LCD TFT Module Specification

Riverdi
Display Solution Experts

RVT70HSBNWC00

EVE4 IPS 7.0” LCD TFT Datasheet

Rev.0.1

2020-12-29

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally Black/IPS	/
Size	7.0	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	179.96 x 119.00 x 14.47	mm
Active Area (W × H)	154.21 × 85.92	mm
Pixel Pitch (W × H)	0.1506 × 0.1432	mm
Resolution	1024 (RGB) × 600	/
Brightness	800	cd/m^2
Color Depth	16.7 M	/
Pixel Arrangement	RGB Vertical Stripe	/
Driver IC of Board	BT817Q	/
Rectangular pixel correction	Yes	/
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	ILI2132A	/
Supply Voltage for Module	3.3	V
Supply Voltage for Backlight	5.0 (TYP.)	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	70	H	S	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**	**70 – 7.0”**
4.	**MODEL SERIAL NO.**	**H – High Brightness, IPS**
5.	**RESOLUTION**	**S – 1024 x 600 px**
6.	**INTERFACE**	**B – SPI/QSPI**
7.	**FRAME**	**N – No Frame**
8.	**BACKLIGHT TYPE**	**W – LED White**
9.	**TOUCH PANEL**	**C – With Capacitive Touch Panel**
10.	**VERSION**	**00 – (00-99)**

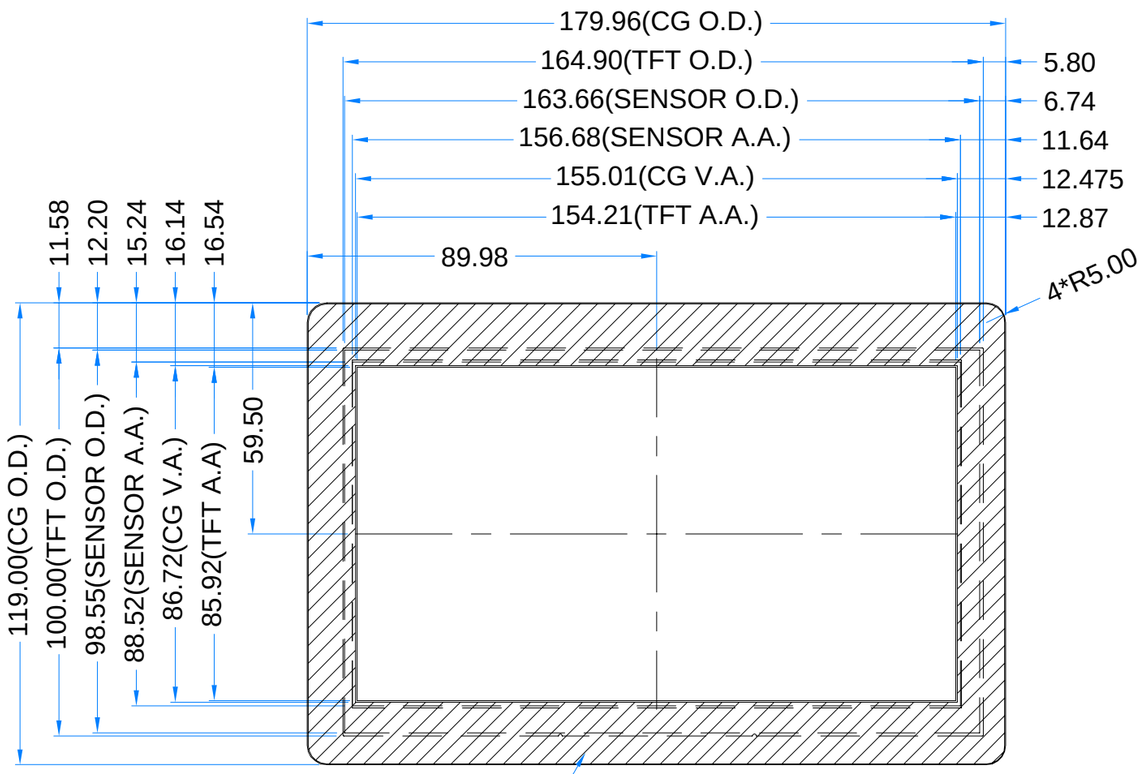
2 UxTOUCH ASSEMBLY

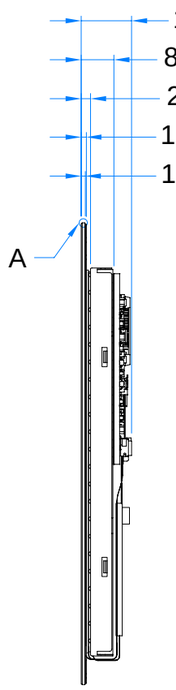
UxTouch are LCD TFT displays with specially designed projected capacitive touch panels. UxTouch display can be mounted without any additional holes in the housing. Our standard UxTouch displays include double-sided adhesive tape (DST) to stick TFT easily to the housing.

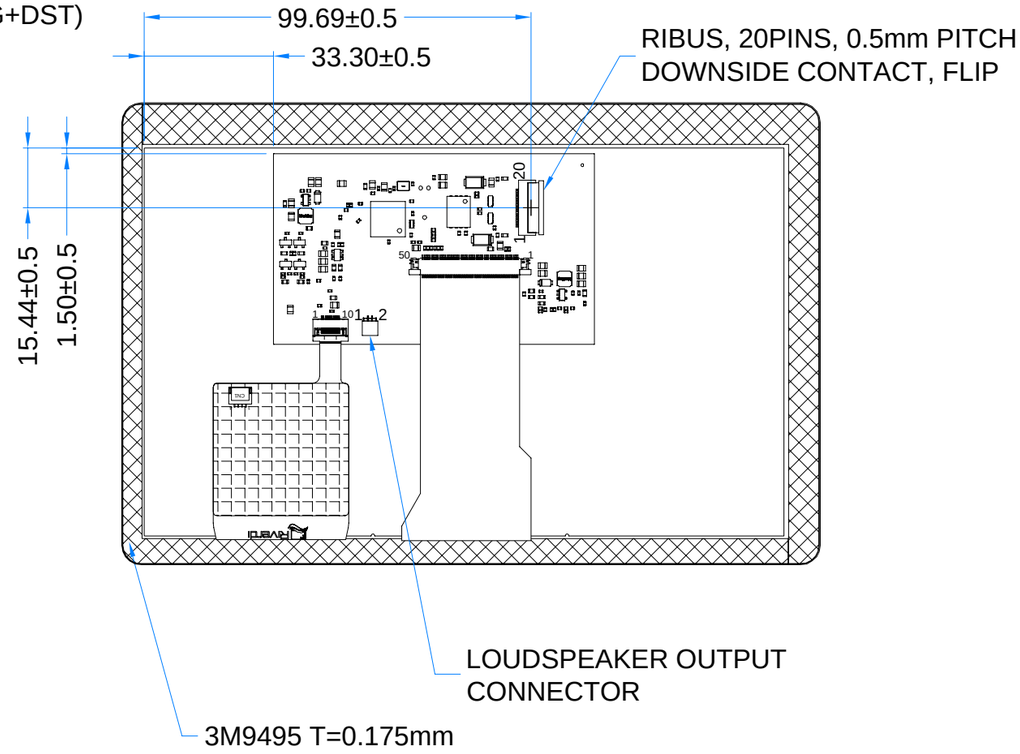
UxTouch models with double-side adhesive tape can be mounted by fastening the glass to the housing. Riverdi recommends to use support brackets assembled to display's back. An additional support will stiffen the whole structure and minimize the influence of external factors such as vibration. Figure 1 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 RVT70HSBNWC00-B, which is superior in optical performance and does not require any extra support.

Figure 1. Example of using the support brackets

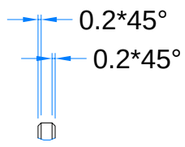
Revision:	Changes:	Date:
1.0	Initial Case	2020.12.09

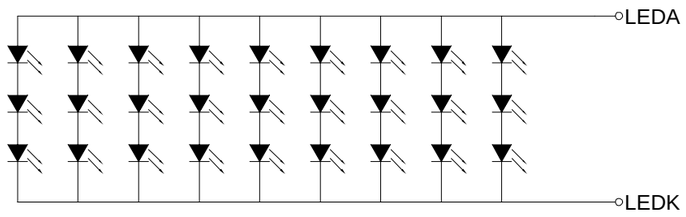






DETAIL A
SCALE 4:1





LED Diagram Circuit

LCD NOTES:
1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS
2. RESOLUTION: 1024x600
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: 3.3V
8. SUPPLY VOLTAGE FOR BACKLIGHT: 5.0V(TYP.), BUILT-IN LED INVERTER

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

GENERAL NOTES:
1. OPERATING TEMPERATURE: -20°C ~ 70°C
2. STORAGE TEMPERATURE: -30°C ~ 80°C
3. WITHOUT INDIVIDUAL TOLERANCE:
   DIM ACCORDING DIRECTLY TO TFT: ±0.2mm
   DIM ACCORDING DIRECTLY TO TP: ±0.3mm
4. RoHS3 COMPLIANT

PN: RVT70HSBNWC00

SN:

Riverdi

DRAWN: M.Natywa	2020.11.30	1:1.58	
CHECKED: Carol Gao	2020.12.09	[mm]	
APPR:		ISO A3	P. 1 of 1

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	Note 1, 2
Supply voltage for Backlight	BLVDD	-0.3	6	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	90	% RH	
Operating Ambient Humidity (@ 25 ± 5°C)	H_{OP}	10	90	% 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}	TBD	248	TBD	mA
Input Voltage “H” Level	V_{IH}	2.0	3.3	5.5	V
Input Voltage “L” Level	V_{IL}	-	-	0.8	V

6 BACKLIGHT ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Backlight	BLVDD	TBD	5.0	6.0	V	
Current drawn from BLVDD @5.0V	$I_{BLVDD=5.0V}$	TBD	702	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	$I_{BLVDD=5.0\,V}$	TBD	287	TBD	mA	50% of backlight, Note 1
Life Time	-	-	50,000	-	hours	Note 2

Note 1. Backlight intensity is driven by BT817Q controller by PWM wave from GPIO pin. Please refer to subchapter 9.4.

Note 2. 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

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25 °C. The values specified are at an approximate distance 500mm from the LCD surface at a viewing angle of Φ and θ equal to 0°.

ITEM		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time		Tr+Tf	θ=0° Ø=0° Ta=25 °C	-	35	-	ms	FIG 2.	4
Contrast Ratio		Cr		-	800	-	---	FIG 3.	1
Luminance Uniformity		δ WHITE		-	75	-	%	FIG 3.	3
Surface Luminance		Lv		-	800		cd/m^2	FIG 3.	2
Viewing Angle Range		θ	Ø = 90°	-	85	-	deg	FIG 4.	6
			Ø = 270°	-	85	-	deg	FIG 4.	
			Ø = 0°	-	85	-	deg	FIG 4.	
			Ø = 180°	-	85	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	θ=0° Ø=0° Ta=25 °C	0.578	0.618	0.658	FIG 3.		5
		y		0.489	0.329	0.369			
	Green	x		0.376	0.416	0.456			
		y		0.493	0.533	0.573			
	Blue	x		0.071	0.111	0.151			
		y		0.108	0.148	0.188			
	White	x		0.270	0.310	0.350			
		y		0.290	0.330	0.370			

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 = 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 Figure2. 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 calculate the 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

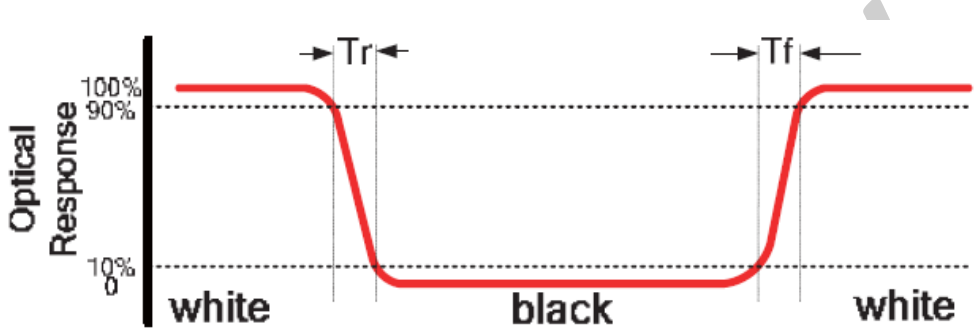
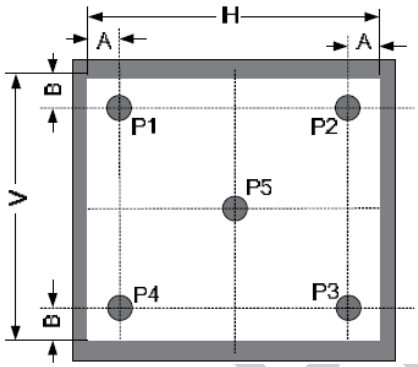


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

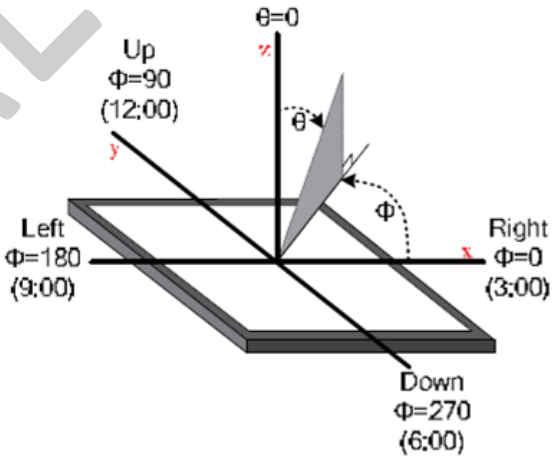
B: 5mm

H,V: Active Area

Light spot size ϕ=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 description – RiBUS

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 47k Pull UP	
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 – loudspeaker output

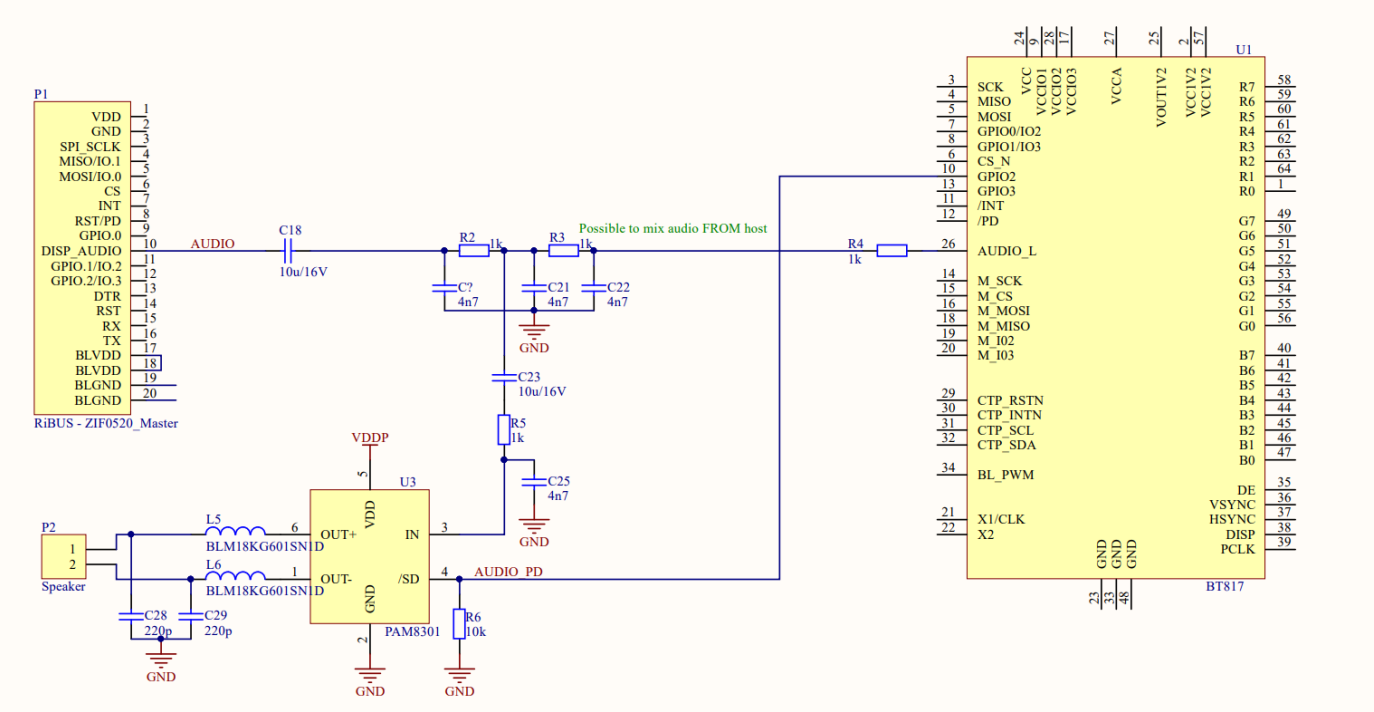
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil "+" terminal	Note 1
2	SPEAKER -	Speaker coil "-" terminal	

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 RVT70HSBNWC00 is equipped with the separate 512Mb flash memory chip, which allows to store up to 170 full resolution (1024 * 600 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

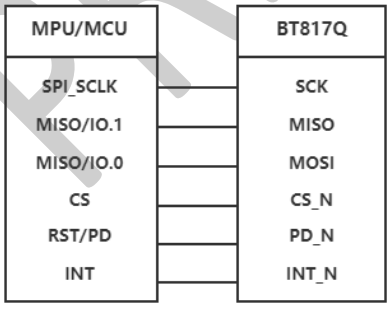
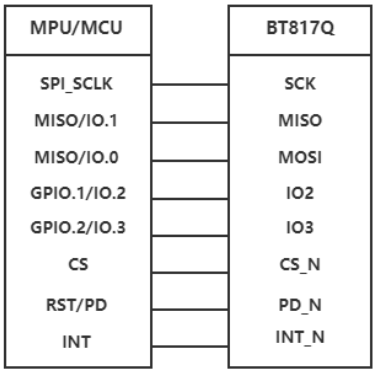


Figure 7. QSPI interface connection



SPI Interface – the SPI slave interface operates up to 30MHz (It depends on EVE4 system clock frequency and needs verification in Riverdi lab).

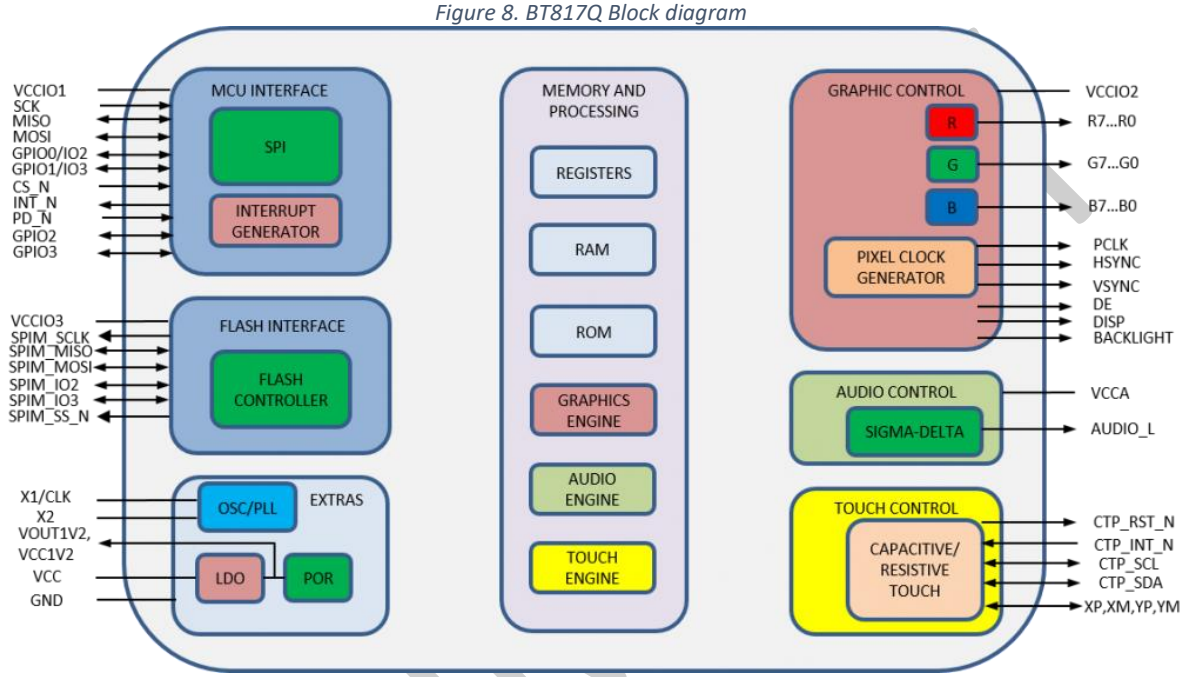
Only SPI mode 0 is supported. The SPI interface is selected by default.

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.

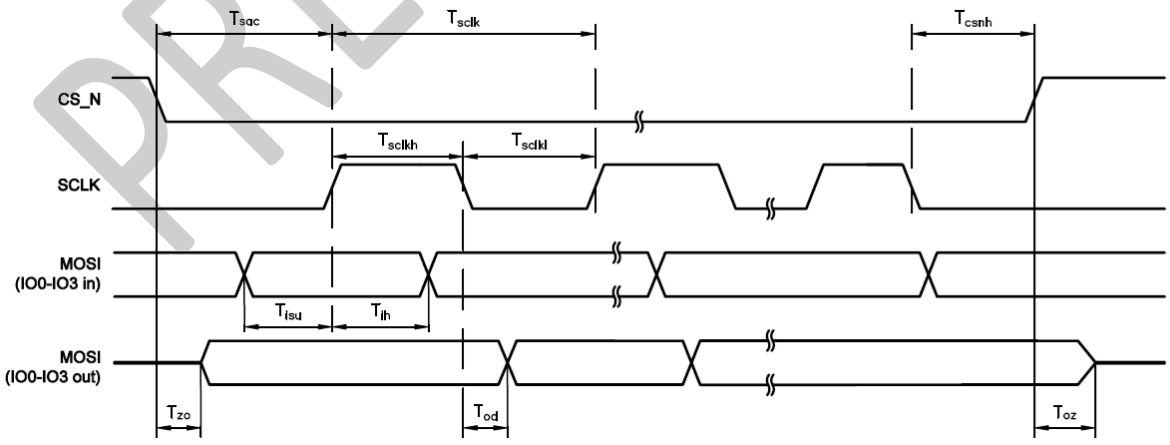
9.2 Block Diagram

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.

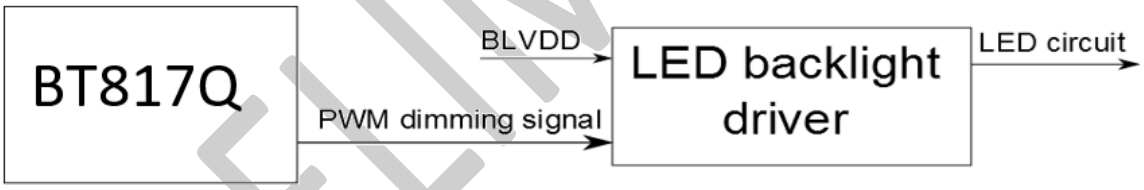
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T_{sclk}	SPI clock period	33.3		33.3		33.3		ns
T_{sclkl}	SPI clock low duration	13		13		13		ns
T_{sclkh}	SPI clock high duration	13		13		13		ns
T_{sac}	SPI access time	4		3.5		3		ns
T_{isu}	Input Setup	4		3.5		3		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.

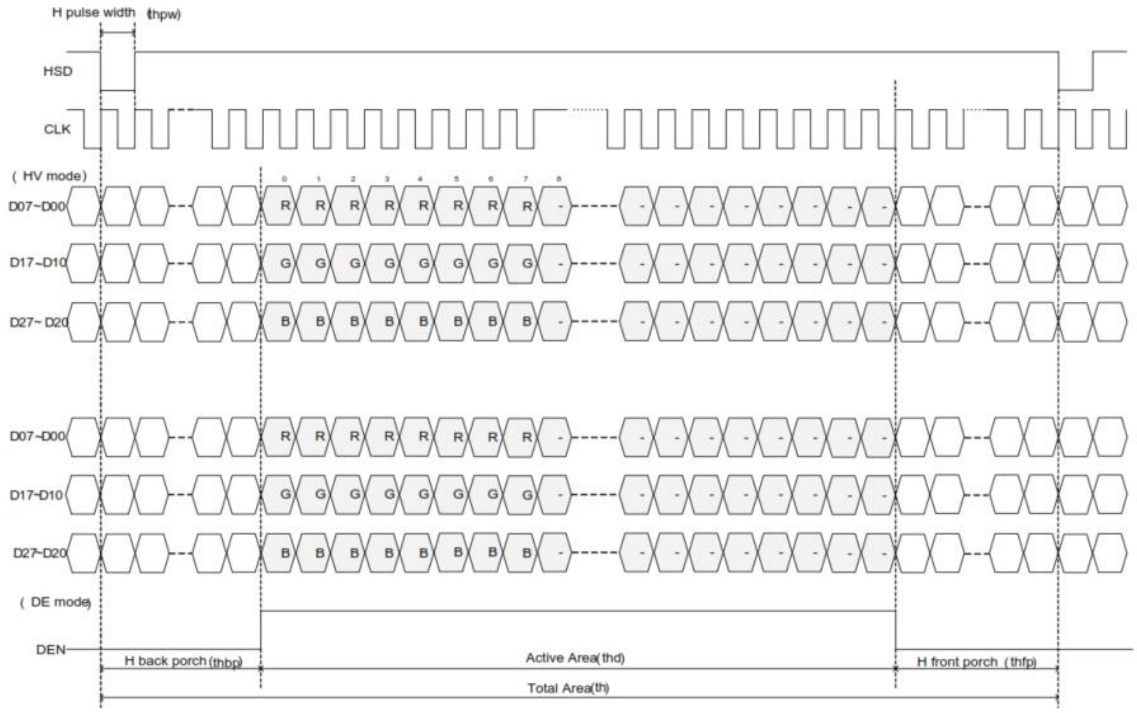
Figure 10. Backlight driver block diagram



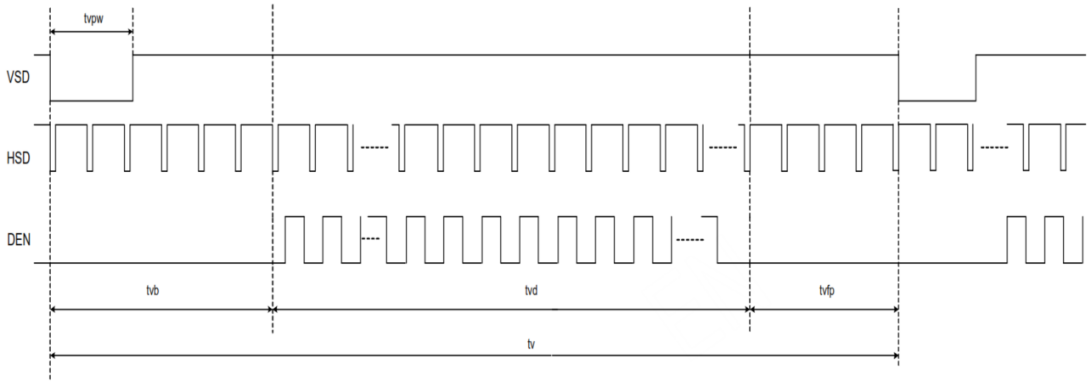
The LED backlight driver used in this module does not burst the LED current. Therefore, it does not generate audible noises on the output capacitor. It is equipped with soft start subsystem, which increases LED life time, as LED current peaks are reduced significantly.

10 TFT LCD TIMING CHARACTERISTIC

10.1 Horizontal input timing



10.2 Vertical input timing



10.3 Parallel RGB timing characteristic

Note: DE/SYNC mode select. Pin is internally pulled high. H: DE Mode. L: HS/VS mode. When select DE mode, MODE = "1", VS and HS must be pulled high.

10.3.1 DE MODE

PARAMETER	SYMBOL	VALUE			UNIT
		MIN.	TYP.	MAX.	
DCLK frequency (Frame rate 60Hz)	f_{clk}	40.8	51.2	67.2	MHz
Horizontal display area	t_{hd}		1024		DCLK
HSYNC period time	t_h	1114	1344	1400	DCLK
HSYNC blanking	$t_{hb}+t_{hfp}$	90	320	376	DCLK
Vertical display area	t_{vd}		600		H
VSYNC period time	t_v	610	635	800	H
VSYNC blanking	$t_{vb}+t_{vfp}$	10	85	200	H

10.3.2 HV MODE – Horizontal input timing

PARAMETER	SYMBOL	VALUE			UNIT
		MIN.	TYP.	MAX.	
Horizontal display area	t_{hd}		1024		DCLK
DCLK frequency (frame rate 60Hz)	f_{clk}	44.9	51.2	63	MHz
1 Horizontal Line	t_h	1200	1344	1400	DCLK
HSYNC pulse width	t_{hpw}	1	-	140	DCLK
HSYNC back porch	t_{hbp}	160	160	160	DCLK
HSYNC front porch	t_{hfp}	16	160	216	DCLK

10.3.3 HV MODE – Vertical input timing

PARAMETER	SYMBOL	VALUE			UNIT
		MIN.	TYP.	MAX.	
Vertical display area	t_{vd}		600		H
VSYNC period time	t_v	624	635	750	H
VSYNC pulse width	t_{vpw}	1	-	20	H
VSYNC back porch	t_{vb}	23	23	23	H
VSYNC front porch	t_{vfp}	1	12	127	H

11 CAPACITIVE TOUCH SCREEN PANEL SPECIFICATIONS

11.1 Mechanical characteristics

DESCRIPTION	SPECIFICATION	REMARK
Touch Panel Size	7.0 inch	UxTouch
Outline Dimension of CTP	179.96 mm x 119.00 mm	UxTouch
Product Thickness	2.45 mm	UxTouch
Glass Thickness	1.1 mm	UxTouch
CTP View Area	155.01 mm x 86.72 mm	UxTouch
Sensor Active Area	156.68 mm x 88.52 mm	UxTouch
Structure type	Glass + Glass	UxTouch
Surface Hardness	7H	UxTouch

11.2 Electrical characteristics

DESCRIPTION		SPECIFICATION	NOTE
Power Consumption (IDD)	Active Mode	90 mA	Note 1
	Sleep Mode	10 mA	Note 1
Linearity		+/-1.5 mm	
Controller		ILI2132A	
Resolution		1024 x 600	

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:

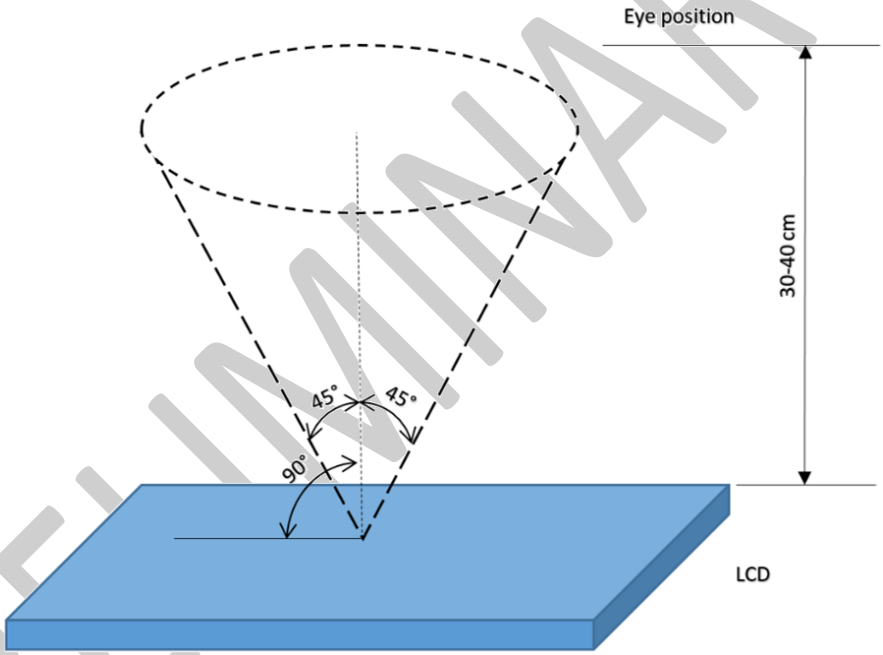
- Temperature: 25±2 °C
- Humidity: (60±10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

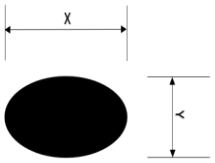
35±5 cm between inspector bare eye and LCD.

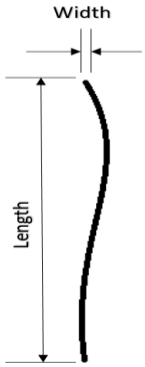
Viewing Angle:

U/D: 45°/45°, L/R: 45°/45°



13.2 Inspection standard

<table>
<tr><th>Item</th><th>Criterion</th></tr>
<tr><td>Black spots, white spots, light leakage, Foreign Particle (round Type)</td><td>


$$D = \frac{(x+y)}{2}$$
*Spots density: 10 mm
<table>
<tr><th colspan="2">Size = 7”</th></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 ≤ 3</td></tr>
<tr><td>0.5mm < D</td><td>Not allowed</td></tr>
</table>
</td></tr>
<tr><td>LCD black spots, white spots, light leakage (line Type)</td><td>


*Spots density: 10 mm
<table>
<tr><th colspan="3">Size = 7”</th></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>3</td></tr>
<tr><td>5.0 < L</td><td>0.10 < W</td><td>Not allowed</td></tr>
</table>
</td></tr>
<tr><td>Bright/Dark Dots</td><td>
<table>
<tr><th colspan="2">Size = 7”</th></tr>
<tr><td>Item</td><td>Qualified Qty</td></tr>
<tr><td>Bright Dots</td><td>N ≤ 2</td></tr>
<tr><td>Dark Dots</td><td>N ≤ 3</td></tr>
<tr><td>Total Bright and Dark Dots</td><td>N ≤ 4</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Item</th><th>Criterion</th></tr>
<tr><td>Clear spots</td><td>
<table>
<tr><th colspan="2">Size >= 5”</th></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>4</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>
</table>
*Spots density: 10 mm
</td></tr>
<tr><td>Polarizer bubbles</td><td>
<table>
<tr><th colspan="2">Size = 7.0”</th></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 ≤ 0.5 mm</td><td>2</td></tr>
<tr><td>0.5 mm < D</td><td>1</td></tr>
</table>
</td></tr>
<tr><td>Touch panel spots</td><td>
<table>
<tr><th colspan="2">Size >= 5”</th></tr>
<tr><td>Average Diameter</td><td>Qualified Qty</td></tr>
<tr><td>D < 0.25 mm</td><td>Ignored</td></tr>
<tr><td>0.25 mm < D < 0.5 mm</td><td>4</td></tr>
<tr><td>0.5 mm < D</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>Touch panel White line Scratch</td><td>
<table>
<tr><th colspan="3">Size >= 5”</th></tr>
<tr><td>Length</td><td>Width</td><td>Qualified Qty</td></tr>
<tr><td>-</td><td>W < 0.03</td><td>Ignored</td></tr>
<tr><td>L < 5.0</td><td>0.03 < W < 0.05</td><td>2</td></tr>
<tr><td>-</td><td>0.05 < W</td><td>0</td></tr>
</table>
</td></tr>
</table>

14 RELIABILITY TEST

NO.	TEST ITEM	TEST CONDITION	REMARK
1	High Temperature Storage	80 °C / 120 hours	Note 1
2	Low Temperature Storage	-30 °C / 120 hours	Note 1
3	High Temperature Operating	70 °C / 120 hours	Note 1
4	Low Temperature Operating	-20 °C / 120 hours	Note 1
5	High Temperature && High Humidity	Humidity 40 ℃, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 ℃ for 30 min, 70 ℃ for 30 min. 100 cycles. Then test at room temperature after 1 hour	Note 2
7	Damp Proof Test	40 °C, 90 %RH/120 hours	
8	Vibration Test	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)	
9	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 running the cosmetic and function tests, the product must have enough recovery time, at least 2 hours at room temperature.

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