



## RiTFT-50 series

### 5" EVE3 SERIES LCD TFT

Rev.1.0

2018-10-22

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally white	/
Size	5.0	Inch
Viewing Direction	12:00 (without image inversion)	O' Clock
Gray Scale Inversion Direction	6:00	O' Clock
Number of Dots	800 x (RGB) x 480	/
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>50</b>	<b>X</b>	<b>Q</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>50 – 5.0”</b>
4.	<b>MODEL SERIAL NO.</b>	A (A-Z) Ux - UxTouch
5.	<b>RESOLUTION</b>	<b>Q– 800x480 px</b>
6.	<b>INTERFACE</b>	<b>B – TFT + Controller BT81x</b>
7.	<b>FRAME</b>	N – No Frame F – Mounting Frame U – UxTouch
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

Three options of rear side adhesive tape are available: double side adhesive tape 0.2 mm with 3M 467MP glue, foam double side adhesive tape 0.5 mm with DST 3M 9495LE glue or without any tape. There are also two versions of glass color: black and white.

Rear side adhesive tape options:

		
Double side adhesive tape with DST 3M 9495LE glue (total thickness 0.2mm)	Foam double side adhesive tape with 3M 9495LE glue (total thickness 0.5mm)	Without tape

Cover glass color options:

	
BLACK	WHITE

Product options:

NAME OF THE PRODUCT	PART NUMBER	DESCRIPTION
<b>RiTFT-50</b>	RVT50AQBWNW00	BT816, no touch panel
<b>RiTFT-50-RES</b>	RVT50AQBWNWR00	BT816, resistive touch panel
<b>RiTFT-50-CAP</b>	RVT50AQBWNWC00	BT815, capacitive touch panel
<b>RiTFT-50-FR</b>	RVT50AQBFWN00	BT816, no touch panel, mounting frame
<b>RiTFT-50-RES-FR</b>	RVT50AQBFWR00	BT816, resistive touch panel, mounting frame
<b>RiTFT-50-CAP-FR</b>	RVT50AQBFWC00	BT815, capacitive touch panel, mounting frame
<b>RiTFT-50-CAP-UX</b>	RVT50UQBNWC00	BT815, uxTouch, black cover glass, 0.2mm DST
	RVT50UQBNWC01	BT815, uxTouch, black cover glass, 0.5 mm DST
	RVT50UQBNWC02	BT815, uxTouch, black cover glass, no DST
	RVT50UQBNWC03	BT815, uxTouch, white cover glass, 0.2mm DST
	RVT50UQBNWC04	BT815, uxTouch, white cover glass, 0.5 mm DST
	RVT50UQBNWC05	BT815, uxTouch, white cover glass, no DST

## 2.1 UxTouch assembly

UxTouch are LCD TFT displays with specially designed projected capacitive touch panels. UxTouch display can be mounted without any hole in the housing. Our standard UxTouch displays include double-sided adhesive tape (DST) to stick TFT easily to the housing. Basic series include 4.3", 5.0" and 7.0" display sizes.

UxTouch models with double-side adhesive tape (PN with endings 00, 01, 03, 04) can be mounted by connecting the glass to the housing. Riverdi recommends to use support brackets assembled to display's back. An additional support will stiffen the whole structure and minimize the influence of external factors such as vibration. Figure 1 and Figure 2 below show examples of using support elements.

Figure 1. Example of using support brackets

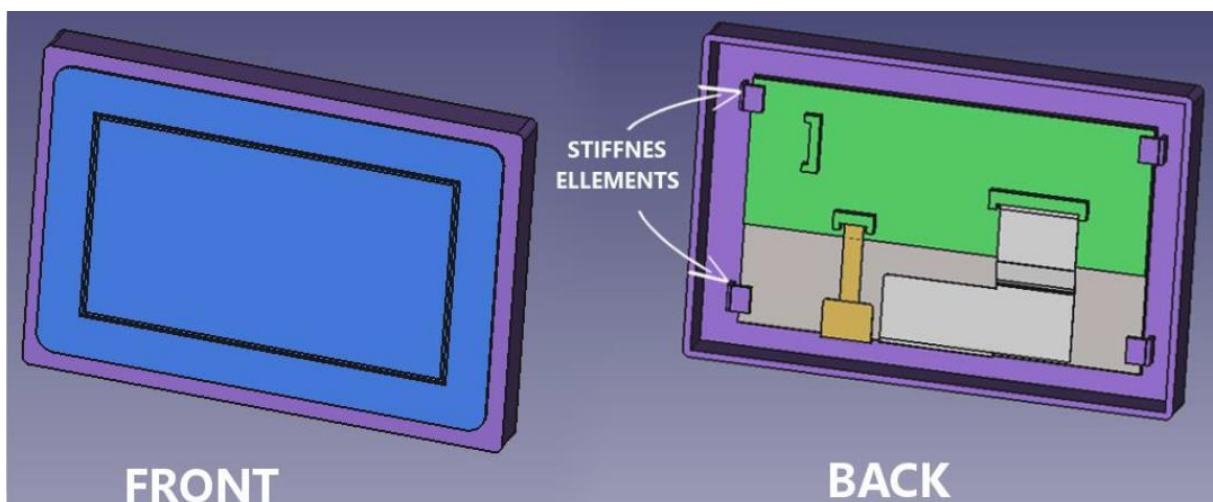
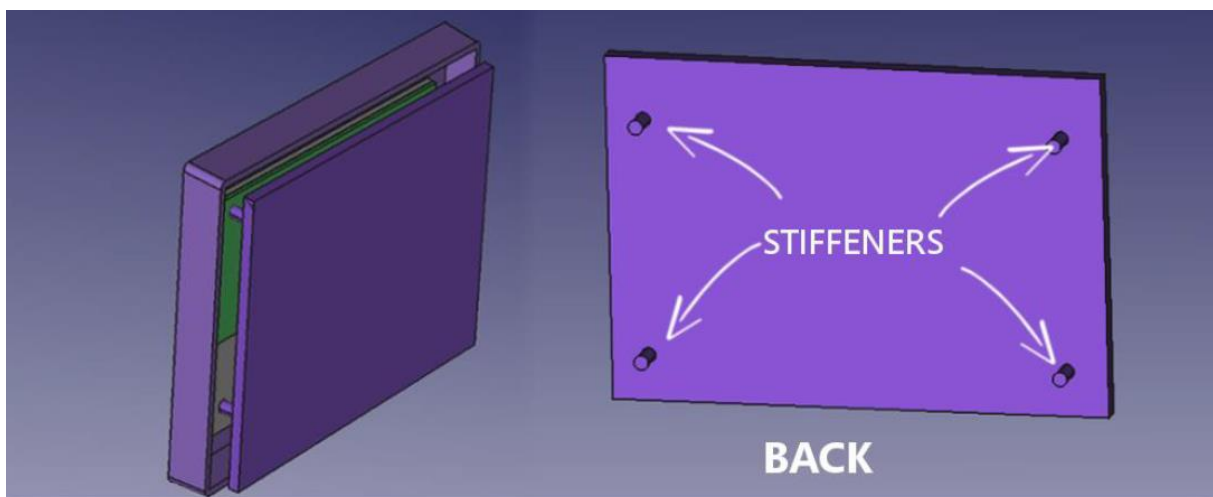


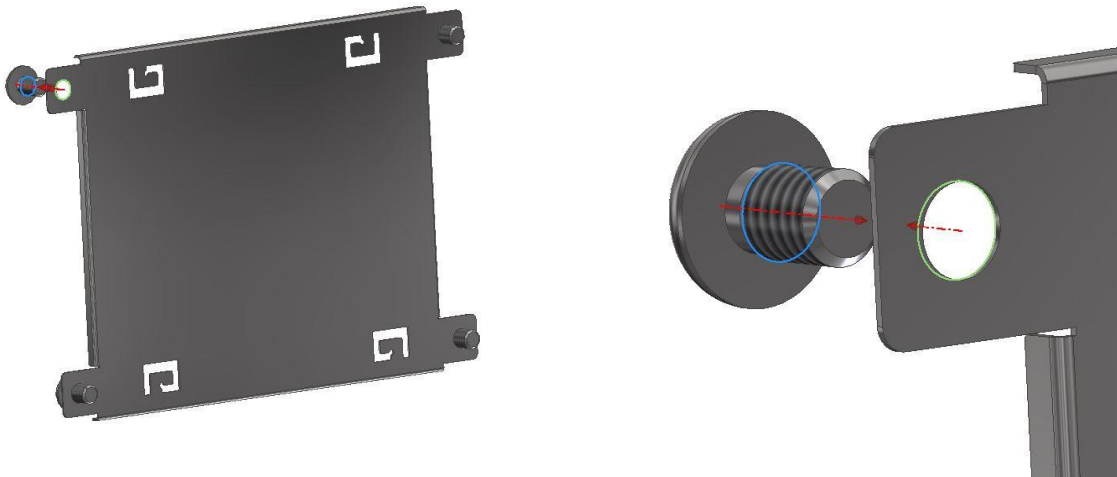
Figure 2. Example of using fixing sleeves



## 2.2 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.

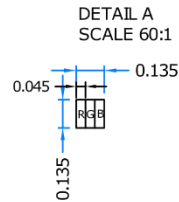
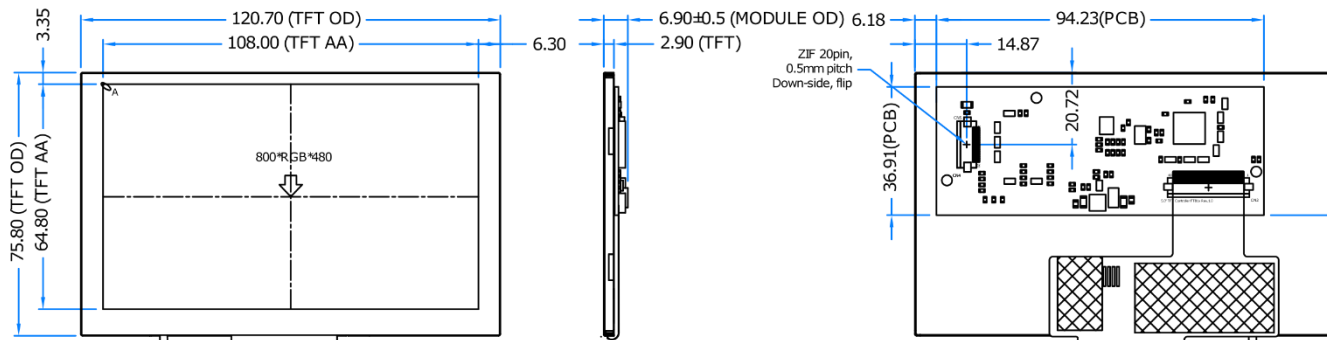
*Figure 3. Mounting frame*



LCD TFT Datasheet Rev.1.0  
 RiTFT-50 series

Revision:	
1.0	

# RiTFT-50



**GENERAL NOTES:**

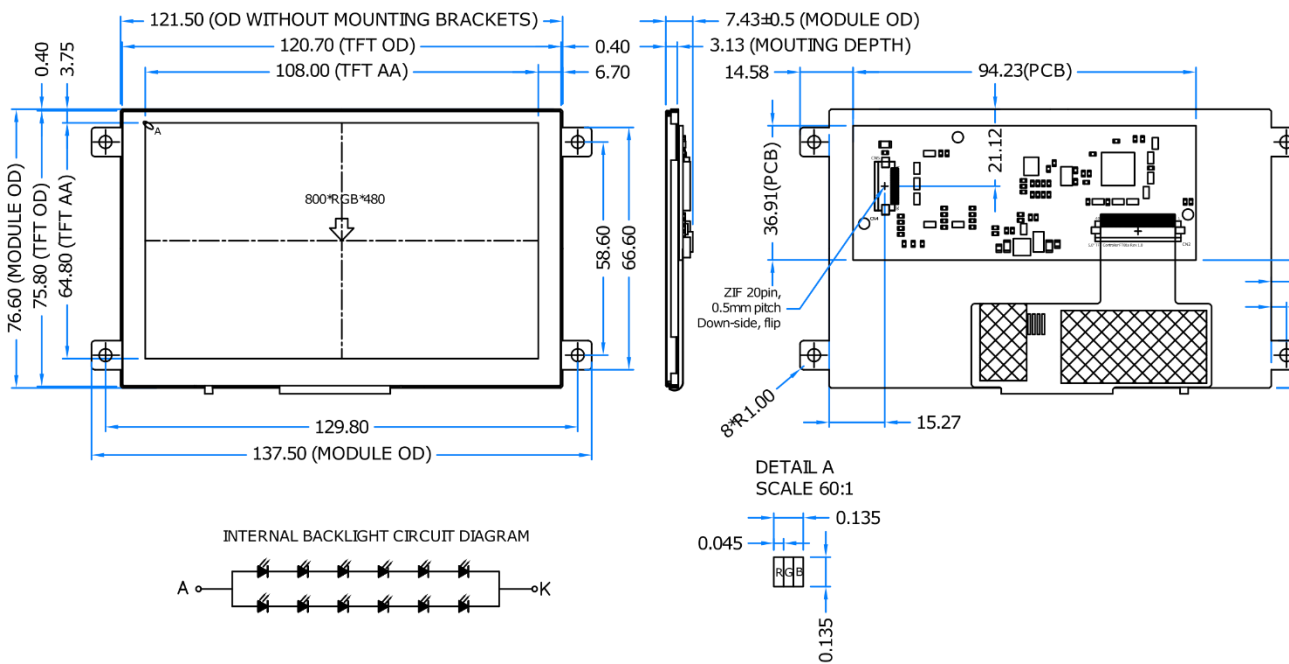
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
2. OPERATING VOLTAGE: VDD=3.3V
3. VIEWING DIRECTION: 12 O'CLOCK
4. IC DRIVER: BT816
5. OPERATING TEMP.: -20°C ~ 70°C
6. STORAGE TEMP.: -30°C ~ 80°C
7. LED BACKLIGHT: 12 WHITE LED, BUILT-IN INVERTER

9. LCM SURFACE LUMINANCE 600 cd/m<sup>2</sup>
10. GENERAL TOLERANCE: ±0.2 mm
11. RoHS COMPLIANT

PN: RVT50AQBWNW
SN: ###
DRAWN: P.M.
CHECKED:
APPR:

Revision:	
1.0	

# RiTFT-50-FR



**GENERAL NOTES:**

1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
2. OPERATING VOLTAGE: VDD=3.3V
3. VIEWING DIRECTION: 12 O'CLOCK
4. IC DRIVER: BT816
5. OPERATING TEMP.: -20°C ~ 70°C
6. STORAGE TEMP.: -30°C ~ 80°C
7. LED BACKLIGHT: 12 WHITE LED, BUILT-IN INVERTER

9. LCM SURFACE LUMINANCE 600 cd/m<sup>2</sup>
10. GENERAL TOLERANCE: ±0.2 mm
11. RoHS COMPLIANT

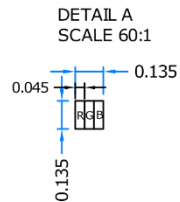
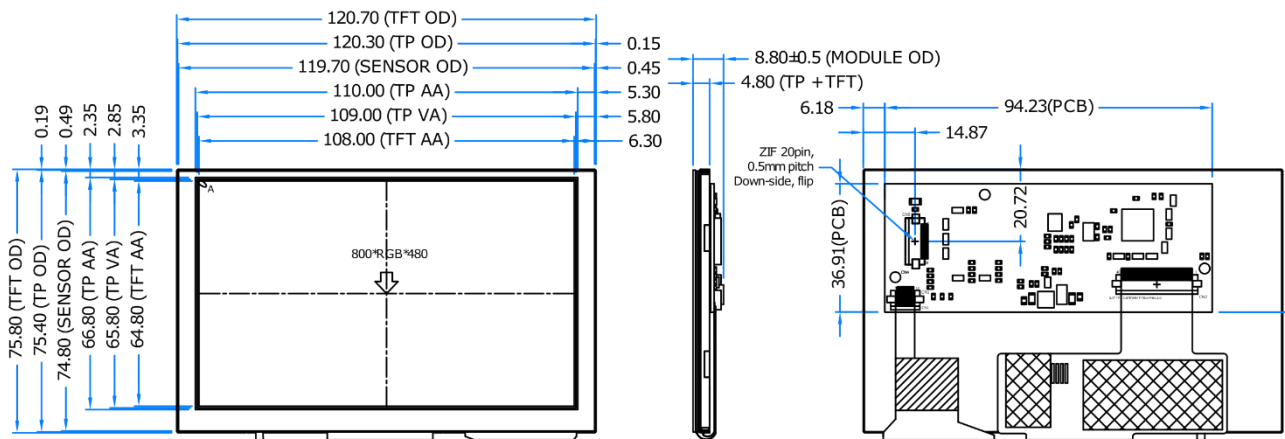
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SN: ###
DRAWN: P.M.
CHECKED:
APPR:



LCD TFT Datasheet Rev.1.0  
 RiTFT-50 series

Revision:	
1.0	

# RiTFT-50-CAP



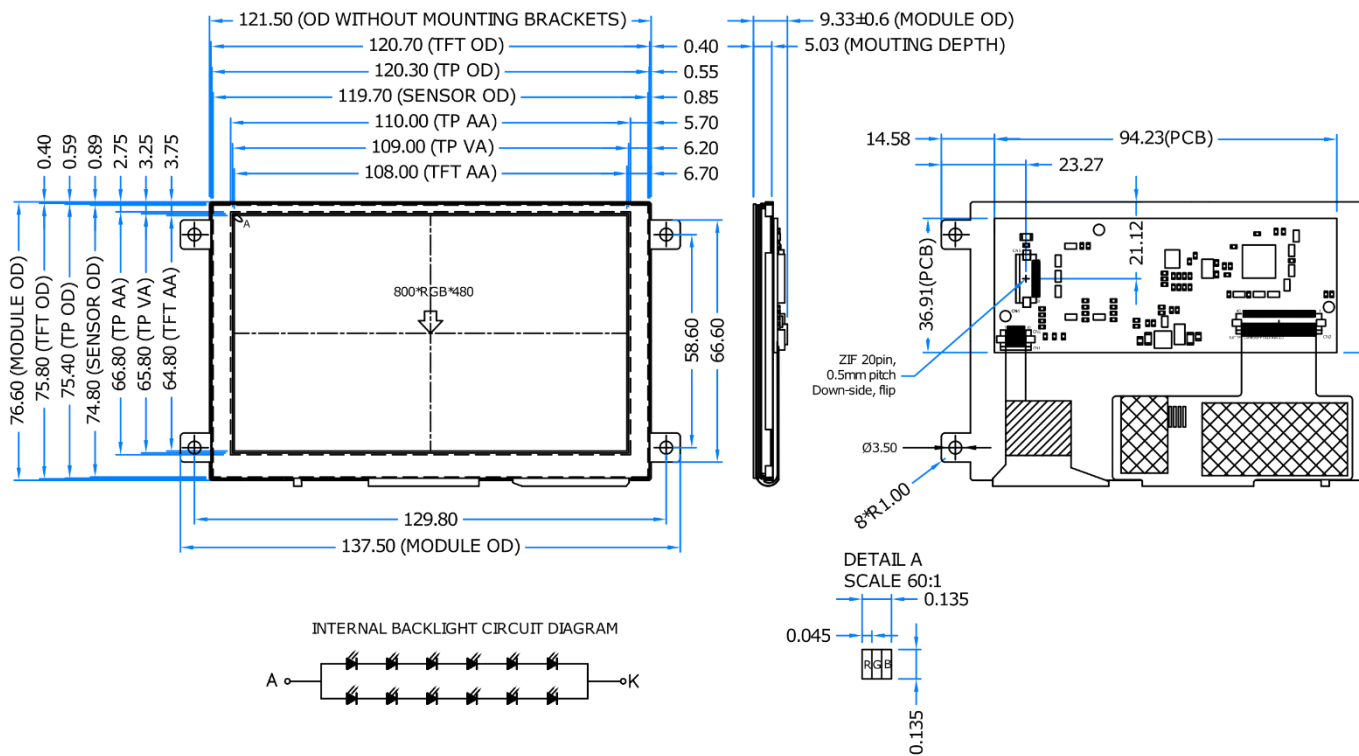
**GENERAL NOTES:**  
 1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE  
 2. OPERATING VOLTAGE: VDD=3.3V  
 3. VIEWING DIRECTION: 12 O'CLOCK  
 4. IC DRIVER: BT815  
 5. IC DRIVER CTP: FT5446  
 6. OPERATING TEMP.: -20°C ~ 70°C  
 7. STORAGE TEMP.: -30°C ~ 80°C  
 8. LED BACKLIGHT: 12 WHITE LED, BUILT-IN INVERTER

9. LCM SURFACE LUMINANCE 510 cd/m<sup>2</sup>  
 10. GENERAL TOLERANCE: ±0.2 mm  
 11. RoHS COMPLIANT

PN: RVT50AQBNCW
SN: ###
DRAWN: P.M.
CHECKED:
APPR:

Revision:	
1.0	

# RiTFT-50-CAP-FR



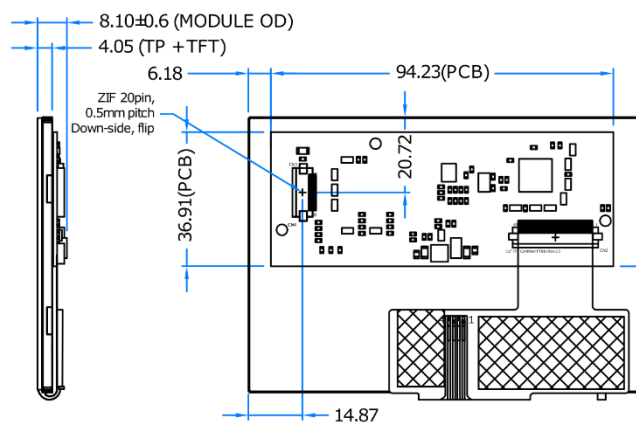
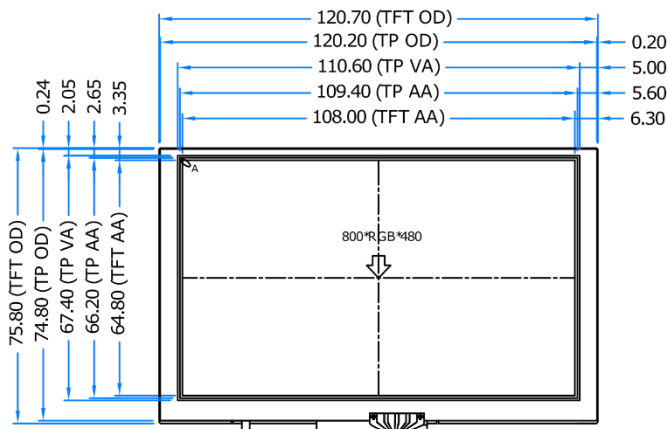
- GENERAL NOTES:**
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
  2. OPERATING VOLTAGE: VDD=3.3V
  3. VIEWING DIRECTION: 12 O'CLOCK
  4. IC DRIVER: BT815
  5. IC DRIVER CTP: FT5446
  6. OPERATING TEMP.: -20°C ~ 70°C
  7. STORAGE TEMP.: -30°C ~ 80°C
  8. LED BACKLIGHT: 12 WHITE LED, BUILT-IN INVERTER

9. LCM SURFACE LUMINANCE 510 cd/m<sup>2</sup>
10. GENERAL TOLERANCE: ±0.2 mm
11. RoHS COMPLIANT

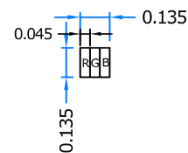
PN: RVT50AQBFWCC
SN: ###
DRAWN: P.M.
CHECKED:
APPR:

Revision:	
1.0	

# RiTFT-50-RES



DETAIL A  
 SCALE 60:1



**GENERAL NOTES:**

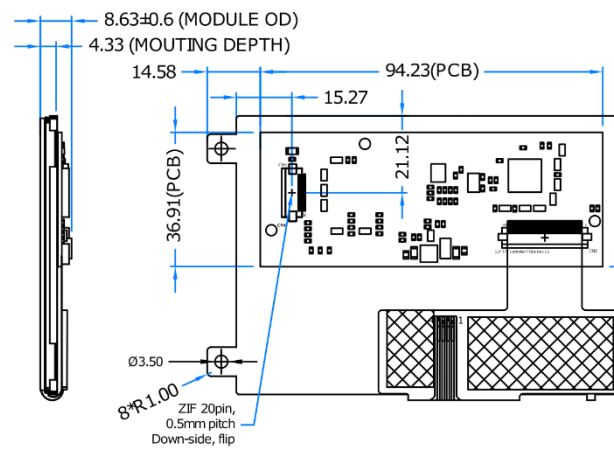
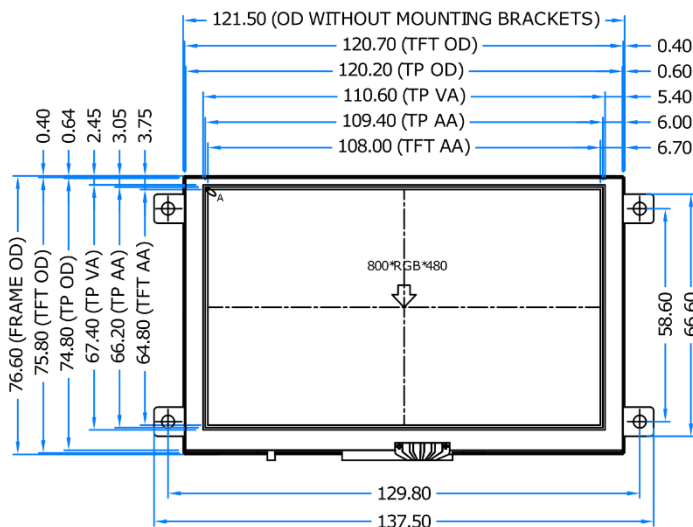
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
2. OPERATING VOLTAGE: VDD=3.3V
3. VIEWING DIRECTION: 12 O'CLOCK
4. IC DRIVER: BT816
5. OPERATING TEMP.: -20°C ~ 70°C
6. STORAGE TEMP.: -30°C ~ 80°C
7. LED BACKLIGHT: 12 WHITE LED, BUILT-IN INVERTER

9. LCM SURFACE LUMINANCE 480 cd/m<sup>2</sup>
10. GENERAL TOLERANCE: ±0.2 mm
11. RoHS COMPLIANT

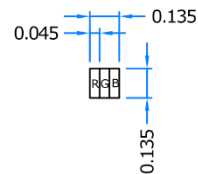
PN: RVT50AQBWNWR
SN: ###
DRAWN: P.M.
CHECKED:
APPR:

Revision:	
1.0	

# RiTFT-50-RES-FR



DETAIL A  
SCALE 60:1



**GENERAL NOTES:**

1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
2. OPERATING VOLTAGE: VDD=3.3V
3. VIEWING DIRECTION: 12 O'CLOCK
4. IC DRIVER: BT816
5. OPERATING TEMP.: -20°C ~ 70°C
6. STORAGE TEMP.: -30°C ~ 80°C
7. LED BACKLIGHT: 12 WHITE LED, BUILT-IN INVERTER

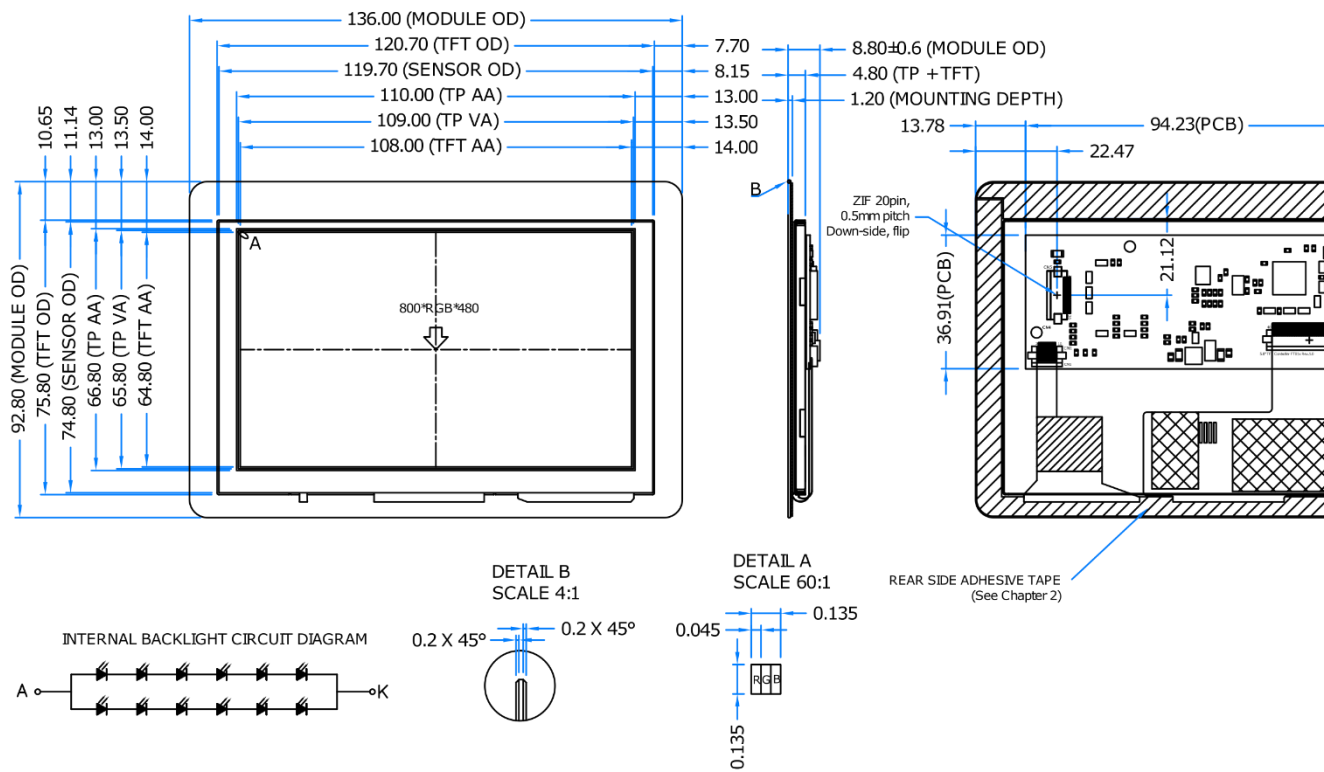
9. LCM SURFACE LUMINANCE 480 cd/m<sup>2</sup>
10. GENERAL TOLERANCE: ±0.2 mm
11. RoHS COMPLIANT

PN: RVT50AQBFWRC
SN: ###
DRAWN: P.M.
CHECKED:
APPR:

LCD TFT Datasheet Rev.1.0  
 RiTFT-50 series

Revision:	
1.0	

# RiTFT-50-UX



**GENERAL NOTES:**

1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
2. OPERATING VOLTAGE: VDD=3.3V
3. VIEWING DIRECTION: 12 O'CLOCK
4. IC DRIVER: BT815
5. IC DRIVER CTP: FTS446
6. OPERATING TEMP.: -20°C ~ 70°C
7. STORAGE TEMP.: -30°C ~ 80°C
8. LED BACKLIGHT: 12 WHITE LED, BUILT-IN INVERTER

9. LCM SURFACE LUMINANCE 510 cd/m<sup>2</sup>
10. GENERAL TOLERANCE: ±0.2 mm
11. RoHS COMPLIANT

PN: RVT50UQBWNWC  
 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>	-	290	363	mA	BLVDD=3.3V
LED Backlight Current	IDD <sub>backlight</sub>	-	180	225	mA	BLVDD=5V
Input Voltage 'H' level	V <sub>IH</sub>	0.8VDD	-	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>	17.4	18.3	19.6	V
Current for LED backlight	I <sub>I</sub>	30	40	50	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>= 40mA.

## 7 ELECTRO-OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	θ=0° φ=0° Ta=25	-	20	-	ms	Figure 4	4
Contrast Ratio	Cr		-	500	-	---	Figure 5	1
Luminance Uniformity	δ WHITE		75	80	-	%	Figure 5	3
Surface Luminance	TFT	Lv	540	600	-	cd/m <sup>2</sup>	Figure 5	2
	TFT+CTP		500	540	-			
	TFT+RTP		450	500	-			
Viewing Angle Range	θ	φ = 90°	40	50	-	deg	Figure	6
		φ = 270°	60	70	-	deg	Figure 6	
		φ = 0°	60	70	-	deg	Figure	
		φ = 180°	60	70	-	deg	Figure 6	
CIE (x, y) Chromaticity	Red	x	0.540	0.590	0.640	Figure 5	5	
		y	0.300	0.350	0.400			
	Green	x	0.298	0.348	0.398			
		y	0.520	0.570	0.620			
	Blue	x	0.095	0.145	0.195			
		y	0.060	0.110	0.160			
	White	x	0.270	0.320	0.370			
		y	0.310	0.360	0.410			

**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 4. The definition of response time

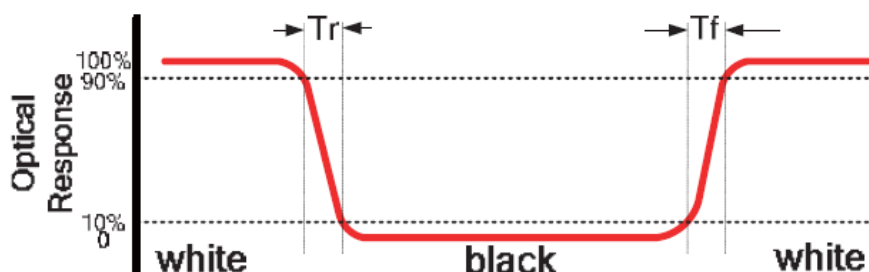


Figure 5. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

A : 5 mm  
 B : 5 mm  
 H, V : Active Area  
 Light spot size  $\varnothing=5\text{mm}$ , 500mm distance from the LCD surface to detector lens  
 measurement instrument is TOPCON's luminance meter BM-5

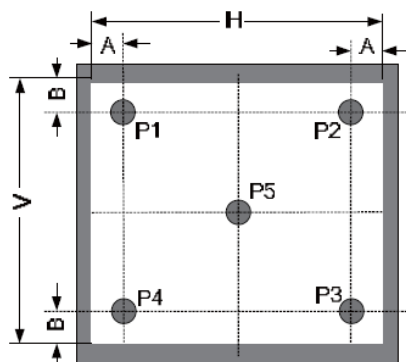
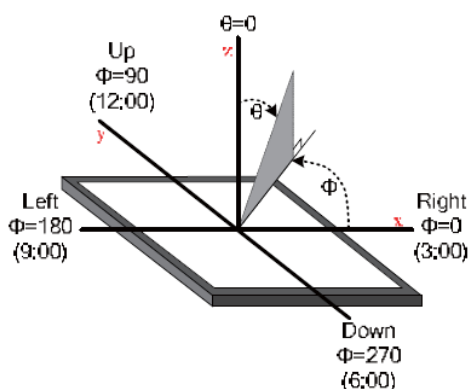


Figure 6. The definition of viewing angle



## 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 7. SPI interface connection

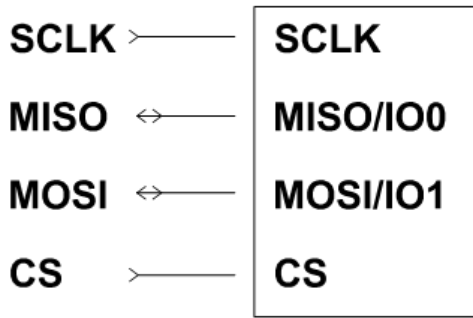
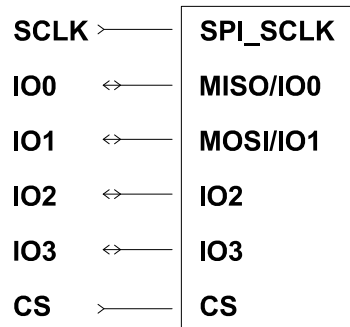


Figure 8. QSPI interface connection



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

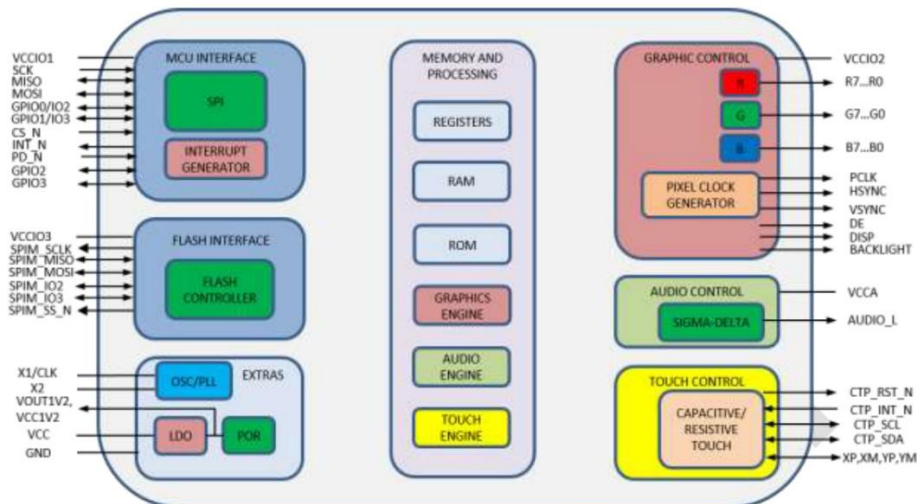
Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

**QSPI Interface** – the QSPI slave interface operates up to 30MHz. Only SPI mode 0 is supported. The QSPI can be configured as a SPI slave in SINGLE, DUAL or QUAD data bus modes.

By default the SPI slave operates in the SINGLE channel mode with MOSI as input from the master and MISO as output to the master. DUAL and QUAD channel modes can be configured through the SPI slave itself. To change the channel modes, write to register REG\_SPI\_WIDTH.

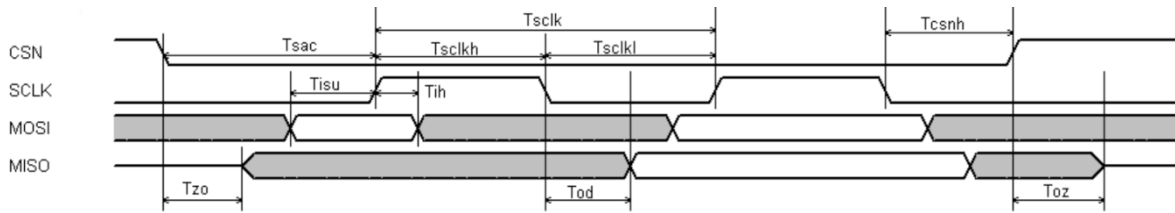
### 9.2 Block Diagram

Figure 9. BT8x Block diagram



9.3 Host interface SPI mode 0

Figure 10. SPI timing diagram



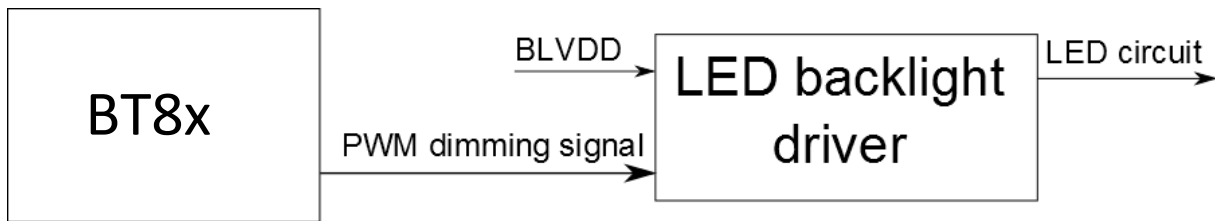
For more information about BT8x controller please go to official BT8x website.

<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 11. Backlight driver block diagram



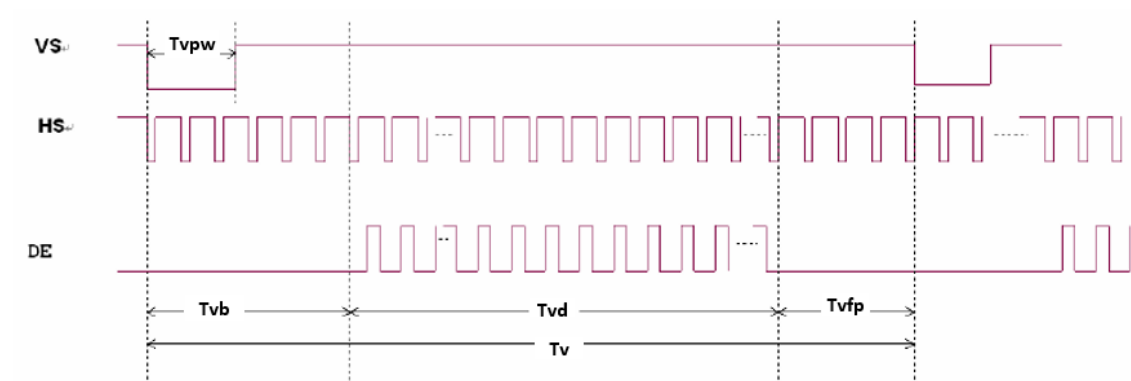
10 LCD TIMING CHARACTERISTICS

10.1 Clock and data input time diagram

Figure 12. Horizontal input timing diagram



Figure 13.. Vertical input timing diagram



## 10.2 Parallel RGB timing table

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Horizontal Display Area	Thd	-	800	-	DCLK
DCLK Frequency	Fclk	-	30	50	MHz
One Horizontal Line	Th	889	928	1143	DCLK
HS pulse width	Thpw	1	48	255	DCLK
HS Blanking	Thb	-	88	-	DCLK
HS Front Porch	Thfp	1	40	255	DCLK
Vertical Display Area	Tvd	-	480	-	TH
VS period time	Tv	513	525	767	TH
VS pulse width	Tvpw	3	3	255	TH
VS Blanking	Tvb	-	32	-	TH
VS Front Porch	Tvfp	1	13	255	TH

## 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

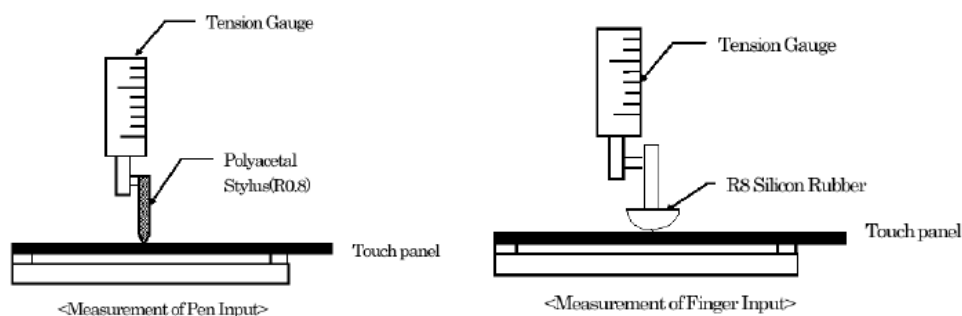
DESCRIPTION		SPECIFICATION
Operating Voltage		DC 2.8~3.3V
Power Consumption (IDD)	Active Mode	TBD mA
	Sleep Mode	TBD $\mu$ A
Interface		I <sup>2</sup> C
Controller		FT5446
I2C address		0x38 (7 bit address)
Resolution		800*480

11.1.2 For resistive touch panel

ITEM	VALUE			UNIT	REMARK
	Min.	Typ.	Max.		
Linearity	-1.5	-	1.5	%	Analog X and Y directions
Terminal Resistance	350	-	1000	Ω	X
	100	-	450	Ω	Y
Insulation Resistance	-	-	-	MΩ	DC 25V
Voltage	-	-	10	V	DC
Chattering	-	-	10	ms	100kΩ pull-up
Transparency	80	-	-	%	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 pane

DESCRIPTION	INL SPECIFICATION	REMARK
Touch Panel Size	5.0 inch	
Outline Dimension (OD)	120.3mm x 75.4mm	Cover Lens Outline
Outline Dimension (OD) - UxTouch	136.0mm x 92.8mm	Cover Lens Outline
Product Thickness	1.9mm	
Glass Thickness	0.7mm	
Ink View Area	109.00mm x 65.80mm	
Sensor Active Area	110.0mm x 66.8mm	
Input Method	5 Finger	
Activation Force	Touch	
Surface Hardness	≥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	80	-	-	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:*

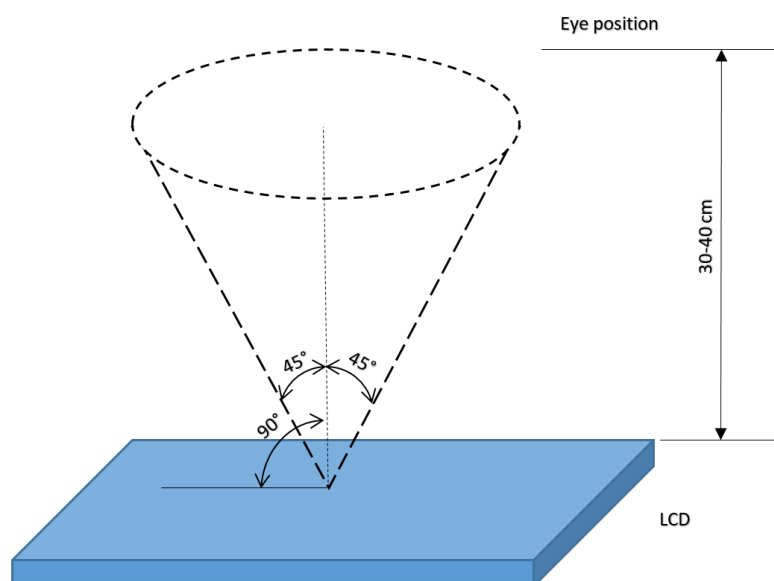
- Temperature:  $25\pm^{\circ}\text{C}$
- Humidity:  $(60\pm 10)\% \text{RH}$
- Illumination: Single fluorescent lamp non-directive (300 to 700 lux)

*Viewing distance:*

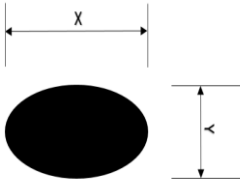
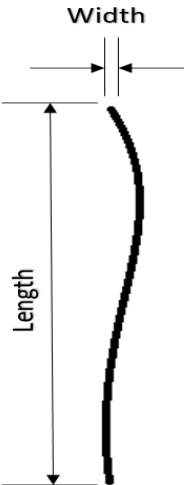
$35\pm 5\text{cm}$  between inspector bare eye and LCD.

*Viewing Angle:*

U/D:  $45^{\circ}/45^{\circ}$ , L/R  $45^{\circ}/45^{\circ}$



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> $D = \frac{(x + y)}{2}$ <p>*Spots density: 10 mm</p> <div style="display: flex; align-items: center; justify-content: center; margin-top: 20px;"> <table border="1" style="margin-right: 20px;"> <thead> <tr> <th colspan="2">Size &gt;= 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>4</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>	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	Size >= 5"		Average Diameter	Qualified Qty	D < 0.2 mm	Ignored	0.2 mm < D < 0.3 mm	4	0.3 mm < D < 0.5 mm	2	0.5 mm < D	0										
Size < 5"																																			
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0.2 mm < D < 0.3 mm	4																																		
0.3 mm < D < 0.5 mm	2																																		
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> <p>*Spots density: 10 mm</p> <div style="display: flex; align-items: center; justify-content: center; margin-top: 20px;"> <table border="1" style="margin-right: 20px;"> <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>	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
Size < 5"																																			
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L < 3.0	0.02 < W < 0.05	4																																	
L < 2.5	0.05 < W < 0.08																																		
-	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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