



RiTFT-50-IOT series

5" IOT SERIES LCD TFT

Rev.1.1

2019-03-06

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	/
Chip on board	BT81x, ESP32 WROOM 32	/
Interface Connection	WiFi, Bluetooth, USB	/
Module Graphic Memory	1 MB (BT81x) + 64 Mb (nor flash)	/
Zerynth Python License	Included	/
MikroBus Output	2	/
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	2019-02-10	Initial Release	
1.1	2019-03-06	Added links for chapter 8 th and 9 th	

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1 MODULE CLASSIFICATION INFORMATION

RV	T	50	X	Q	E	X	W	X	0X
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.

1.	BRAND	RV – Riverdi
2.	PRODUCT TYPE	T – TFT Standard F – TFT Custom
3.	DISPLAY SIZE	50 – 5.0”
4.	MODEL SERIAL NO.	A (A-Z) Ux - UxTouch
5.	RESOLUTION	Q– 800x480 px
6.	INTERFACE	E – IOT display
7.	FRAME	N – No Frame F – Mounting Frame U – UxTouch
8.	BACKLIGHT TYPE	W – LED White
9.	TOUCH PANEL	N – No Touch Panel R – Resistive Touch Panel C – Capacitive Touch Panel
10.	VERSION	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
RiTFT-50-IOT-RES	RVT50AQEFWR00	BT816, frame, RTP
RiTFT-50-IOT-CAP	RVT50AQEFWC00	BT815, frame, CTP
RiTFT-50-IOT-UXB	RVT50UQENWC01	BT815, UxTouch Black
RiTFT-50-IOT-UXW	RVT50UQENWC04	BT815, UxTouch White

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

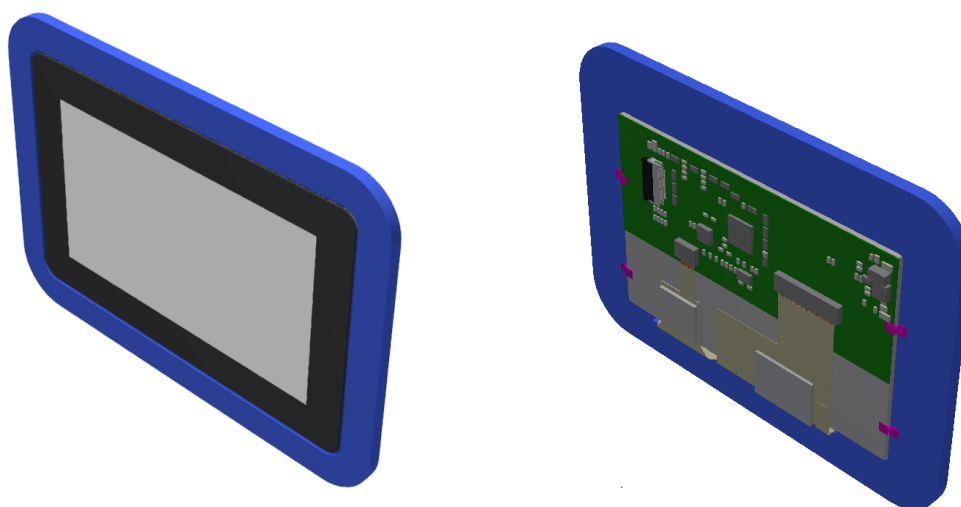
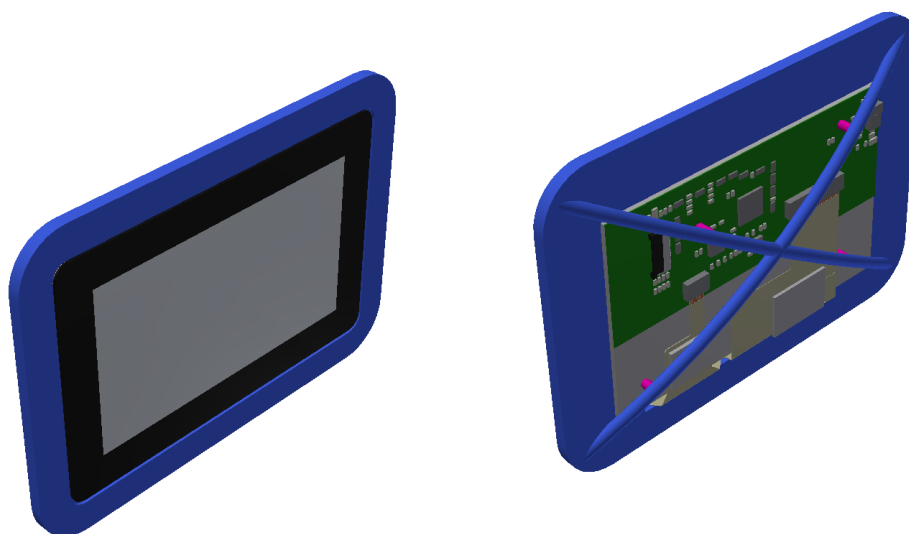


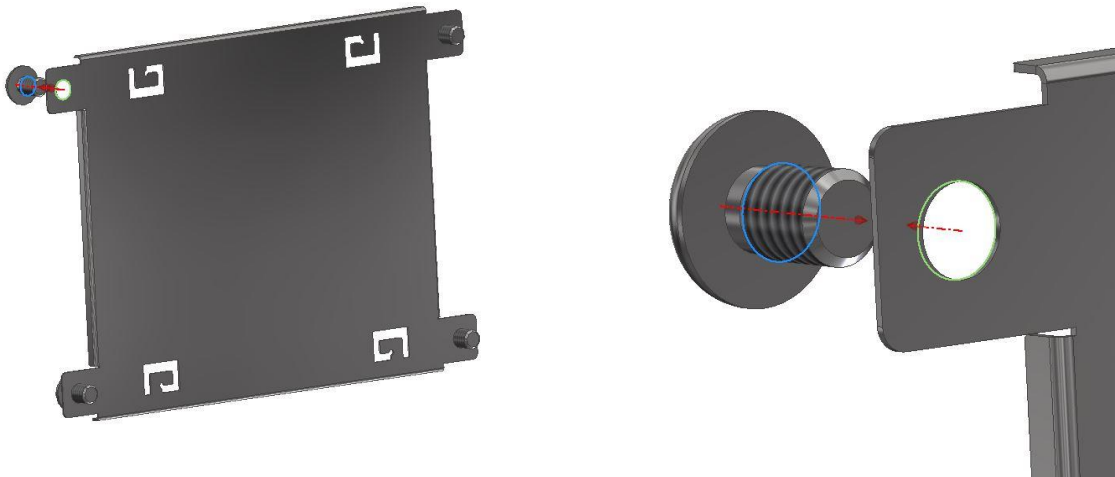
Figure 2. Example of using support pylons



2.2 Mounting frame

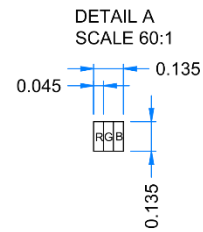
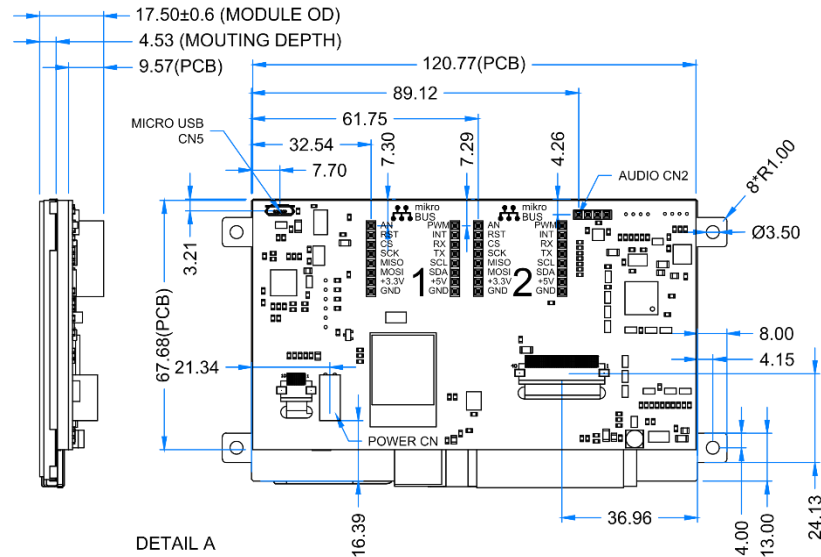
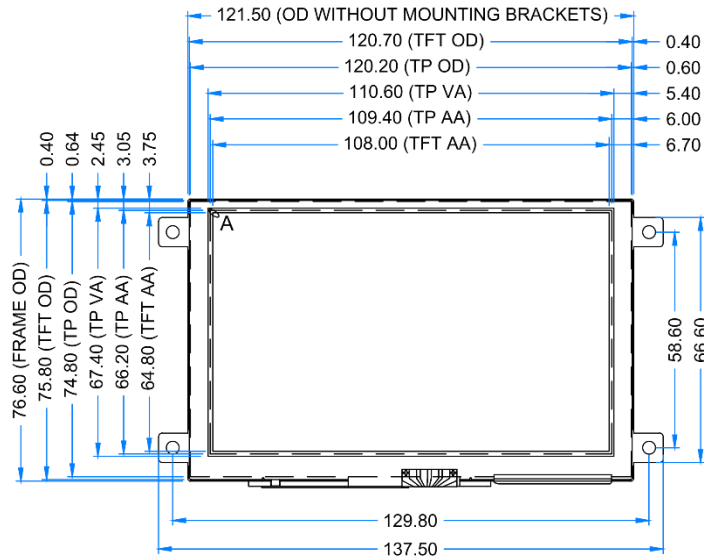
For dimensions 3.5", 4.3", 5.0" and 7.0" the product with mounting frame version is available. Thanks to the four catches attached to the side, frame provides strong assembly to the surface by mounting element (like the screw, see Figure 3). The frames are specially designed to fit Riverdi products perfectly.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

Figure 3. Mounting frame



Revision:	Changes:	Date:
1.0	Initial Case	25.02.2019

RiTFT-50-IOT-RES



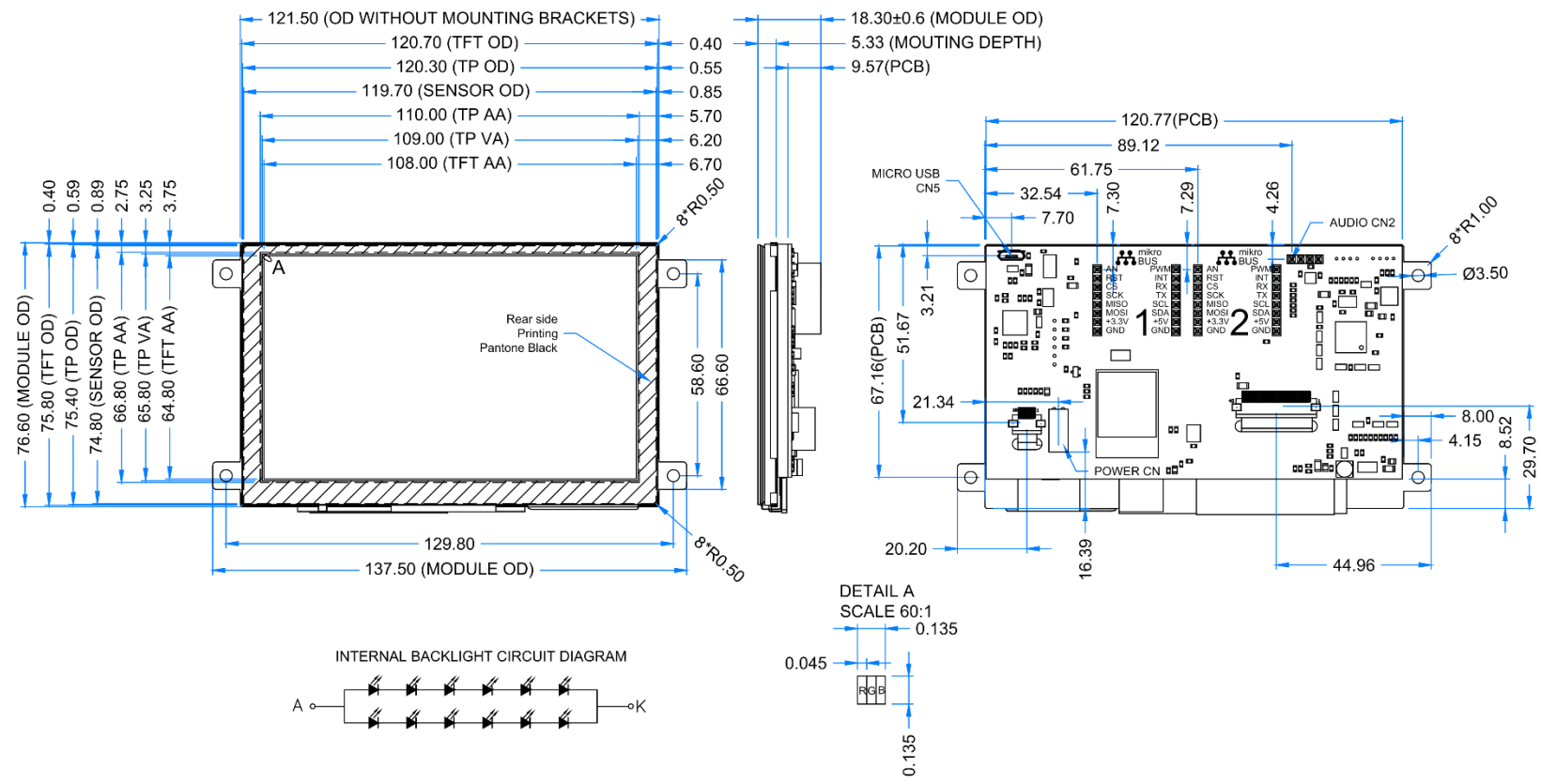
GENERAL NOTES:
 1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
 2. RESOLUTION: 800x480
 3. OPERATING VOLTAGE: VDD=3.3V
 4. VIEWING DIRECTION: 12 O'CLOCK
 5. IC DRIVER: BT816
 6. OPERATING TEMP.: -20°C ~ 70°C
 7. STORAGE TEMP.: -30°C ~ 80°C
 8. LED BACKLIGHT: 12 WHITE LED, BUILT-IN INVERTER

9. LCM SURFACE LUMINANCE 480 cd/m²
 10. GENERAL TOLERANCE: ±0.2 mm
 11. RoHS COMPLIANT

PN: RiTFT-50-IOT-RES			
SN: #####			
DRAWN: PM	2/25/2019	1:1.20	
CHECKED:		[mm]	
APPR:		ISO A3	

Revision:	Changes:	Date:
1.0	Initial Case	25.02.2019

RiTFT-50-IOT-CAP



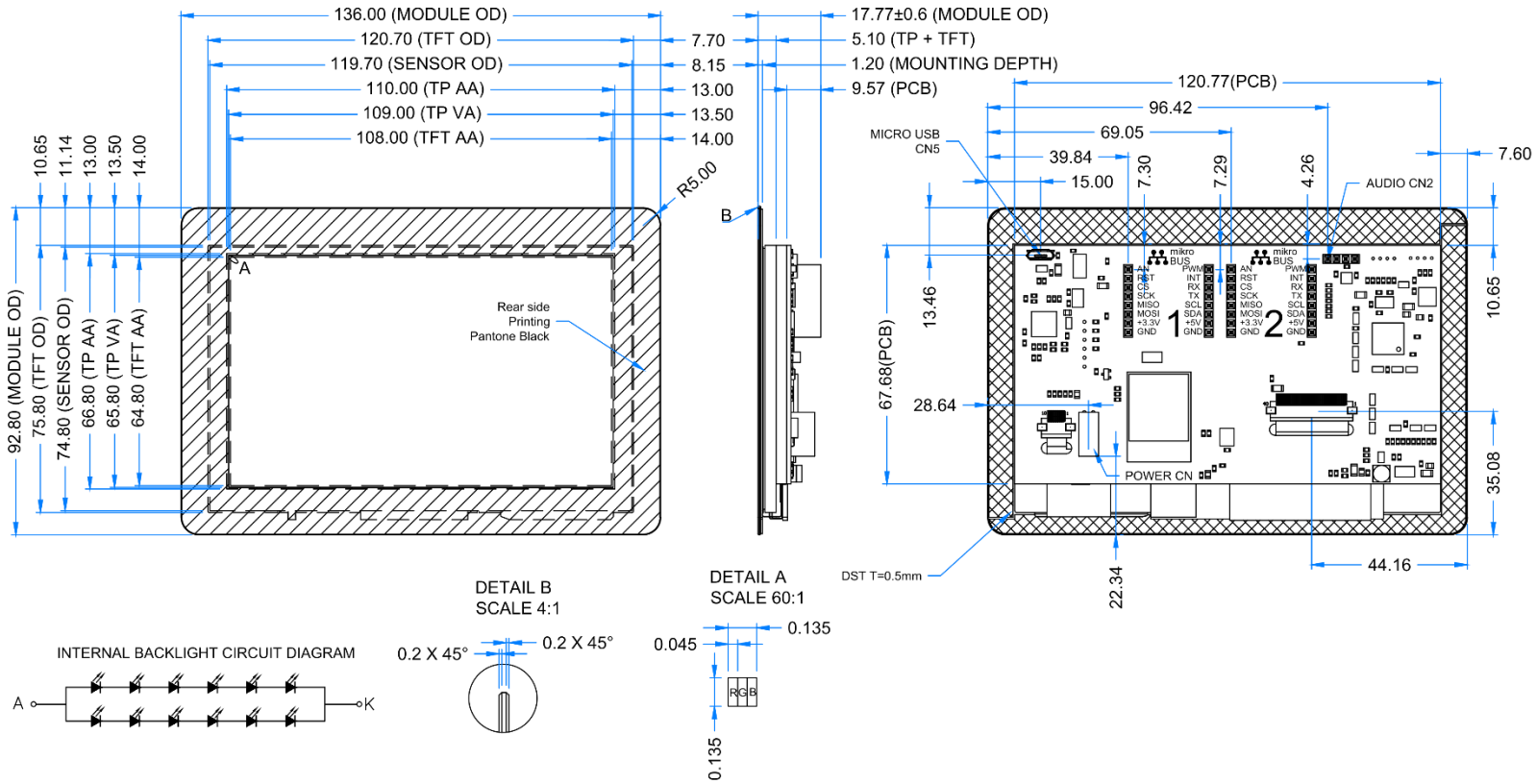
- GENERAL NOTES:**
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
 2. RESOLUTION: 800x480
 3. OPERATING VOLTAGE: VDD=3.3V
 4. VIEWING DIRECTION: 12 O'CLOCK
 5. IC DRIVER: BT815
 6. IC DRIVER CTP: FT5446
 7. OPERATING TEMP.: -20°C ~ 70°C
 8. STORAGE TEMP.: -30°C ~ 80°C

9. LED BACKLIGHT: 12 WHITE LED, BUILT-IN INVERTER
10. LCM SURFACE LUMINANCE 510 cd/m²
11. GENERAL TOLERANCE: ±0.2 mm
12. RoHS COMPLIANT

PN: RiTFT-50-IOT-CAP			
SN: #####			
DRAWN: P.M.	2/25/2019	1:1.20	
CHECKED:		[mm]	
APPR:		ISO A3	P. 1 of 1

Revision:	Changes:	Date:
1.0	Initial Case	25.02.2019

RiTFT-50-IOT-UXB



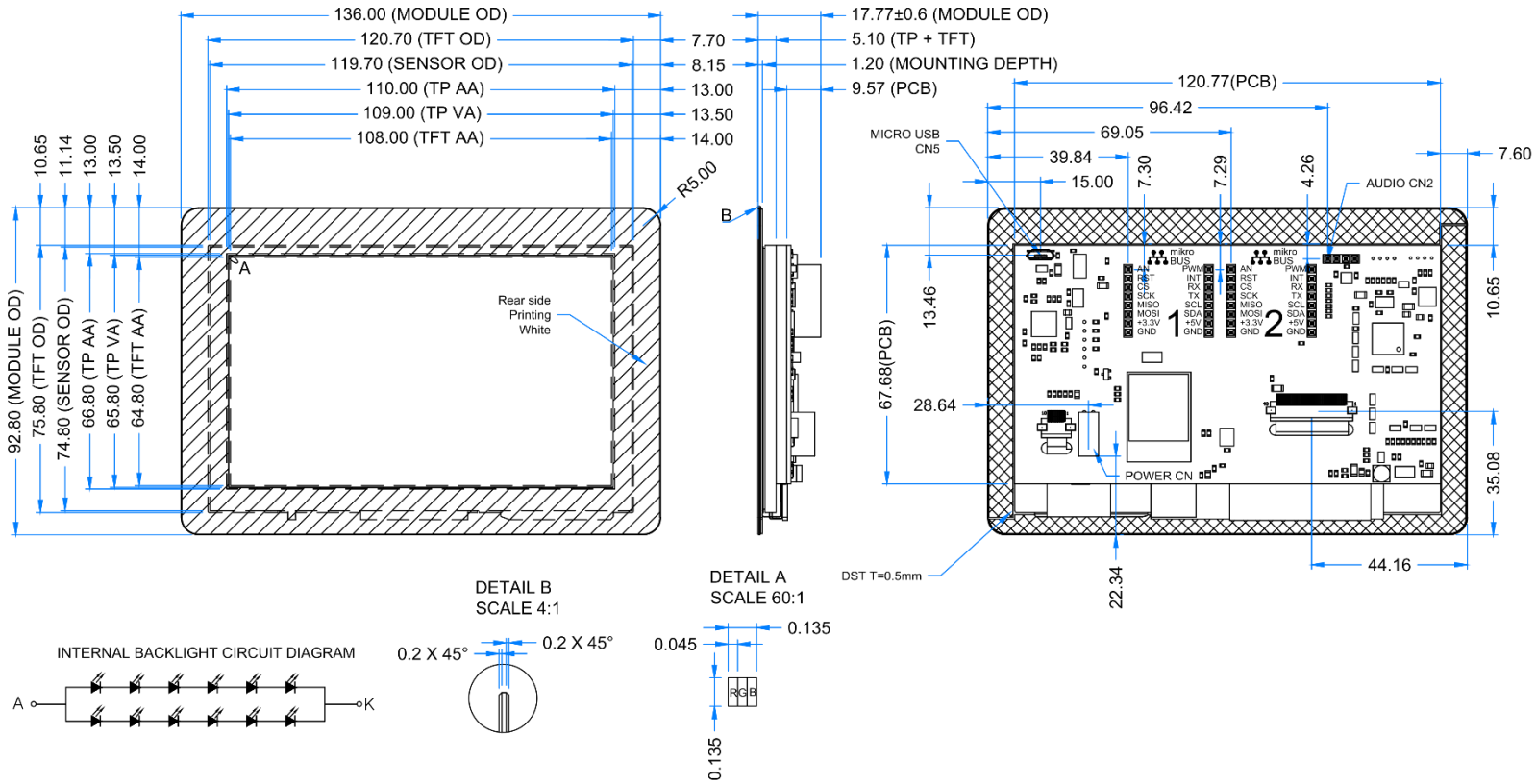
- GENERAL NOTES:**
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
 2. RESOLUTION: 800x480
 3. OPERATING VOLTAGE: VDD=3.3V
 4. VIEWING DIRECTION: 12 O'CLOCK
 5. IC DRIVER: BT815
 6. IC DRIVER CTP: FT5446
 7. OPERATING TEMP.: -20°C ~ 70°C
 8. STORAGE TEMP.: -30°C ~ 80°C

9. LED BACKLIGHT: 12 WHITE LED, BUILT-IN INVERTER
10. LCM SURFACE LUMINANCE 510 cd/m²
11. GENERAL TOLERANCE: ±0.2 mm
12. RoHS COMPLIANT
- 13.

PN: RiTFT-50-IOT-UXB			
SN: #####			
DRAWN: PM	2/25/2019	1:1.20	
CHECKED:		[mm]	
APPR:		ISO A3	

Revision:	Changes:	Date:
1.0	Initial Case	25.02.2019

RiTFT-50-IOT-UXW



- GENERAL NOTES:**
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
 2. RESOLUTION: 800x480
 3. OPERATING VOLTAGE: VDD=3.3V
 4. VIEWING DIRECTION: 12 O'CLOCK
 5. IC DRIVER: BT815
 6. IC DRIVER CTP: FT5446
 7. OPERATING TEMP.: -20°C ~ 70°C
 8. STORAGE TEMP.: -30°C ~ 80°C

9. LED BACKLIGHT: 12 WHITE LED, BUILT-IN INVERTER
10. LCM SURFACE LUMINANCE 510 cd/m²
11. GENERAL TOLERANCE: ±0.2 mm
12. RoHS COMPLIANT
- 13.

PN: RiTFT-50-IOT-UXW			
SN: #####			
DRAWN: PM	2/25/2019	1:1.20	
CHECKED:		[mm]	
APPR:		ISO A3	

4 ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNIT
Supply Voltage	V _{BUS}	0	7.0	V
USB data lines	D- and D+	-0.5	3.8	V
ESP32_GPIO	V _{GPIO}	-0.3	3.6	V
Cumulative IO output current	I _{GPIO}	-	1.1	A
Operating Temperature	T _{OP}	-20	70	°C
Storage Temperature	T _{ST}	-30	80	°C
Humidity	RH	-	90% (Max 60°C)	RH

5 ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTES
Input Voltage	V _{BUS}	TBD	5.0	5.5	V	
Power Current	I _{BUS}	-	TBD	-	mA	
USB Input Switching Threshold	V _{In}	1.0	1.2	1.5	V	
USB Input Switching Hysteresis	V _{Hys}	20	25	30	mV	
Input Voltage 'H' level for GPIO	V _{IH}	2.5	-	3.3	V	
Input Voltage 'L' level for GPIO	V _{IL}	0	-	0.6	V	

6 ELECTRO-OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	$\theta=0^\circ$ $\phi=0^\circ$ 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+CTP		500	540	-	cd/m ²	Figure 5	2
	TFT+RTP	450	500	-				
Viewing Angle Range	θ	$\phi = 90^\circ$	40	50	-	deg	Figure	6
		$\phi = 270^\circ$	60	70	-	deg	Figure 6	
		$\phi = 0^\circ$	60	70	-	deg	Figure	
		$\phi = 180^\circ$	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			
LED Lifetime	-	-	30000	50000	-	Hrs	9	

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 δ 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

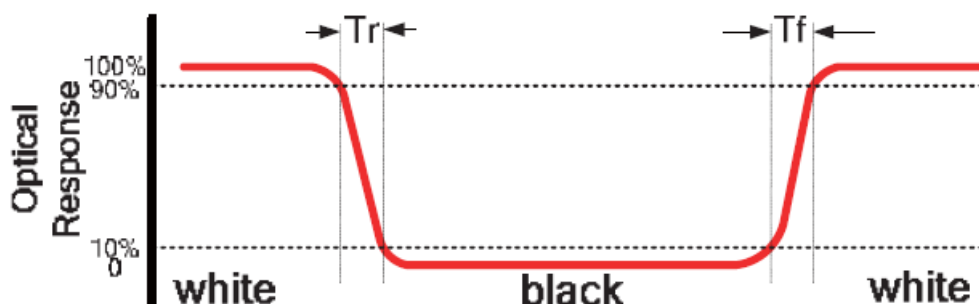


Figure 5. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

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

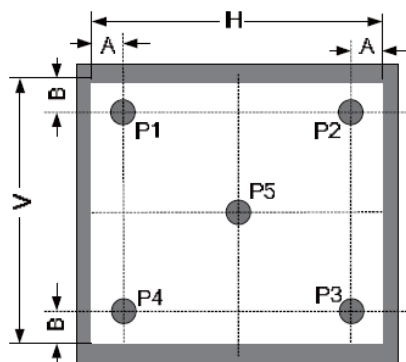
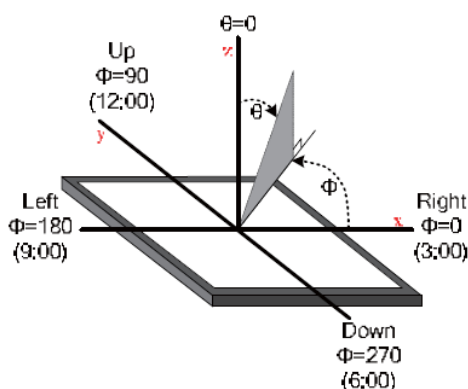


Figure 6. The definition of viewing angle



Note 9. The LED life time is defined as the module brightness decrease to 50% original brightness at $T_a=25^\circ\text{C}$.

7 INTERFACE DESCRIPTION

CN5 Micro USB		
PIN NO.	SYMBOL	DESCRIPTION
1	VBUS	Power Supply
2	D-	Data -
3	D+	Data +
4	ID	NC
5	GND	Ground
6	SHIELD	Shorted to Ground

POWER CN Manufacturer PN: JS-1143R-02		
PIN NO.	SYMBOL	DESCRIPTION
1	VBUS	Power Supply
2	GND	Ground

AUDIO CN2

PIN NO.	SYMBOL	DESCRIPTION
1	GND	Ground
2	F_A	Filtered Audio Output before Power Amplifier
3	SP-	Negative BTL output of Power Amplifier
4	SP+	Positive BTL output of Power Amplifier

MIKROBUS 1

PIN NO.	SYMBOL	DESCRIPTION
1	AN	SENSOR_VN signal from ESP32-WROOM-32
2	RST	GPIO0 signal from ESP32-WROOM-32
3	CS	CS_M1 on SPI bus (ESP32_GPIO21)
4	SCK	Clock signal for SPI bus (ESP32_GPIO14), Internally 47k Pull UP
5	MISO	Master Input, Slave Output for SPI bus (ESP32_GPIO2), Internally 47k Pull UP
6	MOSI	Slave Input, Master Output for SPI bus (ESP32_GPIO15), Internally 47k Pull UP
7	VDD	Power
8	GND	Ground
9	PWM	GPIO23 signal from ESP32-WROOM-32
10	INT	GPIO25 signal from ESP32-WROOM-32
11	RX	Receive line for UART2 (ESP32_GPIO3)
12	TX	Transmit line for UART2 (ESP32_GPIO1)
13	SCL	Clock signal for I2C bus (ESP32_GPIO10), Internally 2k2 Pull UP
14	SDA	Clock signal for I2C bus (ESP32_GPIO13), Internally 2k2 Pull UP
15	VBUS	Power
16	GND	Ground

MIKROBUS 2

PIN NO.	SYMBOL	DESCRIPTION
1	AN	SENSOR_VP signal from ESP32-WROOM-32
2	RST	GPIO0 signal from ESP32-WROOM-32
3	CS	CS_M2 on SPI bus (ESP32_GPIO22)
4	SCK	Clock signal for SPI bus (ESP32_GPIO14), Internally 47k Pull UP
5	MISO	Master Input, Slave Output for SPI bus (ESP32_GPIO2), Internally 47k Pull UP
6	MOSI	Slave Input, Master Output for SPI bus (ESP32_GPIO15), Internally 47k Pull UP
7	VDD	Power
8	GND	Ground
9	PWM	GPIO27 signal from ESP32-WROOM-32
10	INT	GPIO26 signal from ESP32-WROOM-32
11	RX	Receive line for UART2 (ESP32_GPIO3)
12	TX	Transmit line for UART2 (ESP32_GPIO1)
13	SCL	Clock signal for I2C bus, (ESP32_GPIO10), Internally 2k2 Pull UP
14	SDA	Clock signal for I2C bus, (ESP32_GPIO13), Internally 2k2 Pull UP
15	VBUS	Power
16	GND	Ground

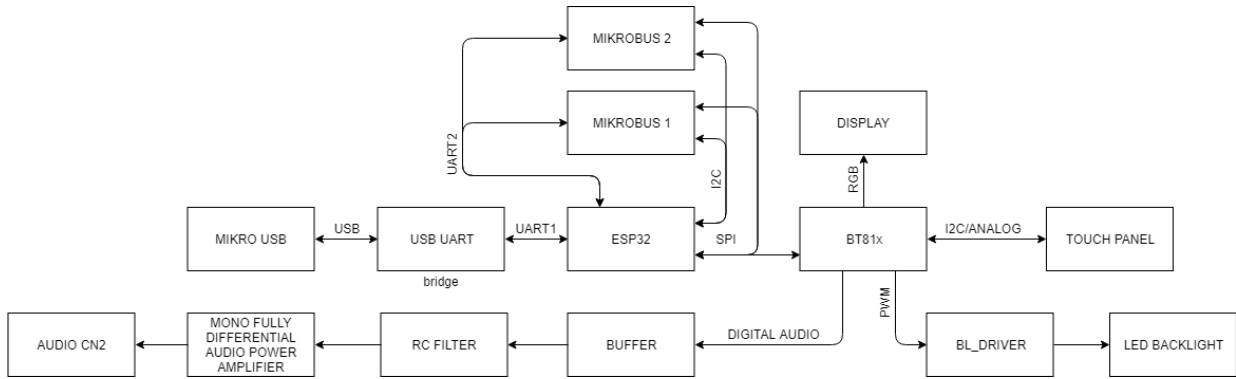


Figure 7. Module block diagram

8 ESP32 SPECIFICATION

The ESP32 integrates the Bluetooth, Bluetooth Low Energy and Wifi. That ensures that the module has a physical direct connection to the Internet via WiFi router and the Bluetooth allows you to connect the smartphone or broadcast low energy beacons for detection. These embedded chip is designed to be scalable and adaptable to a and variety of tasks (need examples). Thus it has possibility to integrate rich set of peripherals – the module is programmable via USB UART bridge.

For more information about integration of the module with Zerynth application, please see:

https://docs.zerynth.com/latest/official/board.zerynth.riverdi_tft50_iotxxx/docs/index.html

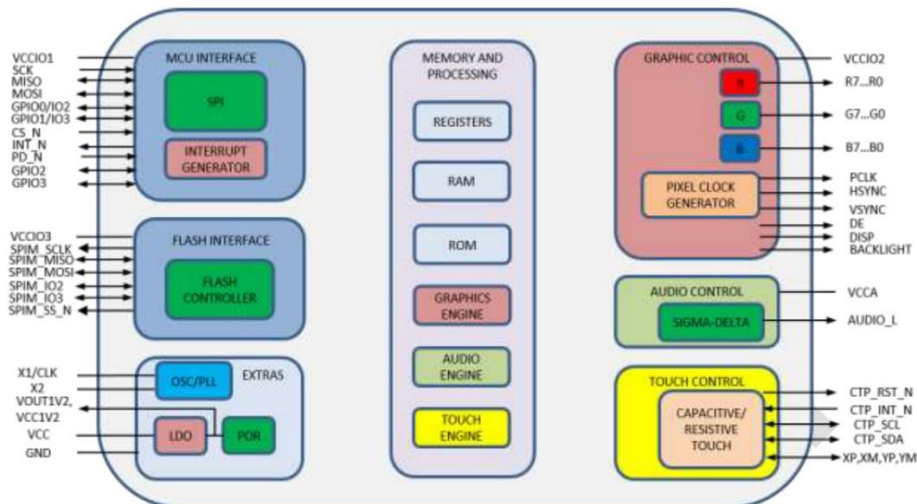
9 BT8x CONTROLLER SPECIFICATIONS

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.

For Zerynth-ready EVE library please see: https://docs.zerynth.com/latest/o_bridgetek.html

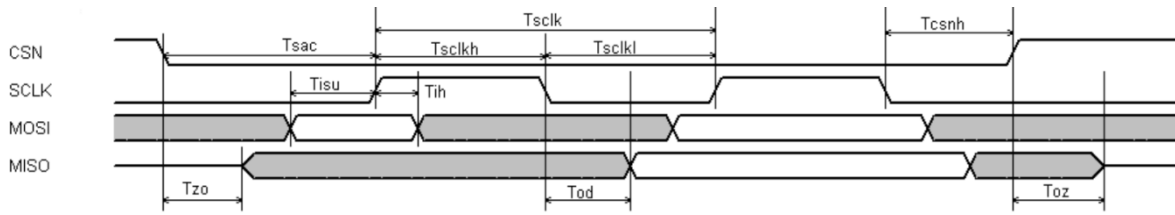
9.1 Block Diagram

Figure 8. BT8x Block diagram



9.2 Host interface SPI mode 0

Figure 9. SPI timing diagram



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

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

10 LCD TIMING CHARACTERISTICS

10.1 Clock and data input time diagram

Figure 10. Horizontal input timing diagram

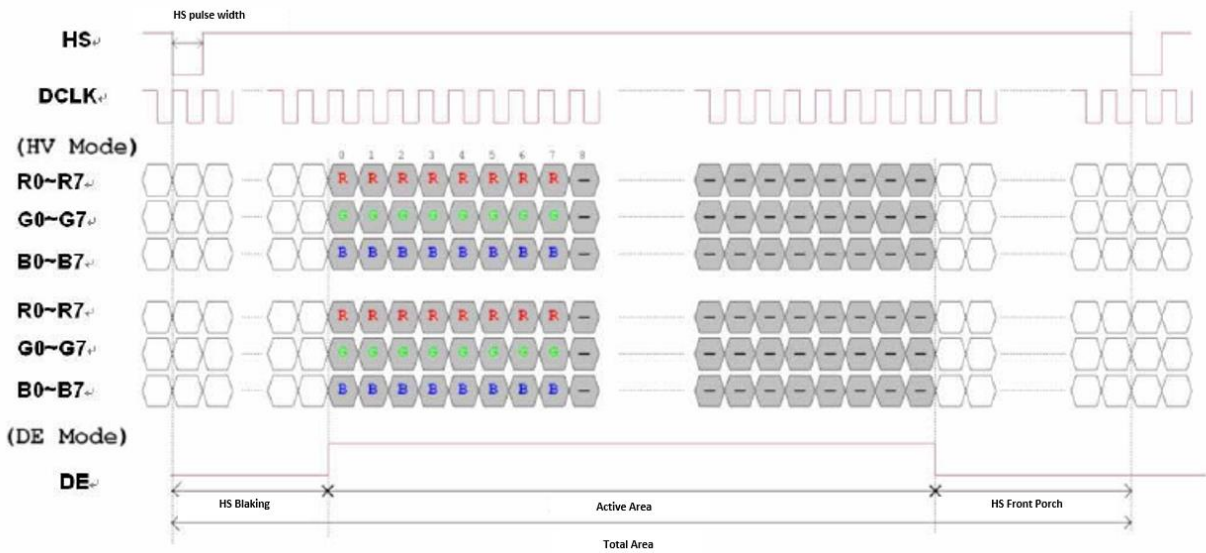
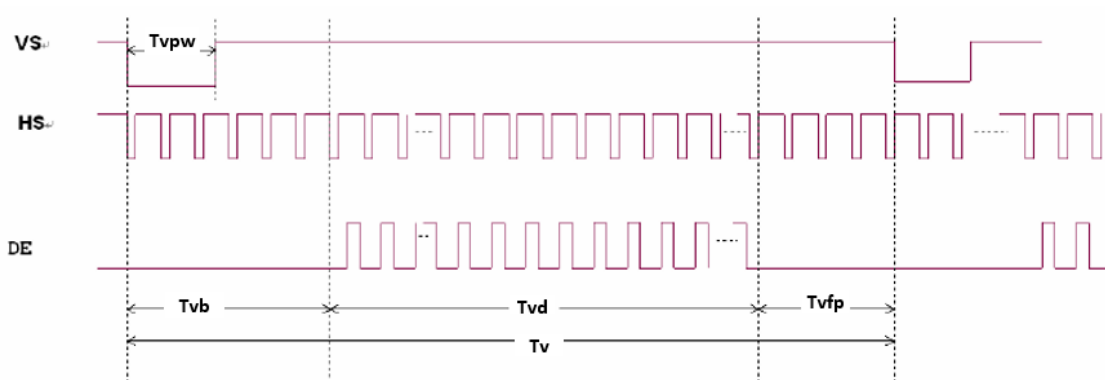


Figure 11.. Vertical input timing diagram



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

10.2.1 Proposed Bridgetek register values for RGB interface

BT81x	VALUE
REG_HCYCLE	1056
REG_HSIZE	800
REG_HOFFEST	46
REG_HSYNC0	0
REG_HSYNC1	10
REG_VCYCLE	525
REG_VSIZE	480
REG_VOFFSET	23
REG_VSYNC0	0
REG_VSYNC1	10
REG_PCLK	2

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

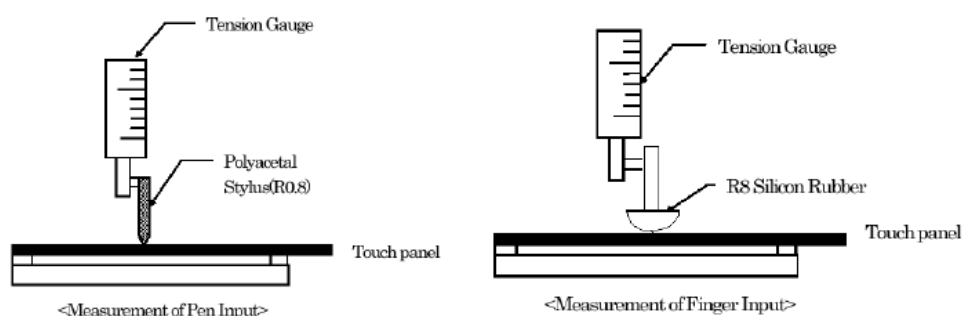
DESCRIPTION	SPECIFICATION
Operating Voltage	DC 2.8~3.3V
Power Consumption (IDD)	Active Mode
	Sleep Mode
Interface	I ² C
Controller	FT5446
I2C address	0x38 (7 bit address)
Resolution	800*480

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:

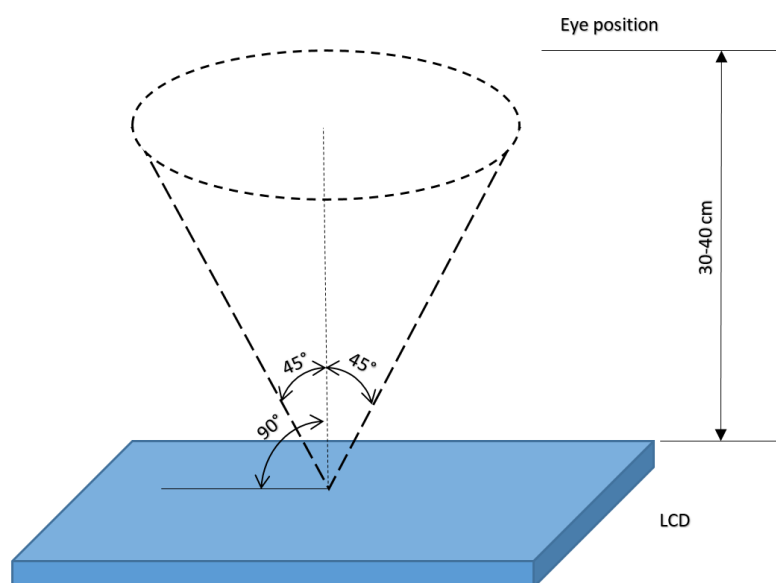
- Temperature: 25±°C
- Humidity: (60±10) %RH
- Illumination: Single fluorescent lamp non-directive (300 to 700 lux)

Viewing distance:

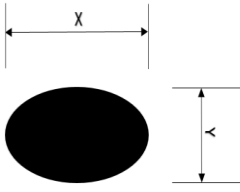
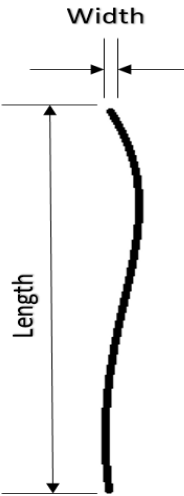
35±5cm between inspector bare eye and LCD.

Viewing Angle:

U/D: 45°/45°, L/R 45°/45°



12.2 Inspection standard

Item	Criterion																																		
<p>Black spots, white spots, light leakage, Foreign Particle (round Type)</p>	<div style="display: flex; align-items: center; justify-content: center;">  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="2">Size < 5"</th> </tr> <tr> <th>Average Diameter</th> <th>Qualified Qty</th> </tr> </thead> <tbody> <tr> <td>D < 0.2 mm</td> <td>Ignored</td> </tr> <tr> <td>0.2 mm < D < 0.3 mm</td> <td>3</td> </tr> <tr> <td>0.3 mm < D < 0.5 mm</td> <td>2</td> </tr> <tr> <td>0.5 mm < D</td> <td>0</td> </tr> </tbody> </table> </div> <div style="text-align: center; margin: 10px 0;"> $D = \frac{(x + y)}{2}$ </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>LCD black spots, white spots, light leakage (line Type)</p>	<div style="display: flex; align-items: center; justify-content: center;">  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="3">Size < 5"</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Qualified Qty</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>W < 0.02</td> <td>Ignored</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>0.05 < W < 0.08</td> </tr> <tr> <td>-</td> <td>0.08 < W</td> <td>0</td> </tr> </tbody> </table> </div> <div style="text-align: center; margin: 10px 0;"> <table border="1"> <thead> <tr> <th colspan="3">Size >= 5"</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Qualified Qty</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>W < 0.02</td> <td>Ignored</td> </tr> <tr> <td>L < 3.0</td> <td>0.02 < W < 0.05</td> <td rowspan="2">4</td> </tr> <tr> <td>L < 2.5</td> <td>0.05 < W < 0.08</td> </tr> <tr> <td>-</td> <td>0.08 < 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"	
	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
	*Spots density: 10 mm	
	Polarizer bubbles	Size < 5"
Average Diameter		Qualified Qty
D < 0.2 mm		Ignored
0.2 mm < D < 0.5 mm		3
0.5 mm < D < 1 mm		2
1 mm < D		0
Total Q'ty		3
Size >= 5"		
Average Diameter		Qualified Qty
D<0.25 mm		Ignored
0.25 mm < D < 0.5 mm		3
0.5 mm < D		0
Electrical Dot Defect		Size < 5"
		item
	Black do defect	4
	Bright dot defect	2
	Total Dot	5
	Size >= 5"	
	item	Qualified Qty
	Black do defect	5
	Bright dot defect	2
	Total Dot	5



Item	Criterion		
Touch panel spot	Size < 5"		
	Average Diameter	Qualified Qty	
	D < 0.2 mm	Ignored	
	0.2 mm < D < 0.4 mm	5	
	0.4 mm < D < 0.5 mm	2	
	0.5 mm < D	0	
	Size >= 5"		
	Average Diameter	Qualified Qty	
	D < 0.25 mm	Ignored	
	0.25 mm < D < 0.5 mm	4	
	0.5 mm < D	0	
	Touch panel White Line Scratch	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 < 0.03	Ignored
L < 5.0		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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