LCD TFT Module Specification

Riverdi
Display Solution Experts

RVT70HSBNWN00

EVE4 IPS 7.0” LCD TFT Datasheet

Rev.0.1

2020-01-18

PRELIMINARY

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally Black/IPS	/
Size	7.0	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	164.90 x 100.00 x 10.56	mm
Active Area (W × H)	154.21 × 85.92	mm
Pixel Pitch (W × H)	0.1506 × 0.1432	mm
Resolution	1024 (RGB) × 600	/
Brightness	1000	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	Without Touch Panel	/
Supply Voltage for Module	3.3	V
Supply Voltage for Backlight	5.0 (TYP.)	V
Weight	TBD	g

Note 1: RoHS compliant

Note 2: LCM weight tolerance: ± 5%.

REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
0.1	2020-01-18	Preliminary	

CONTENTS

REVISION RECORD 2
CONTENTS 2
1 MODULE CLASSIFICATION INFORMATION 3
2 MODULE DRAWING 4
3 ABSOLUTE MAXIMUM RATINGS 5
4 ELECTRICAL CHARACTERISTICS 5
5 BACKLIGHT ELECTRICAL CHARACTERISTICS 5
6 ELECTRO-OPTICAL CHARACTERISTICS 6
7 INTERFACES DESCRIPTION 8
7.1 P1 connector description – RiBUS 8
7.2 P2 connector description – loudspeaker output 8
8 BT817Q CONTROLLER SPECIFICATION 9
8.1 Serial host interface 9
8.2 Block Diagram 10
8.3 Host interface SPI mode 0 10
8.4 Backlight driver block diagram 11
9 TFT LCD TIMING CHARACTERISTIC 12
9.1 Horizontal input timing 12
9.2 Vertical input timing 12
9.3 Parallel RGB timing characteristic 13
9.3.1 DE MODE 13
9.3.2 HV MODE – Horizontal input timing 13
9.3.3 HV MODE – Vertical input timing 13
10 INITIALIZATION CODE 14
11 INSPECTION 15
11.1 Inspection condition 15
11.2 Inspection standard 16
12 RELIABILITY TEST 18
13 LEGAL INFORMATION 19

PRELIMINARY

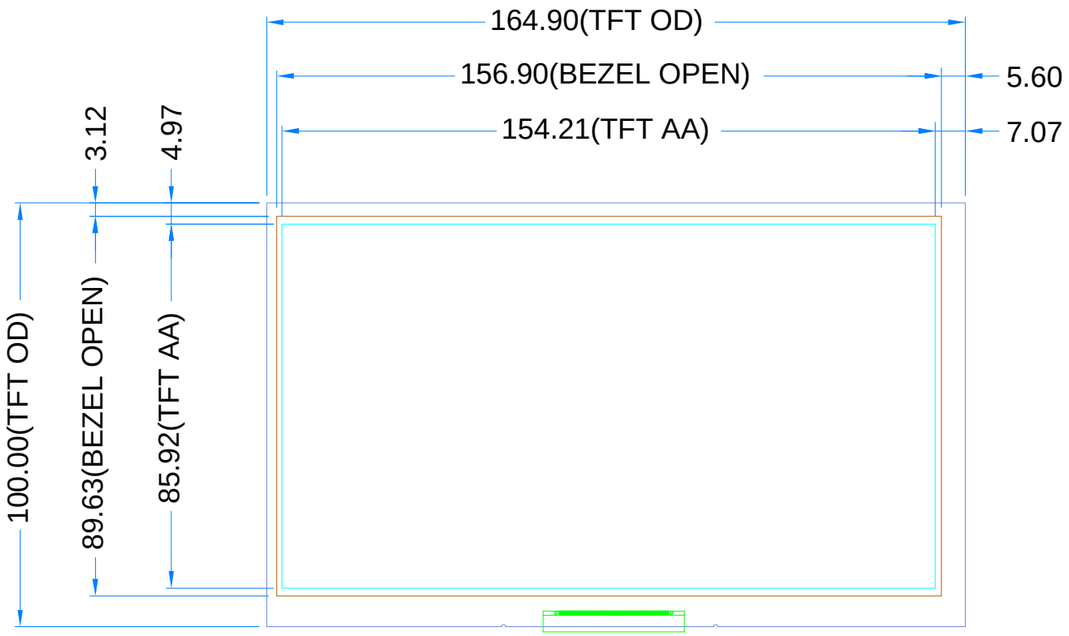
1 MODULE CLASSIFICATION INFORMATION

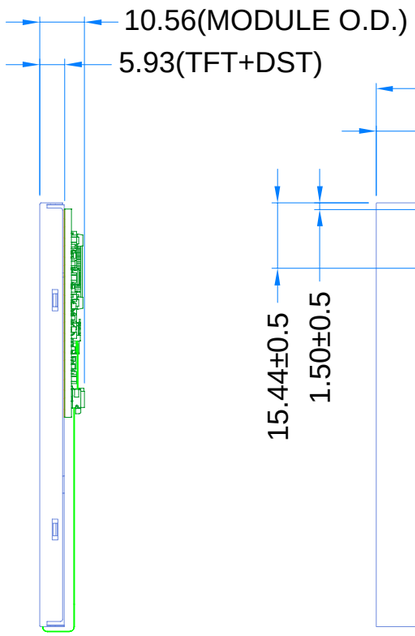
RV	T	70	H	S	B	N	W	N	00
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.

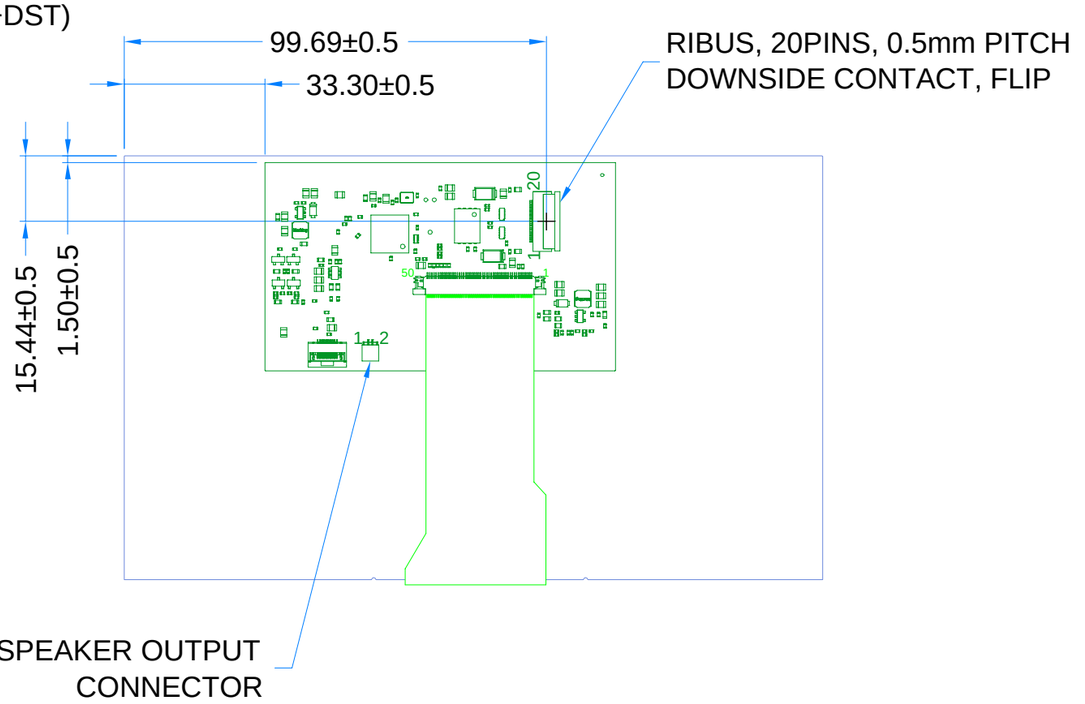
1.	**BRAND**	**RV – Riverdi**
2.	**PRODUCT TYPE**	**T – TFT Standard**
3.	**DISPLAY SIZE**	**70 – 7.0”**
4.	**MODEL SERIAL NO.**	**H – High Brightness, IPS**
5.	**RESOLUTION**	**S – 1024 x 600 px**
6.	**INTERFACE**	**B – SPI/QSPI**
7.	**FRAME**	**N – No Frame**
8.	**BACKLIGHT TYPE**	**W – LED White**
9.	**TOUCH PANEL**	**N – Without Touch Panel**
10.	**VERSION**	**00 – (00-99)**

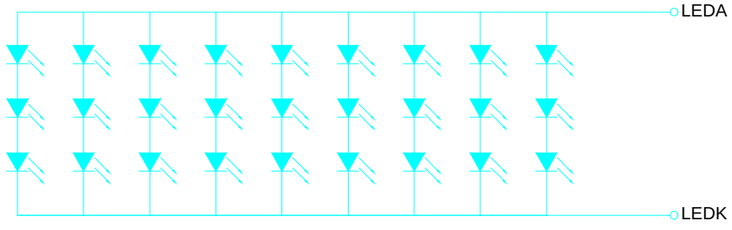
PRELIMINARY

Revision:	Changes:	Date:
1.0	Initial Case	2020.12.09









LED Diagram Circuit

LCD NOTES:
1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS
2. RESOLUTION: 1024x600
3. VIEWING ANGLE: FREE
4. SURFACE LUMINANCE: 1000cd/m^2
5. DRIVER IC ON 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

GENERAL NOTES:
1. OPERATING TEMPERATURE: -20°C ~ 70°C
2. STORAGE TEMPERATURE: -30°C ~ 80°C
3. WITHOUT INDIVIDUAL TOLERANCE: ±0.2mm
4. RoHS3 COMPLIANT

PN: RVT70HSBNWN00

SN:

Riverdi

DRAWN:	M.Natywa	2020.12.01	1:1.45
CHECKED:	Carol Gao	2020.12.09	[mm]
APPR:			ISO A3

3 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).

4 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	235	TBD	mA
Input Voltage “H” Level	V_{IH}	2.0	3.3	5.5	V
Input Voltage “L” Level	V_{IL}	-	-	0.8	V

5 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	365	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	$I_{BLVDD=5.0\,V}$	TBD	175	TBD	mA	50% of backlight, Note 1
Current drawn from BLVDD @3.3V	$I_{BLVDD=3.3V}$	TBD	1090	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@3.3V	$I_{BLVDD=3.3V}$	TBD	425	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 8.4.

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.

PRELIMINARY

6 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		-	1000		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.

PRELIMINARY

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

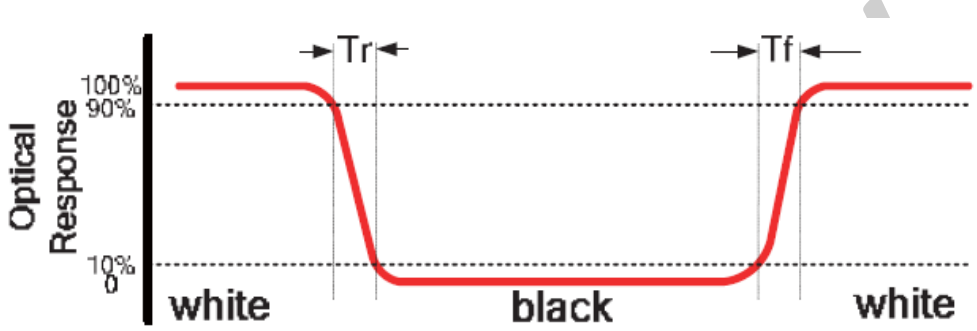
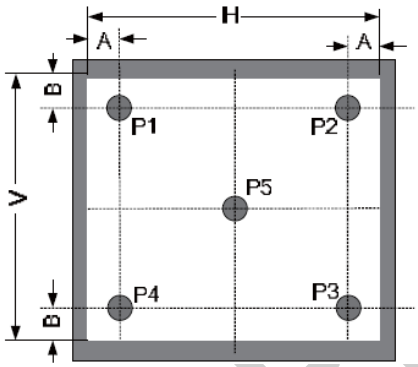


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

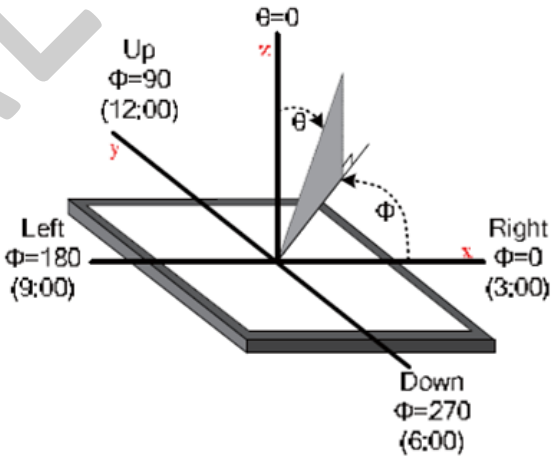
B: 5mm

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



PRELIMINARY

7 INTERFACES DESCRIPTION

7.1 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.

7.2 P2 connector description – loudspeaker output

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

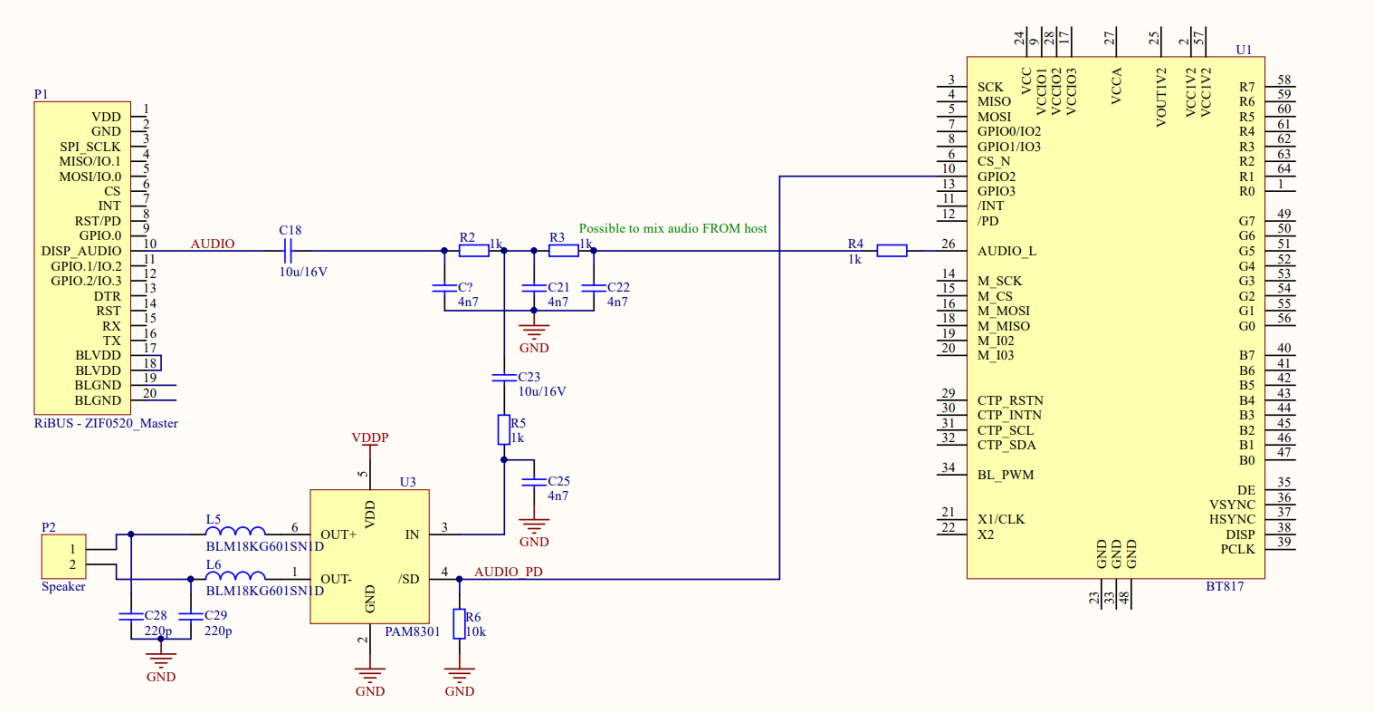
The audio circuit allows for the following 3 things:

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.

PRELIMINARY

Figure 5.The simplified audio circuit design



Note 2. Controller board in RVT70HSBNWN00 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

8 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.

8.1 Serial host interface

Figure 6.SPI single/dual interface connection

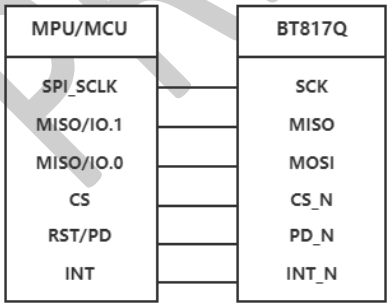
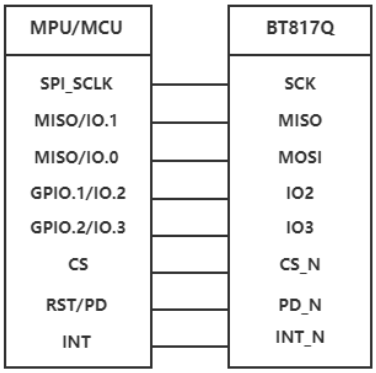


Figure 7. QSPI interface connection



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.

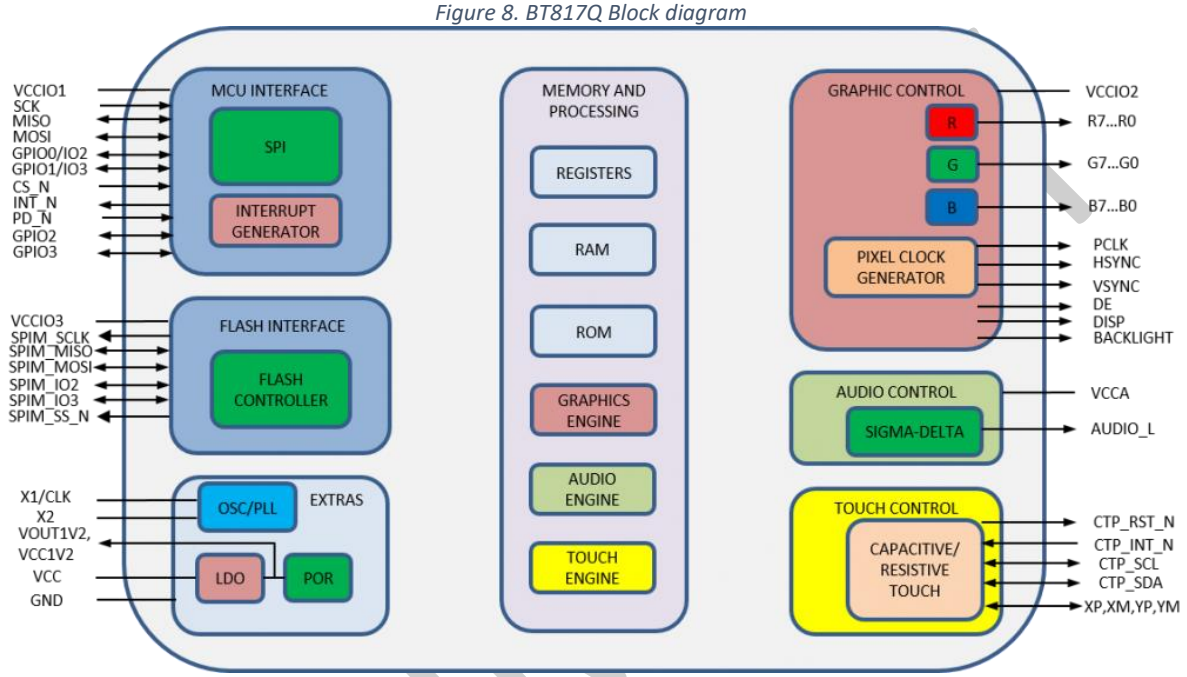
PRELIMINARY

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.

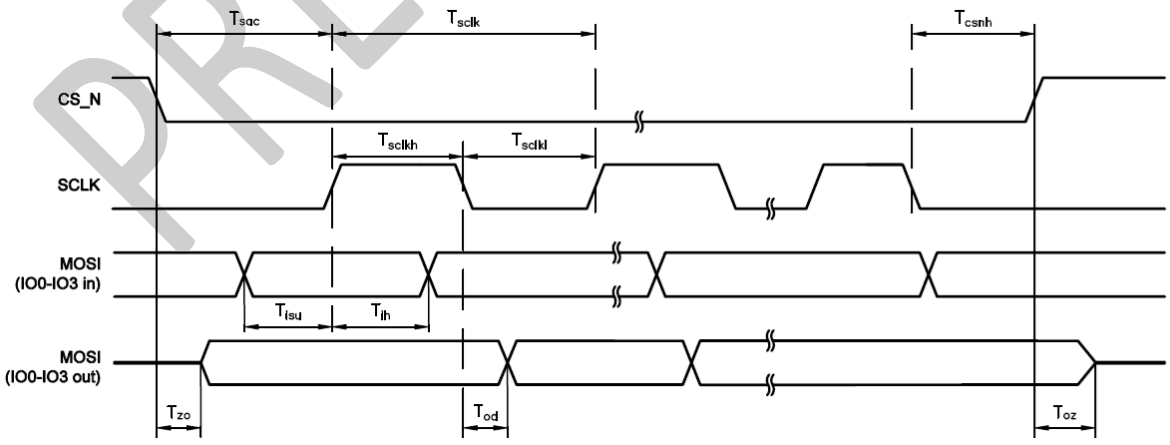
8.2 Block Diagram

Figure 8. BT817Q Block diagram



8.3 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.

PRELIMINARY

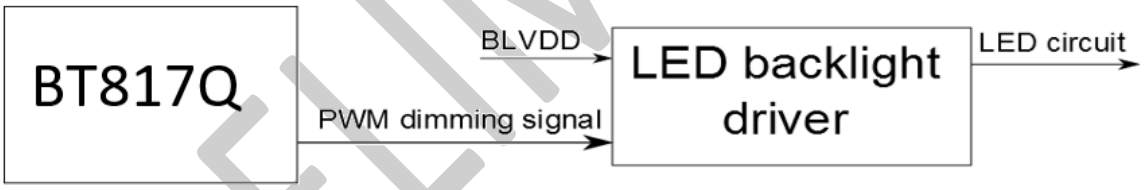
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T_{sclk}	SPI clock period	33.3		33.3		33.3		ns
T_{sclkl}	SPI clock low duration	13		13		13		ns
T_{sclkh}	SPI clock high duration	13		13		13		ns
T_{sac}	SPI access time	4		3.5		3		ns
T_{isu}	Input Setup	4		3.5		3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

8.4 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

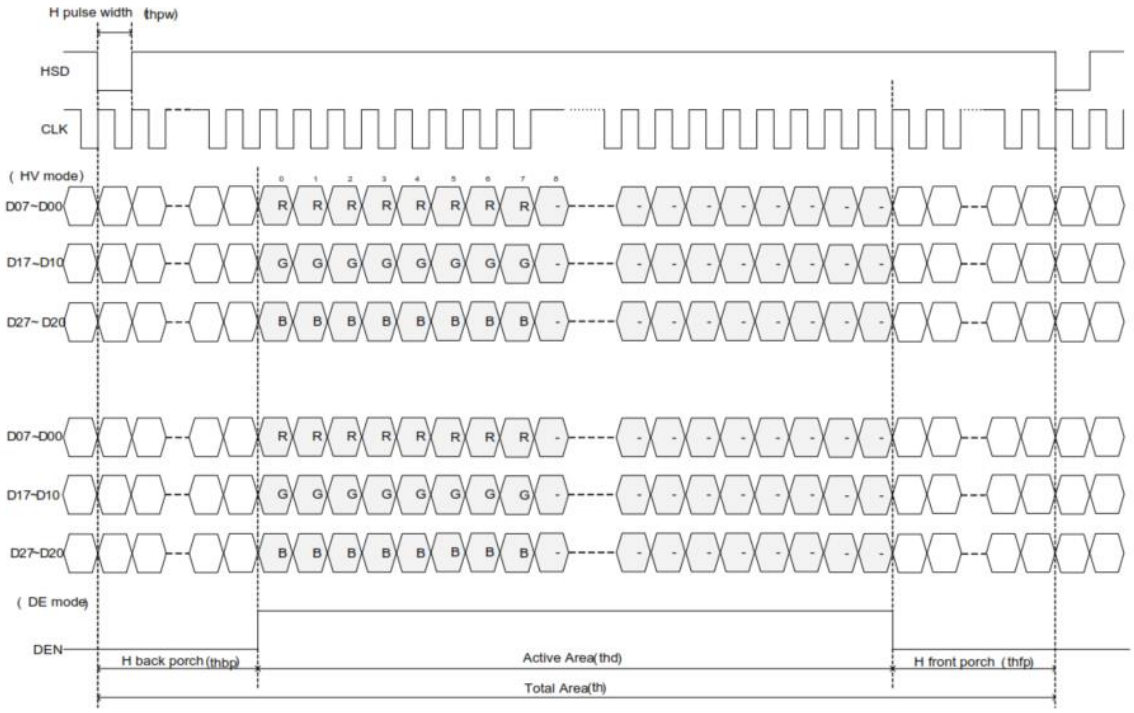


The LED backlight driver used in this module does not burst the LED current. Therefore, it does not generate audible noises on the output capacitor. It is equipped with soft start subsystem, which increases LED life time, as LED current peaks are reduced significantly.

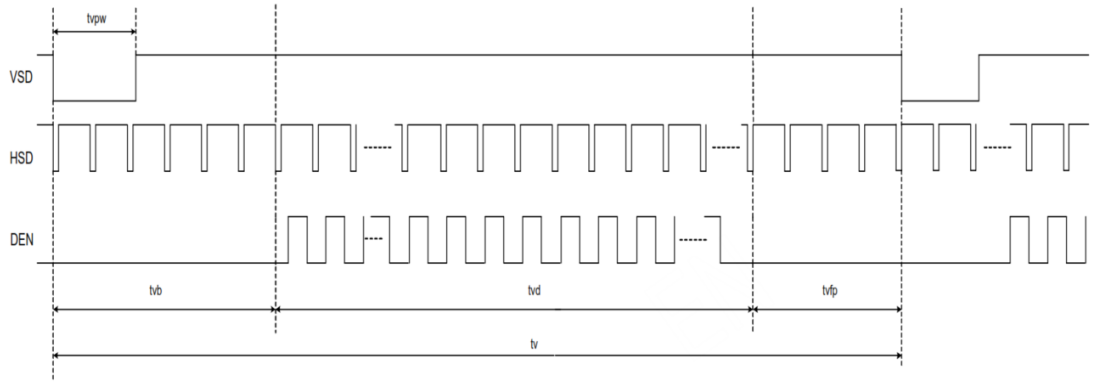
PRELIMINARY

9 TFT LCD TIMING CHARACTERISTIC

9.1 Horizontal input timing



9.2 Vertical input timing



9.3 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.

9.3.1 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

9.3.2 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

9.3.3 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

PRELIMINARY

10 INITIALIZATION CODE

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

PRELIMINARY

11 INSPECTION

Standard acceptance/rejection criteria for TFT module.

11.1 Inspection condition

Ambient conditions:

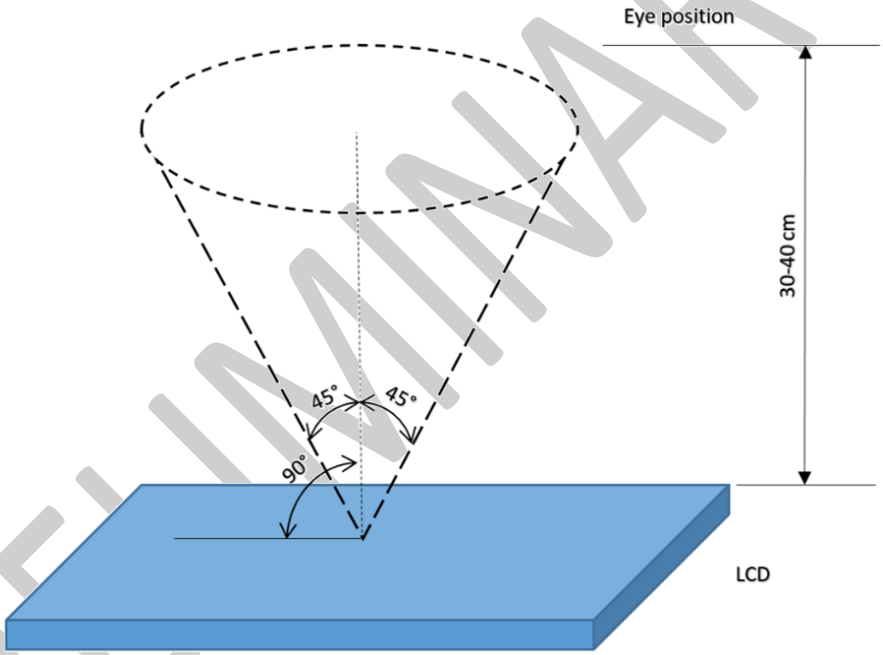
- Temperature: 25±2 °C
- Humidity: (60±10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

35±5 cm between inspector bare eye and LCD.

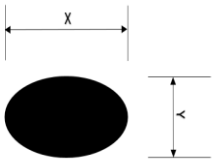
Viewing Angle:

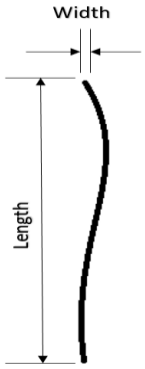
U/D: 45°/45°, L/R: 45°/45°



PRELIMINARY

11.2 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>

PRELIMINARY

<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>
</table>

PRELIMINARY

12 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.

PRELIMINARY

13 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.

Information about device is the property of Riverdi and may be the subject of patents pending or granted. It is not allowed to copy or disclose this document to the third parties without prior written Riverdi permission.

Riverdi endeavors to ensure that the all contained information in this document is correct but does not accept liability for any error or omission. Riverdi products are in development process and published information may be not up to date. Riverdi reserves the right to update and makes changes to Specifications or written material without prior notice at any time. It is important to check the current position with Riverdi.

Images and graphics used in this document are only for illustrative the purpose. All images and graphics are possible to be displayed on the range products of Riverdi, however the quality may vary. Riverdi is not liable to the buyer or to any third party for any indirect, incidental, special, consequential, punitive or exemplary damages (including without limitation: lost profits, lost savings, or loss of business opportunities) relating to any product, service provided or to be provided by Riverdi, or the use or inability to use the same, even if Riverdi has been advised of the possibility of such damages.

Riverdi products are not fault tolerant nor designed, manufactured or intended for use or resale as on line control equipment in hazardous environments requiring fail–safe performance, such as in the operation of nuclear facilities, aircraft navigation or communication systems, air traffic control, direct life support machines or weapons systems in which the failure of the product could lead directly to death, personal injury or severe physical or environmental damage (‘High-Risk Activities’). Riverdi and its suppliers specifically disclaim any expressed or implied warranty of fitness for High-Risk Activities. Using Riverdi products and devices in 'High-Risk Activities' and in any other application is entirely at the buyer’s risk, and the buyer agrees to defend, indemnify and hold harmless Riverdi from any and all damages, claims or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Riverdi intellectual property rights.

PRELIMINARY

Riverdi
Display Solution Experts