



## RVT101HVBFWN00

### EVE4 IPS 10.1" LCD TFT Datasheet

Rev.1.0

2021-04-15

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	10.1	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D )	229.46 x 149.10 x 10.82	mm
Active Area (W × H)	216.96 × 135.60	mm
Pixel Pitch (W × H)	0.1695 × 0.1695	mm
Resolution	1280 × 800	/
Brightness	1000	cd/m <sup>2</sup>
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	Without Touch Panel	/
Supply Voltage for Module	3.3	V
Supply Voltage for Backlight	5.0 ÷ 12.0	V
Weight	560	g

**Note 1:** RoHS3 compliant

**Note 2:** LCM weight tolerance: ± 5%.

## REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
1.0	2021-04-15	Initial release	

## CONTENTS

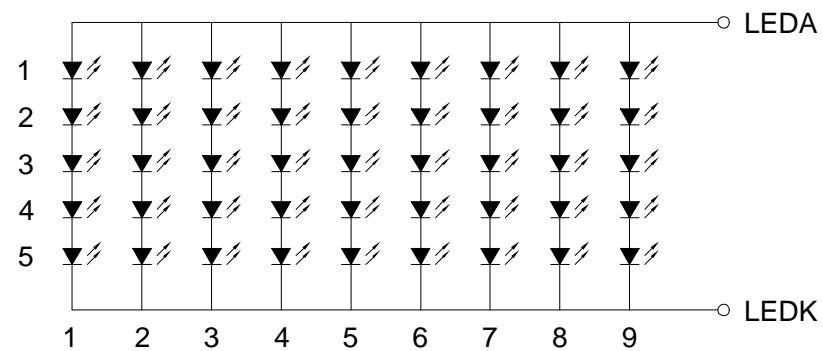
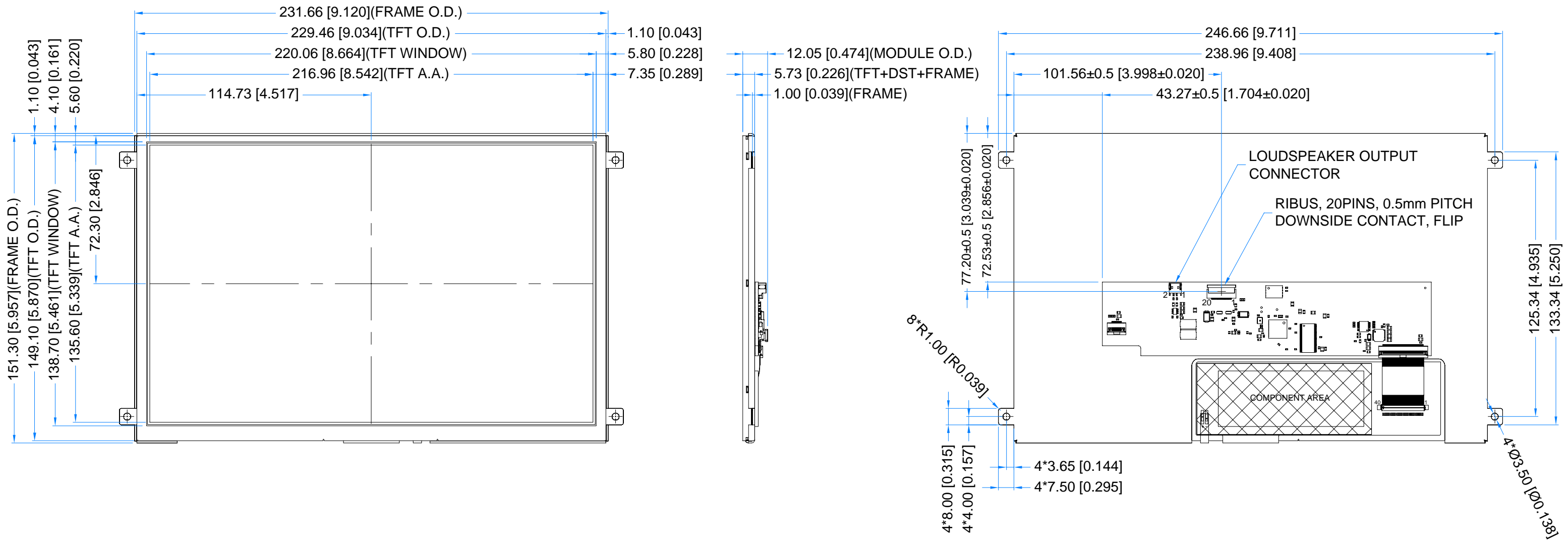
REVISION RECORD .....	2
CONTENTS .....	2
1 MODULE CLASSIFICATION INFORMATION .....	3
2 MODULE DRAWING.....	4
3 ABSOLUTE MAXIMUM RATINGS.....	5
4 ELECTRICAL CHARACTERISTICS.....	5
5 BACKLIGHT ELECTRICAL CHARACTERISTICS.....	5
6 ELECTRO-OPTICAL CHARACTERISTICS .....	6
7 INTERFACES DESCRIPTION.....	8
7.1 P1 connector- RIBUS description.....	8
7.2 P2 connector description .....	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 TIMING CHARACTERISTICS .....	12
9.1 LVDS interface characteristic.....	12
9.2 Timing table.....	13
10 INITIALIZATION CODE .....	13
11 INSPECTION .....	14
11.1 Inspection condition.....	14
11.2 Inspection standard.....	15
12 RELIABILITY TEST.....	16
13 LEGAL INFORMATION .....	17

## 1 MODULE CLASSIFICATION INFORMATION

<b>RV</b>	<b>T</b>	<b>101</b>	<b>H</b>	<b>V</b>	<b>B</b>	<b>F</b>	<b>W</b>	<b>N</b>	<b>00</b>
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.

1.	<b>BRAND</b>	<b>RV – Riverdi</b>
2.	<b>PRODUCT TYPE</b>	<b>T – TFT Standard</b>
3.	<b>DISPLAY SIZE</b>	<b>101 – 10.1”</b>
4.	<b>MODEL SERIAL NO.</b>	<b>H – High Brightness, IPS</b>
5.	<b>RESOLUTION</b>	<b>V– 1280 x 800 px</b>
6.	<b>INTERFACE</b>	<b>B – SPI/QSPI</b>
7.	<b>FRAME</b>	<b>F – With Frame</b>
8.	<b>BACKLIGHT TYPE</b>	<b>W – LED White</b>
9.	<b>TOUCH PANEL</b>	<b>N – Without Touch Panel</b>
10.	<b>VERSION</b>	<b>00 – (00-99)</b>

Revision:	Changes:	Date:
1.0	Initial Case	2021.04.15




LED Diagram Circuit

**LCD NOTES:**

1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS
2. RESOLUTION: 1280x800
3. VIEWING ANGLE: FREE
4. SURFACE LUMINANCE: 1000cd/m<sup>2</sup>
5. DRIVER IC ON 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

**GENERAL NOTES:**

1. ZERO BAD PIXELS FOR TFT
2. OPERATING TEMPERATURE: -20°C ~ 70°C
3. STORAGE TEMPERATURE: -30°C ~ 80°C
4. WITHOUT INDIVIDUAL TOLERANCE: ±0.3mm
5. RoHS3 COMPLIANT

PN: RVT101HVBFWN00		
SN:		
DRAWN: M.Natywa	2021.04.15	1:1.87
CHECKED: Carol Gao	2021.04.15	[mm]
APPR:	ISO A3	P. 1 of 1

### 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	Notes 1, 2
Supply voltage for Backlight	BLVDD	-0.3	14.0	V	Note 1
Operating Temperature	T <sub>OP</sub>	-20	70	°C	
Storage Temperature	T <sub>ST</sub>	-30	80	°C	
Storage Humidity (@ 25 ± 5°C)	H <sub>ST</sub>	10	-	% RH	
Operating Ambient Humidity (@ 25 ± 5°C)	H <sub>OP</sub>	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).

### 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 <sub>VDD</sub>	270	500	TBD	mA	Note 1
Input Voltage "H" Level	V <sub>IH</sub>	2.0	3.3	5.5	V	
Input Voltage "L" Level	V <sub>IL</sub>	-	-	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 Backlight 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.

### 5 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 <sub>BLVDD=5.0 V</sub>	TBD	1370	TBD	mA	
Current drawn from BLVDD@7.0V	I <sub>BLVDD=7.0 V</sub>	TBD	860	TBD	mA	
Current drawn from BLVDD @9.0V	I <sub>BLVDD=9.0 V</sub>	TBD	670	TBD	mA	
Current drawn from BLVDD@12.0V	I <sub>BLVDD=12.0 V</sub>	TBD	470	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.

## 6 ELECTRO-OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	-	25	35	ms	FIG 2.	4
Contrast Ratio	Cr		800	1000	-	---	FIG 3.	1
Luminance Uniformity	$\delta$ WHITE		-	75	-	%	FIG 3.	3
Surface Luminance	Lv		-	1000	-	cd/m <sup>2</sup>	FIG 3.	2
Viewing Angle Range	$\theta$	$\phi = 90^\circ$	75	85	-	deg	FIG 4.	6
		$\phi = 270^\circ$	75	85	-	deg	FIG 4.	
		$\phi = 0^\circ$	75	85	-	deg	FIG 4.	
		$\phi = 180^\circ$	75	85	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	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.

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

**Note 3.** The uniformity in surface luminance  $\delta$  WHITE is determined by measuring luminance at each test position 1 through 5, and then dividing the 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

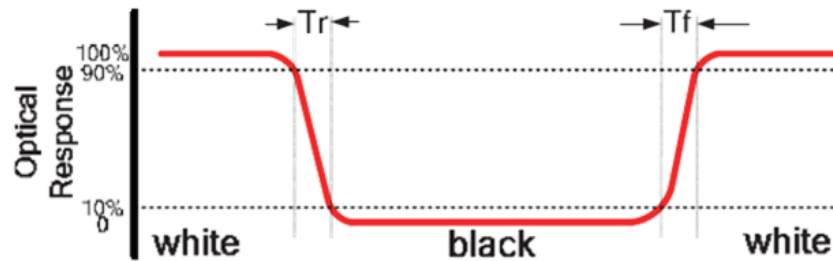


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

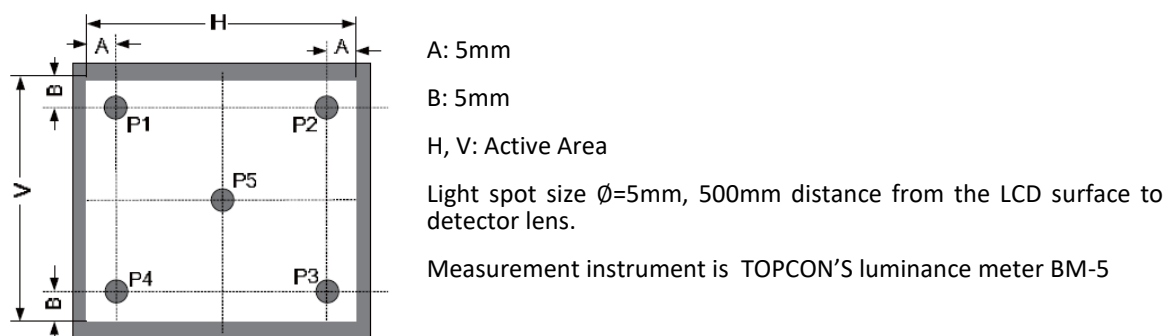
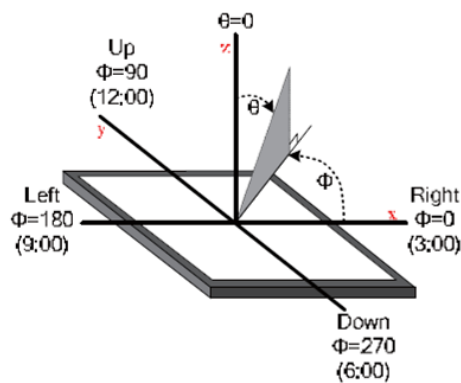


Figure 4. The definition of viewing angle



## 7 INTERFACES DESCRIPTION

### 7.1 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.

### 7.2 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.



## 8 BT817Q CONTROLLER SPECIFICATION

## 8.1 Serial host interface

MPU/MCU		BT817Q
SPI_SCLK		SCK
MISO/IO.1		MISO
MISO/IO.0		MOSI
CS		CS_N
RST/PD		PD_N
INT		INT_N

MPU/MCU		BT817Q
SPI_SCLK		SCK
MISO/IO.1		MISO
MISO/IO.0		MOSI
GPIO.1/IO.2		IO2
GPIO.2/IO.3		IO3
CS		CS_N
RST/PD		PD_N
INT		INT_N

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

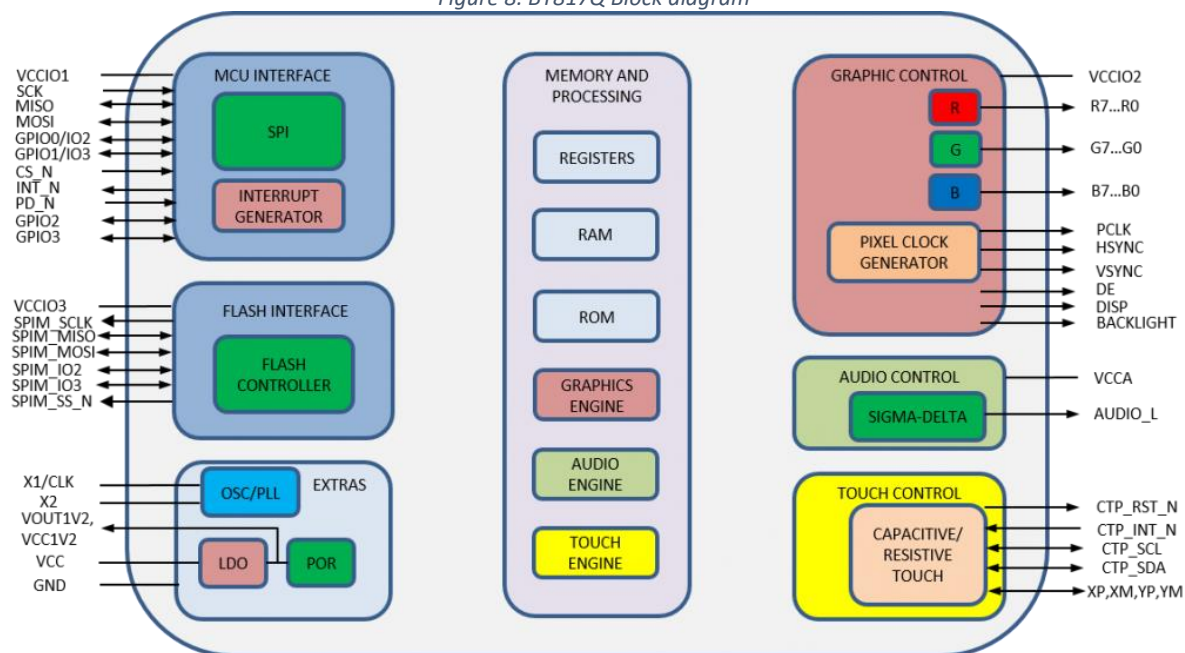
**QSPI Interface** – the QSPI slave interface operates up to 30MHz (It depends on EVE 4 system clock frequency and will be verified in Riverdi lab). Only SPI mode 0 is supported.

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.

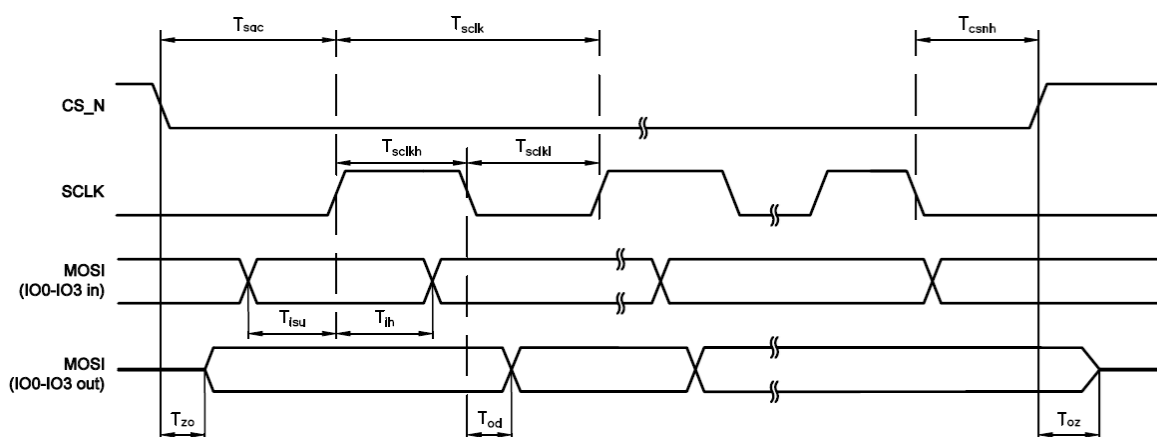
## 8.2 Block Diagram

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.

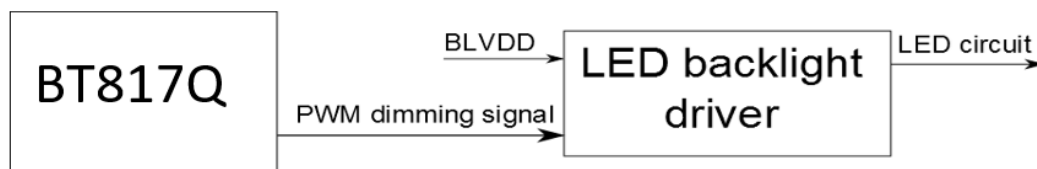
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T <sub>sclk</sub>	SPI clock period	33.3		33.3		33.3		ns
T <sub>sckl</sub>	SPI clock low duration	13		13		13		ns
T <sub>sckh</sub>	SPI clock high duration	13		13		13		ns
T <sub>sac</sub>	SPI access time	4		3.5		3		ns
T <sub>isu</sub>	Input Setup	4		3.5		3		ns
T <sub>ih</sub>	Input Hold	0		0		0		ns
T <sub>zo</sub>	Output enable delay		16		13	11		ns
T <sub>oz</sub>	Output disable delay		13		11	10		ns
T <sub>od</sub>	Output data delay		15		12	11		ns
T <sub>csnh</sub>	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

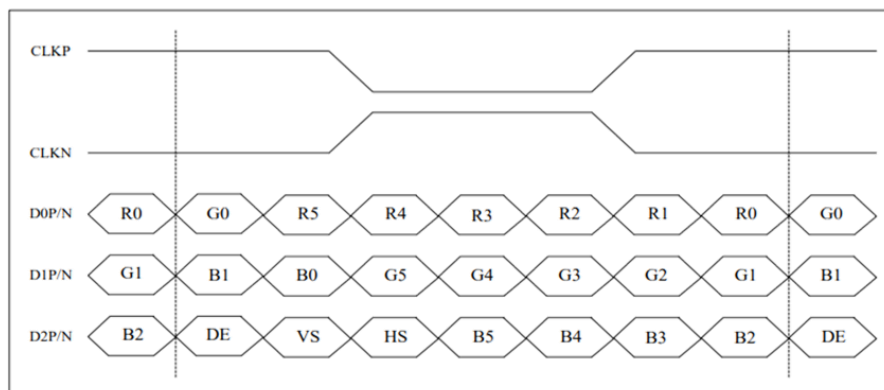


The LED backlight driver used in this module does not burst the LED current. Therefore, it does not generate audible noises on the output capacitor. It is equipped with soft start subsystem, which increases LED life time, as LED current peaks are reduced significantly.

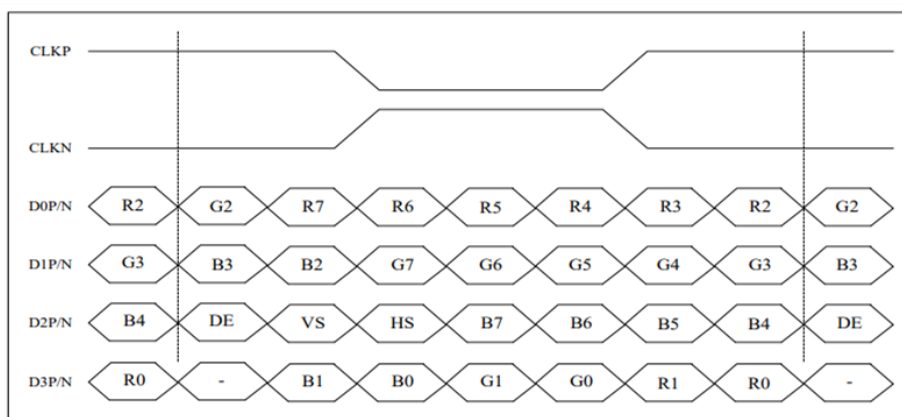
## 9 TIMING CHARACTERISTICS

### 9.1 LVDS interface characteristic

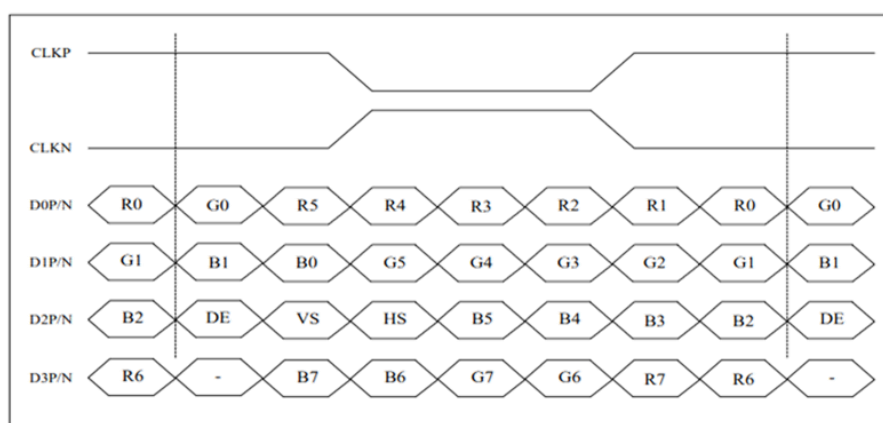
#### 6-bit LVDS input (LVBIT=L, LVFMT=H OR L)



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



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



## 9.2 Timing table

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Clock Frequency (Rate=60Hz(LVDS))	F <sub>DCLK</sub>	66.3	72.4	78.9	MHz
HSYNC Period Time	T <sub>H</sub>	1380	1440	1500	DCLK
Horizontal Display area	T <sub>HD</sub>	1280			DCLK
Hsync Pulse Width	T <sub>HPW</sub>	1	-	40	Tc
Hsync Back Porch (with pulse width)	T <sub>HBP</sub>	88	88	88	DCLK
Hsync Front Porch	T <sub>HFP</sub>	12	72	132	DCLK
VSNC Period Time	T <sub>V</sub>	824	838	872	H
Vertical Display area	T <sub>VD</sub>	800			H
Vsync pulse Width	T <sub>VW</sub>	1	-	20	H
Vsync Back Porch (with pulse width)	T <sub>VBP</sub>	23	23	23	H
Vsync Front Porch	T <sub>VFP</sub>	1	15	49	H

## 10 INITIALIZATION CODE

Initialization data, timings and example codes are available on the Riverdi GitHub, at address:  
<https://github.com/riverdi/riverdi-eve>

## 11 INSPECTION

Standard acceptance/rejection criteria for TFT module.

### 11.1 Inspection condition

Ambient conditions:

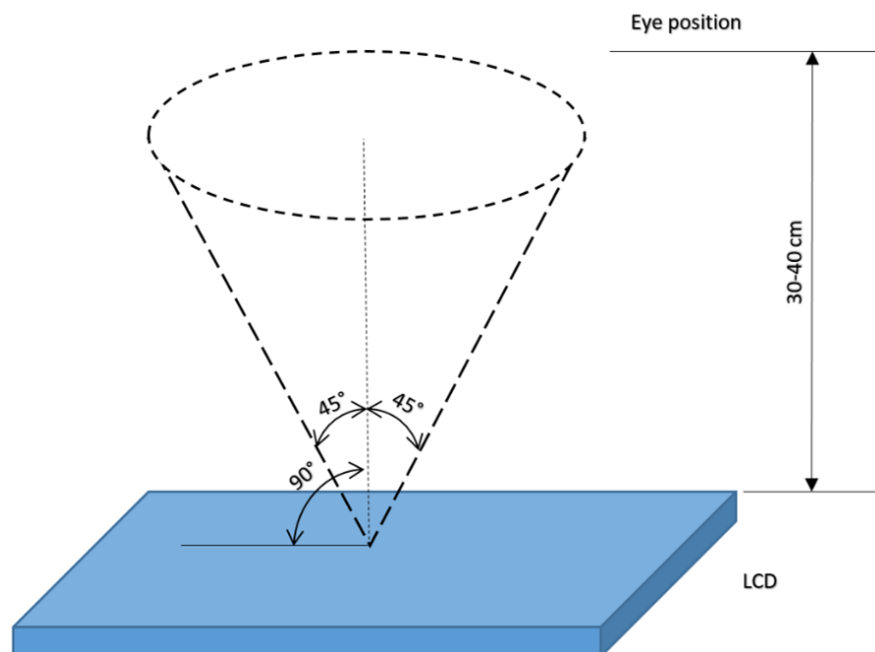
- Temperature:  $25 \pm 2^{\circ}\text{C}$
- Humidity:  $(60 \pm 10) \% \text{RH}$
- Illumination: Single fluorescent lamp non-directive (300 to 700 lux)

Viewing distance:

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

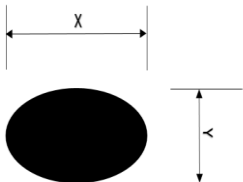
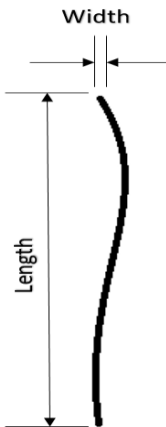
Viewing Angle:

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



## 11.2 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)	<div><math display="block">D = \frac{(x + y)}{2}</math></div> <table><tr><th colspan="2">Size = 10.1"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td><math>D \leq 0.2 \text{ mm}</math></td><td>Ignored</td></tr><tr><td><math>0.2 \text{ mm} &lt; D \leq 0.3 \text{ mm}</math></td><td><math>N \leq 4</math></td></tr><tr><td><math>0.5\text{mm} &lt; D</math></td><td><math>N = 0</math></td></tr></table> <p>*Spots density: 10 mm</p>	Size = 10.1"		Average Diameter	Qualified Qty	$D \leq 0.2 \text{ mm}$	Ignored	$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$	$N \leq 4$	$0.5\text{mm} < D$	$N = 0$					
Size = 10.1"																
Average Diameter	Qualified Qty															
$D \leq 0.2 \text{ mm}$	Ignored															
$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$	$N \leq 4$															
$0.5\text{mm} < D$	$N = 0$															
LCD black spots, white spots, light leakage (line Type)	<div></div> <table><tr><th colspan="3">Size = 10.1"</th></tr><tr><th>Length</th><th>Width</th><th>Qualified Qty</th></tr><tr><td>-</td><td><math>W \leq 0.05</math></td><td>Ignored</td></tr><tr><td><math>L \leq 5.0</math></td><td><math>0.05 &lt; W \leq 0.1</math></td><td><math>N \leq 3</math></td></tr><tr><td><math>5.0 &lt; L</math></td><td><math>0.10 &lt; W</math> or <math>5.0 &lt; L</math></td><td><math>N = 0</math></td></tr></table> <p>*Spots density: 10 mm</p>	Size = 10.1"			Length	Width	Qualified Qty	-	$W \leq 0.05$	Ignored	$L \leq 5.0$	$0.05 < W \leq 0.1$	$N \leq 3$	$5.0 < L$	$0.10 < W$ or $5.0 < L$	$N = 0$
Size = 10.1"																
Length	Width	Qualified Qty														
-	$W \leq 0.05$	Ignored														
$L \leq 5.0$	$0.05 < W \leq 0.1$	$N \leq 3$														
$5.0 < L$	$0.10 < W$ or $5.0 < L$	$N = 0$														
Bright/Dark Dots	<table><tr><th colspan="2">Size = 10.1"</th></tr><tr><th>Item</th><th>Qualified Qty</th></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>	Size = 10.1"		Item	Qualified Qty	Bright Dots	0	Dark Dots	0	Cluster Bright Dots or Dark Dots	0	Total Bright and Dark Dots	0			
Size = 10.1"																
Item	Qualified Qty															
Bright Dots	0															
Dark Dots	0															
Cluster Bright Dots or Dark Dots	0															
Total Bright and Dark Dots	0															
Clear spots	<table><tr><th colspan="2">Size <math>\geq 5''</math></th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td><math>D &lt; 0.2 \text{ mm}</math></td><td>Ignored</td></tr><tr><td><math>0.2 \text{ mm} &lt; D &lt; 0.3 \text{ mm}</math></td><td>4</td></tr><tr><td><math>0.3 \text{ mm} &lt; D &lt; 0.5 \text{ mm}</math></td><td>2</td></tr><tr><td><math>0.5 \text{ mm} &lt; D</math></td><td>0</td></tr></table> <p>*Spots density: 10 mm</p>	Size $\geq 5''$		Average Diameter	Qualified Qty	$D < 0.2 \text{ mm}$	Ignored	$0.2 \text{ mm} < D < 0.3 \text{ mm}$	4	$0.3 \text{ mm} < D < 0.5 \text{ mm}$	2	$0.5 \text{ mm} < D$	0			
Size $\geq 5''$																
Average Diameter	Qualified Qty															
$D < 0.2 \text{ mm}$	Ignored															
$0.2 \text{ mm} < D < 0.3 \text{ mm}$	4															
$0.3 \text{ mm} < D < 0.5 \text{ mm}$	2															
$0.5 \text{ mm} < D$	0															

## 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	40 °C, 90 % RH/120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30min, 70°C 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.



## 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.

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