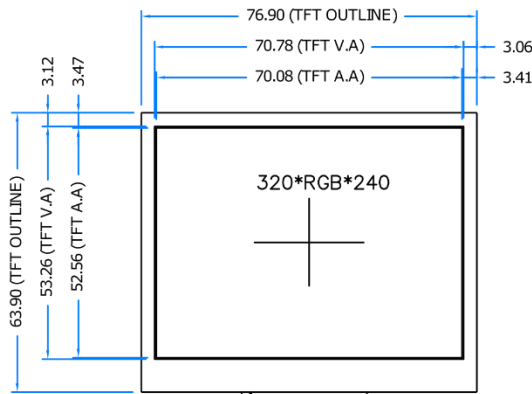
For dimensions 3.5", 4.3", 5.0" and 7.0" the product with mounting frame version is available. Thanks to the four catches attached to the side, frame provides strong assembly to the surface by mounting element (like the screw, see Figure 3). The frames are specially designed to fit Riverdi products perfectly. The diameter of the mounting hole is 3.5mm.

Figure 1. Mounting frame



# RiTFT-35

Revision:	
1.0	

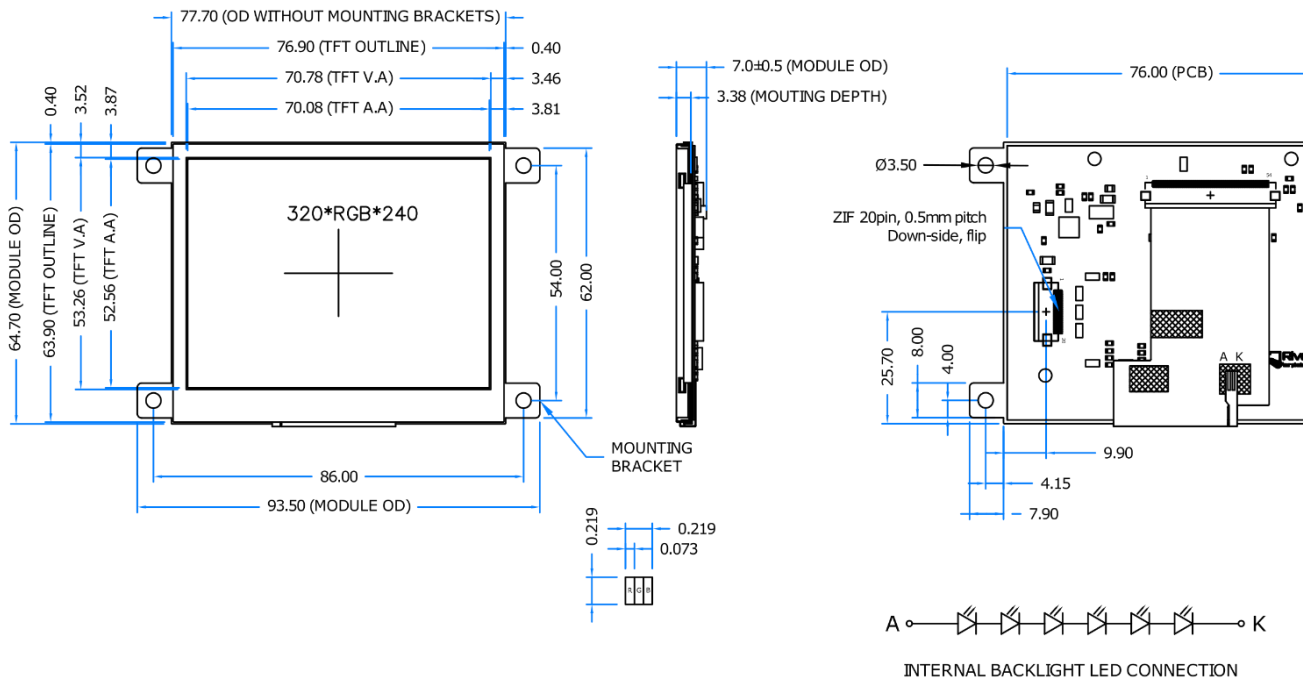


- GENERAL NOTES:**
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
  2. OPERATION VOLTAGE: VDD=3.3V
  3. VIEWING DIRECTION: 12 O'CLOCK
  4. IC CONTROLLER: BT816
  5. OPERATING TEMP.: -20°C ~ 70°C
  6. STORAGE TEMP.: -30°C ~ 80°C
  7. LED BACKLIGHT: 6-LED WHITE, BUILT-IN INVERTER
  8. SURFACE LUMINANCE: 540 cd/m<sup>2</sup>
  9. GENERAL TOLERANCE: ±0.2
  10. RoHS COMPLIANT

PN: RVT35AHBNWNC
SN: ####
DRAWN: P.M.
CHECKED:
APPR:

Revision:	
1.0	

# RiTFT-35-FR

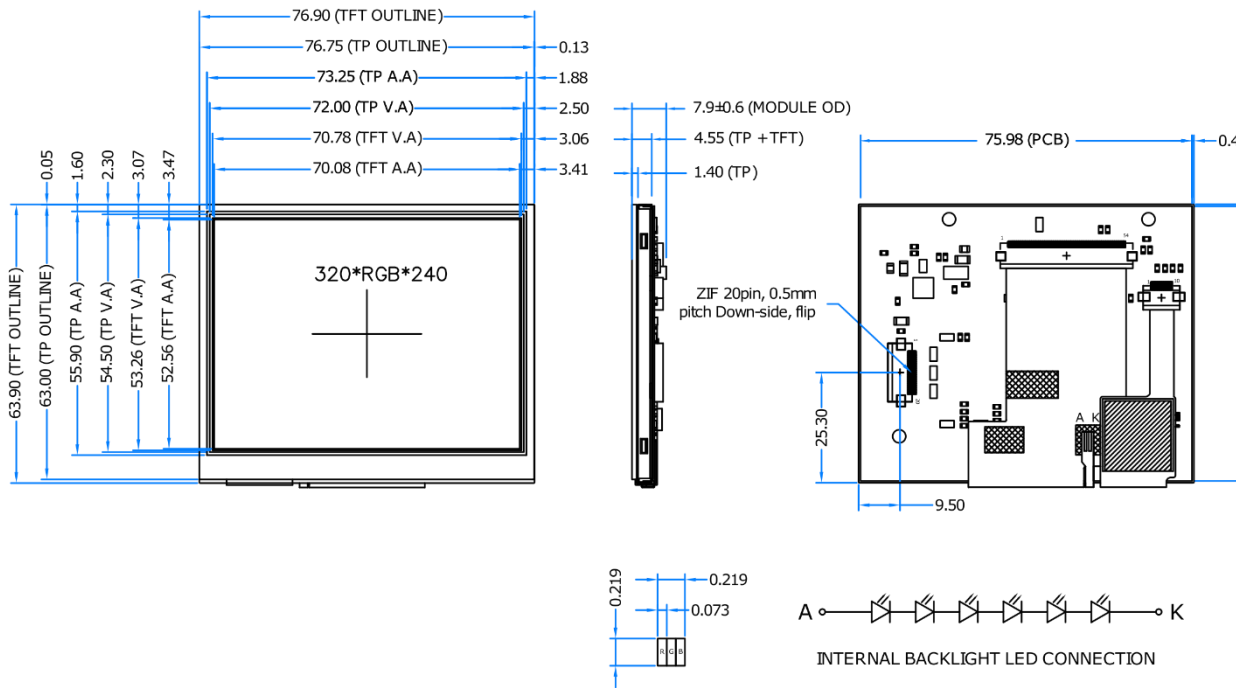


- GENERAL NOTES:**
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
  2. OPERATION VOLTAGE: VDD~3.3V
  3. VIEWING DIRECTION: 12 O'CLOCK
  4. IC CONTROLLER: BT816
  5. OPERATING TEMP.: -20°C ~ 70°C
  6. STORAGE TEMP.: -30°C ~ 80°C
  7. LED BACKLIGHT: 6-LED WHITE, BUILT-IN INVERTER
  8. SURFACE LUMINANCE: 540 cd/m<sup>2</sup>
  9. GENERAL TOLERANCE: ±0.2
  10. RoHS COMPLIANT

PN: RVT35AHBFWN00
SN: #####
DRAWN: P.M.
CHECKED:
APPR:

Revision:	
1.0	

# RiTFT-35-CAP



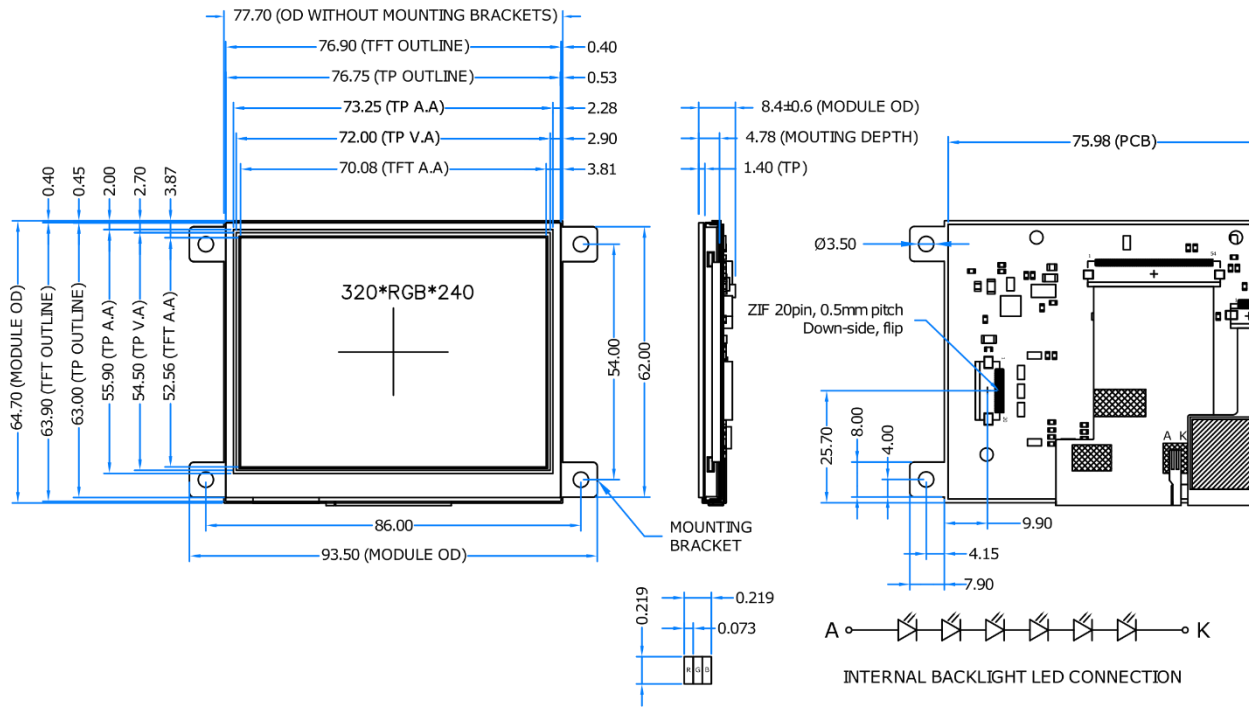
**GENERAL NOTES:**

1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
2. OPERATION VOLTAGE: VDD=3.3V
3. VIEWING DIRECTION: 12 O'CLOCK
4. IC CONTROLLER: BT815
5. OPERATING TEMP.: -20°C ~70°C
6. STORAGE TEMP.: -30°C ~80°C
7. LED BACKLIGHT: 6-LED WHITE, BUILT-IN INVERTER
8. SURFACE LUMINANCE: 480 cd/m<sup>2</sup>
9. GENERAL TOLERANCE: ±0.2
10. RoHS COMPLIANT

PN: RVT35AHBNWC
SN: ###
DRAWN: P.M.
CHECKED:
APPR:

Revision:	
1.0	

# RiTFT-35-CAP-FR



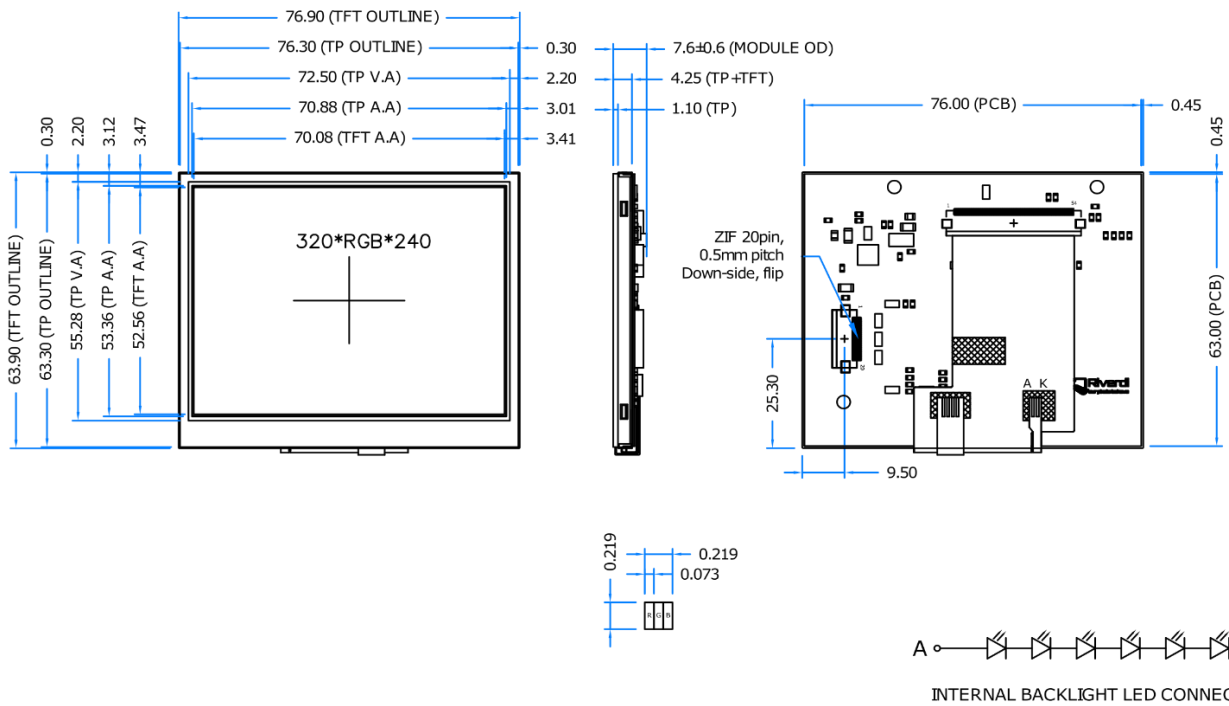
- GENERAL NOTES:**
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
  2. OPERATION VOLTAGE: VDD=3.3V
  3. VIEWING DIRECTION: 12 O'CLOCK
  4. IC CONTROLLER: BT815
  5. OPERATING TEMP.: -20°C ~70°C
  6. STORAGE TEMP.: -30°C ~80°C
  7. LED BACKLIGHT: 6-LED WHITE, BUILT-IN INVERTER
  8. SURFACE LUMINANCE: 480 cd/m<sup>2</sup>
  9. GENERAL TOLERANCE: ±0.2
  10. RoHS COMPLIANT

PN: RVT35AHBFWC0
SN: ###
DRAWN: P.M.
CHECKED:
APPR:



# RiTFT-35-RES

Revision:	
1.0	

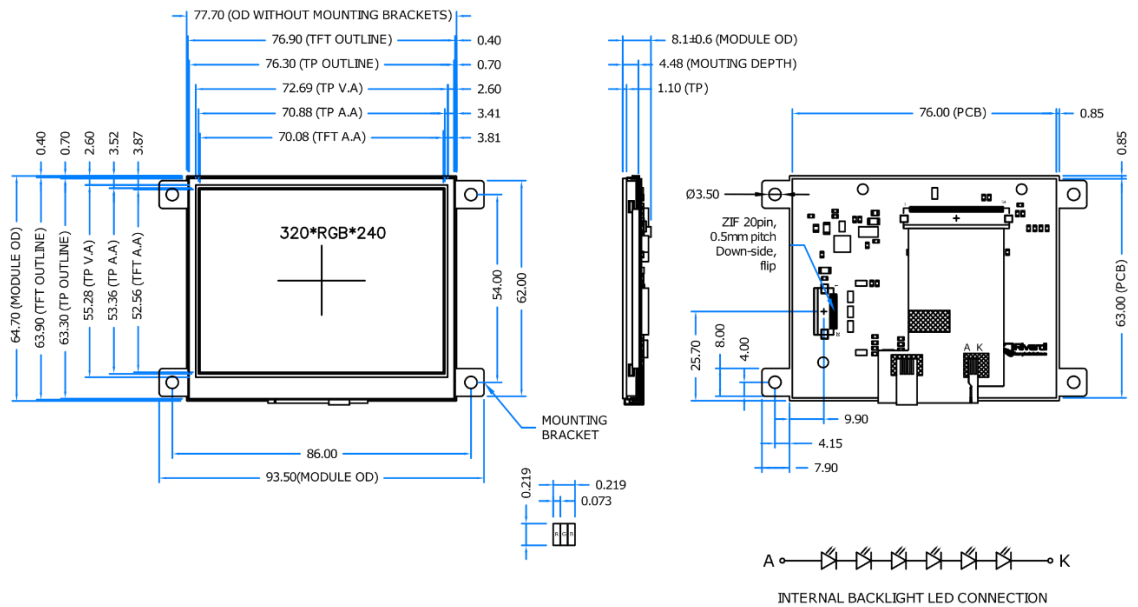


- GENERAL NOTES:**
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
  2. OPERATION VOLTAGE: VDD=3.3V
  3. VIEWING DIRECTION: 12 O'CLOCK
  4. IC CONTROLLER: BT816
  5. OPERATING TEMP.: -20°C ~ 70°C
  6. STORAGE TEMP.: -30°C ~ 80°C
  7. LED BACKLIGHT: 6-LED WHITE, BUILT-IN INVERTER
  8. SURFACE LUMINANCE: 450 cd/m<sup>2</sup>
  9. GENERAL TOLERANCE: ±0.2
  10. ROHS COMPLIANT

PN: RVT35AHBNWR
SN: #####
DRAWN: P.M.
CHECKED:
APPR:

# RiTFT-35-RES-FR

Revision:	
1.0	



- GENERAL NOTES:**
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
  2. OPERATION VOLTAGE: VDD=3.3V
  3. VIEWING DIRECTION: 12 O'CLOCK
  4. IC CONTROLLER: BT816
  5. OPERATING TEMP.: -20°C ~ 70°C
  6. STORAGE TEMP.: -30°C ~ 80°C
  7. LED BACKLIGHT: 6-LED WHITE, BUILT-IN INVERTER
  8. SURFACE LUMINANCE: 450 cd/m<sup>2</sup>
  9. GENERAL TOLERANCE: ±0.2
  10. RoHS COMPLIANT

PN: RVT35AHBFWR  
 SN: ###  
 DRAWN: P.M.  
 CHECKED:  
 APPR:

## 4 ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage for Logic	VDD	0	4.0	V
Supply Voltage for LED Inverter	BLVDD	0	7.0	V
Input Voltage for Logic	VIN	0	4.0	V
LED forward current (each LED)	IF	-	25	mA
Operating Temperature	T <sub>OP</sub>	-20	70	°C
Storage Temperature	T <sub>ST</sub>	-30	80	°C
Humidity	RH	-	90% (Max 60°C)	RH

## 5 ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTES
Supply Voltage For Module	VDD	3.0	3.3	3.6	V	
Input Voltage for LED Inverter	BLVDD	2.8	5.0	5.5	V	
LED Backlight Current	IDD <sub>backlight</sub>	-	150	187	mA	BLVDD=3.3V
LED Backlight Current	IDD <sub>backlight</sub>	-	93	117	mA	BLVDD=5V
Input Voltage 'H' level	V <sub>IH</sub>	0.7VDD	-	VDD	V	
Input Voltage 'L' level	V <sub>IL</sub>	0	-	0.2VDD	V	
Input Current	I <sub>in</sub>		TBD		mA	
Input Current for module with CTP	I <sub>inc</sub>		TBD		mA	

**Note:** The LED life time is defined as the module brightness decrease to 50% original brightness at Ta=25°C.

## 6 BACKLIGHT CHARACTERISTICS

ITEM	SYMBOL	MIN	TYP	MAX	UNIT
Voltage for LED backlight	V <sub>I</sub>	-	19.2	20.4	V
Current for LED backlight	I <sub>I</sub>	-	20	25	mA
LED Life Time	-	30000	50000	-	Hrs

**Note:** The LED Supply Voltage is defined by the numbers of LED at Ta=25°C and I<sub>L</sub>= 20mA.

## 7 ELECTRO-OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf		-	25	30	ms	Figure 2	4
Contrast Ratio	Cr		-	350	-	---	Figure 3	1
Luminance Uniformity	δ WHITE	θ=0° φ=0° Ta=25	75	80	-	%	Figure 3	3
Surface Luminance	TFT	Lv	490	540	-	cd/m <sup>2</sup>	Figure 3	2
	TFT+CTP		440	490	-			
	TFT+RTP		400	440	-			
Viewing Angle Range	θ	φ = 90°	30	40	-	deg	Figure 4	6
		φ = 270°	50	60	-	deg	Figure 4	
		φ = 0°	50	60	-	deg	Figure 4	
		φ = 180°	50	60	-	deg	Figure	
CIE (x, y) Chromaticity	Red	θ=0° φ=0° Ta=25	x	0.574	0.624	0.674	Figure 3	5
			y	0.318	0.368	0.418		
	Green		x	0.300	0.350	0.400		
			y	0.500	0.550	0.600		
	Blue		x	0.093	0.143	0.193		
			y	0.069	0.119	0.169		
	White		x	0.260	0.310	0.360		
			y	0.283	0.333	0.383		

**Note 1.** Contrast Ratio(CR) is defined mathematically as below, for more information see Figure .

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P3, P4, P5)}}$$

**Note 2.** Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information, see Figure .

$L_v$  = Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)

**Note 3.** The uniformity in surface luminance  $\delta$  WHITE is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information, see Figure .

$$\delta \text{ WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}$$

**Note 4.** Response time is the time required for the display to transition from white to black (Rise Time,  $T_r$ ) and from black to white (Decay Time,  $T_f$ ). For additional information see FIG 1. The test equipment is Autronic-Melchers's ConoScope series.

**Note 5.** CIE (x, y) chromaticity, the x, y value is determined by measuring luminance at each test position 1 through 5, and then make average value.

**Note 6.** Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see Figure .

**Note 7.** For viewing angle and response time testing, the testing data is based on Autronic-Melchers's ConoScope series. Instruments for Contrast Ratio, Surface Luminance, Luminance Uniformity, CIE the test data is based on TOPCON's BM-5 photo detector.

**Note 8.** For TFT module, Gray scale reverse occurs in the direction of panel viewing angle.

Figure 2. The definition of response time

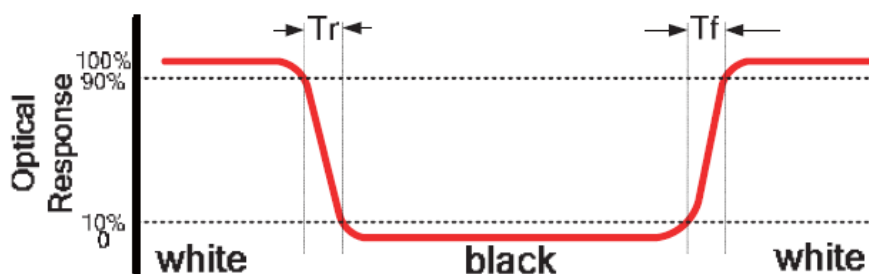


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

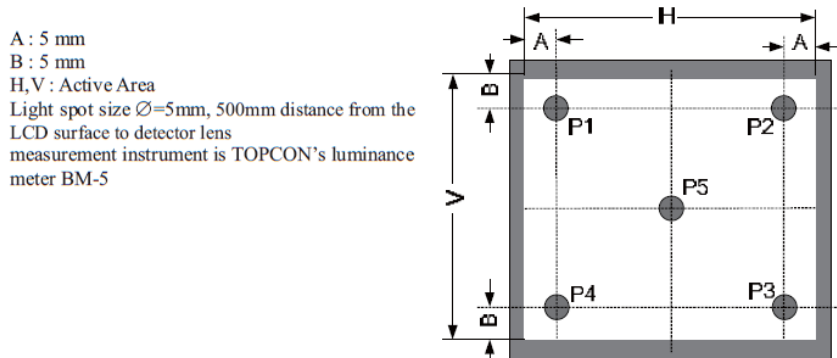
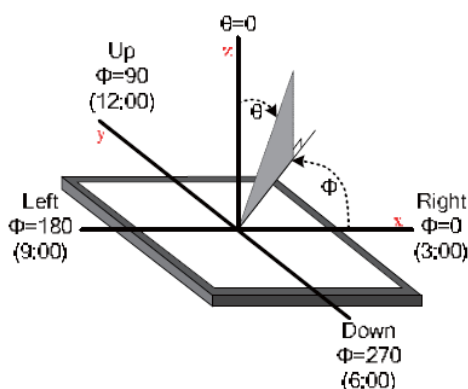


Figure 4. The definition of viewing angle



## 8 INTERFACE DESCRIPTION

PIN NO.	SYMBOL	DESCRIPTION
1	VDD	Power Supply
2	GND	Ground
3	SPI_SCLK	SPI SCK Signal, Internally 47k Pull UP
4	MISO/ IO1	SPI MISO Signal / SPI Quad mode: SPI data line 1
5	MOSI/ IO0	SPI MOSI Signal / SPI Quad mode: SPI data line 0
6	CS	SPI Chip Select Signal , Internally 47k Pull UP
7	INT	Interrupt Signal, Active Low, Internally 47k Pull UP
8	PD	Power Down Signal, Active Low, Internally 47k Pull UP
9	NC	Not Connected
10	AUDIO_OUT	Audio Out Signal
11	GPIO0/IO2	SPI Single mode: General purpose IO0/ SPI Quad mode: SPI data line 2
12	GPIO1/IO3	SPI Single mode: General purpose IO1/ SPI Quad mode: SPI data line 3
13	GPIO2	General purpose IO2
14	GPIO3	General purpose IO3 or analog input for ADC
15	NC	Not Connected
16	NC	Not Connected
17	BLVDD	Backlight Power Supply, Can Be Connected to VDD
18	BLVDD	Backlight Power Supply, Can Be Connected to VDD
19	BLGND	Backlight Ground, Internally connected to GND
20	BLGND	Backlight Ground, Internally connected to GND

## 9 BT8x CONTROLLER SPECIFICATIONS

BT8x or EVE3 (Embedded Video Engine 3) simplifies the system architecture for advanced human machine interfaces (HMIs) by providing functionality for display, audio, and touch as well as an object oriented architecture approach that extends from display creation to the rendering of the graphics.

### 9.1 Serial host interface

Figure 5. SPI interface connection

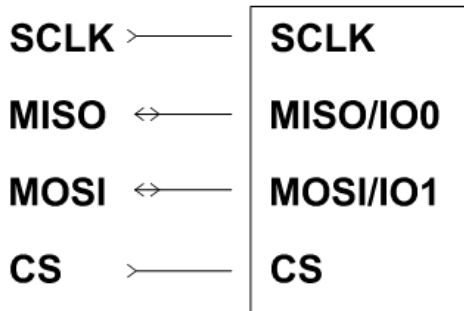
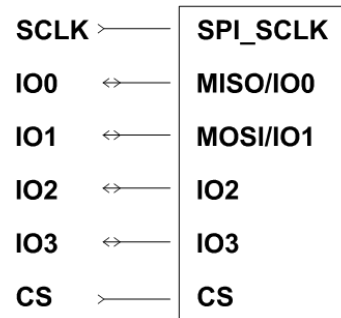


Figure 6. QSPI interface connection

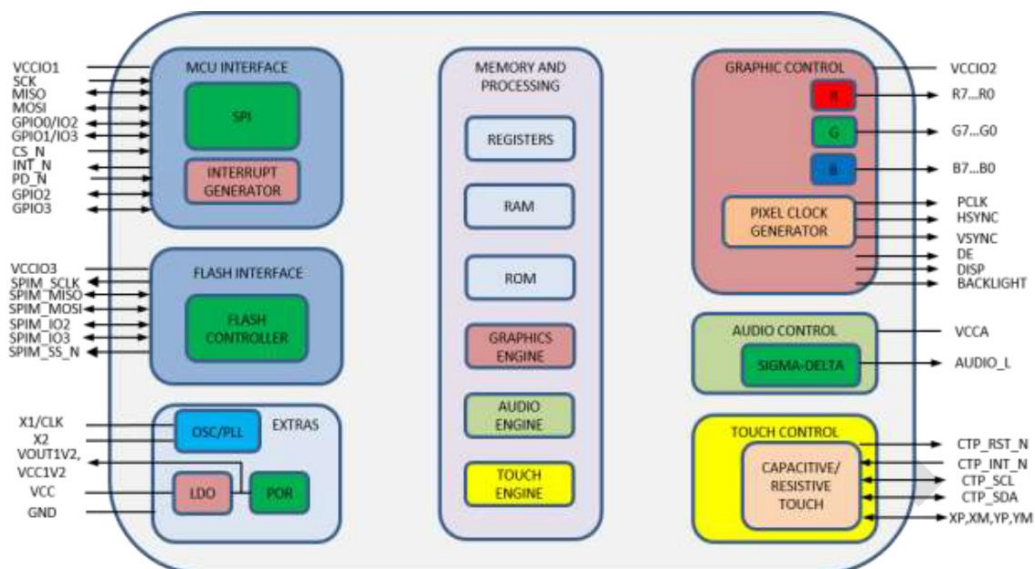


**SPI Interface** – the SPI slave interface operates up to 30MHz.

Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

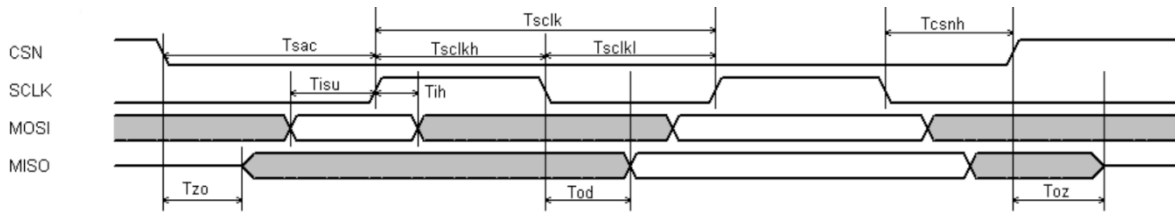
### 9.2 Block Diagram

Figure 7.. BT8x Block diagram



9.3 Host interface SPI mode 0

Figure 8. SPI timing diagram



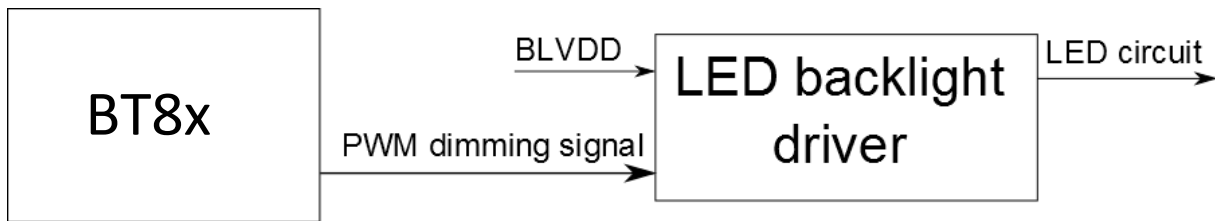
For more information about BT8x controller please go to official BT8x website.

<https://www.ftdichip.com/Products/ICs/BT81X.html>

9.4 Backlight driver block diagram

Backlight enable signal is internally connected to BT8x Backlight control pin. This pin is controlled by two BT8x’s registers. One of them specifies the PWM output frequency, second one specifies the duty cycle. Refer to BT8x datasheet for more information.

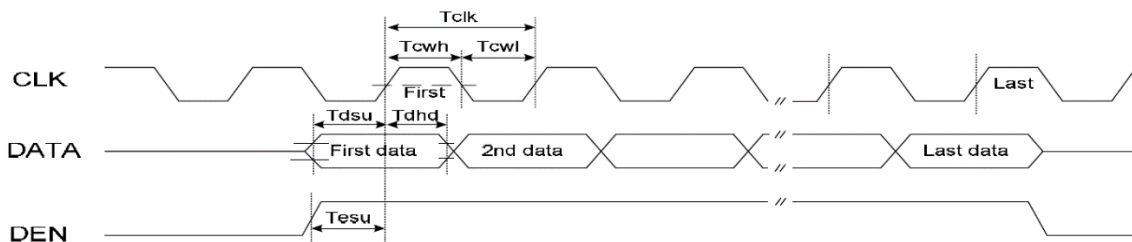
Figure 9. Backlight driver block diagram



10 LCD TIMING CHARACTERISTICS

10.1 Clock and data input time diagram

Figure 10. DE mode timing diagram







## 10.2 Parallel RGB timing table

Timing parameter (VDD=3.3V, GND=0V, Ta=25°C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	CONDITION
CLK Clock Time	$T_{clk}$	$1/\text{Max}(F_{CLK})$	-	$1/\text{Min}(F_{CLK})$	ns	-
CLK Pulse Duty	$T_{chwh}$	40	50	60	%	$T_{CLK}$
HSYNC to CLK	$T_{hc}$	-	-	1	CLK	-
HSYNC Width	$T_{hwh}$	1	-	-	CLK	-
VSYNC Width	$T_{vwh}$	1	-	-	ns	-
HSYNC Period Time	$T_h$	60	63.56	67	ns	-
VSYNC Set-up Time	$T_{vst}$	12	-	-	ns	-
VSYNC Hold Time	$T_{vhd}$	12	-	-	ns	-
HSYNC Setup Time	$T_{hst}$	12	-	-	ns	-
HSYNC Hold Time	$T_{hhd}$	12	-	-	ns	-
Data Set-up Time	$T_{dsu}$	12	-	-	ns	D00~D23 to CLK
Data Hold Time	$T_{dhd}$	12	-	-	ns	D00~D23 to CLK
DEN Set-up Time	$T_{esu}$	12	-	-	ns	DEN to CLK

## 11 TOUCH SCREEN PANEL SPECIFICATIONS

### 11.1 Electrical characteristics

**Note:** Avoid operating with hard or sharp material such as a ball point pen or a mechanical pencil except a polyacetal pen (tip R0.8mm or less) or a finger

#### 11.1.1 For capacitive touch panel

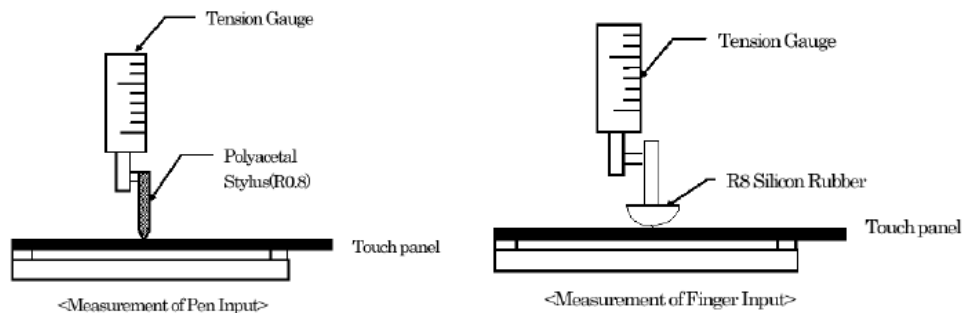
DESCRIPTION		SPECIFICATION
Operating Voltage		DC 2.8~3.6V
Power Consumption (IDD)	Active Mode	10~18mA
	Sleep Mode	30~50μA
Interface		I <sup>2</sup> C
Linearity		<1.5%
Controller		FT5346
I2C address		0x38 (7 bit address)
Resolution		896*640

## 11.1.2 For resistive touch panel

ITEM	VALUE			UNIT	REMARK
	Min.	Typ.	Max.		
Linearity	-	-	1.5	%	Analog X and Y directions
Terminal Resistance	200	-	900	$\Omega$	X
	100	-	600	$\Omega$	Y
Insulation Resistance	20	-	-	M $\Omega$	DC 25V
Voltage	-	-	10	V	DC
Chattering	-	-	10	ms	100k $\Omega$ pull-up
Transparency	78	-	-	%	JIS K7105

## 11.2 Mechanical characteristics

**Note 1: Force test condition,** Input DC 5V on X direction, Drop off Polyacetal Stylus (R0.8), until output voltage stabilize, then get the R8.0mm Silicon rubber and do finger Activation force test. Next step, 9 points.



**Note 2: Measurement surface area conditions,** Scratch 100,000 times straight line on the film with a stylus change every 20,000 times with Force: 250gf, Speed: 60mm/sec by R0.8 polaceteal stylus.

**Note 3: Pitting test,** Pit 1, 000, 000 times on the film with R0.8 silicon rubber with Force: 250gf and Speed: 2 times/sec.

## 11.2.1 For capacitive touch panel

DESCRIPTION	INL SPECIFICATION	REMARK
Touch Panel Size	3.5 inch	
Outline Dimension (OD)	76.75 mm x 63.00mm	Cover Lens Outline
Product Thickness	1.40mm	
Glass Thickness	0.7 mm	
Ink View Area	72.00mm x 54.50mm	
Sensor Active Area	73.25mm x 55.90mm	
Input Method	5 Finger	
Activation Force	Touch	
Surface Hardness	$\geq 7H$	

11.2.2 For resistive touch panel

**Note 1: Force test condition**, Input DC 5V on X direction, drop off Polyacetal Stylus (R0.8), until output voltage stabilize, then get the R8.0mm Silicon rubber and do finger Activation force test. Next step, 9 points.

ITEM	VALUE			UNIT	REMARK
	Min.	Typ.	Max.		
Activation Force	20	-	100	gf	Note 1
Durability-Surface Scratching	Write 100,000	-	-	characters	Note 2
Durability-Surface Pitting	1,000,000	-	-	touches	Note 3
Surface Hardness	3	-	-	H	JIS K5400

## 12 INSPECTION

Standard acceptance/rejection criteria for TFT module.

### 12.1 Inspection condition

*Ambient conditions:*

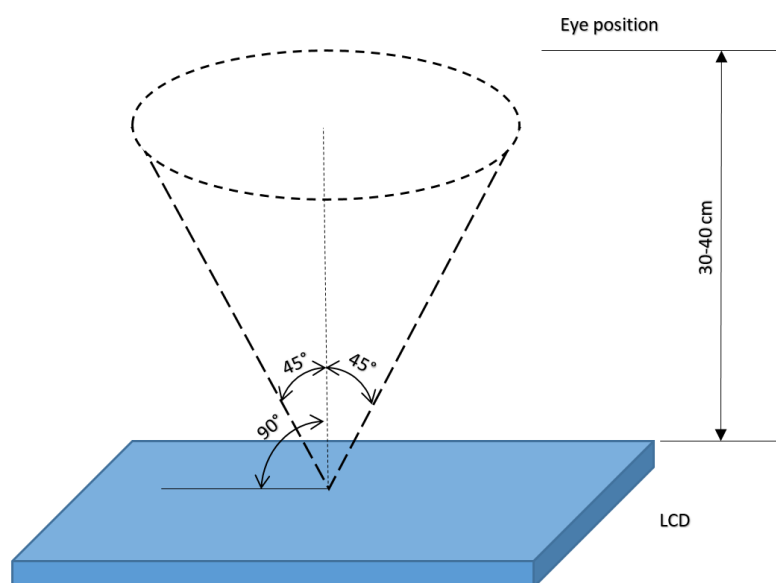
- Temperature: 25±°C
- Humidity: (60±10) %RH
- Illumination: Single fluorescent lamp non-directive (300 to 700 lux)

*Viewing distance:*

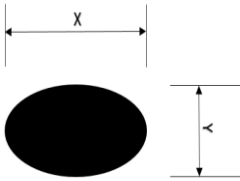
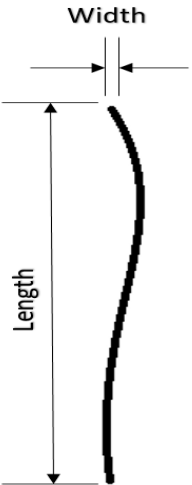
35±5cm between inspector bare eye and LCD.

*Viewing Angle:*

U/D: 45°/45°, L/R 45°/45°



12.2 Inspection standard

Item	Criterion																																		
<p><b>Black spots, white spots, light leakage, Foreign Particle (round Type)</b></p>	<div style="display: flex; align-items: center; justify-content: center;">  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="2">Size &lt; 5"</th> </tr> <tr> <th>Average Diameter</th> <th>Qualified Qty</th> </tr> </thead> <tbody> <tr> <td>D &lt; 0.2 mm</td> <td>Ignored</td> </tr> <tr> <td>0.2 mm &lt; D &lt; 0.3 mm</td> <td>3</td> </tr> <tr> <td>0.3 mm &lt; D &lt; 0.5 mm</td> <td>2</td> </tr> <tr> <td>0.5 mm &lt; D</td> <td>0</td> </tr> </tbody> </table> </div> <div style="text-align: center; margin: 10px 0;"> <math display="block">D = \frac{(x + y)}{2}</math> </div> <p>*Spots density: 10 mm</p>	Size < 5"		Average Diameter	Qualified Qty	D < 0.2 mm	Ignored	0.2 mm < D < 0.3 mm	3	0.3 mm < D < 0.5 mm	2	0.5 mm < D	0																						
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0.5 mm < D	0																																		
<p><b>LCD black spots, white spots, light leakage (line Type)</b></p>	<div style="display: flex; align-items: center; justify-content: center;">  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="3">Size &lt; 5"</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Qualified Qty</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>W &lt; 0.02</td> <td>Ignored</td> </tr> <tr> <td>L &lt; 3.0</td> <td>0.02 &lt; W &lt; 0.05</td> <td rowspan="2">2</td> </tr> <tr> <td>L &lt; 2.5</td> <td>0.05 &lt; W &lt; 0.08</td> </tr> <tr> <td>-</td> <td>0.08 &lt; W</td> <td>0</td> </tr> </tbody> </table> </div> <div style="margin: 10px 0;"> <table border="1"> <thead> <tr> <th colspan="3">Size &gt;= 5"</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Qualified Qty</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>W &lt; 0.02</td> <td>Ignored</td> </tr> <tr> <td>L &lt; 3.0</td> <td>0.02 &lt; W &lt; 0.05</td> <td rowspan="2">4</td> </tr> <tr> <td>L &lt; 2.5</td> <td>0.05 &lt; W &lt; 0.08</td> </tr> <tr> <td>-</td> <td>0.08 &lt; W</td> <td>0</td> </tr> </tbody> </table> </div> <p>*Spots density: 10 mm</p>	Size < 5"			Length	Width	Qualified Qty	-	W < 0.02	Ignored	L < 3.0	0.02 < W < 0.05	2	L < 2.5	0.05 < W < 0.08	-	0.08 < W	0	Size >= 5"			Length	Width	Qualified Qty	-	W < 0.02	Ignored	L < 3.0	0.02 < W < 0.05	4	L < 2.5	0.05 < W < 0.08	-	0.08 < W	0
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-	0.08 < W	0																																	



Item	Criterion	
Clear spots	Size < 5"	
	<b>Average Diameter</b>	Qualified Qty
	<b>D &lt; 0.2 mm</b>	Ignored
	<b>0.2 mm &lt; D &lt; 0.3 mm</b>	3
	<b>0.3 mm &lt; D &lt; 0.5 mm</b>	2
	<b>0.5 mm &lt; D</b>	0
	Size >= 5"	
	<b>Average Diameter</b>	Qualified Qty
	<b>D&lt;0.2 mm</b>	Ignored
	<b>0.2 mm &lt; D &lt; 0.3 mm</b>	4
	<b>0.3 mm &lt; D &lt; 0.5 mm</b>	2
	<b>0.5 mm &lt; D</b>	0
	*Spots density: 10 mm	
	Polarizer bubbles	Size < 5"
<b>Average Diameter</b>		Qualified Qty
<b>D &lt; 0.2 mm</b>		Ignored
<b>0.2 mm &lt; D &lt; 0.5 mm</b>		3
<b>0.5 mm &lt; D &lt; 1 mm</b>		2
<b>1 mm &lt; D</b>		0
<b>Total Q'ty</b>		3
Size >= 5"		
<b>Average Diameter</b>		Qualified Qty
<b>D&lt;0.25 mm</b>		Ignored
<b>0.25 mm &lt; D &lt; 0.5 mm</b>		3
<b>0.5 mm &lt; D</b>		0
Electrical Dot Defect		Size < 5"
		<b>item</b>
	<b>Black do defect</b>	4
	<b>Bright dot defect</b>	2
	<b>Total Dot</b>	5
	Size >= 5"	
	<b>item</b>	Qualified Qty
	<b>Black do defect</b>	5
	<b>Bright dot defect</b>	2
	<b>Total Dot</b>	5



Item	Criterion		
Touch panel spot	<b>Size &lt; 5"</b>		
	<b>Average Diameter</b>	Qualified Qty	
	<b>D &lt; 0.2 mm</b>	Ignored	
	<b>0.2 mm &lt; D &lt; 0.4 mm</b>	5	
	<b>0.4 mm &lt; D &lt; 0.5 mm</b>	2	
	<b>0.5 mm &lt; D</b>	0	
	<b>Size &gt;= 5"</b>		
	<b>Average Diameter</b>	Qualified Qty	
	<b>D&lt;0.25 mm</b>	Ignored	
	<b>0.25 mm &lt; D &lt; 0.5 mm</b>	4	
<b>0.5 mm &lt; D</b>	0		
Touch panel White Line Scratch	<b>Size &lt; 5"</b>		
	<b>Length</b>	<b>Width</b>	Qualified Qty
	-	W< 0.02	Ignored
	<b>L &lt; 3.0</b>	0.02 < W <0.05	2
	<b>L &lt; 2.5</b>	0.05 < W <0.08	
	-	0.08 < W	0
	<b>Size &gt;= 5"</b>		
	<b>Length</b>	<b>Width</b>	Qualified Qty
	-	W< 0.03	Ignored
	<b>L &lt; 5.0</b>	0.03 < W <0.05	2
-	0.05 < W	0	

## 13 RELIABILITY TEST

NO.	TEST ITEM	TEST CONDITION	REMARKS
1	High Temperature Storage	80±2°C/240hours	Note 2
2	Low Temperature Storage	-30±2°C/240hours	Note 1,2
3	High Temperature Operating	70±2°C/240hours	
4	Low Temperature Operating	-20±2°C/240hours	Note 1
5	Temperature Cycle	-30±2°C~25±2°C ~80±2°C × 20 cycles (30min.) (5min.) (30min.)	Note 1,2
6	Damp Proof Test	60°C ±5°C × 90%RH/240hours	
7	Vibration Test	Frequency 10Hz~55Hz Amplitude of vibration : 1.5mm Sweep time: 12 min X, Y, Z 2 hours for each direction.	
8	Package Drop Test	Height:60 cm 1 corner, 3 edges, 6 surfaces	
9	ESD Test	Air: ±4KV 150pF/330Ω 5 times Contact: ±2KV 150pF/330Ω 5 times	
10	ESD Test for RTP	Air: ±8KV 150pF/330Ω 5 times Contact: ±4KV 150pF/330Ω 5 times	

**Note 1:** Without water condensation.

**Note 2:** The function test shall be conducted after 2 hours storage at the room temperature and humidity after removed from the test chamber.

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