Riverdi
Display Solution Experts

RVT101HVBNWC00

EVE4 IPS 10.1" LCD TFT Datasheet

Rev.0.1

2020-12-29

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	10.1	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	257.96 x 168.60 x 14.28	mm
Active Area (W × H)	216.96 × 135.60	mm
Pixel Pitch (W × H)	0.1695 × 0.1695	mm
Resolution	1280 × 800	/
Brightness	800	cd/m^2
Color Depth	16.7M	/
Pixel Arrangement	RGB Vertical Stripe	/
Driver IC of Board	BT817Q	/
Interface	SPI/QSPI	/
Host Connector	RiBUS, ZIF 20 pin, 0.5mm pitch, down-side contact	/
With/Without Touch	With Projected Capacitive Touch Panel	/
CTP Driver	ILI2312A	/
Supply Voltage for Module	3.3	V
Supply Voltage for Backlight	5.0 ÷ 12.0	V
Weight	TBD	g

Note 1: RoHS compliant

Note 2: TBD = This information will be provided once we have samples

Note 3: LCM weight tolerance: ± 5%.

REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
0.1	2020-12-29	Preliminary	

CONTENTS

1   MODULE CLASSIFICATION INFORMATION

RV	T	101	H	V	B	N	W	C	00
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.

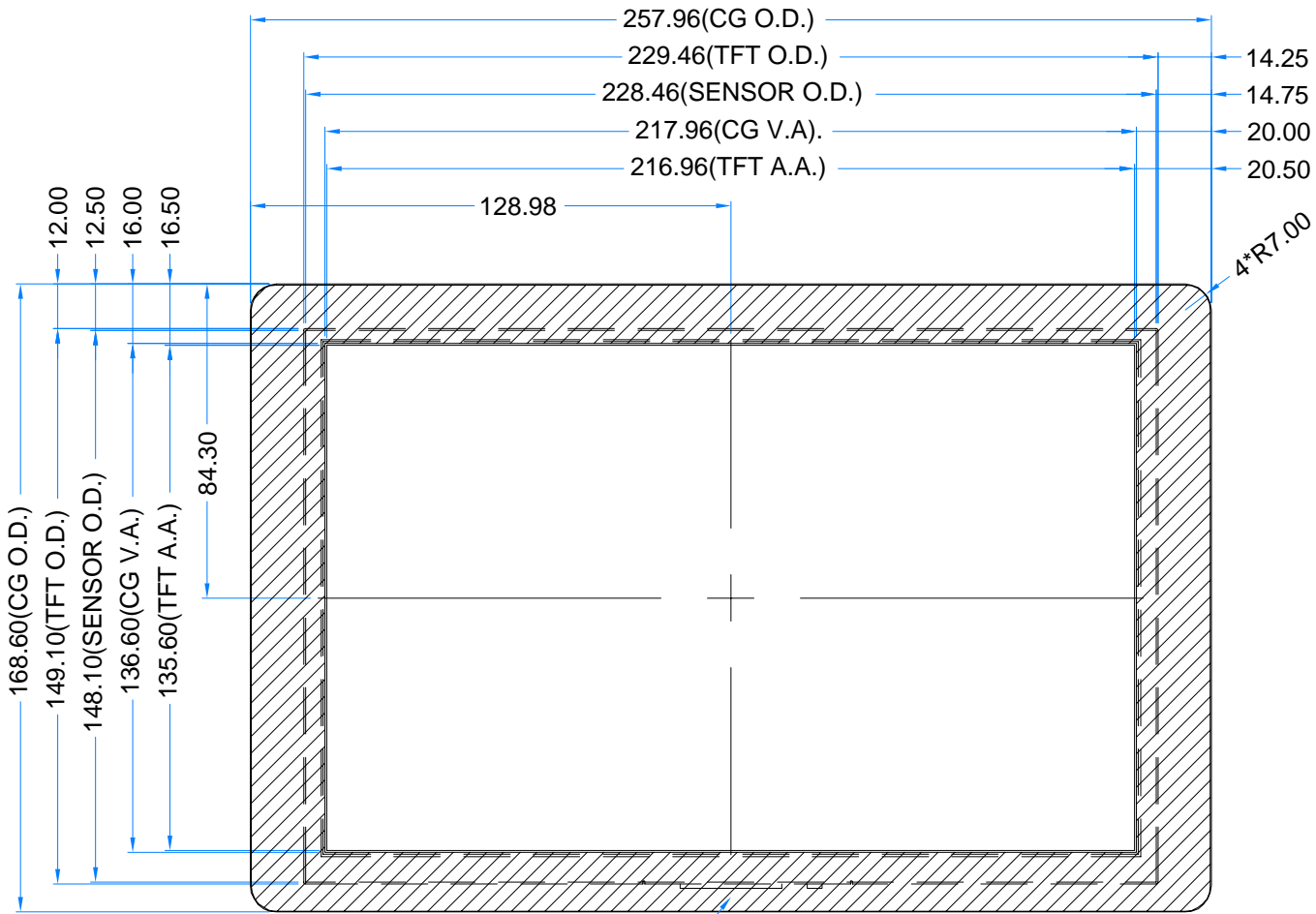|		
1.	BRAND	RV – Riverdi
2.	PRODUCT TYPE	T – TFT Standard
3.	DISPLAY SIZE	101 – 10.1"
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	V– 1280 x 800 px
6.	INTERFACE	B – SPI/QSPI
7.	FRAME	N – No Frame
8.	BACKLIGHT TYPE	W – LED White
9.	TOUCH PANEL	C – With Touch Panel
10.	VERSION	00 – (00-99)

2 UxTOUCH ASSEMBLY

UxTouch are LCD TFT displays with specially designed projected capacitive touch panels. UxTouch display can be mounted without any additional holes in the housing. Our standard UxTouch displays include double-sided adhesive tape (DST) to stick TFT easily to the housing.
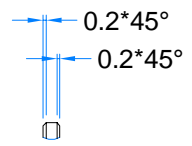
UxTouch models with double-side adhesive tape can be mounted by fastening the glass to the housing. Riverdi recommends to use support brackets assembled to display's back. An additional support will stiffen the whole structure and minimize the influence of external factors such as vibration. Figure 1 below show examples of using the support elements. If you can't add the supportive brackets, you may be interested in optically bonded version of this display RVT101HVBNWC00-B, which is superior in optical performance and does not require any extra support.

Figure 1. Example of using the support brackets

257.96(CG O.D.)
229.46(TFT O.D.)
228.46(SENSOR O.D.)
217.96(CG V.A.)
216.96(TFT A.A.)
128.98

14.25
14.75
20.00
20.50

4*R7.00

12.00
12.50
16.00
16.50

168.60(CG O.D.)
149.10(TFT O.D.)
148.10(SENSOR O.D.)
136.60(CG V.A.)
135.60(TFT A.A.)

84.30

BLACK MASK PRINTING
COLOR: RAL9005

DETAIL A
SCALE 4:1

0.2*45°
0.2*45°

LCD NOTES:
1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS
2. RESOLUTION: 1280x800
3. VIEWING ANGLE: FREE
4. SURFACE LUMINANCE: 800 cd/m^2
5. DRIVING IC ON THE BOARD: BT817Q
6. INTERFACE: SPI/QSPI
7. SUPPLY VOLTAGE FOR MODULE: 3.3 V
8. SUPPLY VOLTAGE FOR BACKLIGHT: 5.0 ÷ 12.0 V,
   BUILT-IN LED INVERTER

TP NOTES:
1. TP STRUCTURE: G+G
2. CG THICKNESS: 1.10mm
3. SURFACE HARDNESS: 7H
4. DRIVER IC: ILI2132A
5. INTERFACE: SPI/QSPI VIA RIBUS AND BT817Q

GENERAL NOTES
1. ZERO BAD PIX
2. OPERATING T
3. STORAGE TEM
4. WITHOUT INDU
5. RoHS3 COMPL

4 ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNIT	NOTE
Supply Voltage for Module	VDD	0	4	V	Note 1
Digital I/O signals (SPI/QSPI/GPIO) Voltage	-	-0.5	5.5	V	Notes 1, 2
Supply voltage for Backlight	BLVDD	-0.3	14.0	V	Note 1
Operating Temperature	T_{OP}	-20	70	°C	
Storage Temperature	T_{ST}	-30	80	°C	
Storage Humidity (@ 25 ± 5°C)	H_{ST}	10	-	% RH	
Operating Ambient Humidity (@ 25 ± 5°C)	H_{OP}	10	-	% RH	

Note 1. Exceeding the maximum values may cause improper operation or permanent damage to the unit.

Note 2. Digital I/O signals are to be connected to pins 3 ÷ 9, 11 and 12 pins at RiBUS connector (P1).

5 ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I_{VDD}	268	498	TBD	mA	Note 1
Input Voltage "H" Level	V_{IH}	2.0	3.3	5.5	V	
Input Voltage "L" Level	V_{IL}	-	-	0.8	V	

Note 1. The minimum current drawn from VDD is defined with the condition that there is no communication on SPI and the Blacklight is off.

The maximum current drawn from VDD is defined with the condition that the LCD displays a white screen with 100% of the backlight.

6 BACKLIGHT ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Backlight	BLVDD	5.0	9.0	14.0	V	
Current drawn from BLVDD @5.0V	$I_{BLVDD=5.0\,V}$	TBD	1367	TBD	mA	
Current drawn from BLVDD@7.0V	$I_{BLVDD=7.0\,V}$	TBD	858	TBD	mA	
Current drawn from BLVDD @9.0V	$I_{BLVDD=9.0\,V}$	TBD	667	TBD	mA	
Current drawn from BLVDD@12.0V	$I_{BLVDD=12.0\,V}$	TBD	469	TBD	mA	
Life Time	-	-	50,000	-	hours	Note 1

Note 1. Operating life means the period of time in which the LED brightness goes down to 50% of the initial brightness. Typical operating life time is the estimated parameter.

7 ELECTRO-OPTICAL CHARACTERISTICS

ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time		Tr+Tf	θ=0° Ø=0° Ta=25 °C	-	25	35	ms	FIG 2.	4
Contrast Ratio		Cr		800	1000	-	---	FIG 3.	1
Luminance Uniformity		δ WHITE		-	75	-	%	FIG 3.	3
Surface Luminance		Lv		-	800	-	cd/m²	FIG 3.	2
Viewing Angle Range		θ	Ø = 90°	75	85	-	deg	FIG 4.	6
			Ø = 270°	75	85	-	deg	FIG 4.	
			Ø = 0°	75	85	-	deg	FIG 4.	
			Ø = 180°	75	85	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	θ=0° Ø=0° Ta=25 °C	0.22	0.26	0.30		FIG 3.	5
		y		0.20	0.24	0.28			
	Green	x		0.34	0.38	0.42			
		y		0.50	0.54	0.58			
	Blue	x		0.10	0.14	0.18			
		y		0.09	0.13	0.17			
	White	x		0.28	0.32	0.36			
		y		0.29	0.33	0.37			

Note 1. Contrast Ratio(CR) is defined mathematically as below, for more information see Figure 2.

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

Note 2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see Figure 3.

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

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 minimum luminance of 5 points luminance by maximum luminance of 5 points luminance. For more information see Figure 3.

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

Note 4. Response time is the time required for the display to transition from white to black (Rise Time, Tr) and from black to white (Decay Time, Tf). For additional information see Figure 2. 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 LCD surface. For more information see Figure 4.

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.
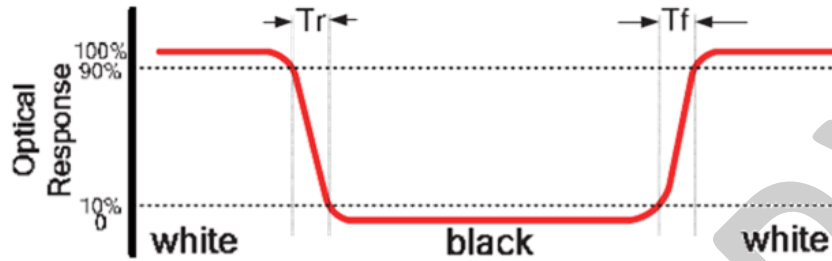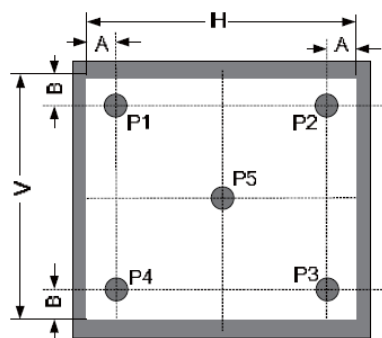
Figure 2. The definition of response time

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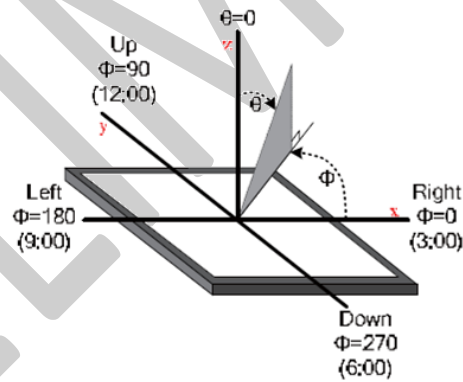

A: 5mm

B: 5mm

H, V: Active Area

Light spot size Ø=5mm, 500mm distance from the LCD surface to detector lens.

Measurement instrument is TOPCON'S luminance meter BM-5

Figure 4.The definition of viewing angle

8 INTERFACES DESCRIPTION

8.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module; TYP 3.3 V	
2	GND	Ground	
3	SPI_SCLK	SPI SCK signal	
4	MISO/ IO.1	SPI MISO signal / SPI Quad mode: SPI data line 1	
5	MOSI/ IO.0	SPI MOSI signal / SPI Quad mode: SPI data line 0	
6	CS	SPI chip select signal	
7	INT	Interrupt signal from device to the system, Active Low, Internally 47k Pull UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally Pulled UP 47k	
9	GPIO.0	GPIO.0	
10	DISP_AUDIO	Display audio in/out	Note 1
11	GPIO.1/IO.2	SPI Single/Dual mode: General purpose IO0. QSPI mode: SPI data line 2	
12	GPIO.2/IO.3	SPI Single/Dual mode: General purpose IO1. QSPI mode: SPI data line 3	
13	NC	Not connected	
14	NC	Not connected	
15	NC	Not connected	
16	NC	Not connected	
17	BLVDD	Supply voltage for backlight	
18	BLVDD	Supply voltage for backlight	
19	BLGND	Backlight Ground, Internally connected to GND	
20	BLGND	Backlight Ground, Internally connected to GND	

Note 1. Requirements for audio external signal voltage will be announced after samples have been tested.

8.2 P2 connector description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil "+" terminal	Note 1
2	SPEAKER -	Speaker coil "-" terminal	

The audio circuit allows for the following 3 things:

1. To play sounds from BT817Q on internal amplifier U3.

2. To play sounds from host on internal amplifier U3.

3. To play sounds from BT817Q on external amplifier.

Note 1. The loudspeaker assembly (loudspeaker + cables + plug compatible with P2 connector) will be sold separately. The documentation of the loudspeaker assembly will be released soon.

Figure 5.The simplified audio circuit design
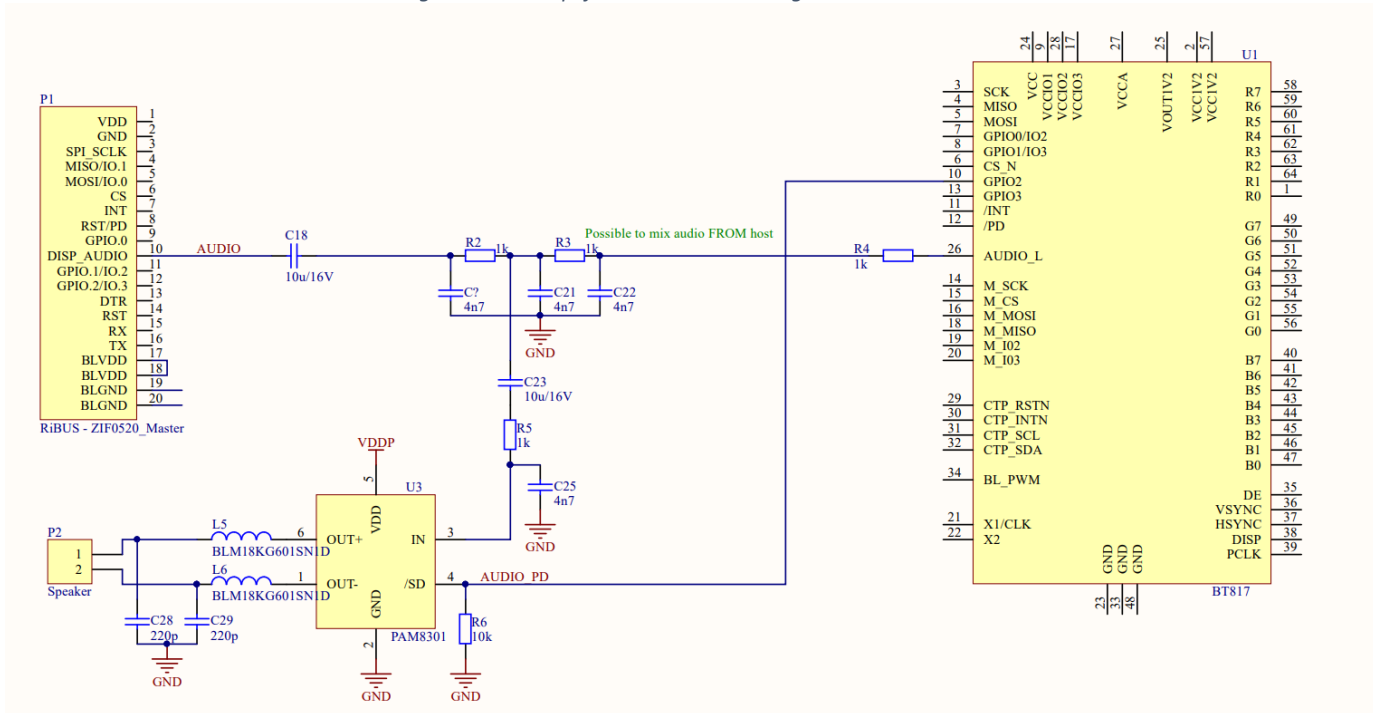
Note 2. Controller board in RVT101HVBNWC00 is equipped with the separate 512Mb flash memory chip, which allows to store up to 110 full resolution (1280 * 800 pixels, JPG) images. If you need to change the memory size, please contact us: contact@riverdi.com

9 BT817Q CONTROLLER SPECIFICATION

BT817Q or EVE4 (Embedded Video Engine 4) 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 6.SPI single/dual interface connection
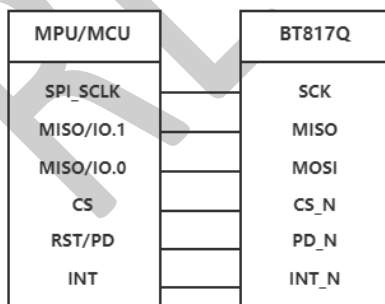
Figure 7. QSPI interface connection
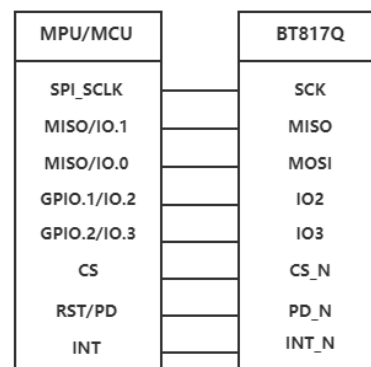
SPI Interface – the SPI slave interface operates up to 30MHz (It depends on EVE4 system clock frequency and needs verification in Riverdi lab).

Only SPI mode 0 is supported. The SPI interface is selected by default.

QSPI Interface – the QSPI slave interface operates up to 30MHz (It depends on EVE 4 system clock frequency and will be verified in Riverdi lab). Only SPI mode 0 is supported.

The QSPI can be configured as a SPI slave in SINGLE, DUAL or QUAD channel 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 8. BT817Q Block diagram
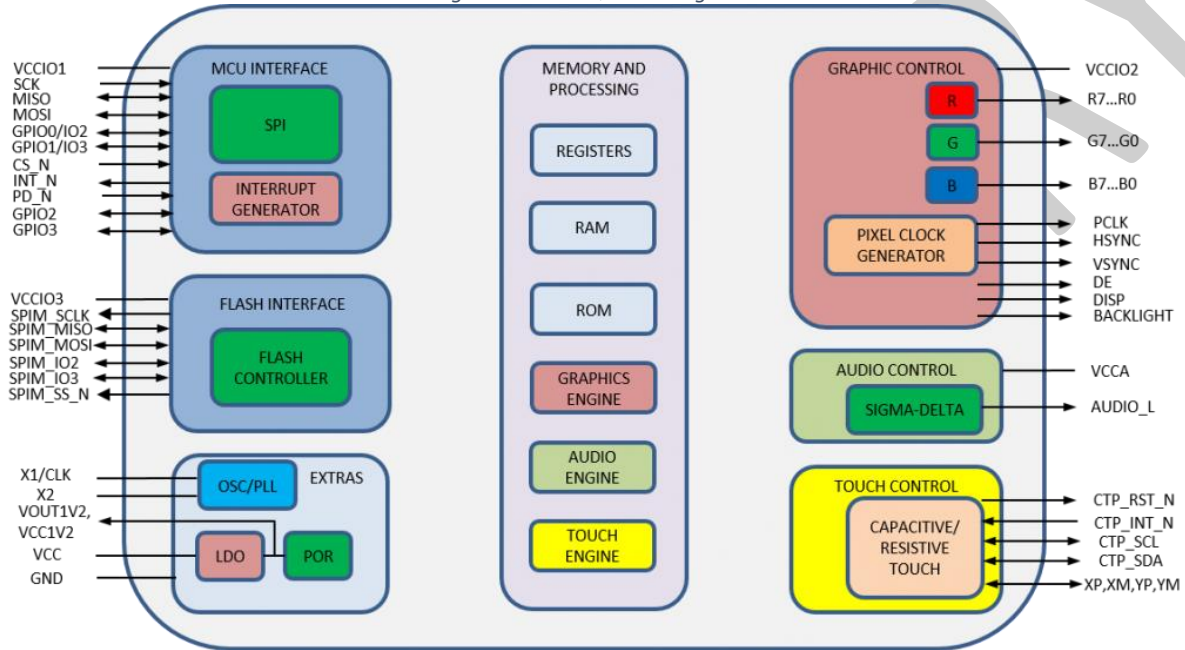
9.3   Host interface SPI mode 0

Figure 9. SPI timing diagram
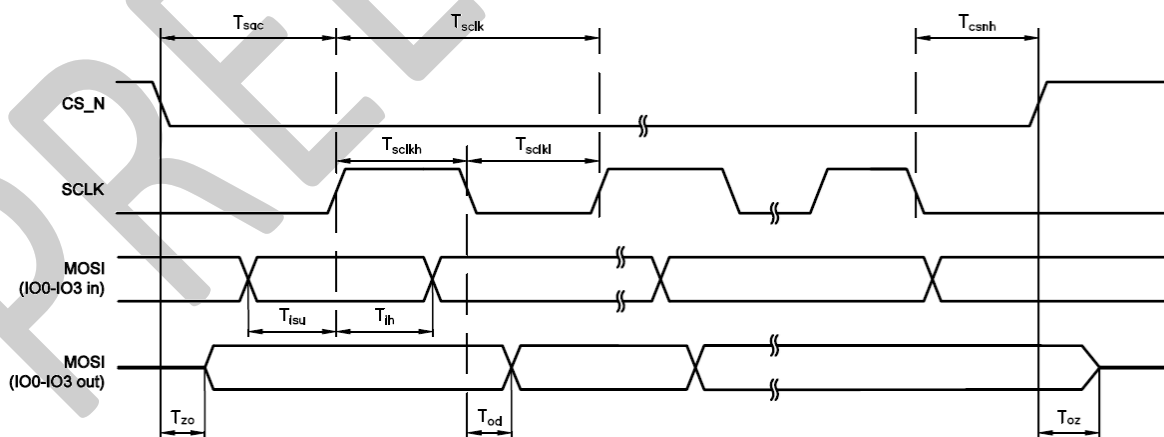
The meanings of the timings in the Figure 9 are defined in the table below.

PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T_{sclk}	SPI clock period	33.3		33.3		33.3		ns
T_{sclkl}	SPI clock low duration	13		13		13		ns
T_{sclkh}	SPI clock high duration	13		13		13		ns
T_{sac}	SPI access time	4		3.5		3		ns
T_{isu}	Input Setup	4		3.5		3		ns
T_{ih}	Input Hold	0		0		0		ns
T_{zo}	Output enable delay		16		13	11		ns
T_{oz}	Output disable delay		13		11	10		ns
T_{od}	Output data delay		15		12	11		ns
T_{csnh}	CSN hold time	0		0		0		ns

For more information about BT817Q controller please go to official BT81x website. https://brtchip.com/bt81x/

9.4   Backlight driver block diagram

Backlight enable signal is internally connected to BT817Q backlight control pin. This pin is controlled by two BT817Q's registers. One of them specifies the PWM output frequency, second one specifies the duty cycle. Refer to BT817Q datasheet for more information. After we have done the test on samples, more detailed description will be given in this document.

*Figure 10. Backlight driver block diagram*
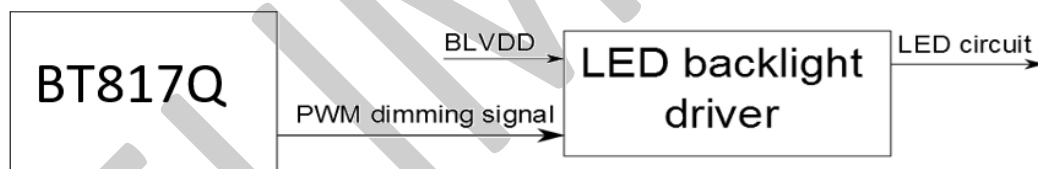
The LED backlight driver used in this module does not burst the LED current. Therefore, it does not generate audible noises on the output capacitor. It is equipped with soft start subsystem, which increases LED life time, as LED current peaks are reduced significantly.
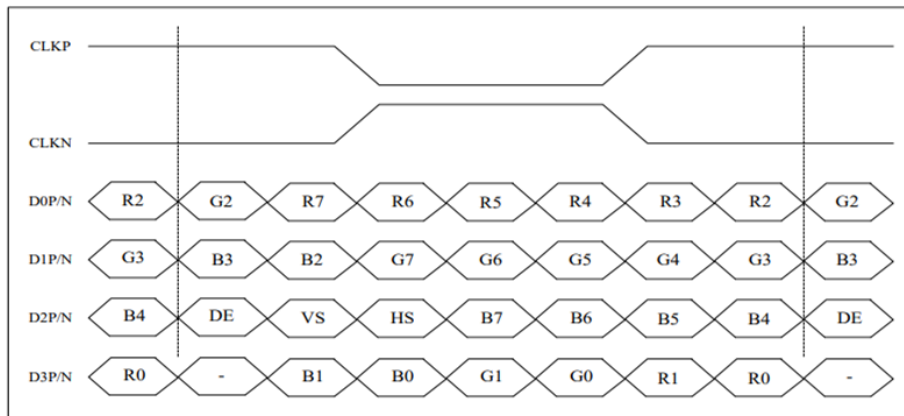
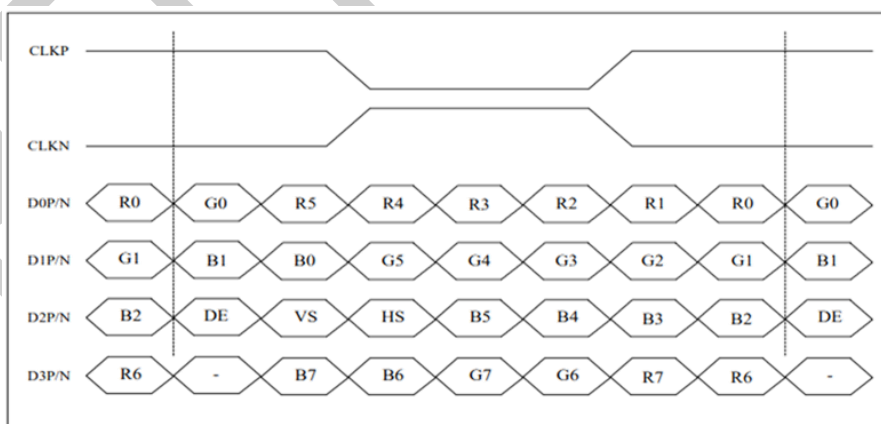# 10 TIMING CHARACTERISTICS

10.1 LVDS interface characteristic

6-bit LVDS input (LVBIT=L, LVFMT=H OR L)
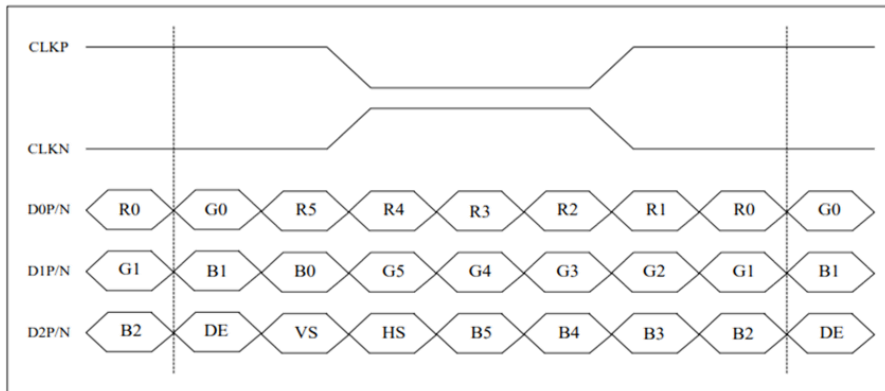
8-bit LVDS input (LVBIT=L, LVFMT=L)

8-bit LVDS input (LVBIT=L, LVFMT=H)

10.2 Timing table

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Clock Frequency (Rate=60Hz(LVDS))	F_{DCLK}	66.3	72.4	78.9	MHz
HSYNC Period Time	T_H	1380	1440	1500	DCLK
Horizontal Display area	T_{HD}		1280		DCLK
Hsync Pluse Width	T_{HPW}	1	-	40	Tc
Hsync Back Porch (with pluse width)	T_{HBP}	88	88	88	DCLK
Hsync Front Porch	T_{HFP}	12	72	132	DCLK
VSYNC Period Time	T_V	824	838	872	H
Vertical Display area	T_{VD}		800		H
Vsync Pluse Width	T_{VW}	1	-	20	H
Vsync Back Porch (with pluse width)	T_{VBP}	23	23	23	H
Vsync Front Porch	T_{VFP}	1	15	49	H

11 CAPACITIVE TOUCH SCREEN PANEL SPECIFICATIONS

11.1 Mechanical characteristics

DESCRIPTION	SPECIFICATION	REMARK
Touch Panel Size	10.1 inch	UxTouch
Outline Dimension of CTP	257.96 mm x 168.60 mm	UxTouch
Product Thickness	2.35 mm	UxTouch
Glass Thickness	1.1 mm	UxTouch
CTP View Area	217.96 mm x 136.60 mm	UxTouch
Sensor Active Area	228.46mm x 148.10 mm	UxTouch
Surface Hardness	7H	UxTouch

11.2 Electrical characteristics

DESCRIPTION		SPECIFICATION	REMARK
Power Consumption (IDD)	Active Mode	90 mA	Note 1
	Sleep Mode	10 mA	Note 1
Linearity		+/- 1.5mm	
Controller		ILI2132A	
Resolution		1280 x 800	

Note 1. These 2 values will be verified on the real samples.

12 INITIALIZATION CODE

This paragraph will be published in next versions of this datasheet.

13 INSPECTION

Standard acceptance/rejection criteria for TFT module.

13.1 Inspection condition

Ambient conditions:
- Temperature: 25 ± 2°C
- Humidity: (60 ± 10)% RH
- Illumination: Single fluorescent lamp non-directive (300 to 700 lux)

Viewing distance:

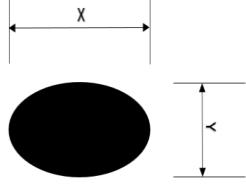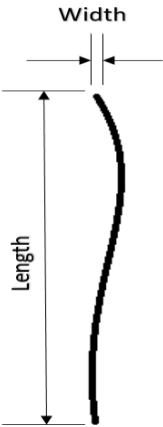35 ± 5cm between inspector bare eye and LCD.

Viewing Angle:

U/D: 45°/45°, L/R: 45°/45°
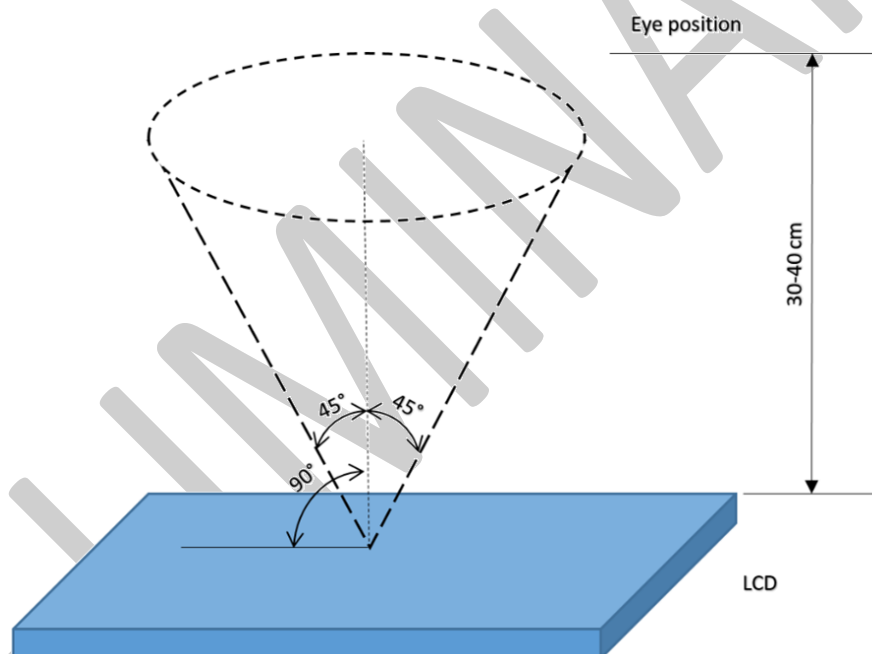
13.2   Inspection standard

The LCD TFT has zero bad pixels. Please refer the item "Bright/Dark dots ".

Item	Criterion
Black spots, white spots, light leakage, Foreign Particle (round Type)	$$D = \frac{(x+y)}{2}$$ *Spots density: 10 mm <table><tr><td colspan="2">Size = 10.1"</td></tr><tr><td>Average Diameter</td><td>Qualified Qty</td></tr><tr><td>D ≤ 0.2 mm</td><td>Ignored</td></tr><tr><td>0.2 mm < D ≤ 0.3 mm</td><td>N ≤ 4</td></tr><tr><td>0.5mm < D</td><td>N = 0</td></tr></table>
LCD black spots, white spots, light leakage (line Type)	*Spots density: 10 mm <table><tr><td colspan="3">Size = 10.1"</td></tr><tr><td>Length</td><td>Width</td><td>Qualified Qty</td></tr><tr><td>-</td><td>W ≤ 0.05</td><td>Ignored</td></tr><tr><td>L ≤ 5.0</td><td>0.05 < W ≤ 0.1</td><td>N ≤ 3</td></tr><tr><td>5.0 < L</td><td>0.10 < W or 5.0 < L</td><td>N = 0</td></tr></table>
Bright/Dark Dots	<table><tr><td colspan="2">Size = 10.1"</td></tr><tr><td>Item</td><td>Qualified Qty</td></tr><tr><td>Bright Dots</td><td>0</td></tr><tr><td>Dark Dots</td><td>0</td></tr><tr><td>Cluster Bright Dots or Dark Dots</td><td>0</td></tr><tr><td>Total Bright and Dark Dots</td><td>0</td></tr></table>

Item	Criterion

Clear spots		

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

Touch panel spot	

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 < 0.03	Ignored
L < 5.0	0.03 < W < 0.05	2
-	0.05 < W	0

14 RELIABILITY TEST

NO.	TEST ITEM	TEST CONDITION	REMARK
1	High Temperature Storage	80 °C/120hours	Note 1
2	Low Temperature Storage	-30 °C/120hours	Note 1
3	High Temperature Operating	70 °C /120hours	Note 1
4	Low Temperature Operating	-20 °C/120hours	Note 1
5	High Temperature && High Humidity	40 °C, 90 % RH/120 Hrs	Note 1
6	Thermal Cycling Test (No operation)	-20 ℃ for 30min, 70℃ for 30 min. 100 cycles. Then test at room temperature after 1 hour	Note 2
7	Vibration Test (No operation)	Frequency: 10 ÷ 55 Hz; Stroke: 1.5 mm; Sweep: 10 Hz ÷ 55 Hz ÷ 10 Hz; 2 hours for each direction of X, Y, Z (6 hours for total)	
8	Package Drop Test	Height: 60 cm, 1 corner, 3 edges, 6 surfaces	
10	ESD Test	Air: ±2 kV, human body mode, 100 pF/1500 Ω	

Note 1. Sample quantity for each test item is 5 ÷ 10 pcs.

Note 2. Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

15 LEGAL INFORMATION

Riverdi grants the guarantee for the proper operation of the goods for a period of 12 months from the date of possession of the goods. If in a consequence of this guarantee execution the customer has received the defects-free item as replacement for the defective item, the effectiveness period of this guarantee shall start anew from the moment the customer receives the defects-free item.

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