



RVT35HHBFWN00

EVE4 IPS 3.5" LCD TFT Datasheet

Rev.0.1

2021-01-18

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	3.5	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	93.50 × 62.00 × 8.65	mm
Active Area (W × H)	70.08 × 52.56	mm
Pixel Pitch (W × H)	0.219 × 0.219	mm
Resolution	320 (RGB) × 240	/
Brightness	1000	cd/m ²
Color Depth	16.7 M	/
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 (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	2021-01-18	Preliminary	

CONTENTS

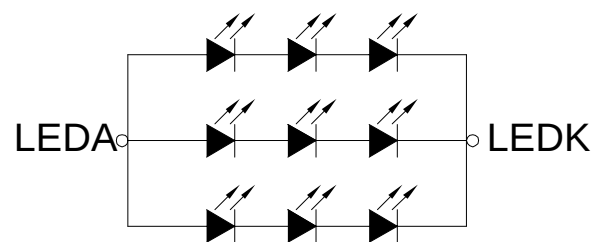
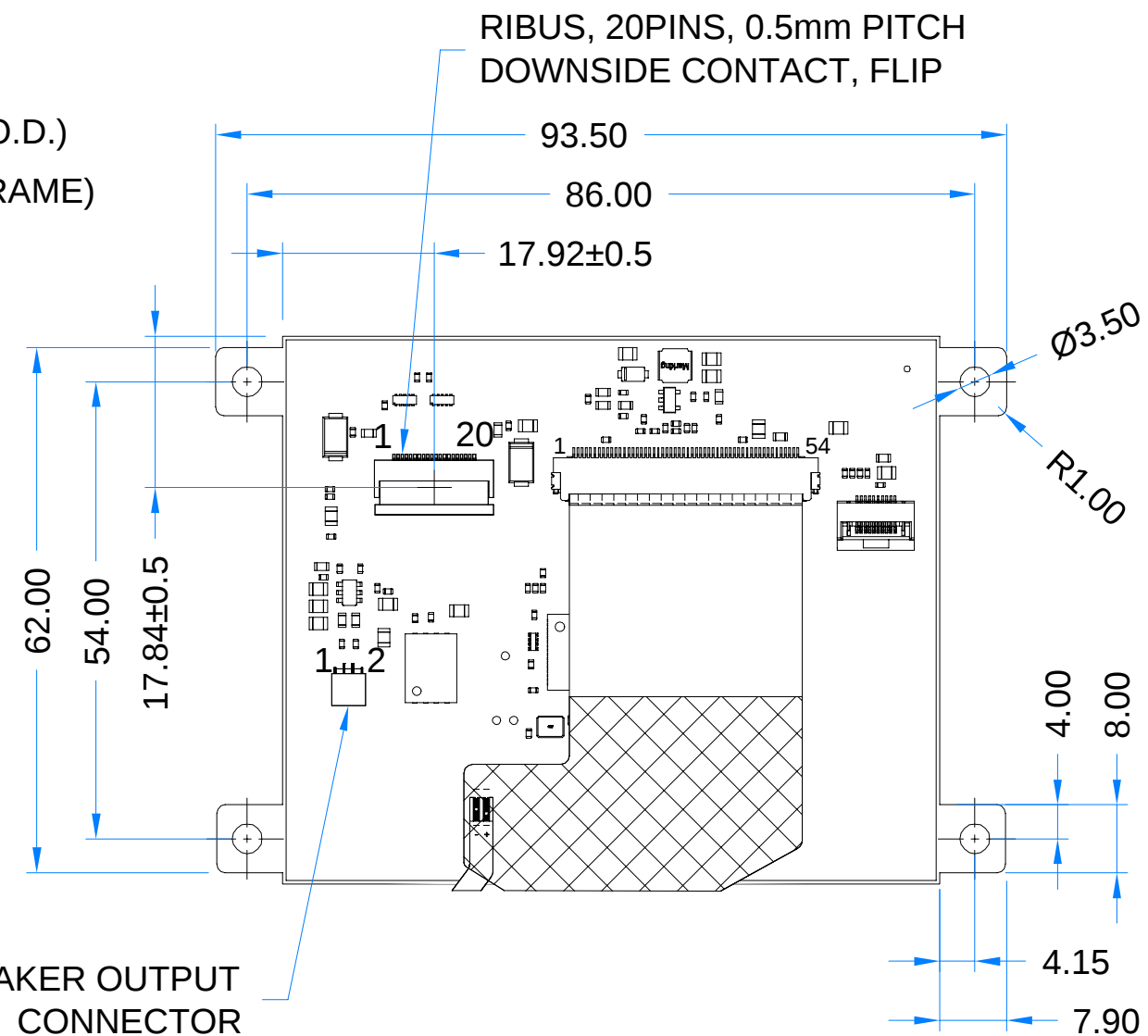
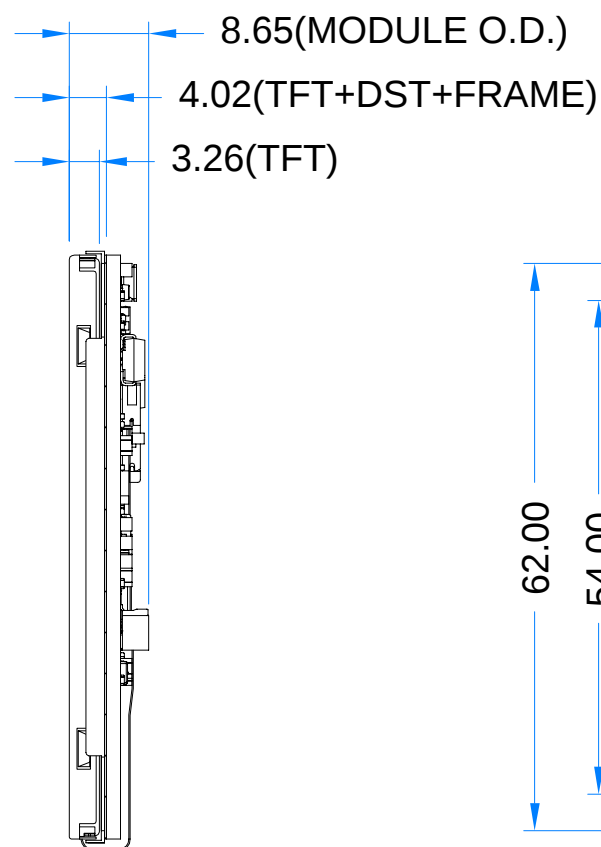
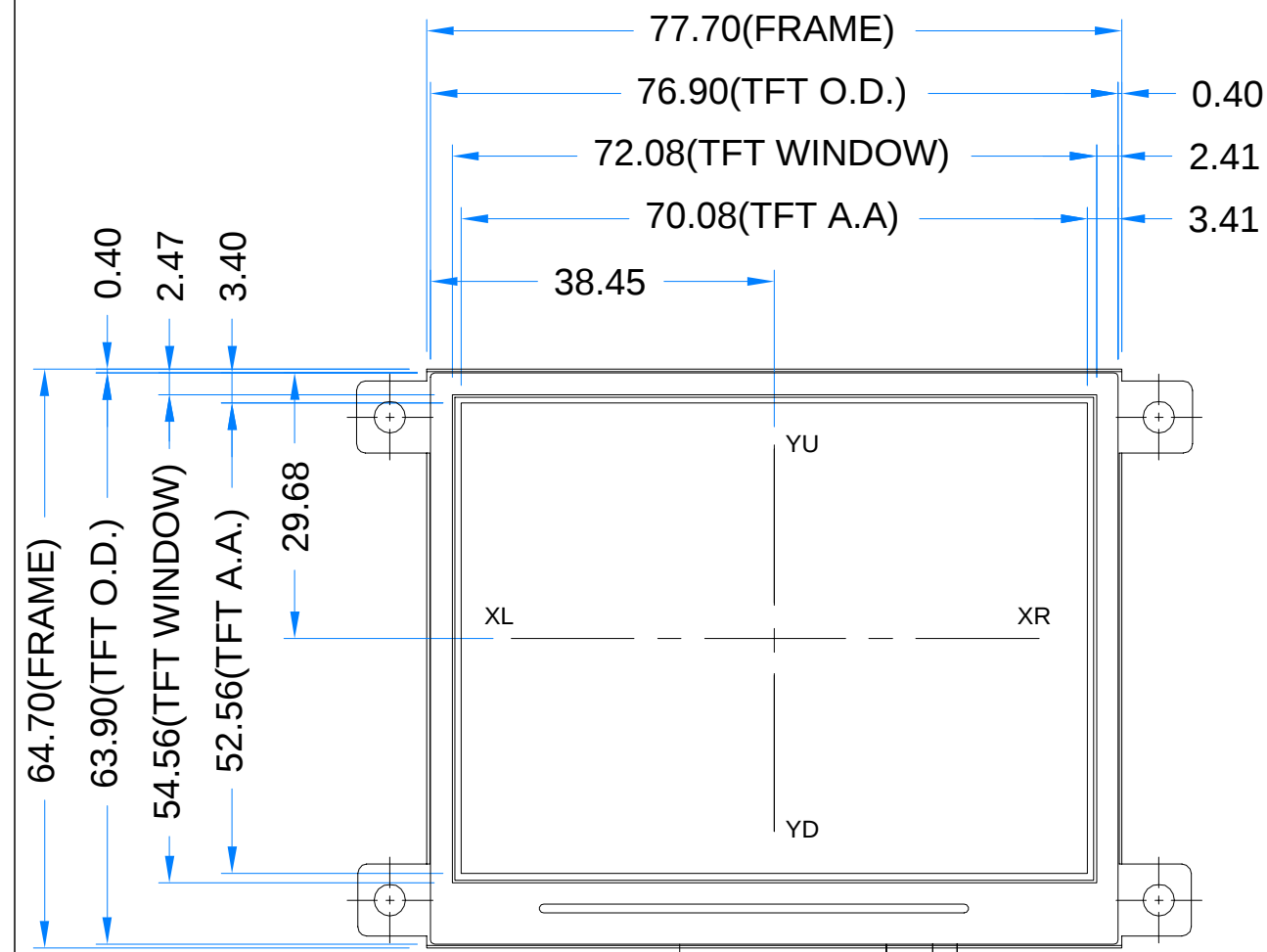
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1 MODULE CLASSIFICATION INFORMATION

RV	T	35	H	H	B	F	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	35 – 3.5”
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	H –320 x 240 px
6.	INTERFACE	B – SPI/QSPI
7.	FRAME	F – With Frame
8.	BACKLIGHT TYPE	W – LED White
9.	TOUCH PANEL	N – Without Touch Panel
10.	VERSION	00 – (00-99)

Revision:	Changes:	Date:
1.0	Initial Case	2020.12.22



TFT NOTES:

1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS
2. RESOLUTION: 320x240
3. VIEWING ANGLE: FREE
4. SURFACE LUMINANCE: 1000 cd/m²
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

GENERAL NOTES:

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

PN: RVT35HHBFWN00

SN:

DRAWN: M.Natywa

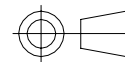


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[mm]



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	VIN	-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	-	% 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).

4 ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	180	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

5 BACKLIGHT ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Backlight	BLVDD	2.7	5.0	6.0	V	
Current drawn from BLVDD @5.0V	I _{BLVDD=5.0V}	TBD	150	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	65	TBD	mA	50% of backlight, Note 1
Current drawn from BLVDD @3.3V	I _{BLVDD=3.3V}	TBD	250	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@3.3V	I _{BLVDD=3.3 V}	TBD	100	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.

6 ELECTRO-OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	-	30	-	ms	FIG 2.	4
Contrast Ratio	Cr		-	1000	-	---	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	$\phi = 90^\circ$	-	80	-	deg	FIG 4.	6
		$\phi = 270^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 0^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 180^\circ$	-	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	0.575	0.615	0.655	FIG 3.		5
		y	0.296	0.336	0.376			
	Green	x	0.352	0.392	0.432			
		y	0.512	0.552	0.592			
	Blue	x	0.100	0.140	0.180			
		y	0.085	0.125	0.165			
	White	x	0.274	0.316	0.358			
		y	0.295	0.336	0.378			

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 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 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 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

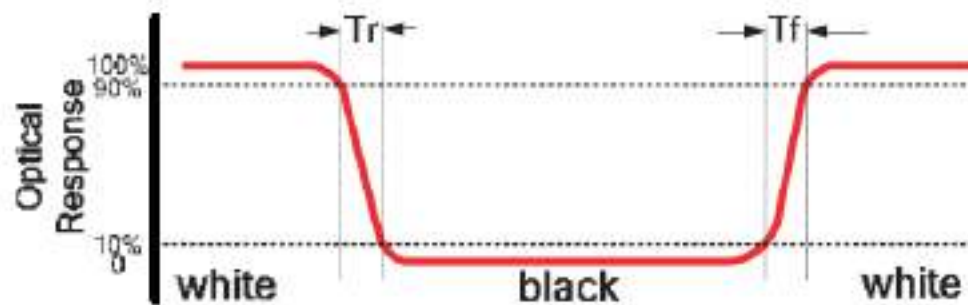
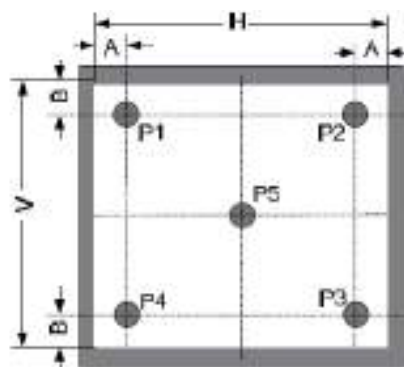


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

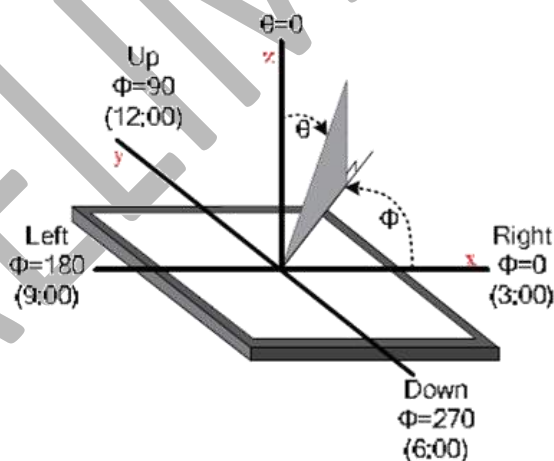
B: 5mm

H,V: Active Area

Light spot size $\phi=5\text{mm}$, 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



7 INTERFACE DESCRIPTION

7.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

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.

[illegible]

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

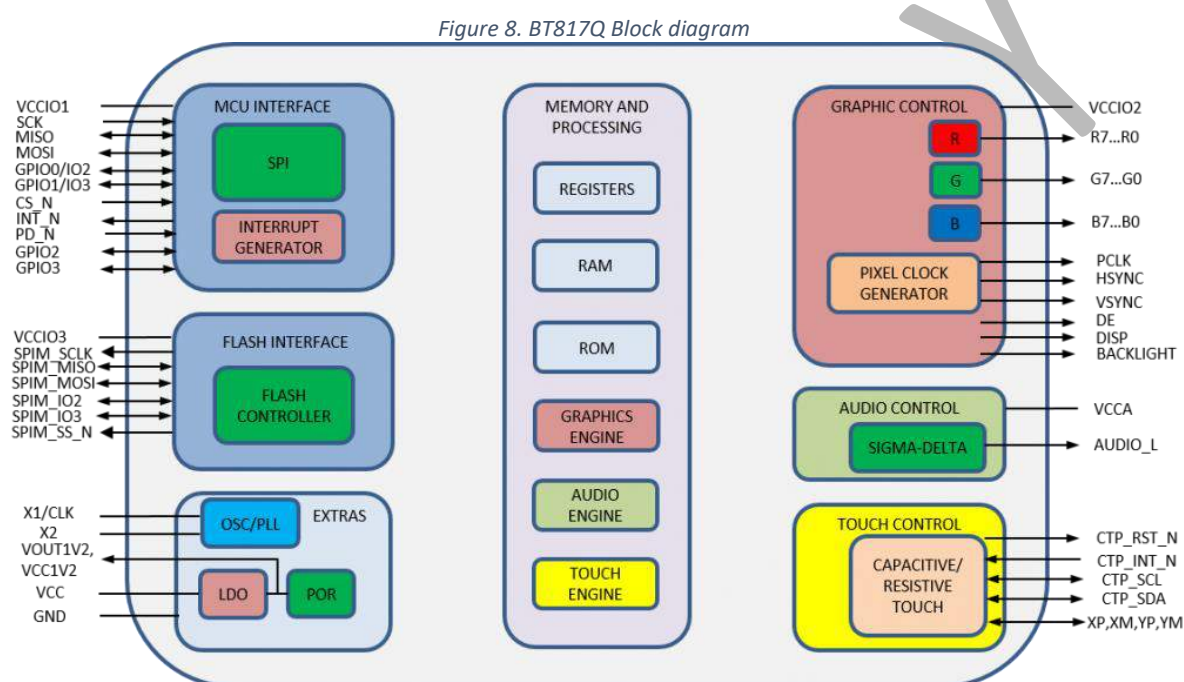
www.riverdi.com

Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

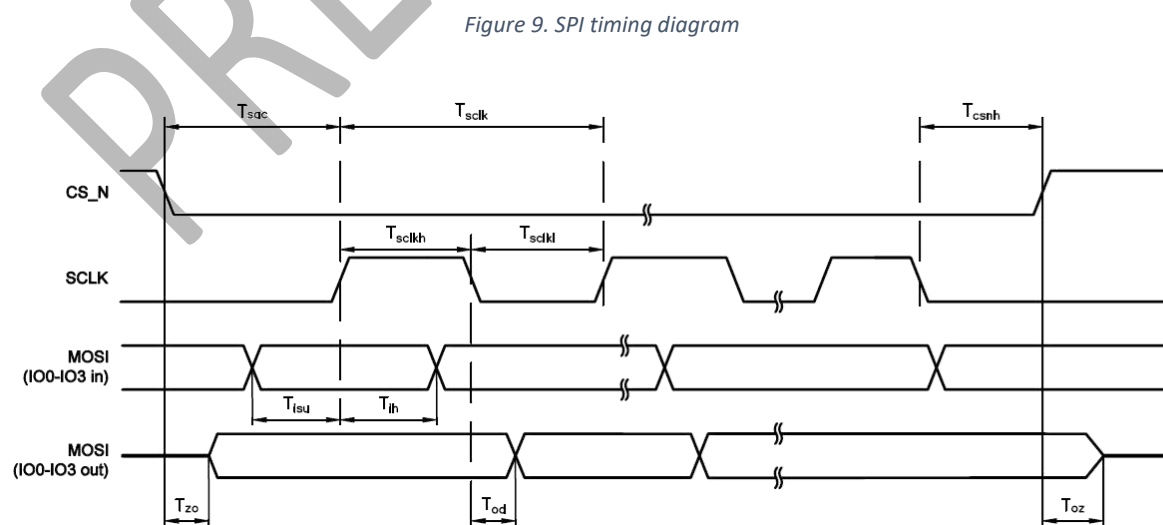
QSPI Interface – the QSPI slave interface operates up to 30MHz (It depends on EVE 4 system clock frequency and will be verified in Riverdi lab). Only SPI mode 0 is supported. The QSPI can be configured as a SPI slave in SINGLE, DUAL or QUAD channel modes.

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



8.3 Host interface SPI mode 0



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

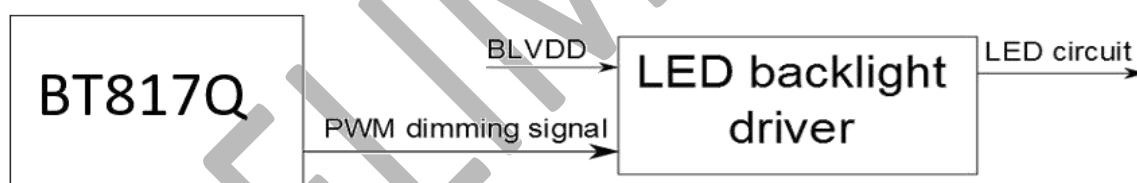
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

9 TIMING CHARACTERISTICS

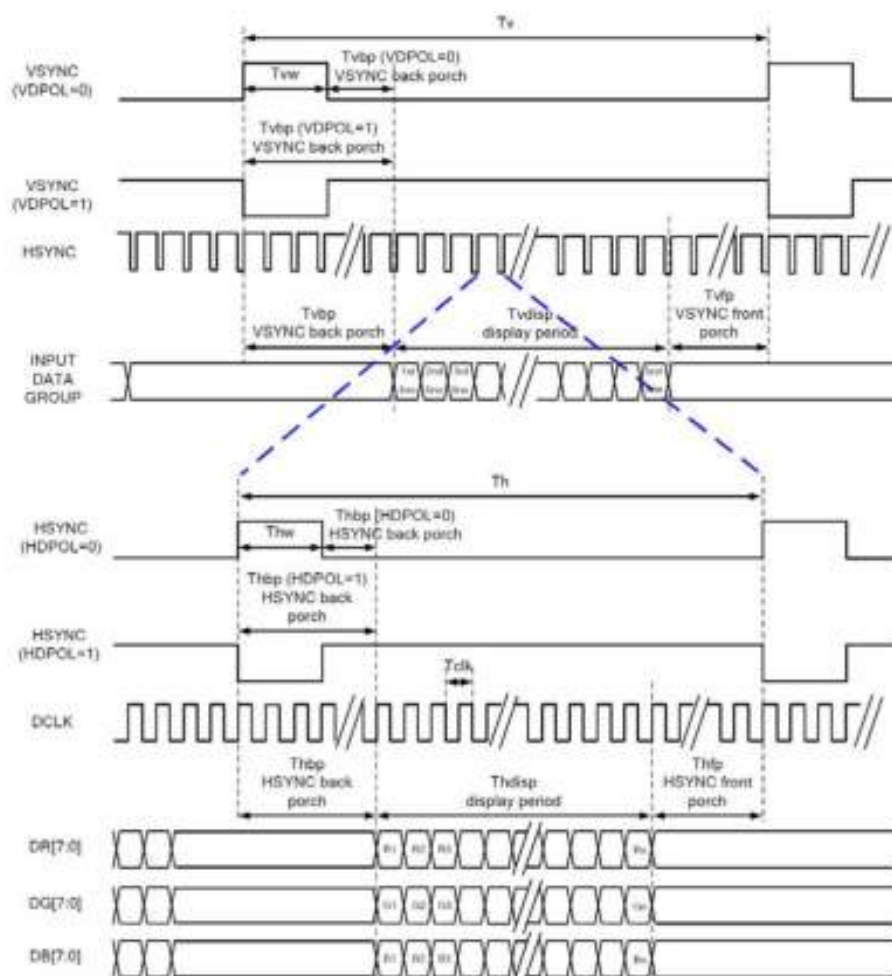
9.1 Input setup timing setting

RGB MODE SELECTION	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

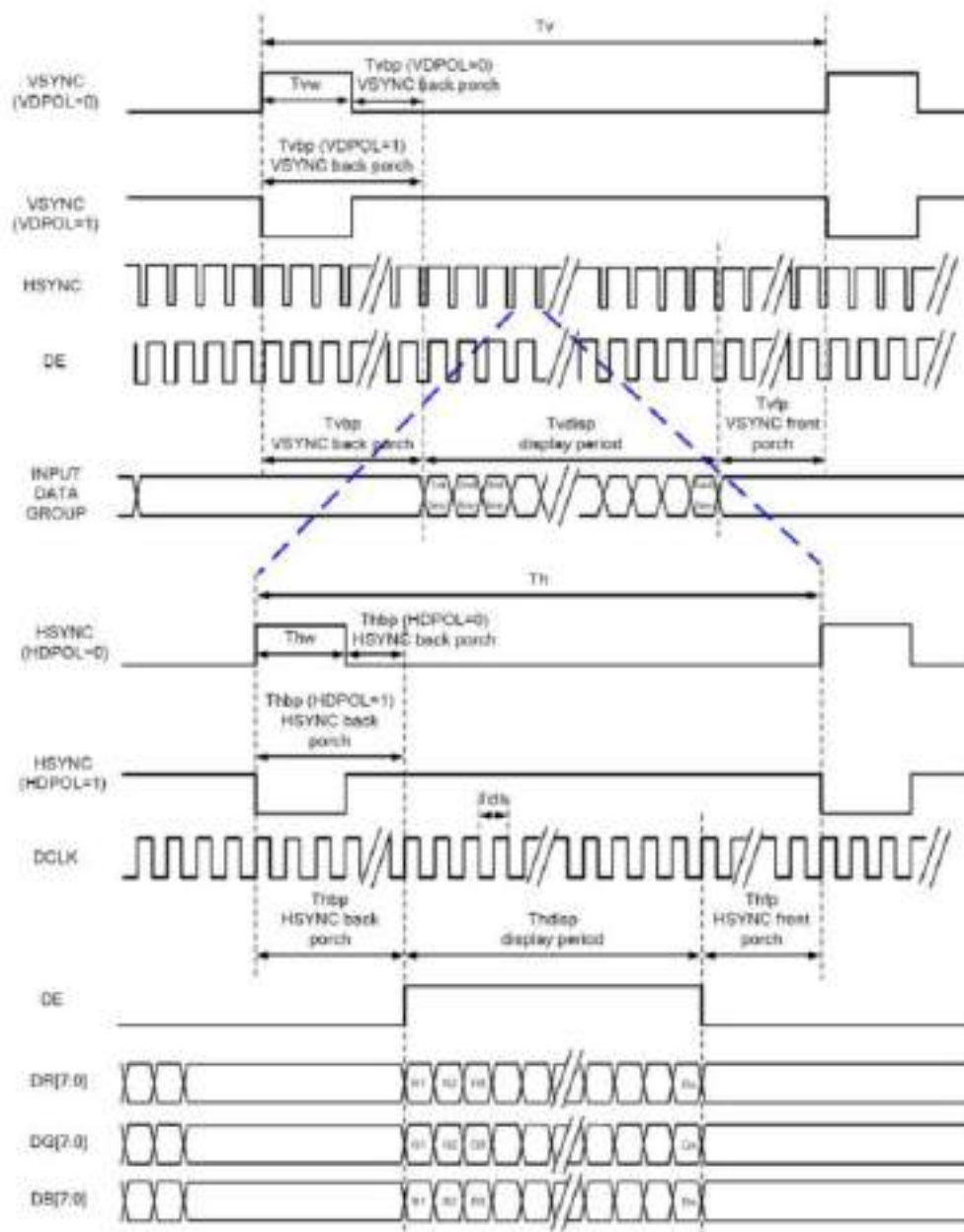
9.1.1 Parallel 24-bit RGB Timing Table

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK Frequency	F_{clk}	5	6	8	MHz	
DCLK Period	T_{clk}	125	167	200	ns	
HSYNC	Period Time	T_h	325	371	438	DCLK
	Display Period	T_{hdisp}	320			DCLK
	Back Porch	T_{hbp}	3	43	43	DCLK SYNC mode back porch control by H_BLANKING [7:0] setting $T_{hbp} = H_BLANKING [7:0]$
	Front Porch	T_{hfp}	2	8	75	DCLK
	Pulse Width	T_{hw}	2	4	43	DCLK
VSYNC	Period Time	T_v	244	260	289	HSYNC
	Display Period	T_{vdisp}	240			HSYNC
	Back Porch	T_{vbp}	2	12	12	HSYNC SYNC mode back porch control by V_BLANKING [7:0] setting $T_{vbp} = V_BLANKING [7:0]$
	Front Porch	T_{vfp}	2	8	37	HSYNC
	Pulse Width	T_{vw}	2	4	12	HSYNC

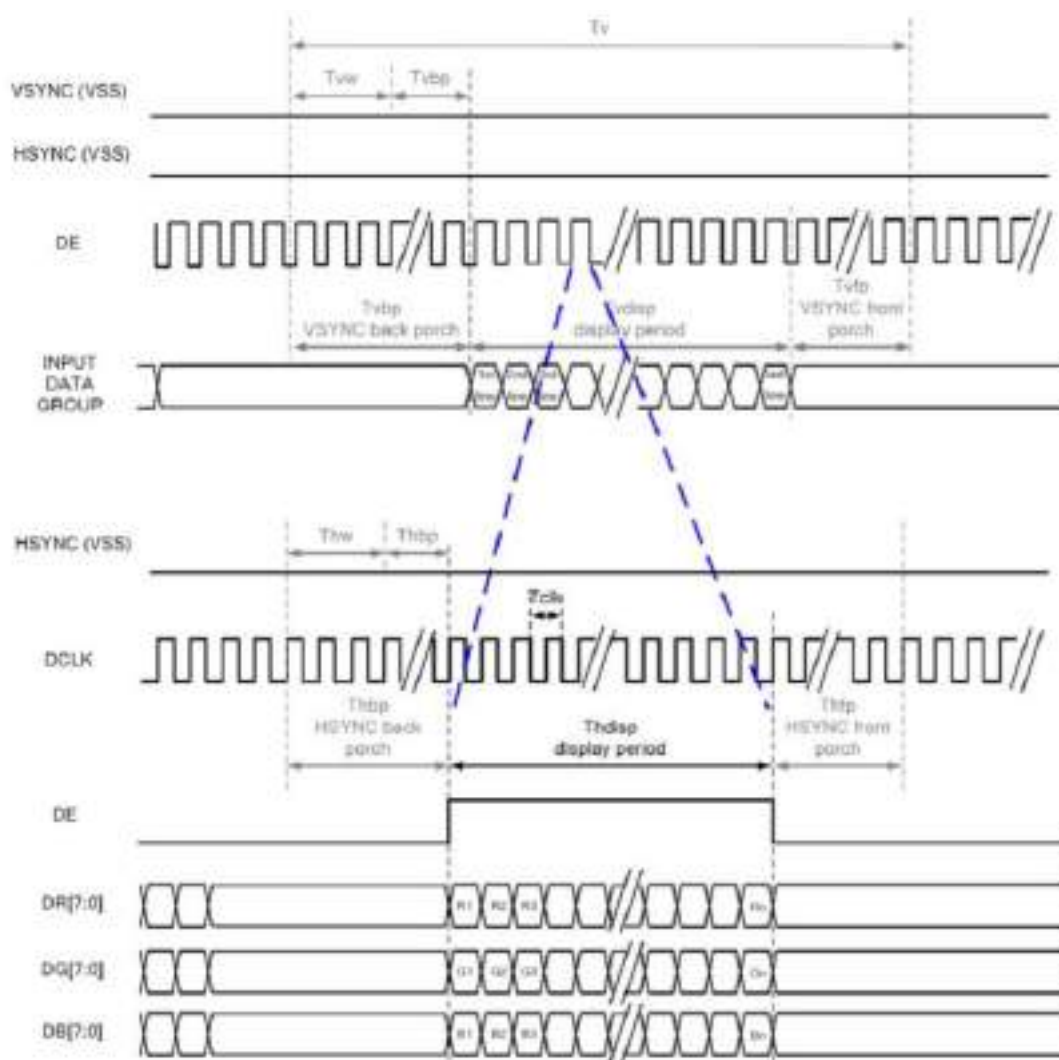
Note. It is necessary to keep $T_{vbp}=12$ and $T_{hbp}=43$ in sync mode. In DE mode it is not necessary.



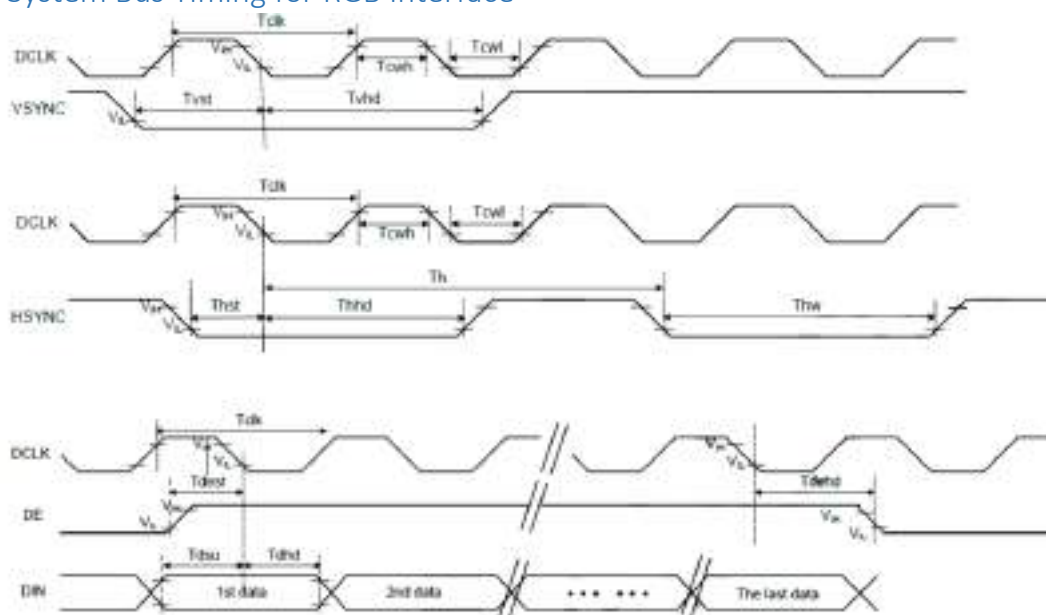
9.1.2 SYNC-DE mode timing diagram



9.1.3 DE mode timing diagram



9.2 System Bus Timing for RGB Interface



PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
CLK Pulse Duty	T_{clk}	40	50	60	%
HSYNC Width	T_{hw}	2	-	-	DCLK
HSYNC Period	T_h	55	60	65	CLK
VSYNC Setup Time	T_{vst}	12	-	-	ns
VSYNC Hold Time	T_{vhd}	12	-	-	ns
HSYNC Setup Time	T_{hst}	12	-	-	ns
HSYNC Hold Time	T_{hhd}	12	-	-	ns
Data Setup Time	T_{dsu}	12	-	-	ns
Data Hold Time	T_{dhd}	12	-	-	ns
DE Setup Time	T_{dest}	12	-	-	ns
DE Hold Time	T_{dehd}	12	-	-	ns

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:

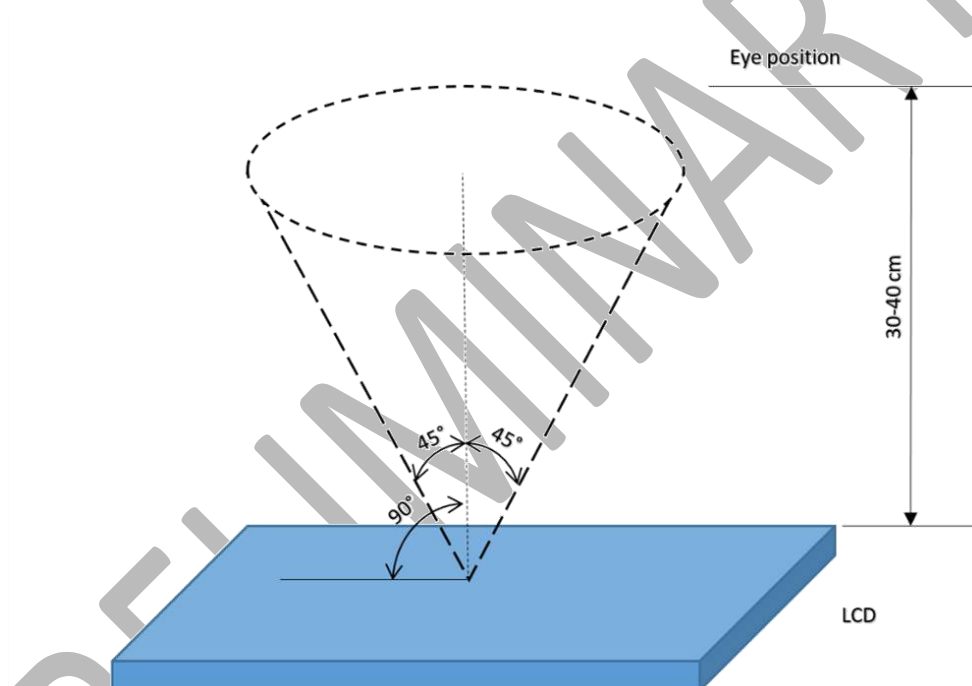
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

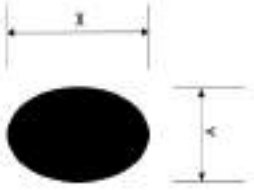
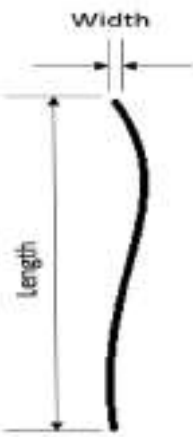
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



11.2 Inspection standard

Item	Criterion																		
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ *Spots density: 10 mm <table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>D ≤ 0.15 mm</td><td>Ignored</td></tr><tr><td>0.15 mm < D ≤ 0.30 mm</td><td>N ≤ 3</td></tr><tr><td>0.3mm < D</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"		Average Diameter	Qualified Qty	D ≤ 0.15 mm	Ignored	0.15 mm < D ≤ 0.30 mm	N ≤ 3	0.3mm < D	Not allowed								
3.5" ≤ Size ≤ 5"																			
Average Diameter	Qualified Qty																		
D ≤ 0.15 mm	Ignored																		
0.15 mm < D ≤ 0.30 mm	N ≤ 3																		
0.3mm < D	Not allowed																		
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <table><tr><th colspan="3">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>W ≤ 0.03</td><td>Ignored</td></tr><tr><td>L ≤ 3.0</td><td>0.03 < W ≤ 0.05</td><td>2</td></tr><tr><td>L ≤ 3.0</td><td>0.05 < W ≤ 0.1</td><td>1</td></tr><tr><td>3.0 < L</td><td>0.1 < W</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"			Length/mm	Width/mm	Qualified Qty	-	W ≤ 0.03	Ignored	L ≤ 3.0	0.03 < W ≤ 0.05	2	L ≤ 3.0	0.05 < W ≤ 0.1	1	3.0 < L	0.1 < W	Not allowed
3.5" ≤ Size ≤ 5"																			
Length/mm	Width/mm	Qualified Qty																	
-	W ≤ 0.03	Ignored																	
L ≤ 3.0	0.03 < W ≤ 0.05	2																	
L ≤ 3.0	0.05 < W ≤ 0.1	1																	
3.0 < L	0.1 < W	Not allowed																	
Bright/Dark Dots	<table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>N ≤ 1</td></tr><tr><td>Dark Dots</td><td>N ≤ 2</td></tr><tr><td>Total Bright and Dark Dots</td><td>N ≤ 3</td></tr></table>	3.5" ≤ Size ≤ 5"		item	Qualified Qty	Bright Dots	N ≤ 1	Dark Dots	N ≤ 2	Total Bright and Dark Dots	N ≤ 3								
3.5" ≤ Size ≤ 5"																			
item	Qualified Qty																		
Bright Dots	N ≤ 1																		
Dark Dots	N ≤ 2																		
Total Bright and Dark Dots	N ≤ 3																		

Item	Criterion
Clear spots	Size < 5"
	Average Diameter
	Qualified Qty
	D < 0.2 mm
	Ignored
	0.2 mm < D < 0.3 mm
	3
Polarizer bubbles	0.3 mm < D < 0.5 mm
	2
	0.5 mm < D
	0
	*Spots density: 10 mm
	3.5" ≤ Size ≤ 5"
	Average Diameter
	Qualified Qty
	D ≤ 0.2 mm
	Ignored
	0.2 mm < D ≤ 0.3 mm
	2
	0.3 mm < D ≤ 0.5 mm
	1
	0.5 mm < D
	0
	Total Q'ty
	3

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 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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 cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

13 LEGAL INFORMATION

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RVT35HHBNWC00-B

EVE4 IPS 3.5" LCD TFT Datasheet

Rev.0.1

2021-01-08

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	3.5	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	136.00 × 92.80 × 11.99	mm
Active Area (W × H)	70.08 × 52.56	mm
Pixel Pitch (W × H)	0.219 × 0.219	mm
Resolution	320 (RGB) × 240	/
Brightness	850	cd/m ²
Color Depth	16.7 M	/
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	ILI2132A	/
Supply Voltage for Module	3.3	V
Supply Voltage for Backlight	5.0 (TYP.)	V
Bonding Technology	Optical Bonding	/
Weight	TBD	g

Note 1: RoHS compliant

Note 2: LCM weight tolerance: ± 5%.

REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
0.1	2021-01-08	Preliminary	

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1 MODULE CLASSIFICATION INFORMATION

RV	T	35	H	H	B	N	W	C	00	B
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.

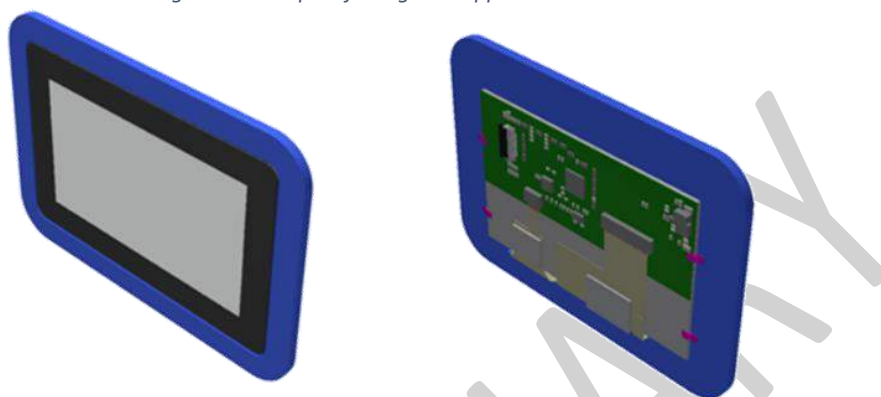
1.	BRAND	RV – Riverdi
2.	PRODUCT TYPE	T – TFT Standard
3.	DISPLAY SIZE	35 – 3.5"
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	H – 320 x 240 px
6.	INTERFACE	B – SPI/QSPI
7.	FRAME	N – No Frame
8.	BACKLIGHT TYPE	W – LED White
9.	TOUCH PANEL	C – With Capacitive Touch Panel
10.	VERSION	00 – (00-99)
11.	BONDING TECHNOLOGY	B – Optical Bonding

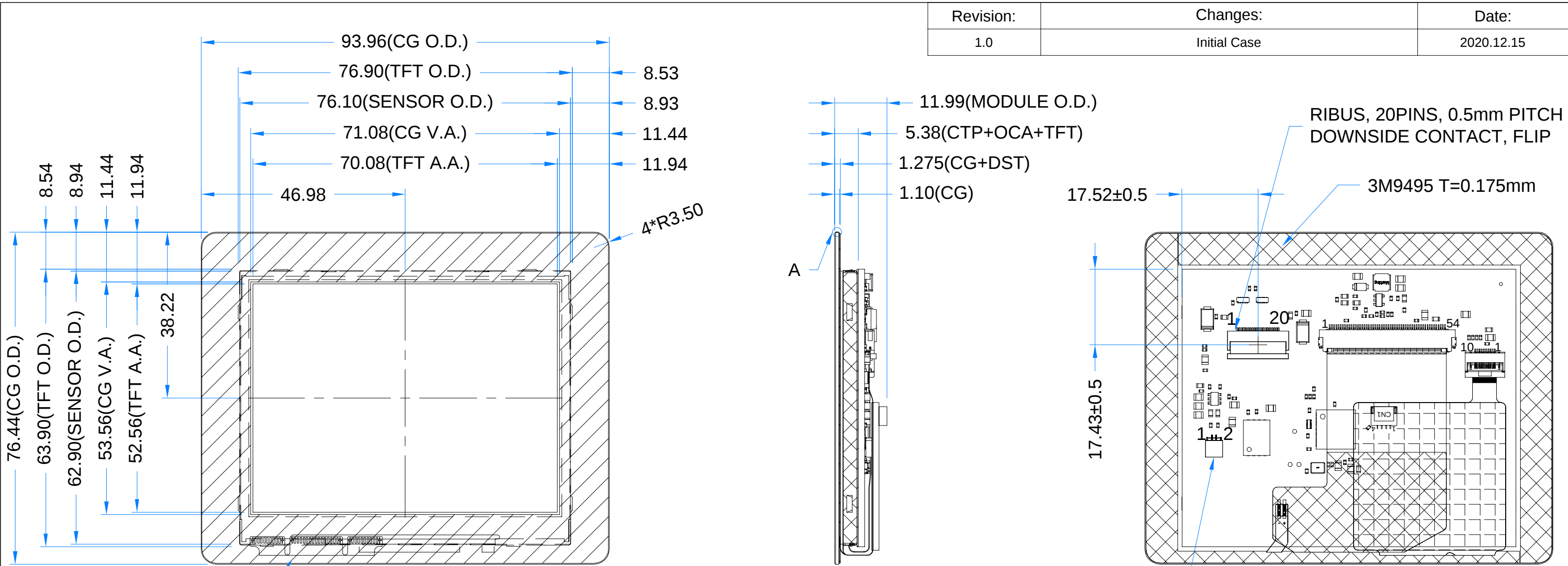
2 UxTOUCH ASSEMBLY

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.

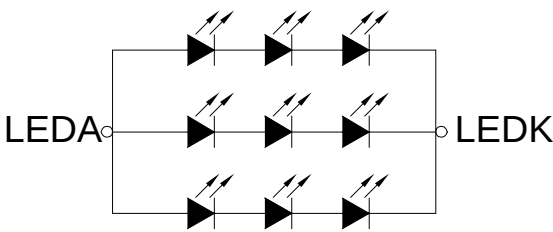
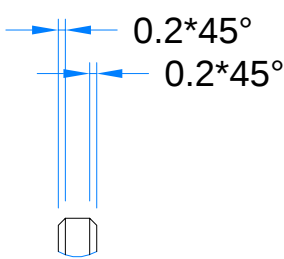
Figure 1. Example of using the support brackets





Revision:	Changes:	Date:
1.0	Initial Case	2020.12.15

DETAIL A
SCALE 4:1



LED Diagram Circuit

PINOUT ON THE 2ND PAGE

TFT NOTES: 1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS 2. RESOLUTION: 320x240 3. VIEWING ANGLE: FREE 4. SURFACE LUMINANCE: 850 cd/m² 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. OPTICAL BONDING 2. OPERATING TEMPERATURE: -20°C ~ 70°C 3. STORAGE TEMPERATURE: -30°C ~ 80°C 4. WITHOUT INDIVIDUAL TOLERANCE: ±0.3mm 5. RoHS3 COMPLIANT					
			PN: RVT35HHBNWC00-B				
			SN:				
			DRAWN: M.Natywa		2020.12.15	1:0.87	
					2021.01.08	[mm]	
			ISO A3	P. 1 of 1			
ES France - Département Composants & Modules - 127 rue de Buzenval BP 26 - 92380 Garches Tél. 01 47 95 99 84 - Fax. 01 47 01 16 22 - e-mail: comp@es-france.com - Site Web: www.es-france.com							

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	VIN	-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	-	% 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	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	180	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

6 BACKLIGHT ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Backlight	BLVDD	2.7	5.0	6.0	V	
Current drawn from BLVDD @5.0V	I _{BLVDD=5.0V}	TBD	150	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	65	TBD	mA	50% of backlight, Note 1
Current drawn from BLVDD @3.3V	I _{BLVDD=3.3V}	TBD	250	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@3.3V	I _{BLVDD=3.3 V}	TBD	100	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

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	-	30	-	ms	FIG 2.	4
Contrast Ratio	Cr		-	1000	-	---	FIG 3.	1
Luminance Uniformity	δ WHITE		-	75	-	%	FIG 3.	3
Surface Luminance	Lv		-	850	-	cd/m ²	FIG 3.	2
Viewing Angle Range	θ	$\phi = 90^\circ$	-	80	-	deg	FIG 4.	6
		$\phi = 270^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 0^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 180^\circ$	-	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	0.575	0.615	0.655	FIG 3.		5
		y	0.296	0.336	0.376			
	Green	x	0.352	0.392	0.432			
		y	0.512	0.552	0.592			
	Blue	x	0.100	0.140	0.180			
		y	0.085	0.125	0.165			
	White	x	0.274	0.316	0.358			
		y	0.295	0.336	0.378			

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 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 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 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

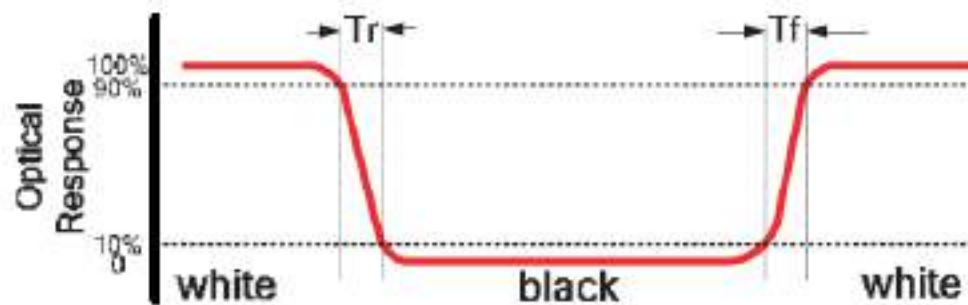
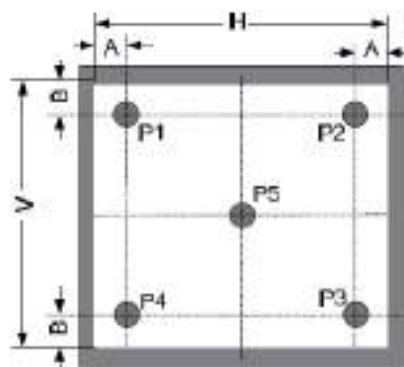


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

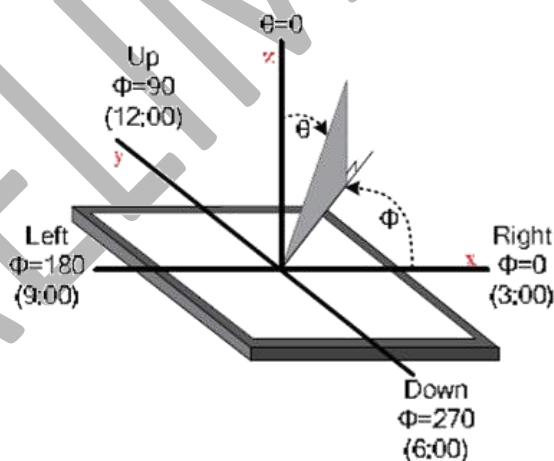
B: 5mm

H,V: Active Area

Light spot size $\phi=5\text{mm}$, 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 INTERFACE DESCRIPTION

8.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

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.

9 BT817Q CONTROLLER SPECIFICATION

9.1 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

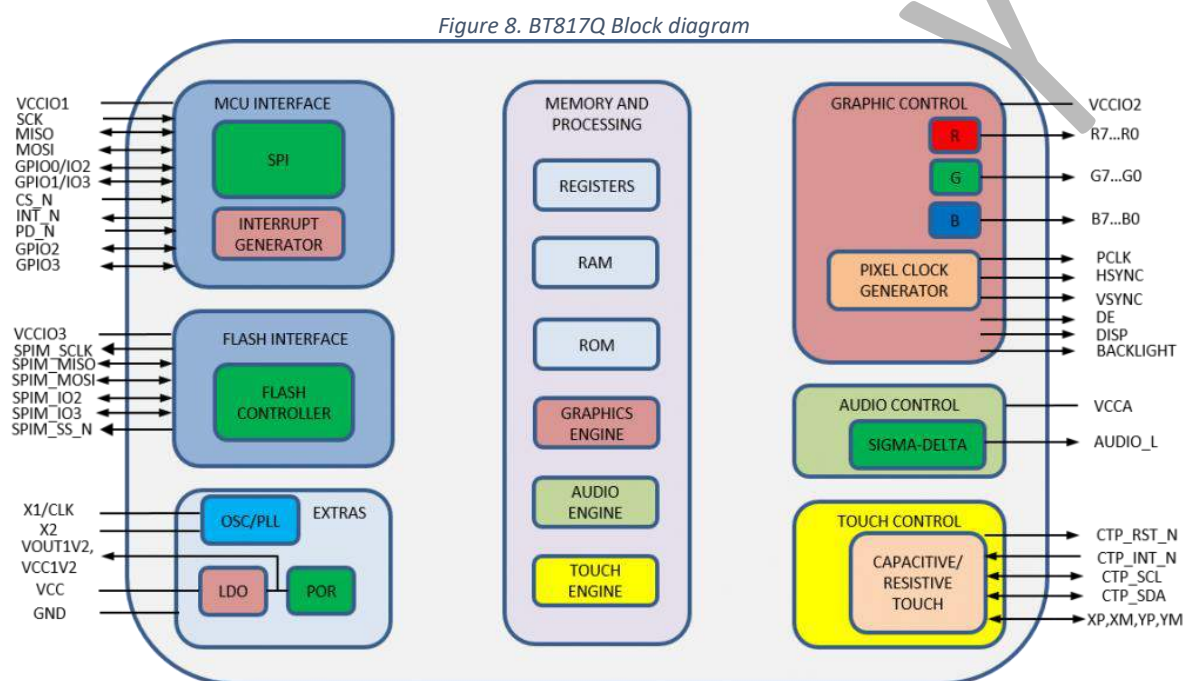
www.riverdi.com

Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

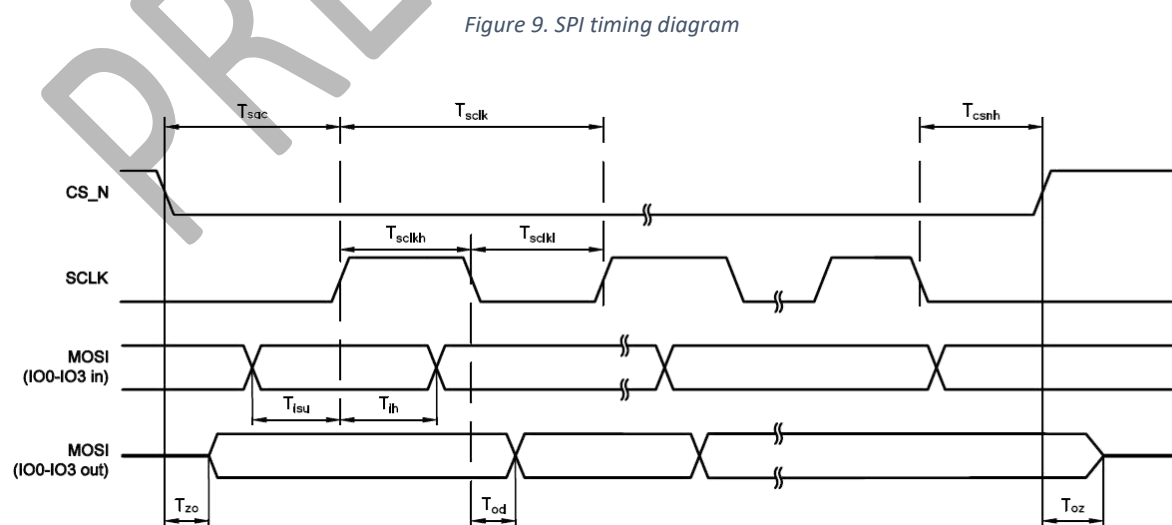
QSPI Interface – the QSPI slave interface operates up to 30MHz (It depends on EVE 4 system clock frequency and will be verified in Riverdi lab). Only SPI mode 0 is supported. The QSPI can be configured as a SPI slave in SINGLE, DUAL or QUAD channel modes.

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



9.3 Host interface SPI mode 0



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

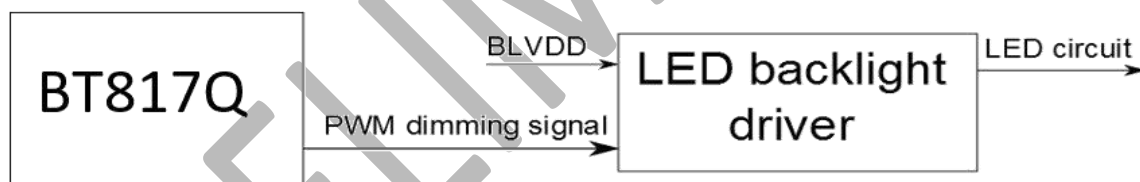
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

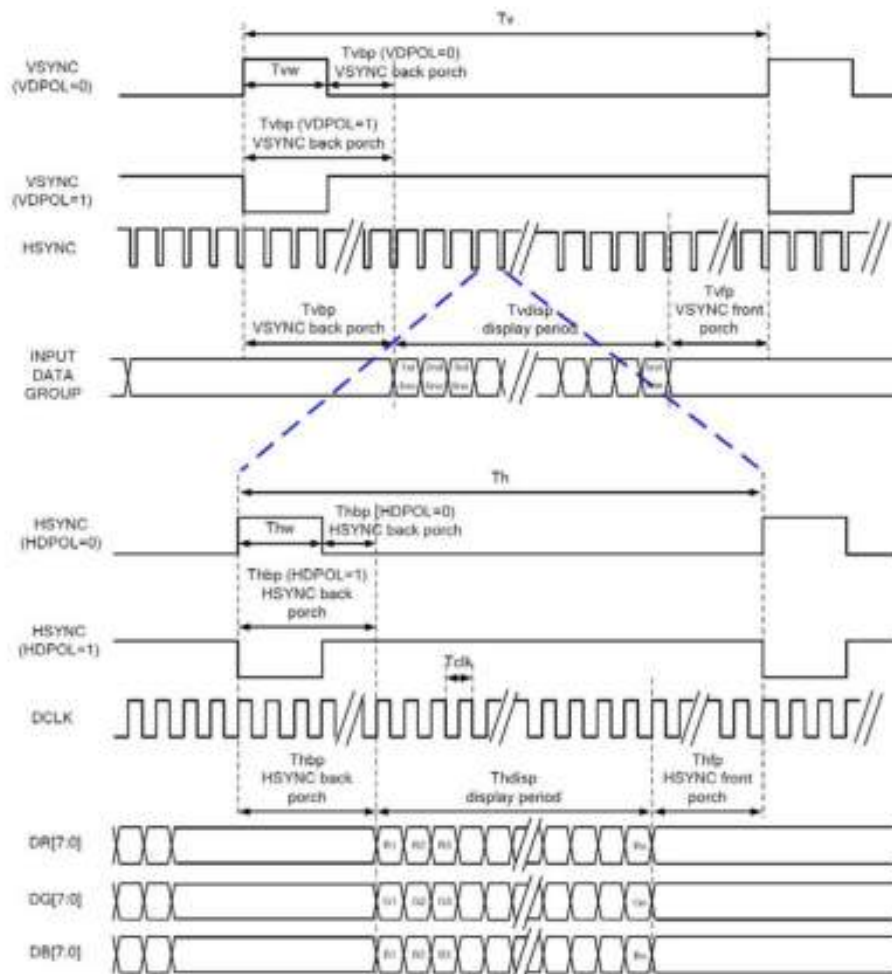
10.1 Input setup timing setting

RGB MODE SELECTION	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

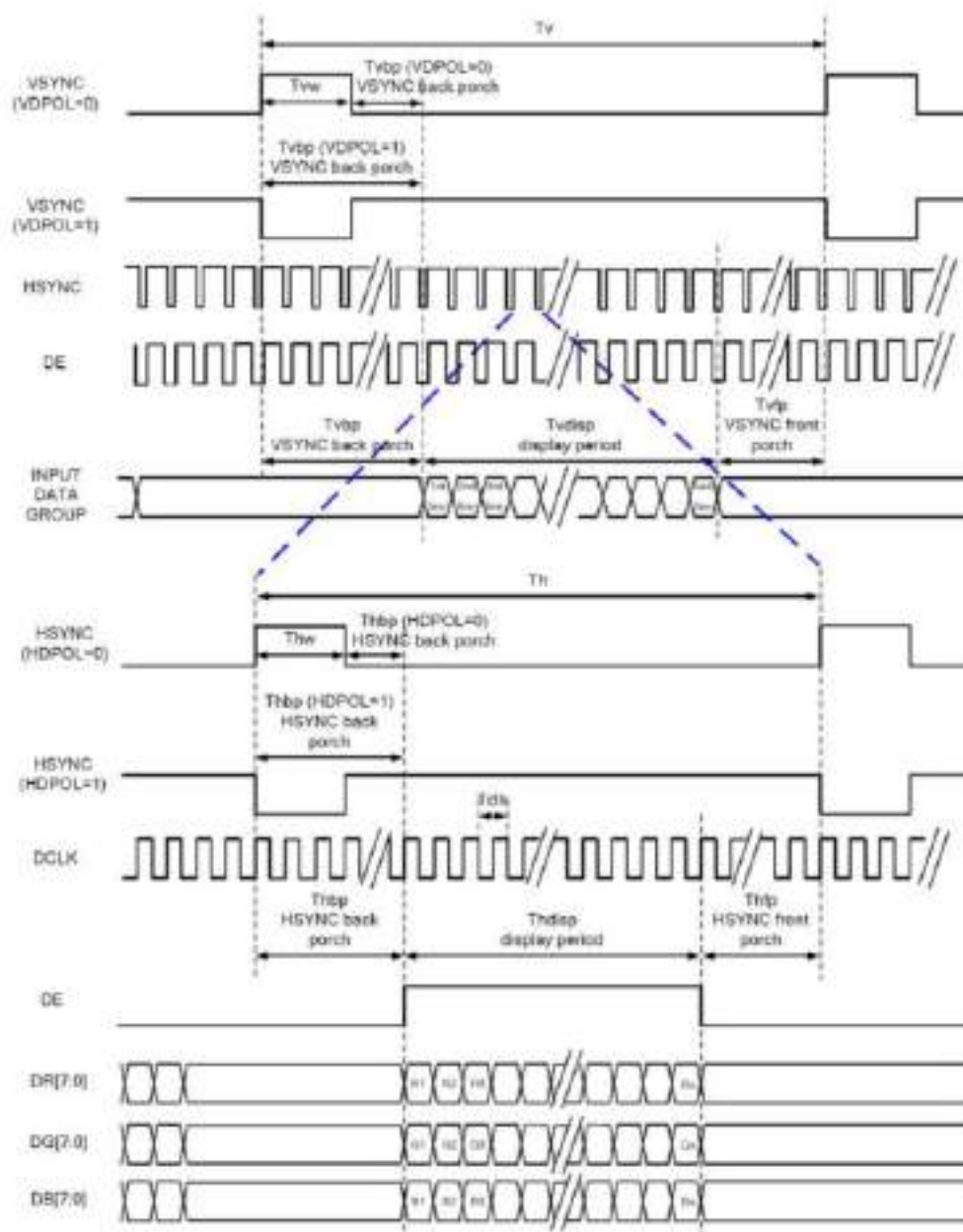
10.1.1 Parallel 24-bit RGB Timing Table

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK Frequency	F_{clk}	5	6	8	MHz	
DCLK Period	T_{clk}	125	167	200	ns	
HSYNC	Period Time	T_h	325	371	438	DCLK
	Display Period	T_{hdisp}	320			DCLK
	Back Porch	T_{hbp}	3	43	43	DCLK SYNC mode back porch control by H_BLANKING [7:0] setting $T_{hbp} = H_BLANKING [7:0]$
	Front Porch	T_{hfp}	2	8	75	DCLK
	Pulse Width	T_{hw}	2	4	43	DCLK
VSYNC	Period Time	T_v	244	260	289	HSYNC
	Display Period	T_{vdisp}	240			HSYNC
	Back Porch	T_{vbp}	2	12	12	HSYNC SYNC mode back porch control by V_BLANKING [7:0] setting $T_{vbp} = V_BLANKING [7:0]$
	Front Porch	T_{vfp}	2	8	37	HSYNC
	Pulse Width	T_{vw}	2	4	12	HSYNC

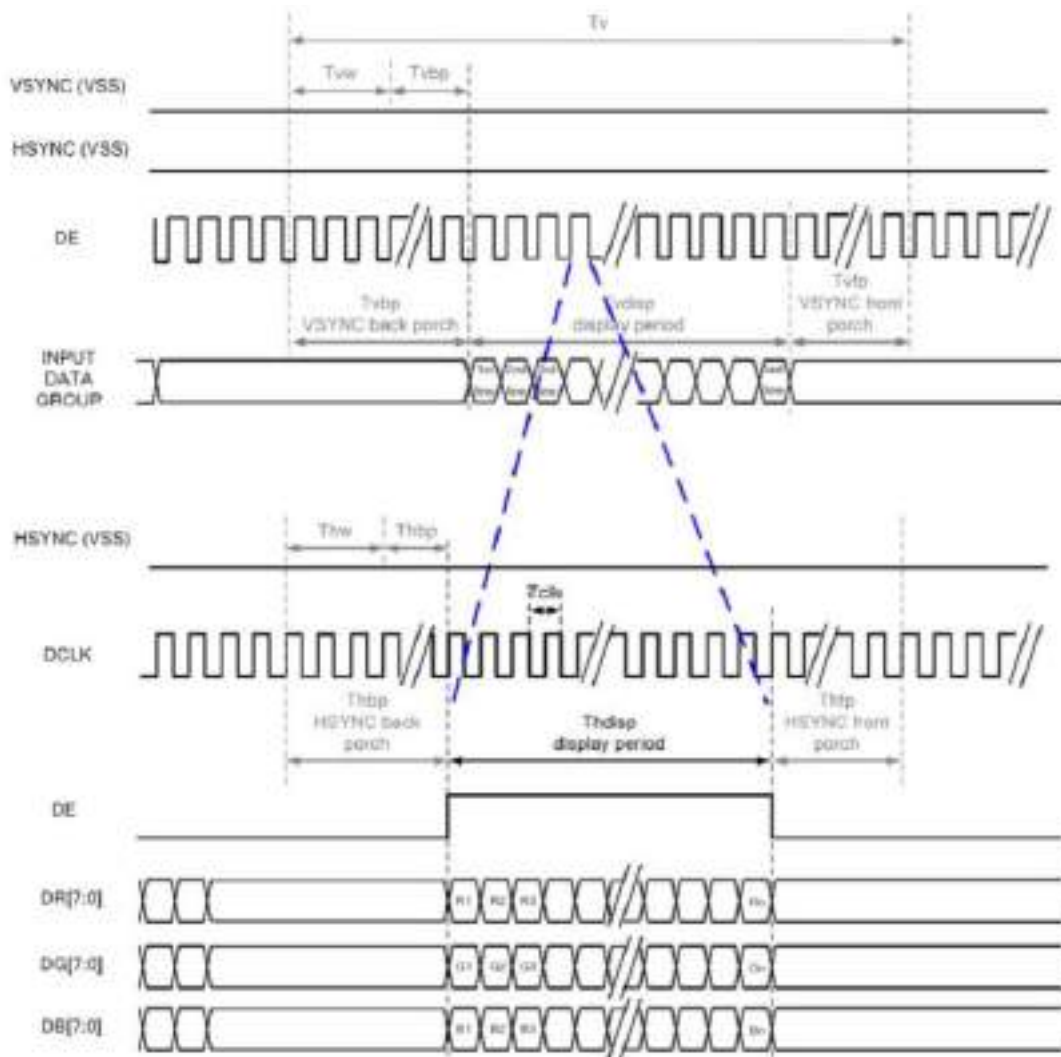
Note. It is necessary to keep $T_{vbp}=12$ and $T_{hbp}=43$ in sync mode. In DE mode it is not necessary.



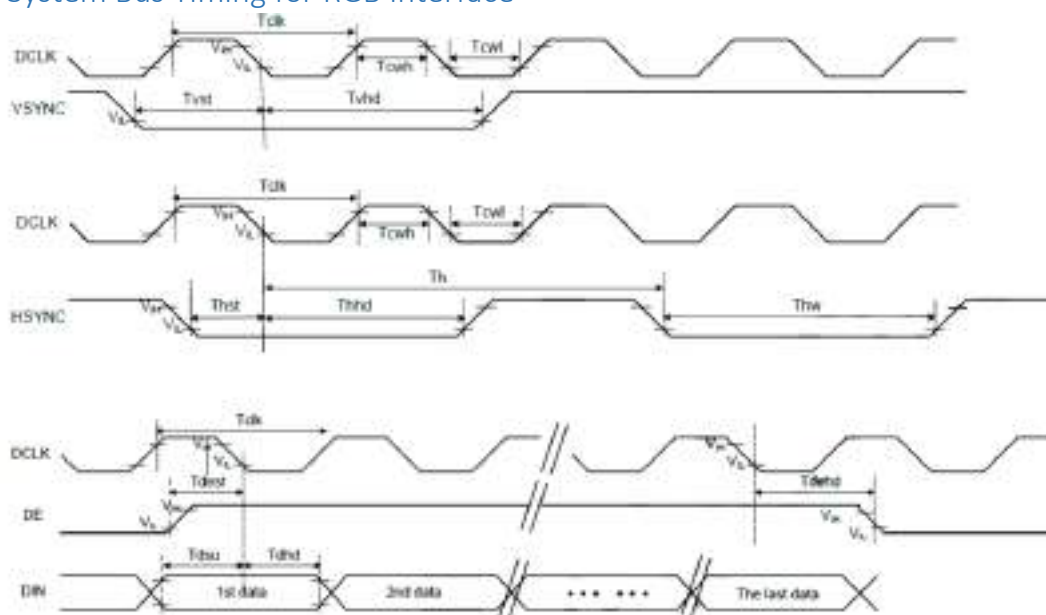
10.1.2 SYNC-DE mode timing diagram



10.1.3 DE mode timing diagram



10.2 System Bus Timing for RGB Interface



PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
CLK Pulse Duty	T_{clk}	40	50	60	%
HSYNC Width	T_{hw}	2	-	-	DCLK
HSYNC Period	T_h	55	60	65	CLK
VSYNC Setup Time	T_{vst}	12	-	-	ns
VSYNC Hold Time	T_{vhd}	12	-	-	ns
HSYNC Setup Time	T_{hst}	12	-	-	ns
HSYNC Hold Time	T_{hhd}	12	-	-	ns
Data Setup Time	T_{dsu}	12	-	-	ns
Data Hold Time	T_{dhd}	12	-	-	ns
DE Setup Time	T_{dest}	12	-	-	ns
DE Hold Time	T_{dehd}	12	-	-	ns

11 CAPACITIVE TOUCH SCREEN PANEL SPECIFICATIONS

11.1 Mechanical characteristics

DESCRIPTION	SPECIFICATION	REMARK
Touch Panel Size	3.5 inch	UxTouch
Outline Dimension of CTP	93.96 x 76.44	UxTouch
Product Thickness	2.15 mm	UxTouch
Glass Thickness	1.1 mm	UxTouch
CTP View Area	70.68 x 53.16	UxTouch
Sensor Active Area	76.10 x 62.90	UxTouch
Structure type	Glass + Glass	UxTouch
Surface Hardness	7H	UxTouch

11.2 Electrical characteristics

DESCRIPTION	SPECIFICATION	NOTE
Power Consumption (IDD)	Active Mode	93 mA
	Sleep Mode	10 mA
Linearity	+/-1.5mm	Note 1
Controller	ILI2132A	
Resolution	320 x 240	

Note 1. The value 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:

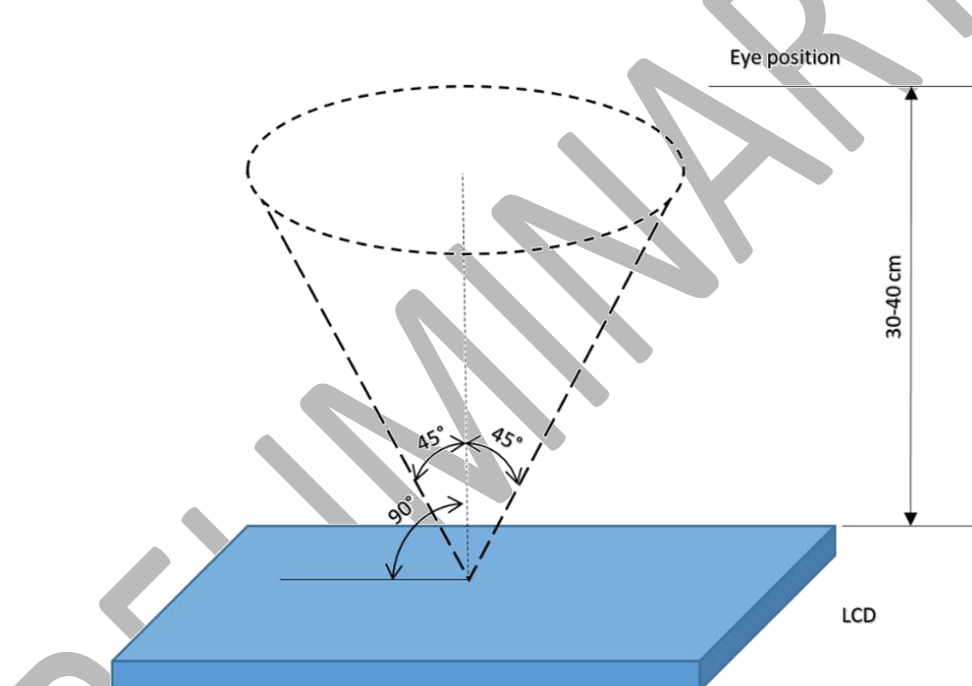
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

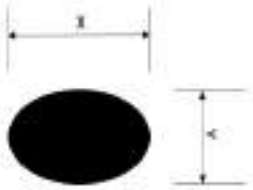
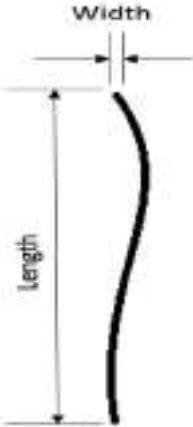
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



13.2 Inspection standard

Item	Criterion																		
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ <table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>D ≤ 0.15 mm</td><td>Ignored</td></tr><tr><td>0.15 mm < D ≤ 0.30 mm</td><td>N ≤ 3</td></tr><tr><td>0.3mm < D</td><td>Not allowed</td></tr></table> *Spots density: 10 mm	3.5" ≤ Size ≤ 5"		Average Diameter	Qualified Qty	D ≤ 0.15 mm	Ignored	0.15 mm < D ≤ 0.30 mm	N ≤ 3	0.3mm < D	Not allowed								
3.5" ≤ Size ≤ 5"																			
Average Diameter	Qualified Qty																		
D ≤ 0.15 mm	Ignored																		
0.15 mm < D ≤ 0.30 mm	N ≤ 3																		
0.3mm < D	Not allowed																		
LCD black spots, white spots, light leakage (line Type)	 <table><tr><th colspan="3">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>W ≤ 0.03</td><td>Ignored</td></tr><tr><td>L ≤ 3.0</td><td>0.03 < W ≤ 0.05</td><td>2</td></tr><tr><td>L ≤ 3.0</td><td>0.05 < W ≤ 0.1</td><td>1</td></tr><tr><td>3.0 < L</td><td>0.1 < W</td><td>Not allowed</td></tr></table> *Spots density: 10 mm	3.5" ≤ Size ≤ 5"			Length/mm	Width/mm	Qualified Qty	-	W ≤ 0.03	Ignored	L ≤ 3.0	0.03 < W ≤ 0.05	2	L ≤ 3.0	0.05 < W ≤ 0.1	1	3.0 < L	0.1 < W	Not allowed
3.5" ≤ Size ≤ 5"																			
Length/mm	Width/mm	Qualified Qty																	
-	W ≤ 0.03	Ignored																	
L ≤ 3.0	0.03 < W ≤ 0.05	2																	
L ≤ 3.0	0.05 < W ≤ 0.1	1																	
3.0 < L	0.1 < W	Not allowed																	
Bright/Dark Dots	<table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>N ≤ 1</td></tr><tr><td>Dark Dots</td><td>N ≤ 2</td></tr><tr><td>Total Bright and Dark Dots</td><td>N ≤ 3</td></tr></table>	3.5" ≤ Size ≤ 5"		item	Qualified Qty	Bright Dots	N ≤ 1	Dark Dots	N ≤ 2	Total Bright and Dark Dots	N ≤ 3								
3.5" ≤ Size ≤ 5"																			
item	Qualified Qty																		
Bright Dots	N ≤ 1																		
Dark Dots	N ≤ 2																		
Total Bright and Dark Dots	N ≤ 3																		

Item	Criterion
Clear spots	Size < 5"
	Average Diameter
	Qualified Qty
	D < 0.2 mm
	Ignored
	0.2 mm < D < 0.3 mm
Polarizer bubbles	3
	0.3 mm < D < 0.5 mm
	2
	0.5 mm < D
	0
	*Spots density: 10 mm
Touch panel spot	3.5" ≤ Size ≤ 5"
	Average Diameter
	Qualified Qty
	D ≤ 0.2 mm
	Ignored
	0.2 mm < D ≤ 0.3 mm
Touch panel White line Scratch	2
	0.3 mm < D ≤ 0.5 mm
	1
	0.5 mm < D
	0
	Total Q'ty
	3
Touch panel spot	Size < 5"
	Average Diameter
	Qualified Qty
	D < 0.2 mm
	Ignored
	0.2 mm < D < 0.4 mm
Touch panel White line Scratch	5
	0.4 mm < D < 0.5 mm
	2
	0.5 mm < D
	0
Touch panel White line Scratch	Size < 5"
	Length
	Width
	Qualified Qty
	-
	W < 0.02
Touch panel White line Scratch	Ignored
	L < 3.0
	0.02 < W < 0.05
	2
	L < 2.5
	0.05 < W < 0.08
Touch panel White line Scratch	0
	-
	0.08 < W

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 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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 cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

15 LEGAL INFORMATION

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RVT35HHBNWC00

EVE4 IPS 3.5" LCD TFT Datasheet

Rev.0.1

2021-01-08

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	3.5	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	136.00 × 92.80 × 12.25	mm
Active Area (W × H)	70.08 × 52.56	mm
Pixel Pitch (W × H)	0.219 × 0.219	mm
Resolution	320 (RGB) × 240	/
Brightness	800	cd/m ²
Color Depth	16.7 M	/
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	ILI2132A	/
Supply Voltage for Module	3.3	V
Supply Voltage for Backlight	5.0 (TYP.)	V
Weight	78	g

Note 1: RoHS compliant

Note 2: LCM weight tolerance: ± 5%.

REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
0.1	2021-01-08	Preliminary	

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1 MODULE CLASSIFICATION INFORMATION

RV	T	35	H	H	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	35 – 3.5”
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	H –320 x 240 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

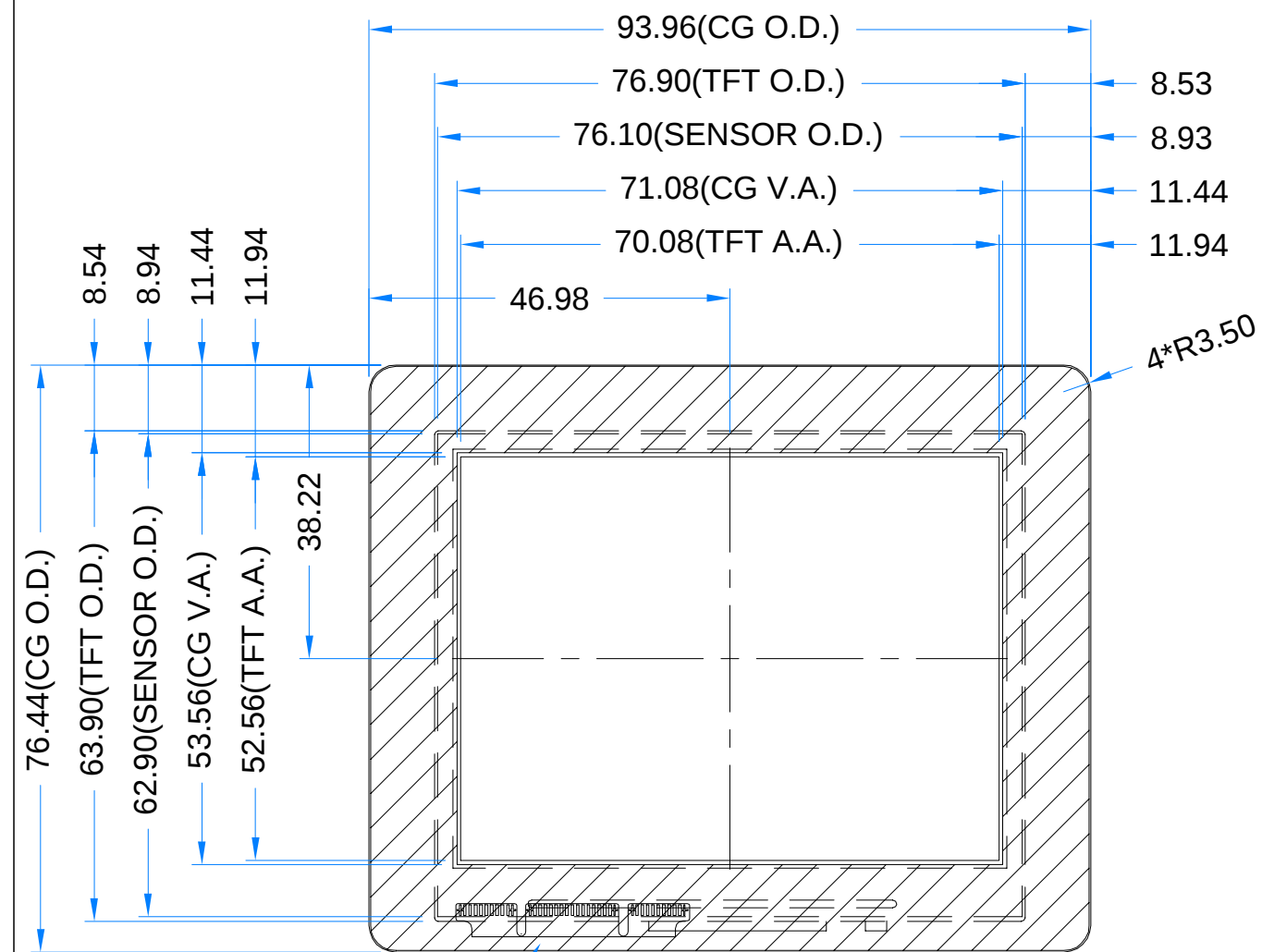
UxTouch are LCD TFT displays with specially designed projected capacitive touch panels. UxTouch display can be mounted without any additional holes in the housing. Our standard UxTouch displays include double-sided adhesive tape (DST) to stick TFT easily to the housing.

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 RVT35HHBNWC00-B, which is superior in optical performance and does not require any extra support.

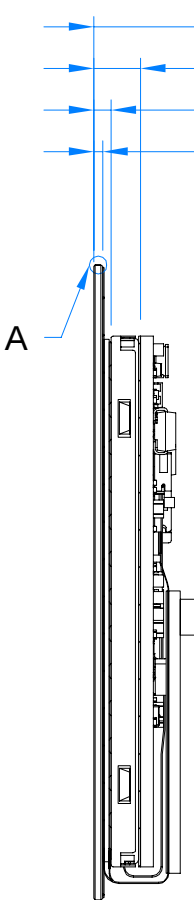
Figure 1. Example of using the support brackets



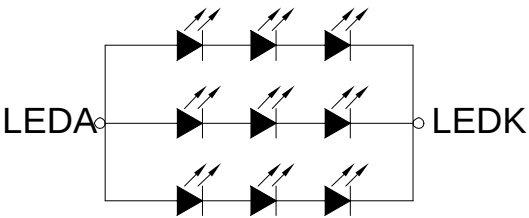
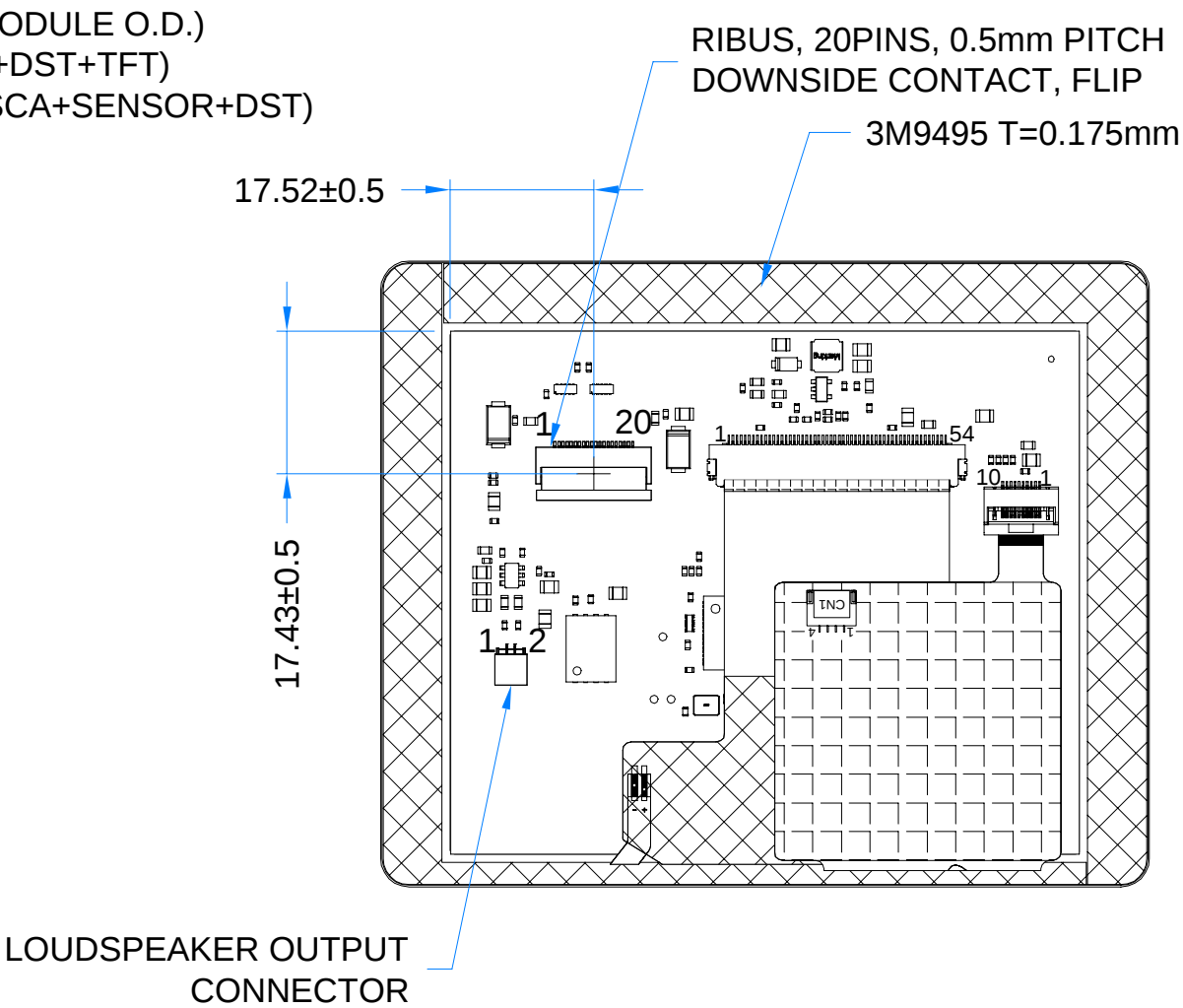
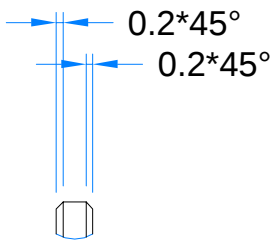
Revision:	Changes:	Date:
1.0	Initial Case	2020.12.15



BLACK MASK PRINTING
COLOR: RAL9005



DETAIL A
SCALE 4:1



LED Diagram Circuit

TFT NOTES: 1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS 2. RESOLUTION: 320x240 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: RVT35HHBNWC00				
			SN:				
			DRAWN: M.Natywa		2020.12.15	1:0.91	
					2021.01.08	[mm]	
			ISO A3	P. 1 of 1			

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Tél. 01 47 95 99 84 - Fax. 01 47 01 16 22 - e-mail: comp@es-france.com - Site Web: www.es-france.com

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	VIN	-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	-	% 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	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	180	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

6 BACKLIGHT ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Backlight	BLVDD	2.7	5.0	6.0	V	
Current drawn from BLVDD @5.0V	I _{BLVDD=5.0V}	TBD	150	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	65	TBD	mA	50% of backlight, Note 1
Current drawn from BLVDD @3.3V	I _{BLVDD=3.3V}	TBD	250	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@3.3V	I _{BLVDD=3.3 V}	TBD	100	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

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	-	30	-	ms	FIG 2.	4
Contrast Ratio	Cr		-	1000	-	---	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	$\phi = 90^\circ$	-	80	-	deg	FIG 4.	6
		$\phi = 270^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 0^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 180^\circ$	-	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	0.575	0.615	0.655	FIG 3.		5
		y	0.296	0.336	0.376			
	Green	x	0.352	0.392	0.432			
		y	0.512	0.552	0.592			
	Blue	x	0.100	0.140	0.180			
		y	0.085	0.125	0.165			
	White	x	0.274	0.316	0.358			
		y	0.295	0.336	0.378			

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 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 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 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

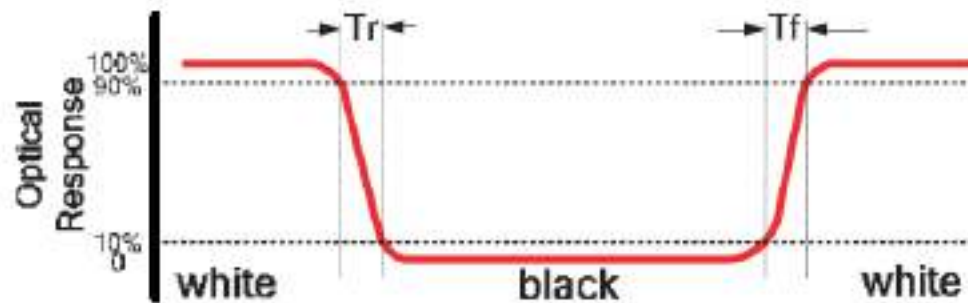
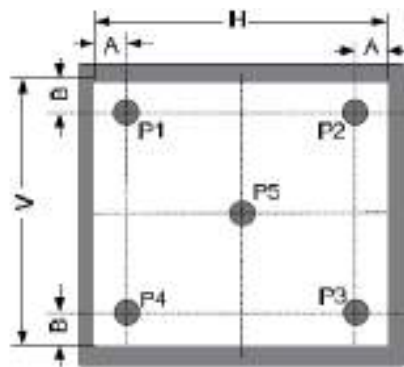


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

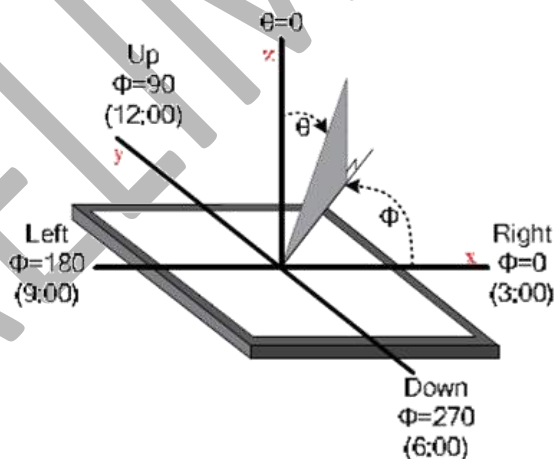
B: 5mm

H,V: Active Area

Light spot size $\phi=5\text{mm}$, 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 INTERFACE DESCRIPTION

8.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

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.

9 BT817Q CONTROLLER SPECIFICATION

9.1 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

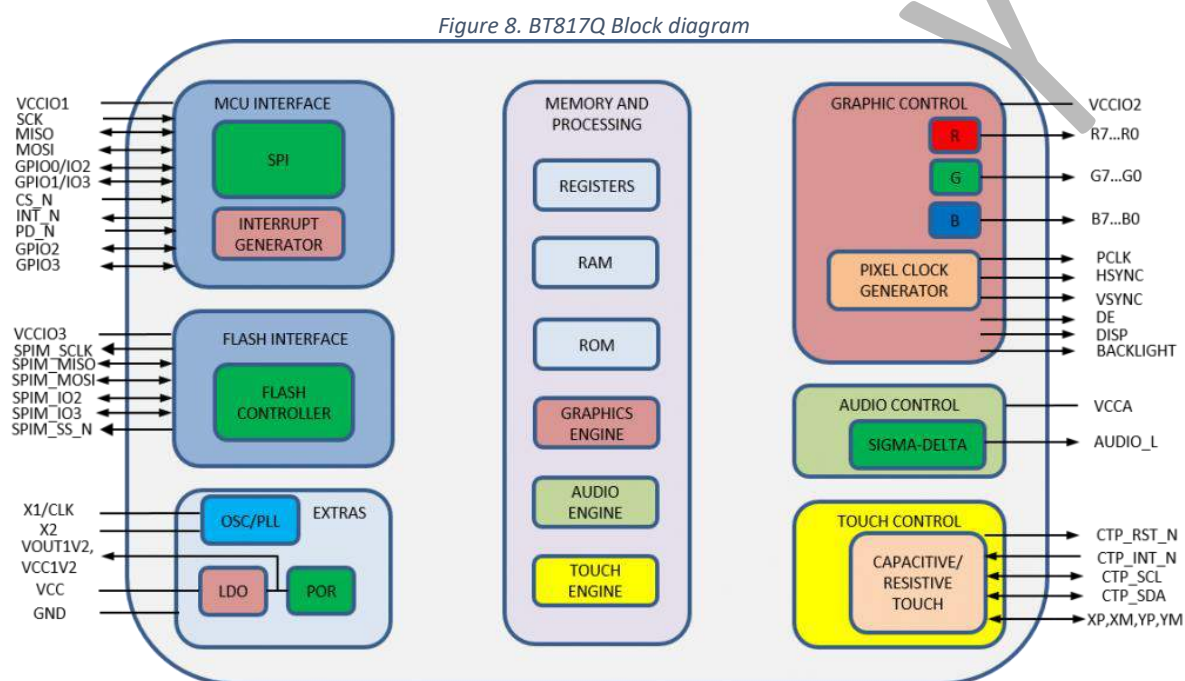
www.riverdi.com

Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

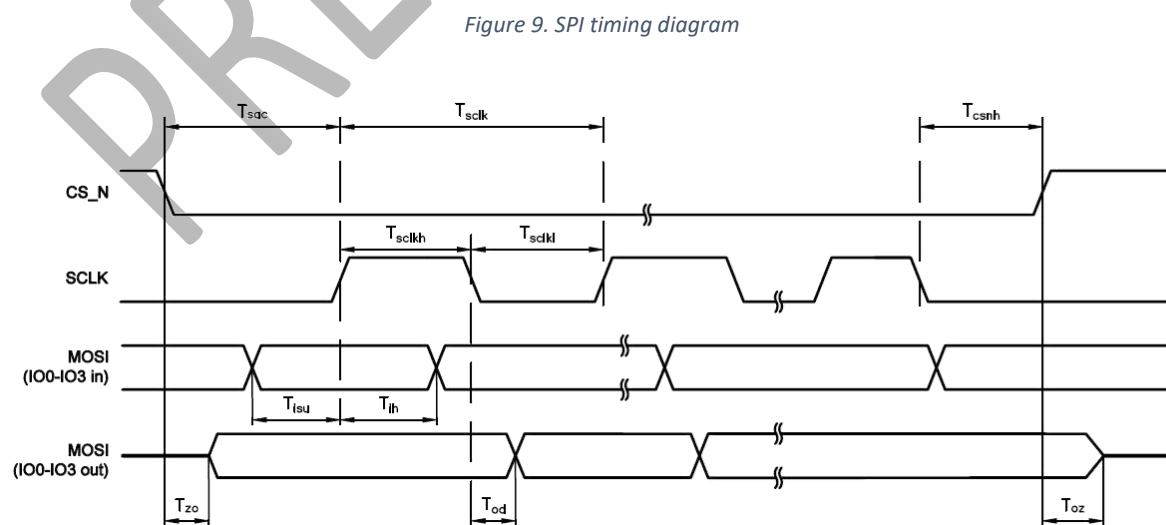
QSPI Interface – the QSPI slave interface operates up to 30MHz (It depends on EVE 4 system clock frequency and will be verified in Riverdi lab). Only SPI mode 0 is supported. The QSPI can be configured as a SPI slave in SINGLE, DUAL or QUAD channel modes.

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



9.3 Host interface SPI mode 0



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

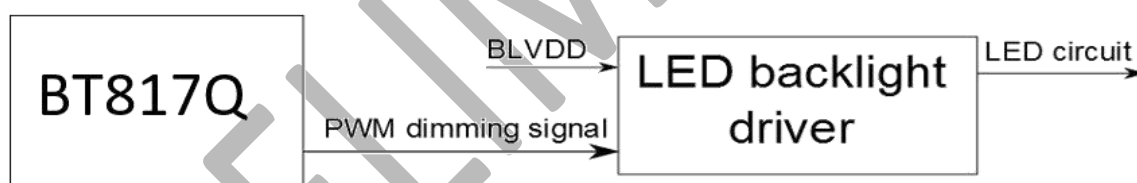
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

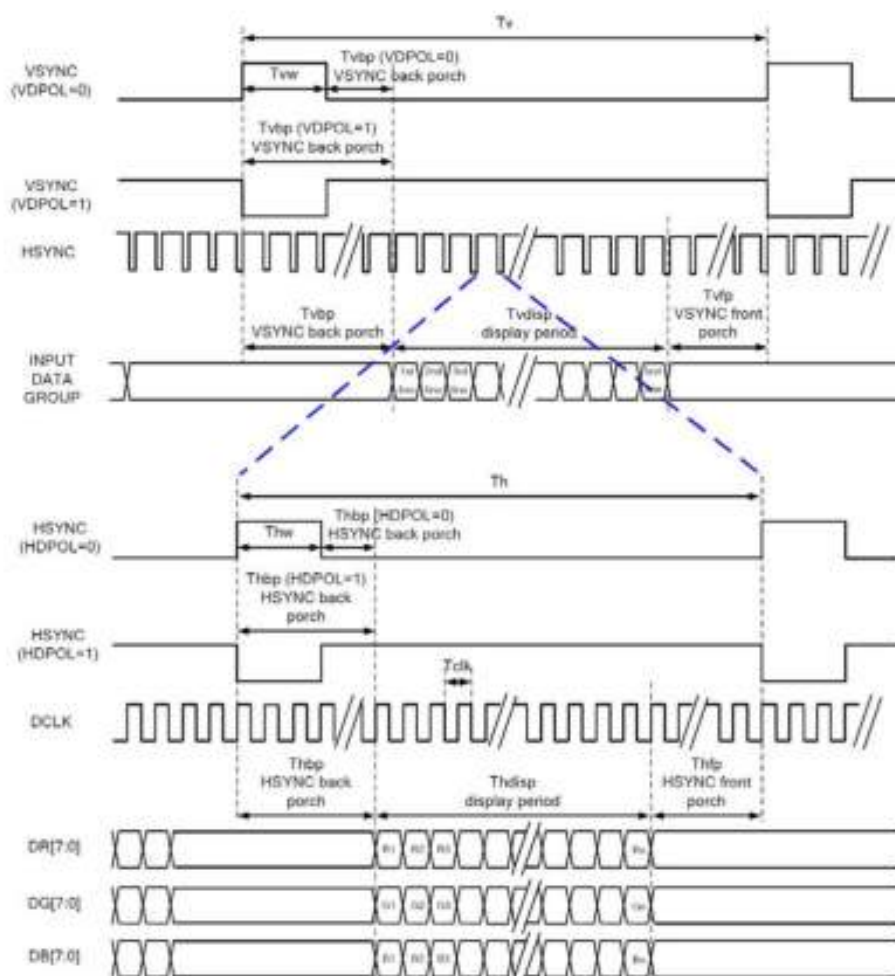
10.1 Input setup timing setting

RGB MODE SELECTION	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

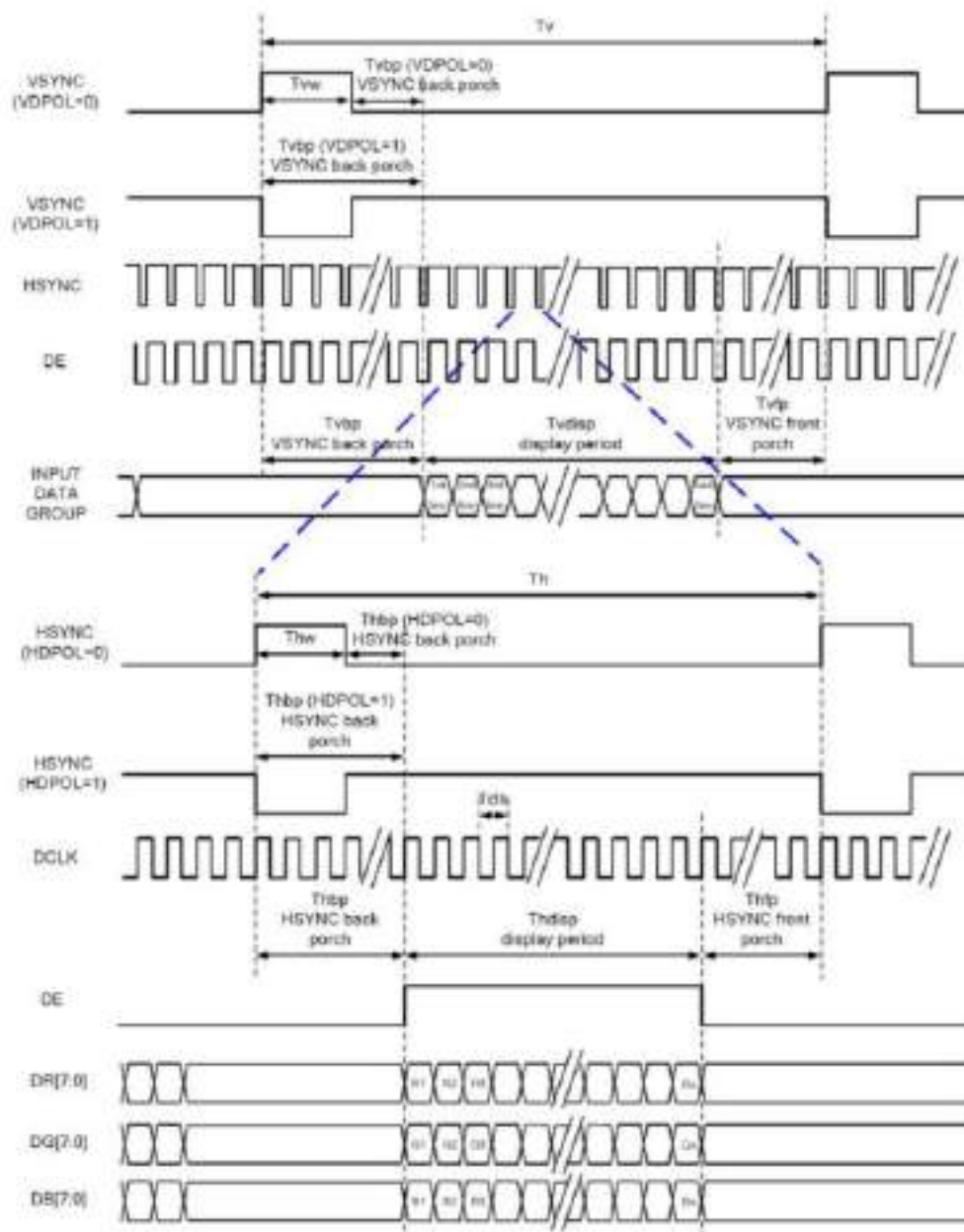
10.1.1 Parallel 24-bit RGB Timing Table

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK Frequency	F_{clk}	5	6	8	MHz	
DCLK Period	T_{clk}	125	167	200	ns	
HSYNC	Period Time	T_h	325	371	438	DCLK
	Display Period	T_{hdisp}	320			DCLK
	Back Porch	T_{hbp}	3	43	43	DCLK SYNC mode back porch control by H_BLANKING [7:0] setting $T_{hbp} = H_BLANKING [7:0]$
	Front Porch	T_{hfp}	2	8	75	DCLK
	Pulse Width	T_{hw}	2	4	43	DCLK
VSYNC	Period Time	T_v	244	260	289	HSYNC
	Display Period	T_{vdisp}	240			HSYNC
	Back Porch	T_{vbp}	2	12	12	HSYNC SYNC mode back porch control by V_BLANKING [7:0] setting $T_{vbp} = V_BLANKING [7:0]$
	Front Porch	T_{vfp}	2	8	37	HSYNC
	Pulse Width	T_{vw}	2	4	12	HSYNC

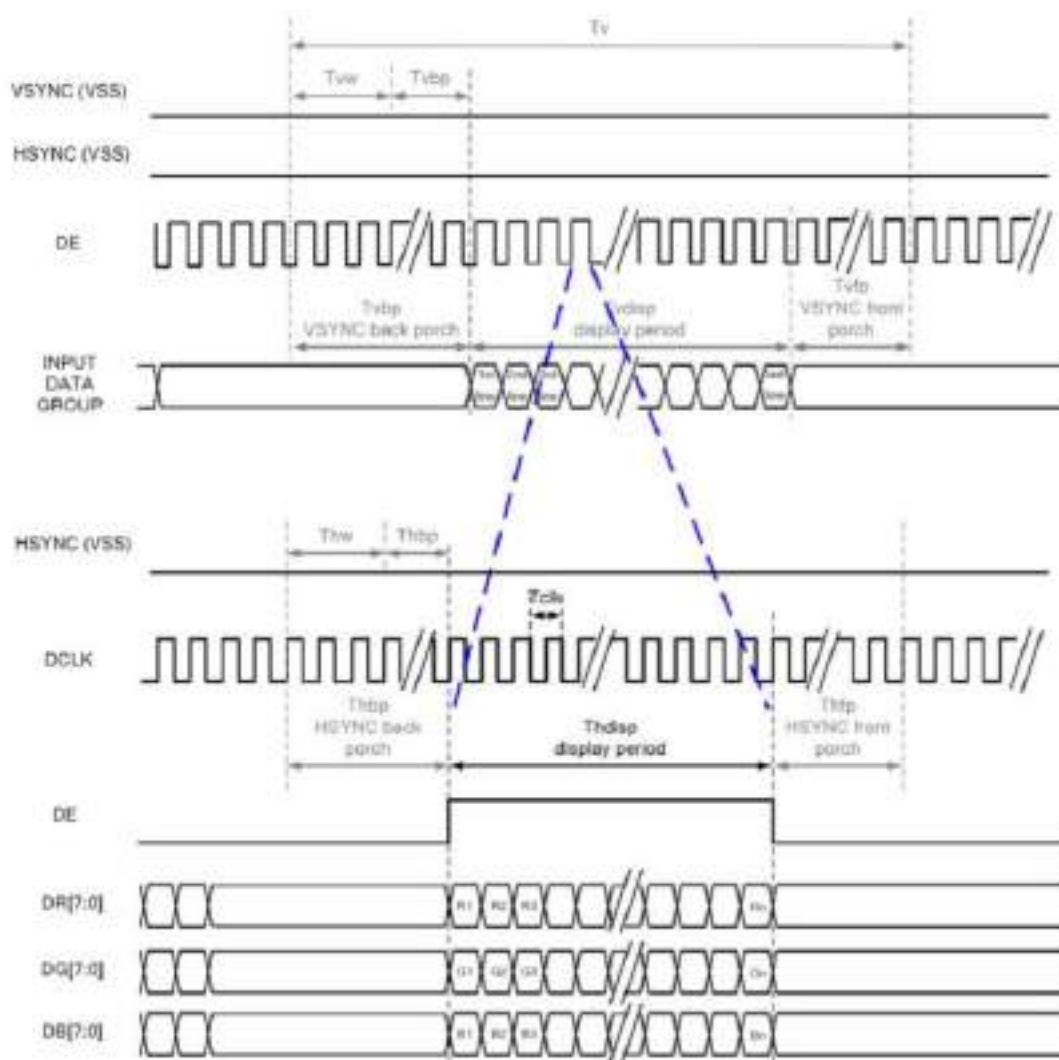
Note. It is necessary to keep $T_{vbp}=12$ and $T_{hbp}=43$ in sync mode. In DE mode it is not necessary.



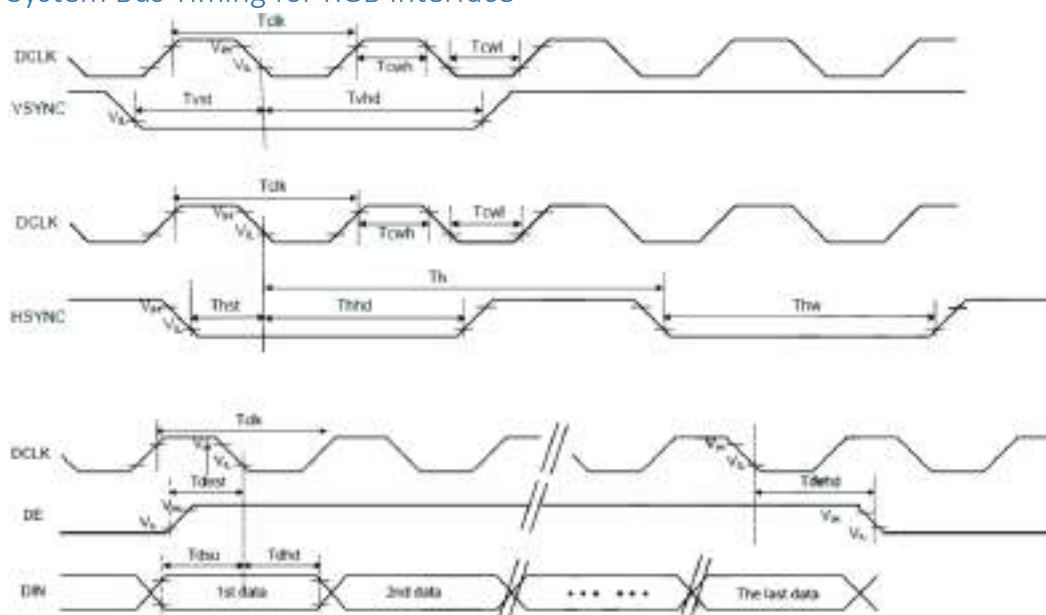
10.1.2 SYNC-DE mode timing diagram



10.1.3 DE mode timing diagram



10.2 System Bus Timing for RGB Interface



PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
CLK Pulse Duty	T_{clk}	40	50	60	%
HSYNC Width	T_{hw}	2	-	-	DCLK
HSYNC Period	T_h	55	60	65	CLK
VSYNC Setup Time	T_{vst}	12	-	-	ns
VSYNC Hold Time	T_{vhd}	12	-	-	ns
HSYNC Setup Time	T_{hst}	12	-	-	ns
HSYNC Hold Time	T_{hhd}	12	-	-	ns
Data Setup Time	T_{dsu}	12	-	-	ns
Data Hold Time	T_{dhd}	12	-	-	ns
DE Setup Time	T_{dest}	12	-	-	ns
DE Hold Time	T_{dehd}	12	-	-	ns

11 CAPACITIVE TOUCH SCREEN PANEL SPECIFICATIONS

11.1 Mechanical characteristics

DESCRIPTION	SPECIFICATION	REMARK
Touch Panel Size	3.5 inch	UxTouch
Outline Dimension of CTP	93.96 x 76.44	UxTouch
Product Thickness	2.15 mm	UxTouch
Glass Thickness	1.1 mm	UxTouch
CTP View Area	70.68 x 53.16	UxTouch
Sensor Active Area	76.10 x 62.90	UxTouch
Structure type	Glass + Glass	UxTouch
Surface Hardness	7H	UxTouch

11.2 Electrical characteristics

DESCRIPTION	SPECIFICATION		NOTE
Power Consumption (IDD)	Active Mode	93 mA	Note 1
	Sleep Mode	10 mA	
Linearity	+/-1.5mm		
Controller	ILI2132A		
Resolution	320 x 240		

Note 1. The value 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:

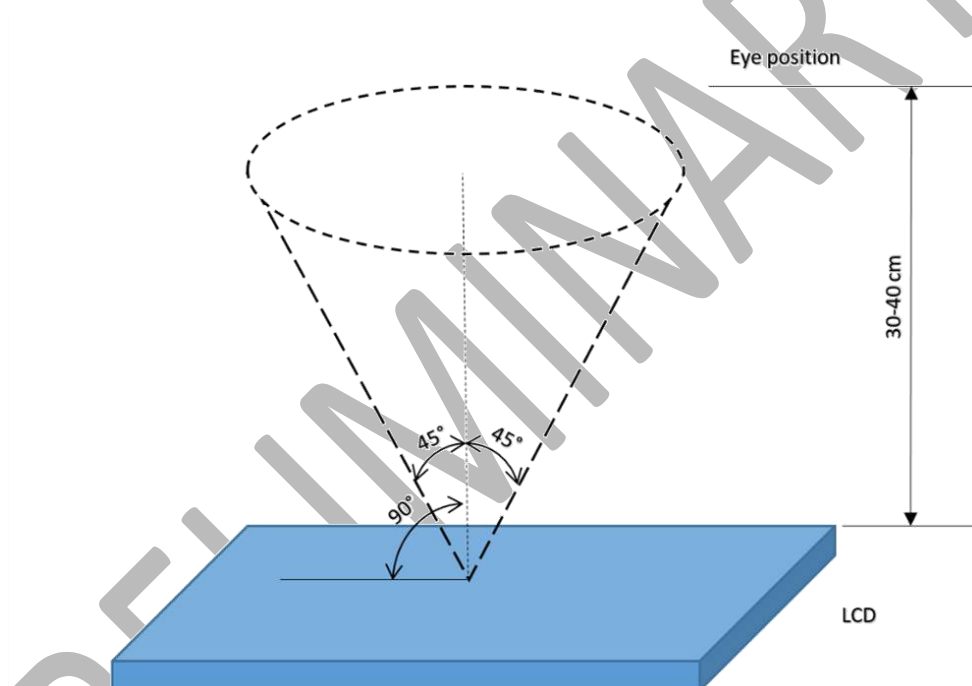
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

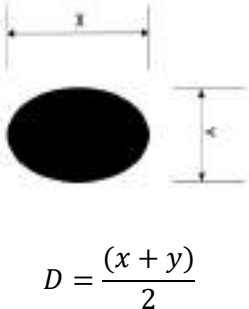
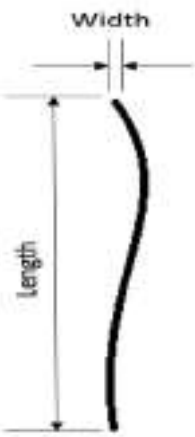
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



13.2 Inspection standard

Item	Criterion															
Black spots, white spots, light leakage, Foreign Particle (round Type)	 3.5" ≤ Size ≤ 5" <table><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>D ≤ 0.15 mm</td><td>Ignored</td></tr><tr><td>0.15 mm < D ≤ 0.30 mm</td><td>N ≤ 3</td></tr><tr><td>0.3mm < D</td><td>Not allowed</td></tr></table> *Spots density: 10 mm	Average Diameter	Qualified Qty	D ≤ 0.15 mm	Ignored	0.15 mm < D ≤ 0.30 mm	N ≤ 3	0.3mm < D	Not allowed							
Average Diameter	Qualified Qty															
D ≤ 0.15 mm	Ignored															
0.15 mm < D ≤ 0.30 mm	N ≤ 3															
0.3mm < D	Not allowed															
LCD black spots, white spots, light leakage (line Type)	 3.5" ≤ Size ≤ 5" <table><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>W ≤ 0.03</td><td>Ignored</td></tr><tr><td>L ≤ 3.0</td><td>0.03 < W ≤ 0.05</td><td>2</td></tr><tr><td>L ≤ 3.0</td><td>0.05 < W ≤ 0.1</td><td>1</td></tr><tr><td>3.0 < L</td><td>0.1 < W</td><td>Not allowed</td></tr></table> *Spots density: 10 mm	Length/mm	Width/mm	Qualified Qty	-	W ≤ 0.03	Ignored	L ≤ 3.0	0.03 < W ≤ 0.05	2	L ≤ 3.0	0.05 < W ≤ 0.1	1	3.0 < L	0.1 < W	Not allowed
Length/mm	Width/mm	Qualified Qty														
-	W ≤ 0.03	Ignored														
L ≤ 3.0	0.03 < W ≤ 0.05	2														
L ≤ 3.0	0.05 < W ≤ 0.1	1														
3.0 < L	0.1 < W	Not allowed														
Bright/Dark Dots	3.5" ≤ Size ≤ 5" <table><tr><th>item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>N ≤ 1</td></tr><tr><td>Dark Dots</td><td>N ≤ 2</td></tr><tr><td>Total Bright and Dark Dots</td><td>N ≤ 3</td></tr></table>	item	Qualified Qty	Bright Dots	N ≤ 1	Dark Dots	N ≤ 2	Total Bright and Dark Dots	N ≤ 3							
item	Qualified Qty															
Bright Dots	N ≤ 1															
Dark Dots	N ≤ 2															
Total Bright and Dark Dots	N ≤ 3															

Item	Criterion
Clear spots	Size < 5"
	Average Diameter
	Qualified Qty
	D < 0.2 mm
	Ignored
	0.2 mm < D < 0.3 mm
Polarizer bubbles	3
	0.3 mm < D < 0.5 mm
	2
	0.5 mm < D
	0
	*Spots density: 10 mm
Touch panel spot	3.5" ≤ Size ≤ 5"
	Average Diameter
	Qualified Qty
	D ≤ 0.2 mm
	Ignored
	0.2 mm < D ≤ 0.3 mm
Touch panel White line Scratch	2
	0.3 mm < D ≤ 0.5 mm
	1
	0.5 mm < D
	0
	Total Q'ty
	3
Touch panel spot	Size < 5"
	Average Diameter
	Qualified Qty
	D < 0.2 mm
	Ignored
	0.2 mm < D < 0.4 mm
Touch panel White line Scratch	5
	0.4 mm < D < 0.5 mm
	2
	0.5 mm < D
	0
Touch panel White line Scratch	Size < 5"
	Length
	Width
	Qualified Qty
	-
	W < 0.02
Touch panel White line Scratch	Ignored
	L < 3.0
	0.02 < W < 0.05
	2
	L < 2.5
	0.05 < W < 0.08
Touch panel White line Scratch	0
	-
	0.08 < W

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 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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 cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

15 LEGAL INFORMATION

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RVT35HHBNWN00

EVE4 IPS 3.5" LCD TFT Datasheet

Rev.0.1

2021-01-18

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	3.5	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	76.90 × 63.90 × 8.12	mm
Active Area (W × H)	70.08 × 52.56	mm
Pixel Pitch (W × H)	0.219 × 0.219	mm
Resolution	320 (RGB) × 240	/
Brightness	1000	cd/m ²
Color Depth	16.7 M	/
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 (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	2021-01-18	Preliminary	

CONTENTS

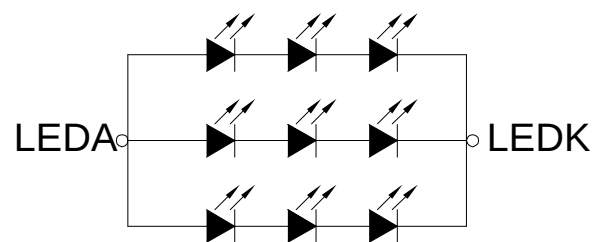
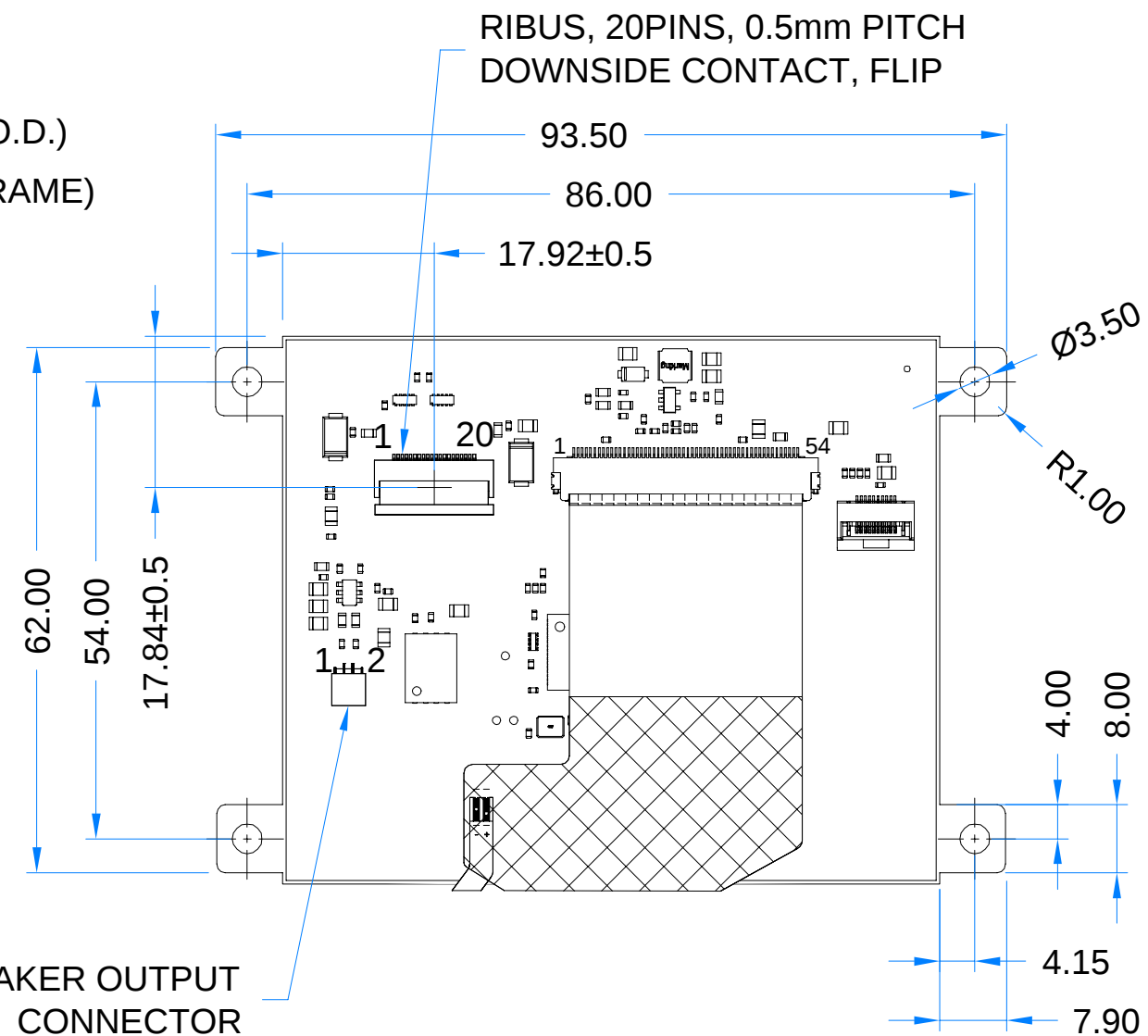
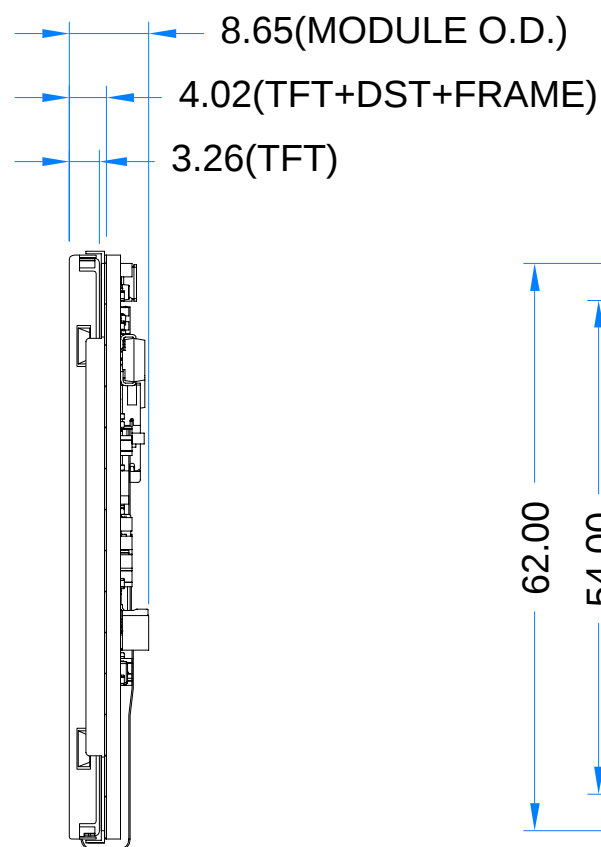
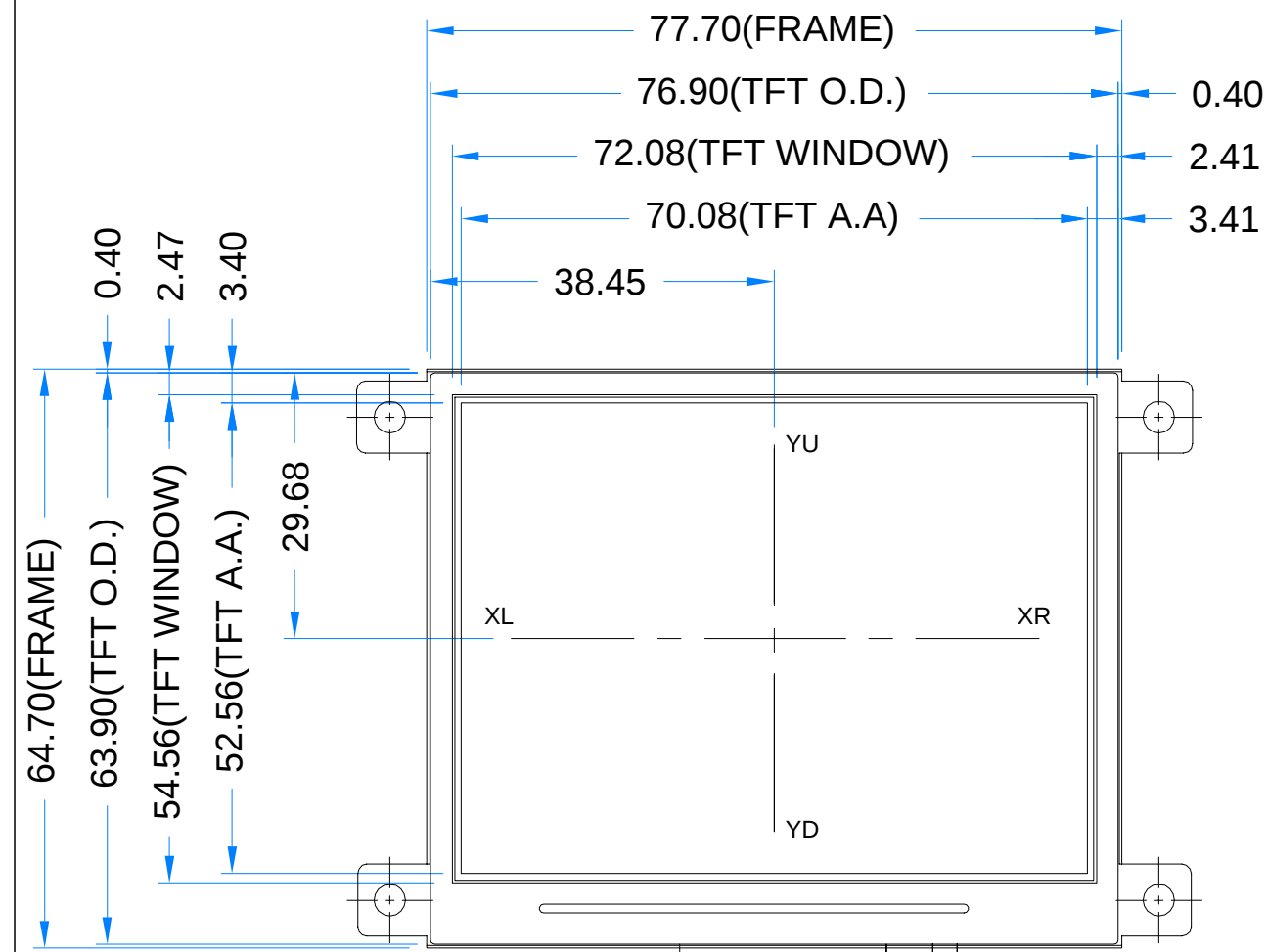
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1 MODULE CLASSIFICATION INFORMATION

RV	T	35	H	H	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	35 – 3.5”
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	H – 320 x 240 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)

Revision:	Changes:	Date:
1.0	Initial Case	2020.12.22



TFT NOTES:

1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS
2. RESOLUTION: 320x240
3. VIEWING ANGLE: FREE
4. SURFACE LUMINANCE: 1000 cd/m²
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

GENERAL NOTES:

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

PN: RVT35HHBFWN00

SN:

DRAWN: M.Natywa

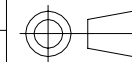


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ISO A3

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	VIN	-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	-	% 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).

4 ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	180	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

5 BACKLIGHT ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Backlight	BLVDD	2.7	5.0	6.0	V	
Current drawn from BLVDD @5.0V	I _{BLVDD=5.0V}	TBD	150	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	65	TBD	mA	50% of backlight, Note 1
Current drawn from BLVDD @3.3V	I _{BLVDD=3.3V}	TBD	250	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@3.3V	I _{BLVDD=3.3 V}	TBD	100	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.

6 ELECTRO-OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	-	30	-	ms	FIG 2.	4
Contrast Ratio	Cr		-	1000	-	---	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	$\phi = 90^\circ$	-	80	-	deg	FIG 4.	6
		$\phi = 270^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 0^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 180^\circ$	-	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	0.575	0.615	0.655	FIG 3.		5
		y	0.296	0.336	0.376			
	Green	x	0.352	0.392	0.432			
		y	0.512	0.552	0.592			
	Blue	x	0.100	0.140	0.180			
		y	0.085	0.125	0.165			
	White	x	0.274	0.316	0.358			
		y	0.295	0.336	0.378			

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 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 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 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

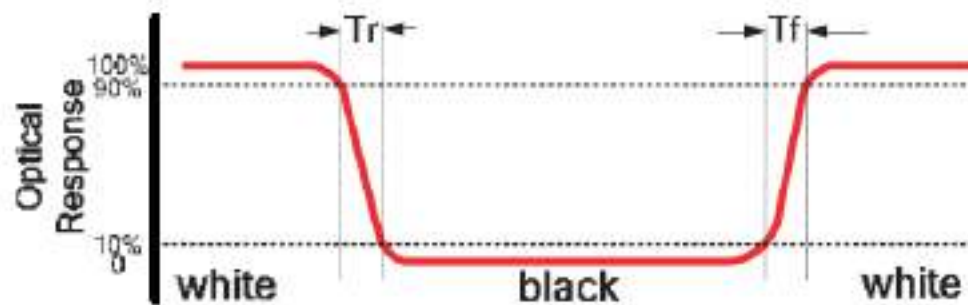
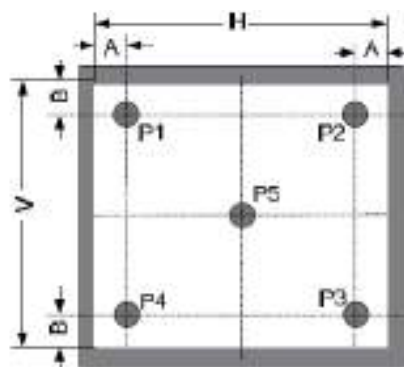


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

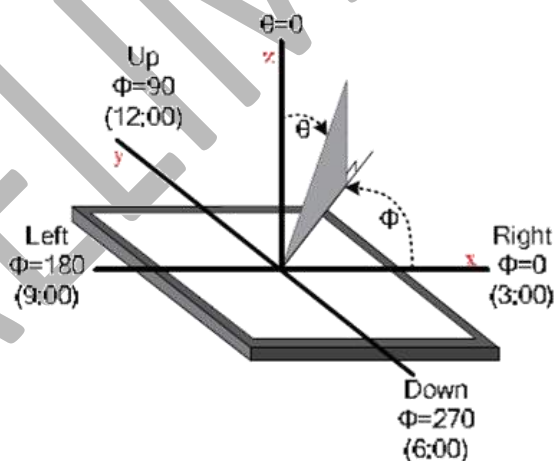
B: 5mm

H,V: Active Area

Light spot size $\phi=5\text{mm}$, 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



7 INTERFACE DESCRIPTION

7.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

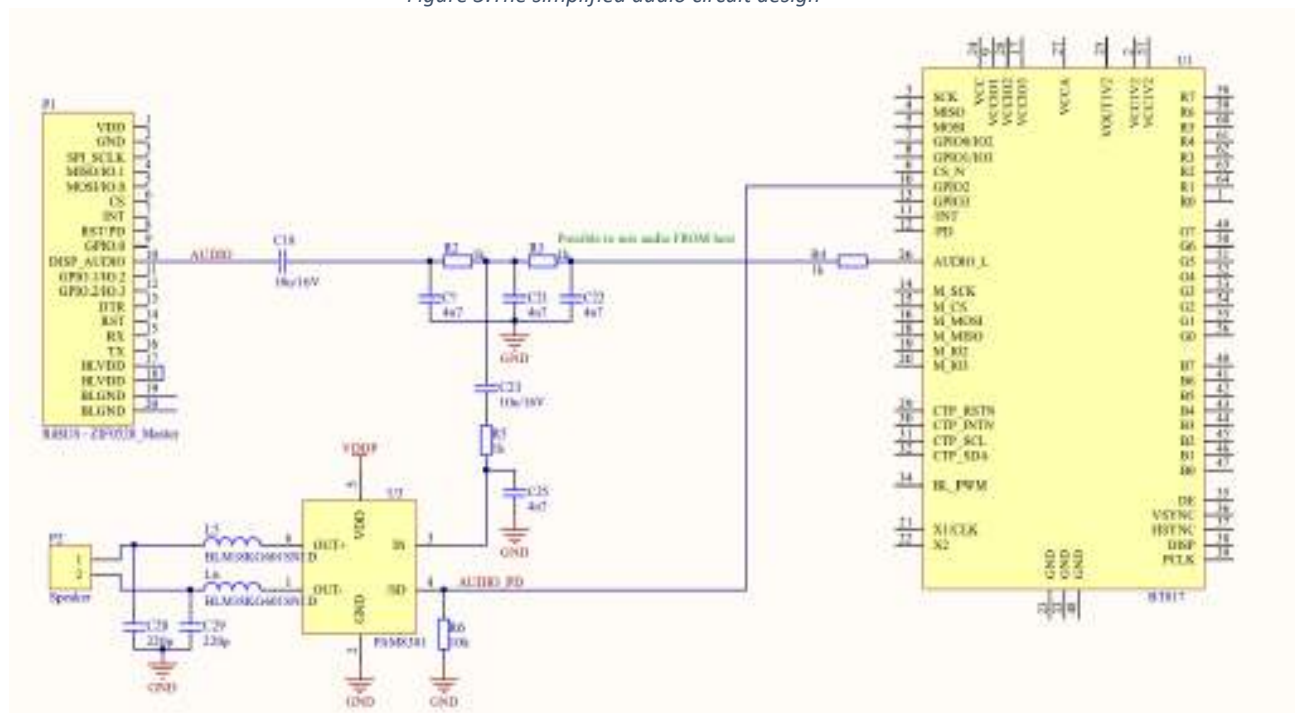
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil "+" terminal	Note 1
2	SPEAKER -	Speaker coil "-" terminal	

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. By standard, the EVE4 board is equipped with the separate 256Mb Flash memory chip, which allows to show up to 270 full resolution (320 * 240 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

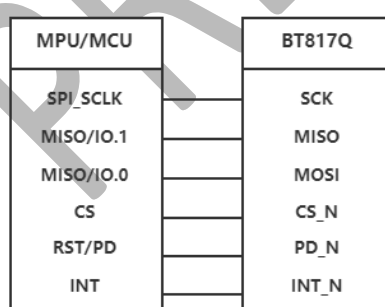
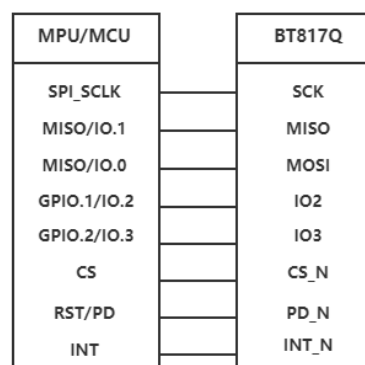


Figure 7. QSPI interface connection



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

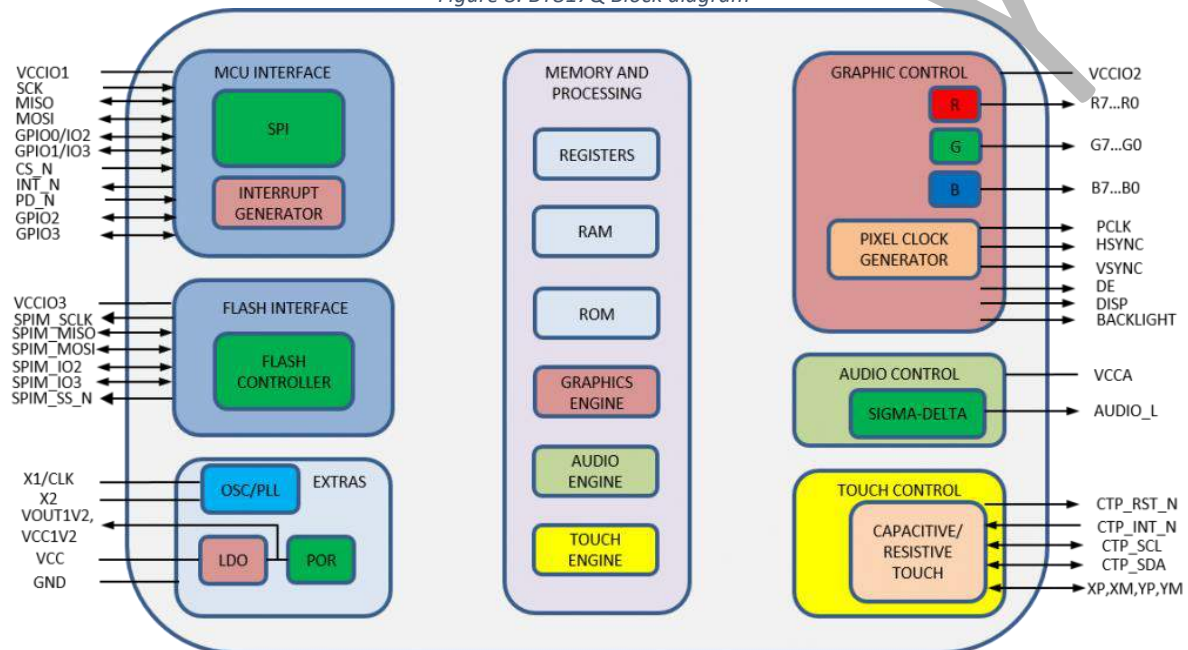
Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

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.

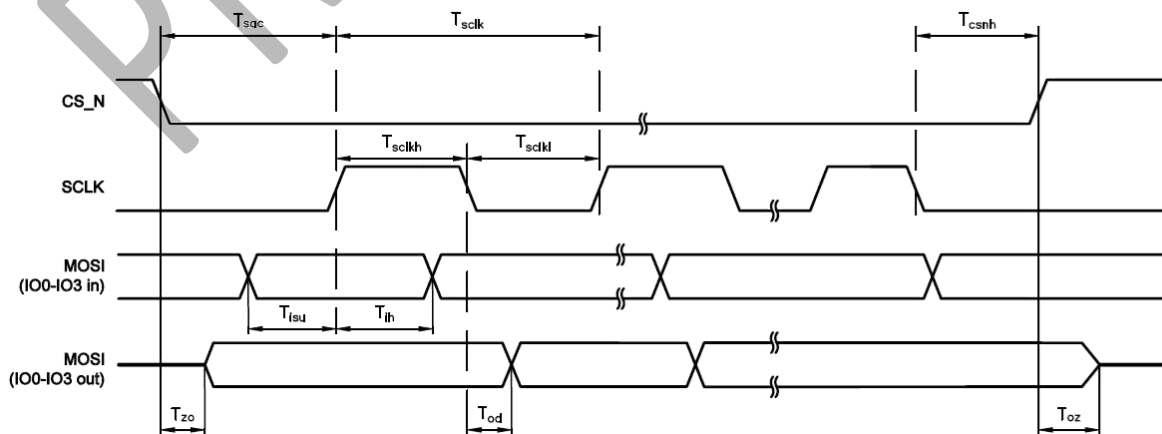
8.2 Block Diagram

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.

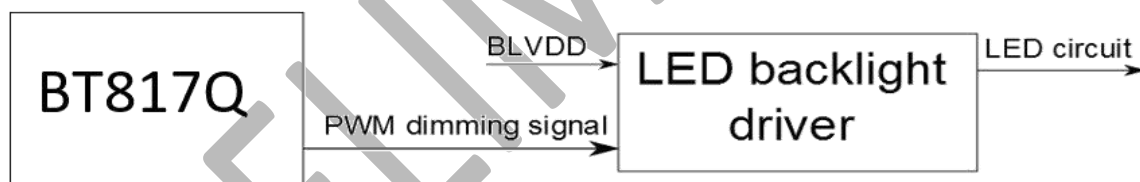
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

9 TIMING CHARACTERISTICS

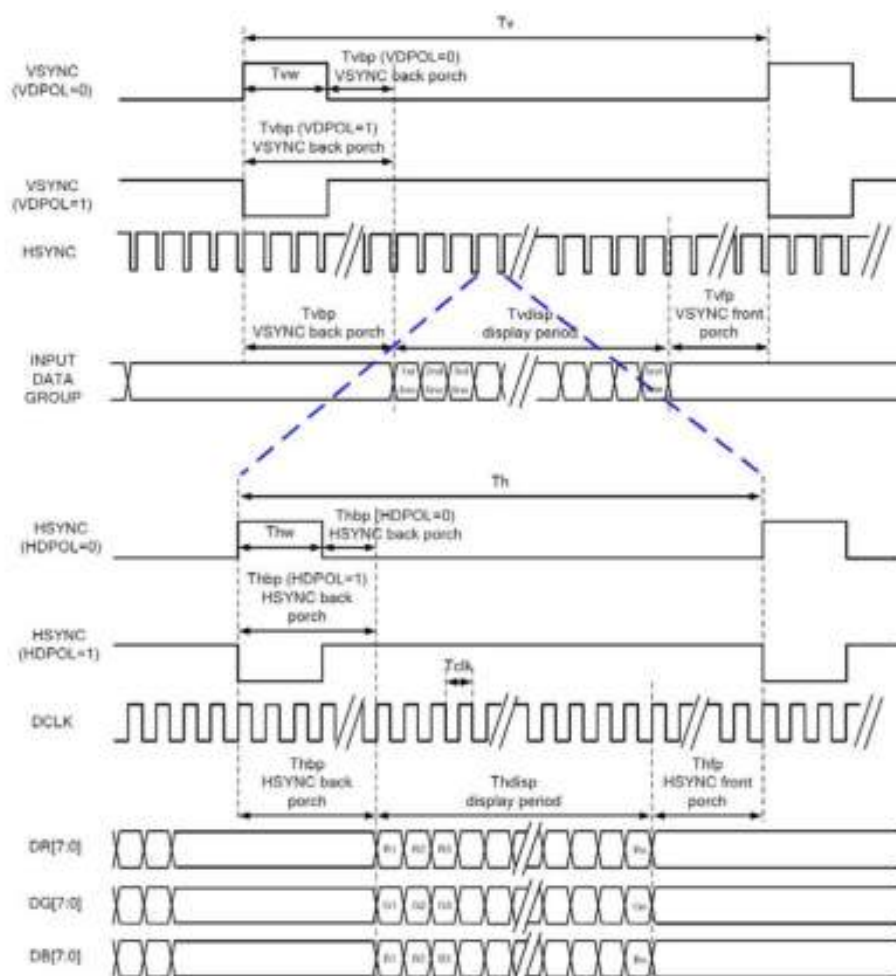
9.1 Input setup timing setting

RGB MODE SELECTION	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

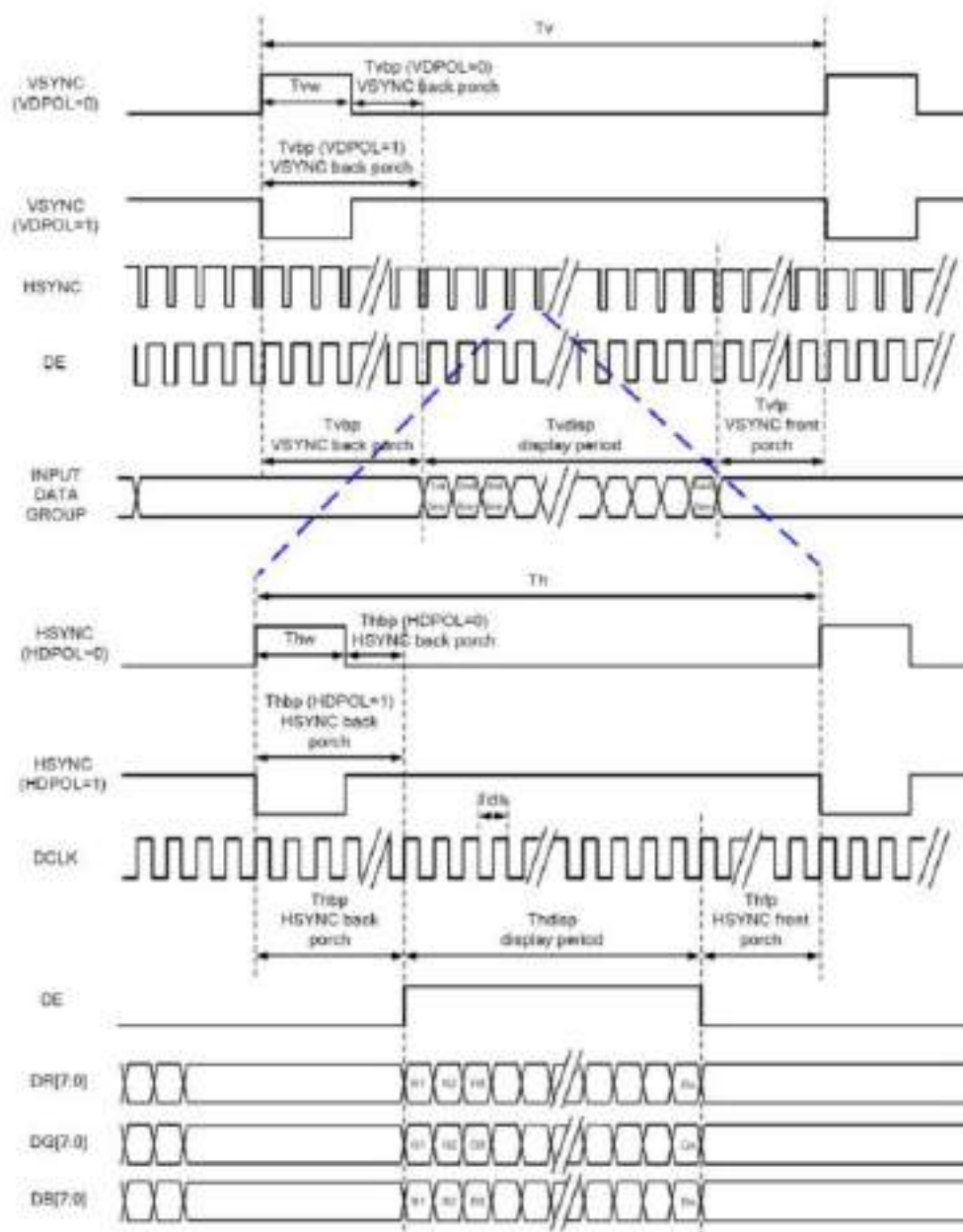
9.1.1 Parallel 24-bit RGB Timing Table

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK Frequency	F_{clk}	5	6	8	MHz	
DCLK Period	T_{clk}	125	167	200	ns	
HSYNC	Period Time	T_h	325	371	438	DCLK
	Display Period	T_{hdisp}	320			DCLK
	Back Porch	T_{hbp}	3	43	43	DCLK SYNC mode back porch control by H_BLANKING [7:0] setting $T_{hbp} = H_BLANKING [7:0]$
	Front Porch	T_{hfp}	2	8	75	DCLK
	Pulse Width	T_{hw}	2	4	43	DCLK
VSYNC	Period Time	T_v	244	260	289	HSYNC
	Display Period	T_{vdisp}	240			HSYNC
	Back Porch	T_{vbp}	2	12	12	HSYNC SYNC mode back porch control by V_BLANKING [7:0] setting $T_{vbp} = V_BLANKING [7:0]$
	Front Porch	T_{vfp}	2	8	37	HSYNC
	Pulse Width	T_{vw}	2	4	12	HSYNC

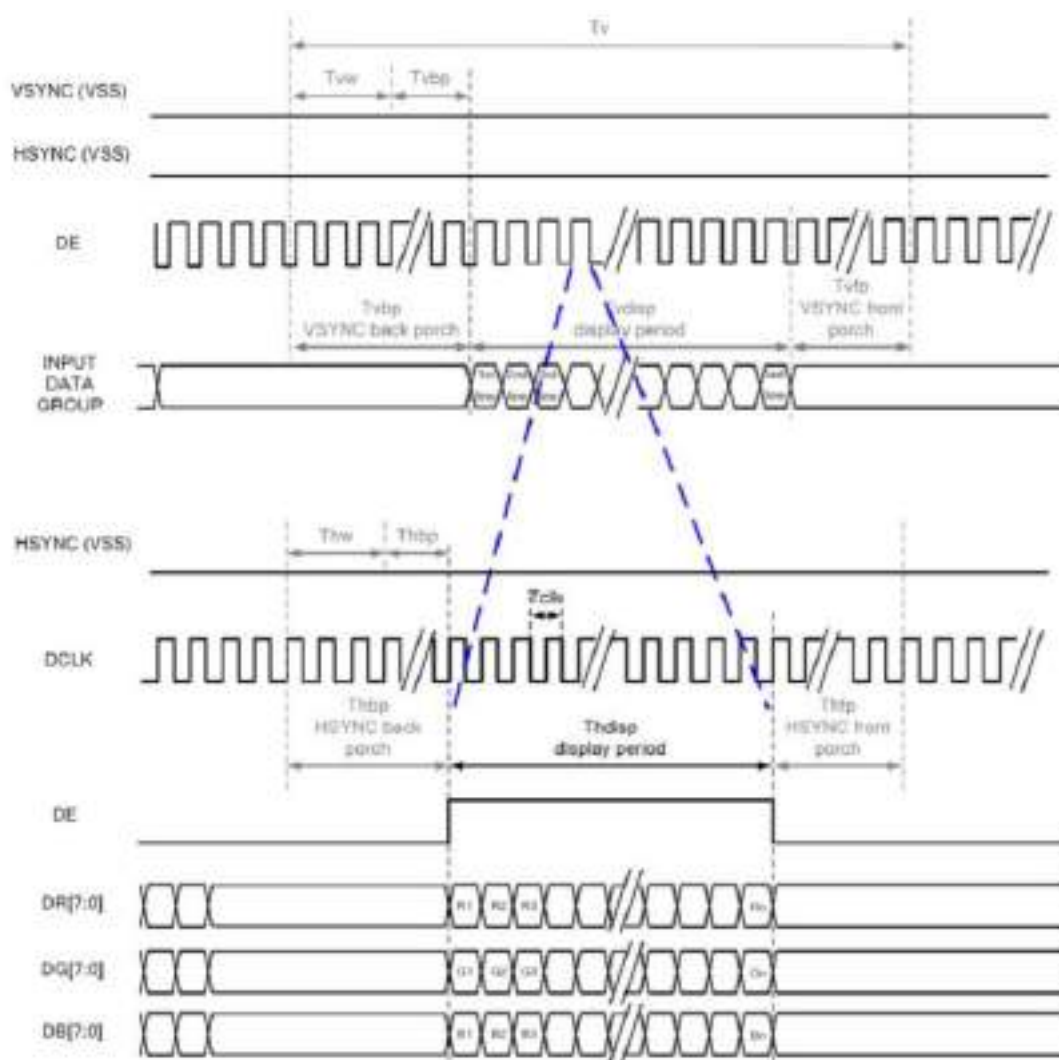
Note. It is necessary to keep $T_{vbp}=12$ and $T_{hbp}=43$ in sync mode. In DE mode it is not necessary.



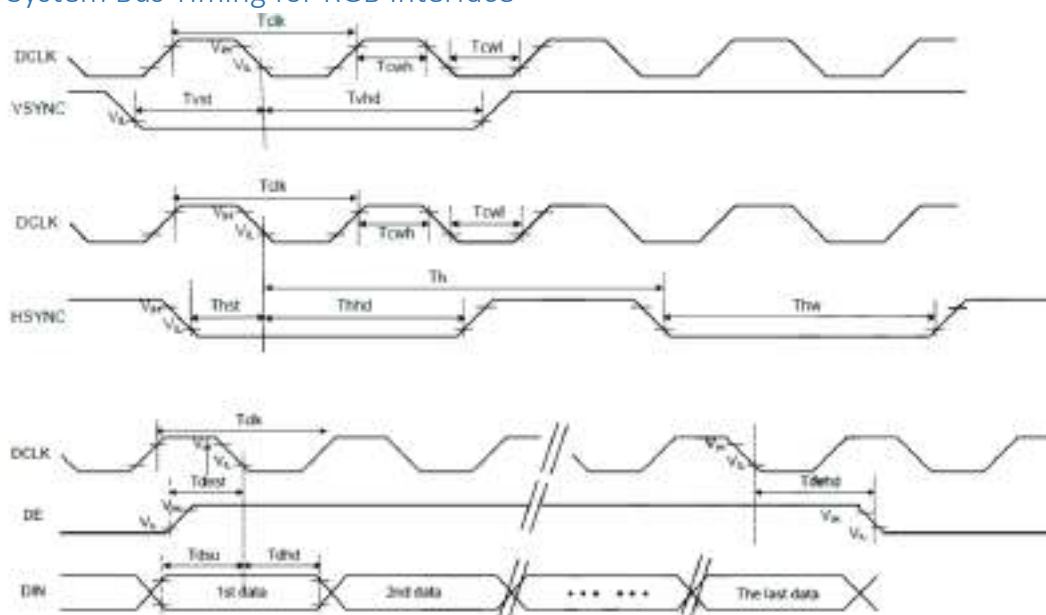
9.1.2 SYNC-DE mode timing diagram



9.1.3 DE mode timing diagram



9.2 System Bus Timing for RGB Interface



PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
CLK Pulse Duty	T_{clk}	40	50	60	%
HSYNC Width	T_{hw}	2	-	-	DCLK
HSYNC Period	T_h	55	60	65	CLK
VSYNC Setup Time	T_{vst}	12	-	-	ns
VSYNC Hold Time	T_{vhd}	12	-	-	ns
HSYNC Setup Time	T_{hst}	12	-	-	ns
HSYNC Hold Time	T_{hhd}	12	-	-	ns
Data Setup Time	T_{dsu}	12	-	-	ns
Data Hold Time	T_{dhd}	12	-	-	ns
DE Setup Time	T_{dest}	12	-	-	ns
DE Hold Time	T_{dehd}	12	-	-	ns

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:

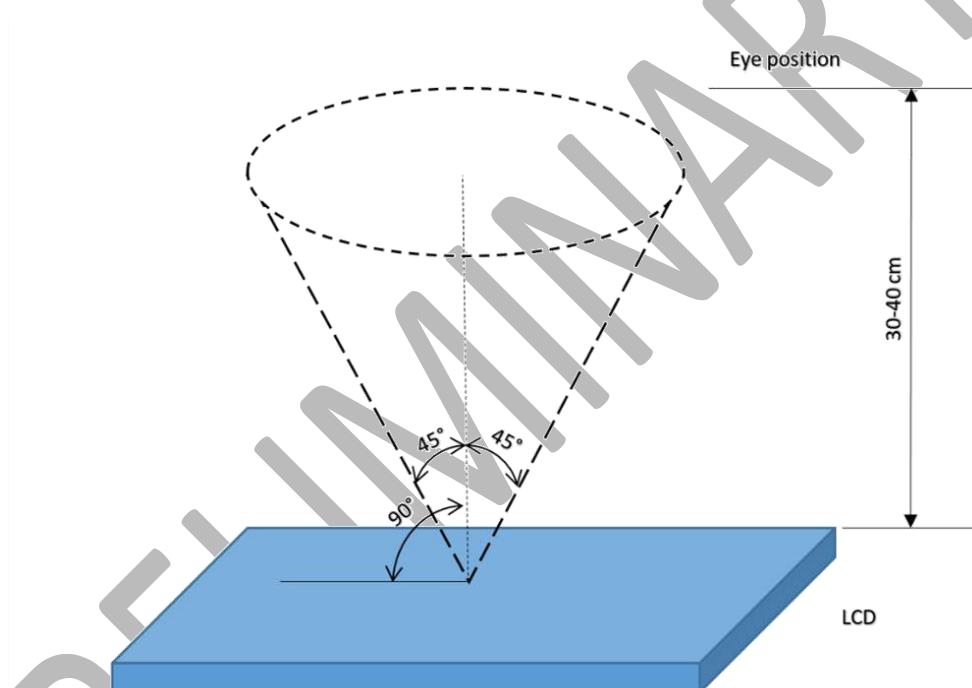
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

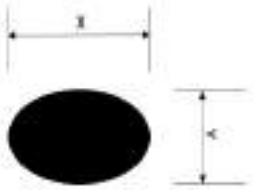
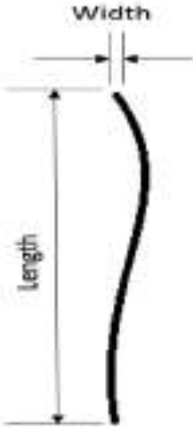
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



11.2 Inspection standard

Item	Criterion																		
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ *Spots density: 10 mm <table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>D ≤ 0.15 mm</td><td>Ignored</td></tr><tr><td>0.15 mm < D ≤ 0.30 mm</td><td>N ≤ 3</td></tr><tr><td>0.3mm < D</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"		Average Diameter	Qualified Qty	D ≤ 0.15 mm	Ignored	0.15 mm < D ≤ 0.30 mm	N ≤ 3	0.3mm < D	Not allowed								
3.5" ≤ Size ≤ 5"																			
Average Diameter	Qualified Qty																		
D ≤ 0.15 mm	Ignored																		
0.15 mm < D ≤ 0.30 mm	N ≤ 3																		
0.3mm < D	Not allowed																		
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <table><tr><th colspan="3">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>W ≤ 0.03</td><td>Ignored</td></tr><tr><td>L ≤ 3.0</td><td>0.03 < W ≤ 0.05</td><td>2</td></tr><tr><td>L ≤ 3.0</td><td>0.05 < W ≤ 0.1</td><td>1</td></tr><tr><td>3.0 < L</td><td>0.1 < W</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"			Length/mm	Width/mm	Qualified Qty	-	W ≤ 0.03	Ignored	L ≤ 3.0	0.03 < W ≤ 0.05	2	L ≤ 3.0	0.05 < W ≤ 0.1	1	3.0 < L	0.1 < W	Not allowed
3.5" ≤ Size ≤ 5"																			
Length/mm	Width/mm	Qualified Qty																	
-	W ≤ 0.03	Ignored																	
L ≤ 3.0	0.03 < W ≤ 0.05	2																	
L ≤ 3.0	0.05 < W ≤ 0.1	1																	
3.0 < L	0.1 < W	Not allowed																	
Bright/Dark Dots	<table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>N ≤ 1</td></tr><tr><td>Dark Dots</td><td>N ≤ 2</td></tr><tr><td>Total Bright and Dark Dots</td><td>N ≤ 3</td></tr></table>	3.5" ≤ Size ≤ 5"		item	Qualified Qty	Bright Dots	N ≤ 1	Dark Dots	N ≤ 2	Total Bright and Dark Dots	N ≤ 3								
3.5" ≤ Size ≤ 5"																			
item	Qualified Qty																		
Bright Dots	N ≤ 1																		
Dark Dots	N ≤ 2																		
Total Bright and Dark Dots	N ≤ 3																		

Item	Criterion
Clear spots	Size < 5"
	Average Diameter
	Qualified Qty
	D < 0.2 mm
	Ignored
	0.2 mm < D < 0.3 mm
Polarizer bubbles	3
	0.3 mm < D < 0.5 mm
	2
	0.5 mm < D
	0
	*Spots density: 10 mm
Polarizer bubbles	3.5" ≤ Size ≤ 5"
	Average Diameter
	Qualified Qty
	D ≤ 0.2 mm
	Ignored
	0.2 mm < D ≤ 0.3 mm
Polarizer bubbles	2
	0.3 mm < D ≤ 0.5mm
	1
	0.5 mm < D
	0
	Total Q'ty
	3

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 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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 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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RVT43HLBFWN00

EVE4 IPS 4.3" LCD TFT Datasheet

Rev.0.1

2020-01-18

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	4.3	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	106.30 x 83.98 x 8.40	mm
Active Area (W × H)	95.04 × 53.86	mm
Pixel Pitch (W × H)	0.198 × 0.198	mm
Resolution	480 × 272 (RGB)	/
Brightness	1000	cd/m ²
Color Depth	16.7 M	/
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 (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

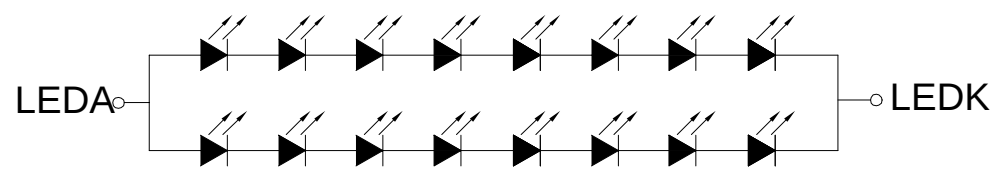
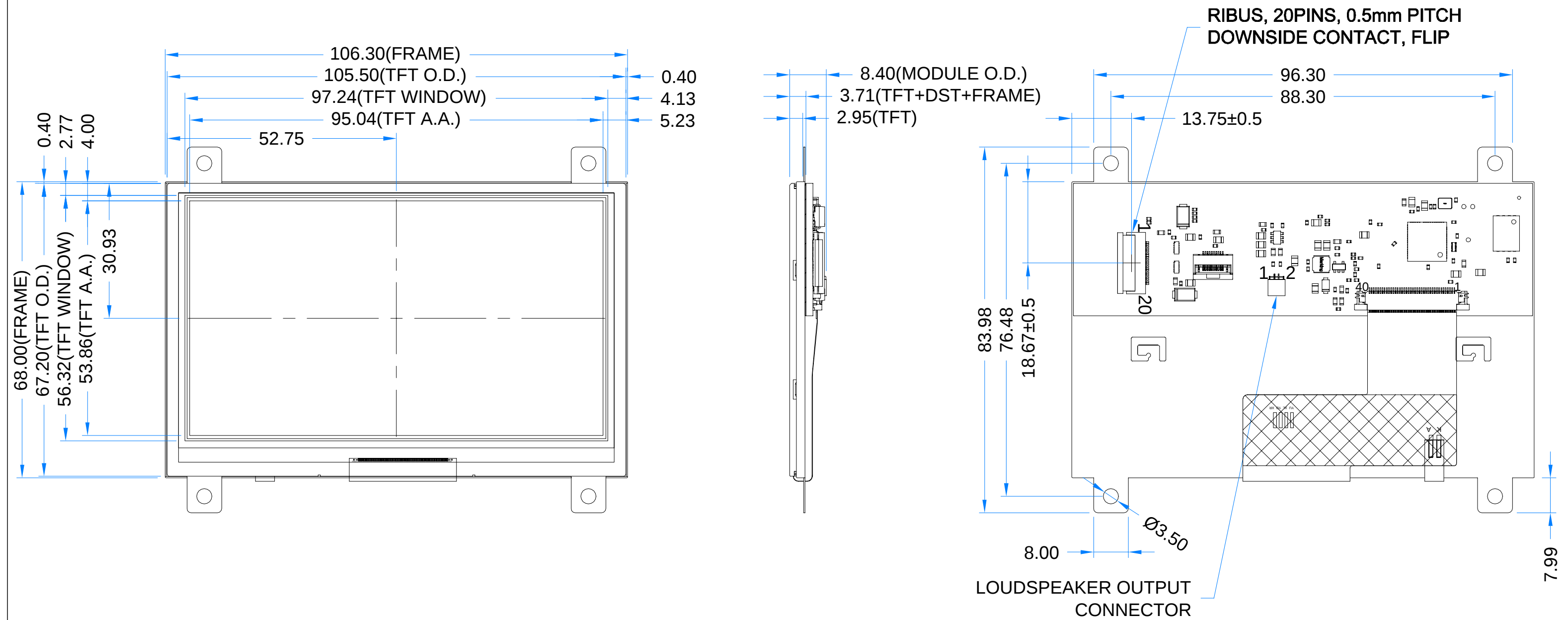
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1 MODULE CLASSIFICATION INFORMATION

RV	T	43	H	L	B	F	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	43 – 4.3”
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	L – 480 x 272 px
6.	INTERFACE	B – SPI/QSPI
7.	FRAME	F – With Frame
8.	BACKLIGHT TYPE	W – LED White
9.	TOUCH PANEL	N – Without Touch Panel
10.	VERSION	00 – (00-99)

Revision:	Changes:	Date:
1.0	Initial Case	2020.12.14



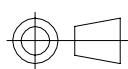
LED Diagram Circuit

TFT NOTES:

1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS
2. RESOLUTION: 480x272
3. VIEWING ANGLE: FREE
4. SURFACE LUMINANCE: 1000 cd/m²
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

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: RVT43HLBFWN00			
SN:			
DRAWN: M.Natywa	2020.12.14	1:0.86	
	2021.01.18	[mm]	
		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	VIN	-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	-	% 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).

4 ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	172	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

5 BACKLIGHT ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Backlight	BLVDD	3.0	5.0	6.0	V	
Current drawn from BLVDD @5.0V	I _{BLVDD=5.0V}	TBD	230	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	110	TBD	mA	50% of backlight, Note 1
Current drawn from BLVDD @3.3V	I _{BLVDD=3.3V}	TBD	385	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@3.3V	I _{BLVDD=3.3V}	TBD	175	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.

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	$\theta=0^{\circ}$ $\phi=0^{\circ}$ Ta=25 °C	-	30	40	ms	FIG 2.	4
Contrast Ratio		Cr		640	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	$\phi = 90^{\circ}$	70	80	-	deg	FIG 4.	6
			$\phi = 270^{\circ}$	70	80	-	deg	FIG 4.	
			$\phi = 0^{\circ}$	70	80	-	deg	FIG 4.	
			$\phi = 180^{\circ}$	70	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	$\theta=0^{\circ}$ $\phi=0^{\circ}$ Ta=25 °C	0.579	0.619	0.659	FIG 3.	5	
		y		0.290	0.330	0.370			
	Green	x		0.346	0.386	0.426			
		y		0.539	0.579	0.619			
	Blue	x		0.070	0.110	0.150			
		y		0.091	0.131	0.171			
	White	x		0.280	0.320	0.360			
		y		0.305	0.345	0.384			

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 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 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 (x, y) chromaticity the test data is based on TOPCON's BM-5 photo detector.

Figure 2. The definition of response time

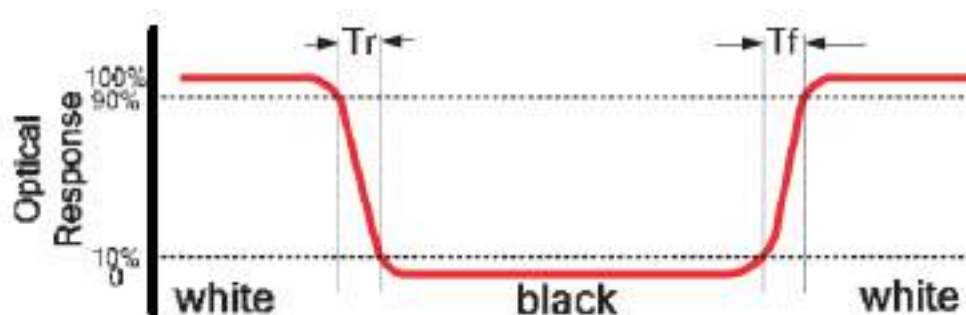


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

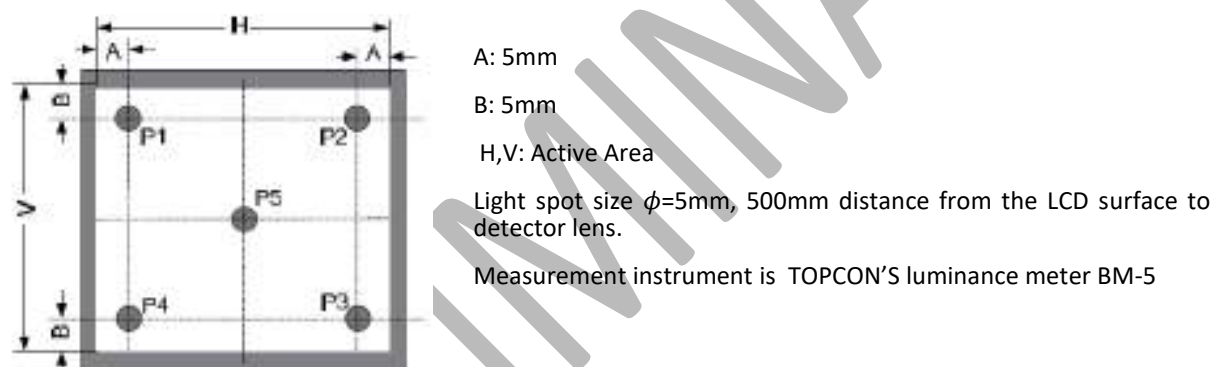
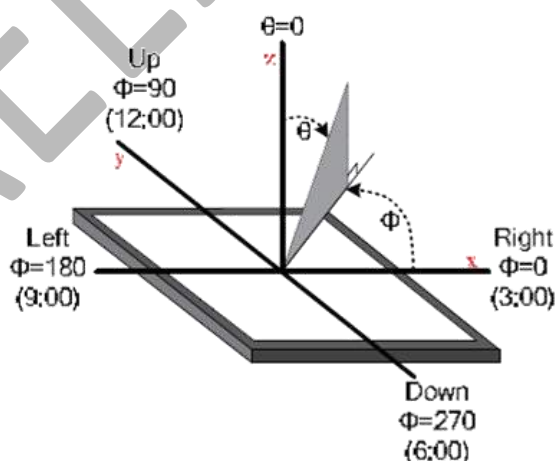


Figure 4. The definition of viewing angle



7 INTERFACE DESCRIPTION

7.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

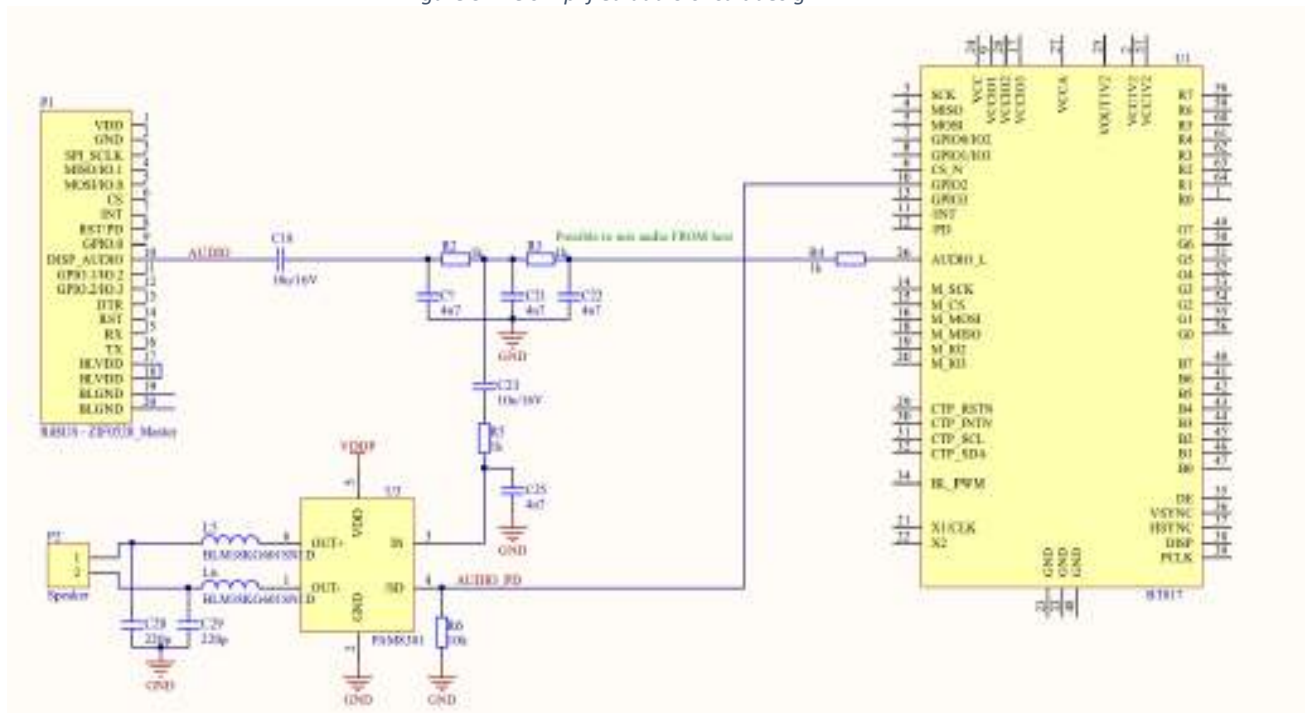
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil "+" terminal	Note 1
2	SPEAKER -	Speaker coil "-" terminal	

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. By standard, the EVE4 board is equipped with the separate 256Mb Flash memory chip, which allows to show up to 270 full resolution (480 * 272 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

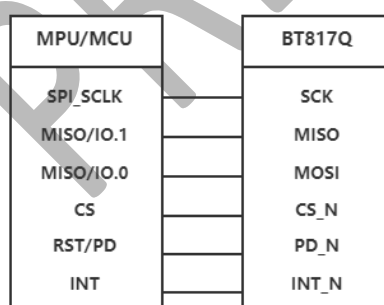
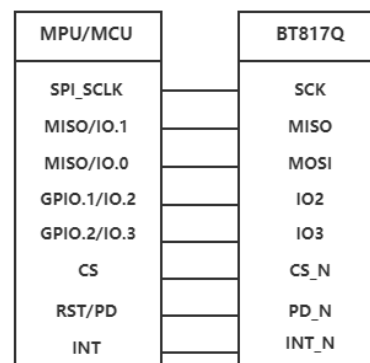


Figure 7. QSPI interface connection



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

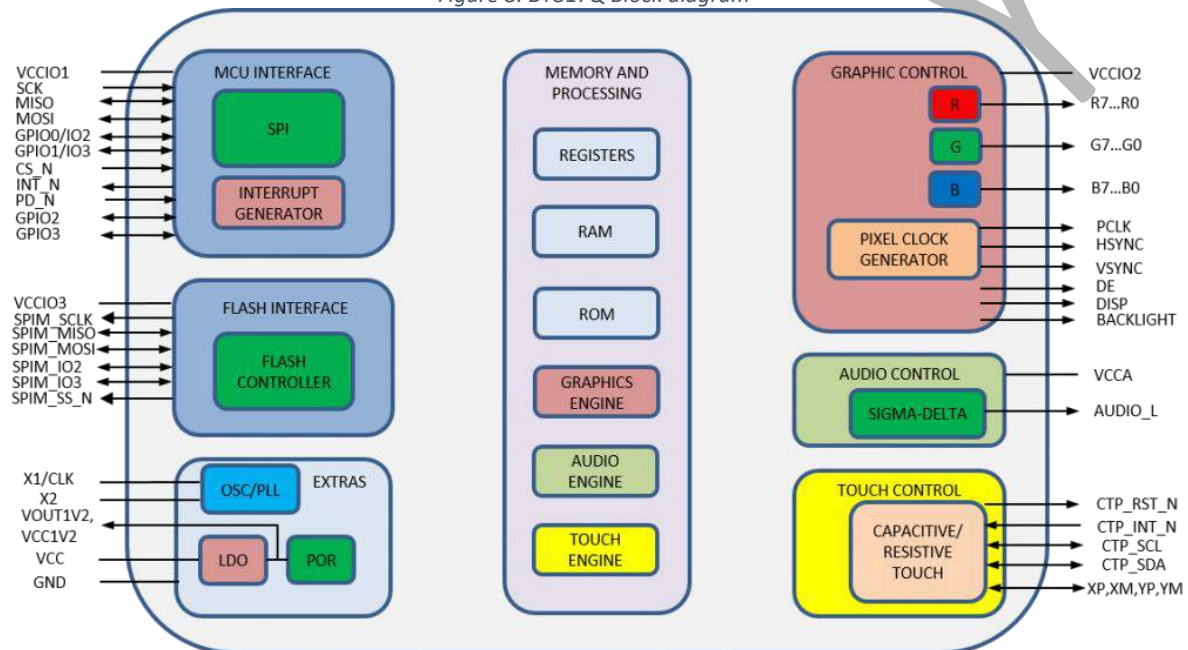
Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

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.

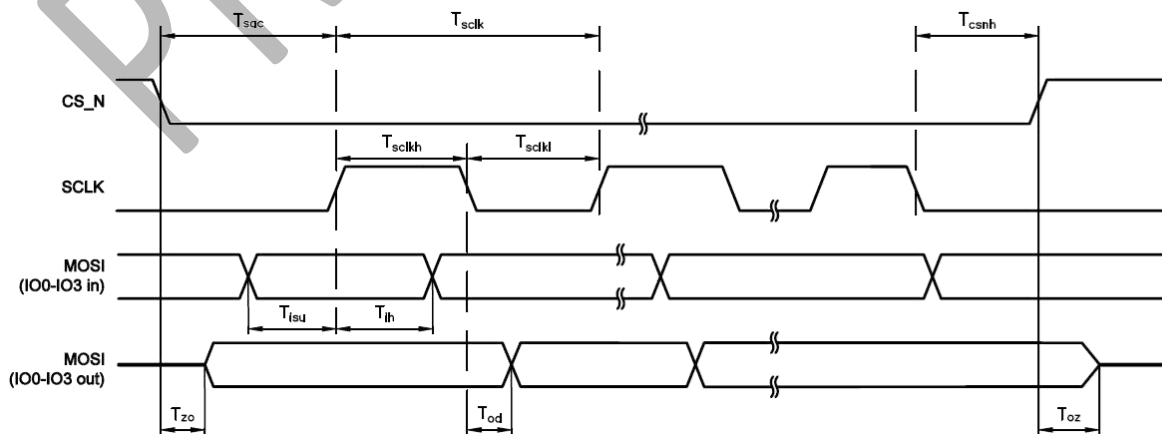
8.2 Block Diagram

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.

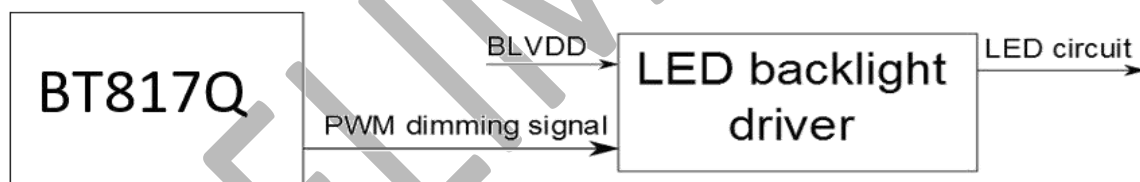
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T_{sclk}	SPI clock period	33.3		33.3		33.3		ns
T_{sckl}	SPI clock low duration	13		13		13		ns
T_{sckh}	SPI clock high duration	13		13		13		ns
T_{sac}	SPI access time	4		3.5		3		ns
T_{isu}	Input Setup	4		3.5		3	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

9 TIMING CHARACTERISTICS

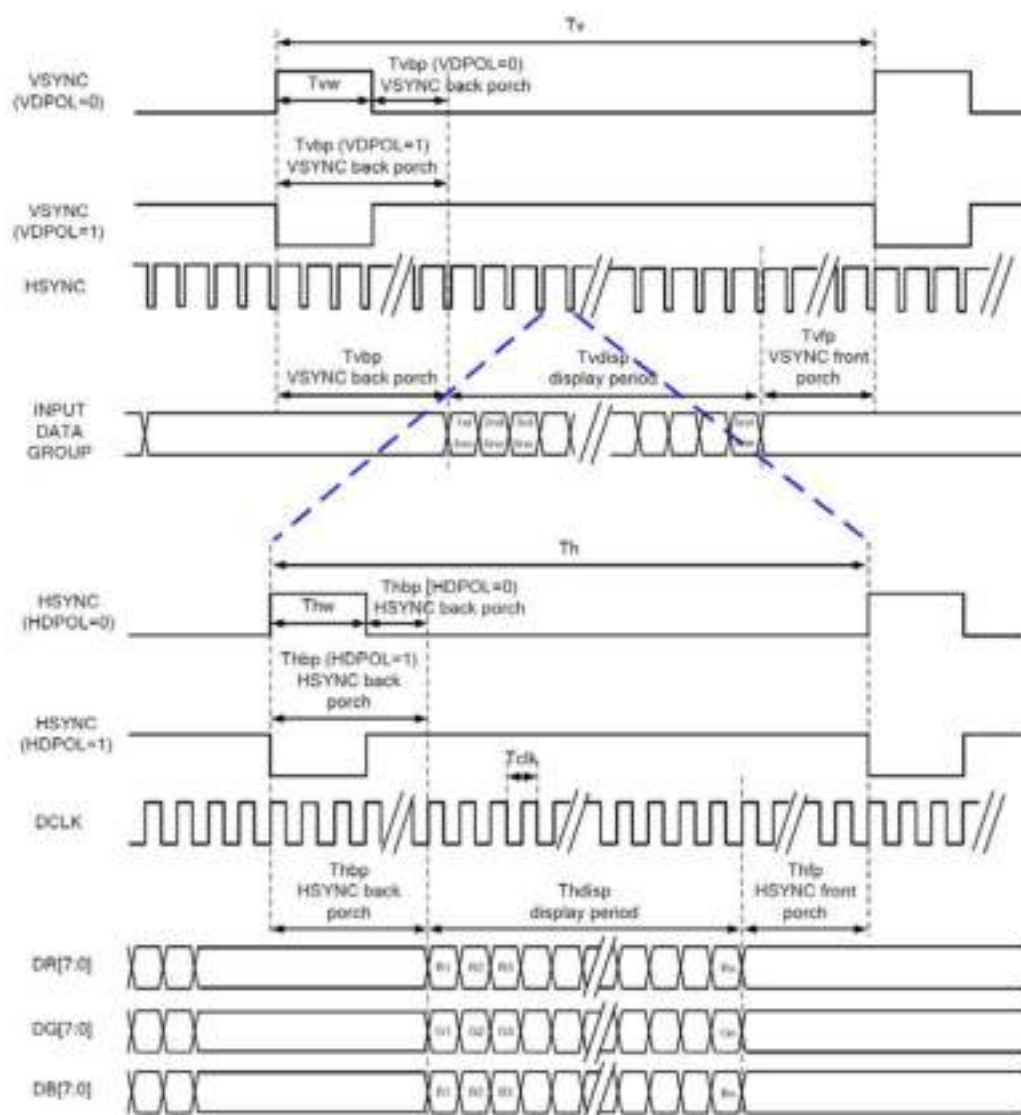
9.1 RGB mode

RGB MODE SELECTION	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

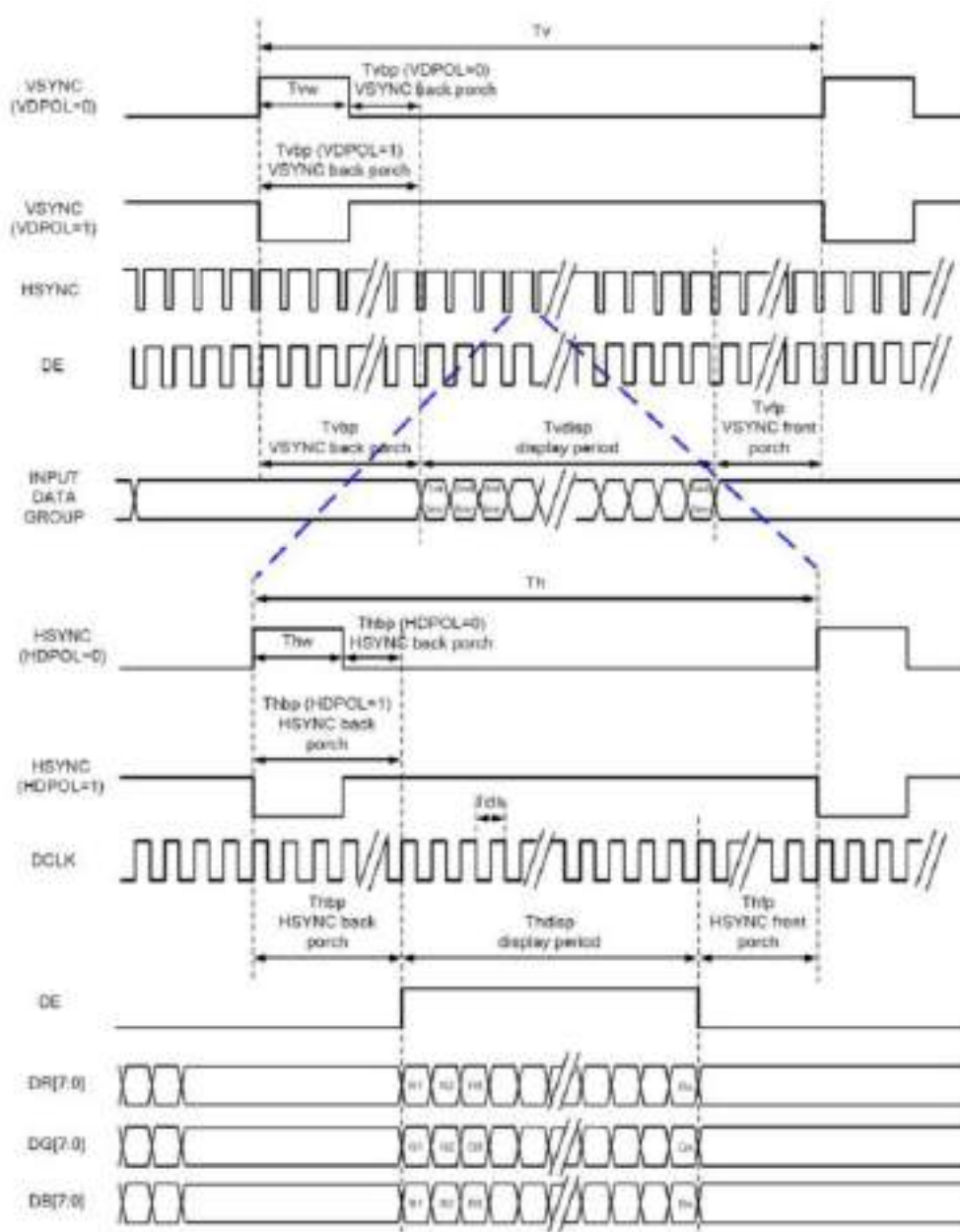
Note. "Input" means these signals are driven by host side.

9.2 Timing diagram and input setup timing setting

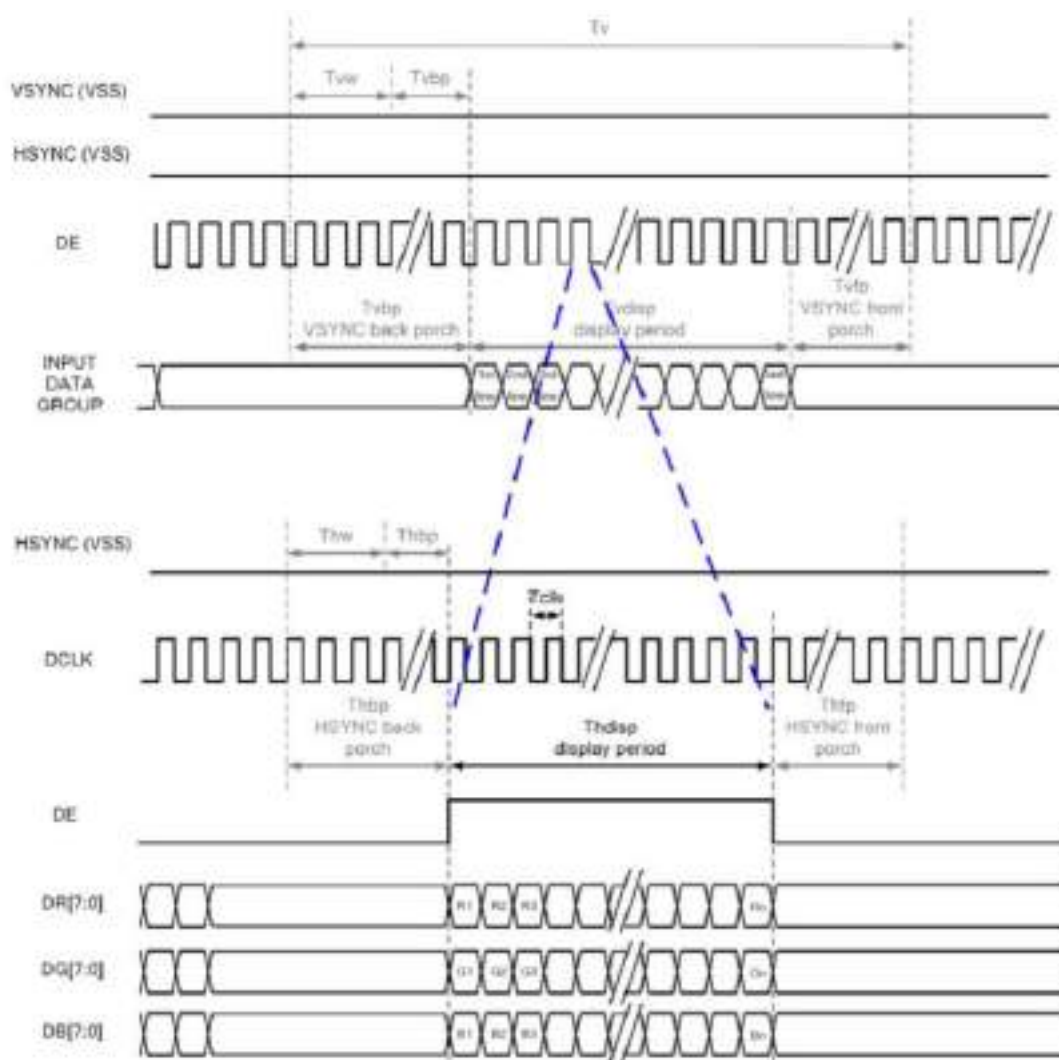
9.2.1 SYNC mode timing diagram



9.2.2 SYNC-DE mode timing diagram



9.2.3 DE mode timing diagram



9.3 Parallel 24-bit RGB input timing table

Parallel 24-bit RGB input Timing (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25 °C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK Frequency	Fclk	8	9	12	MHz	
DCLK Period	Tclk	83	111	125	ns	
HSYNC	Period Time	Th	485	531	598	DCLK
	Display Period	Thdisp	480			DCLK
	Back Porch	Thbp	3	43	43	DCLK By H_BLANKING setting
	Front Porch	Thfp	2	8	75	DCLK
	Pulse Width	Thw	2	4	43	DCLK
VSYNC	Period Time	Tv	276	292	321	HSYNC
	Display Period	Tvdisp	272			HSYNC
	Back Porch	Tvbp	2	12	12	HSYNC By V_BLANKING setting
	Front Porch	Tvfp	2	8	37	HSYNC
	Pulse Width	Tvw	2	4	12	HSYNC

Note. It's necessary to keep Tvbp=12 and Thbp=43 in sync mode. It is unnecessary to keep these values in DE mode.

10 INITIALIZATION CODE

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

11 INSPECTION

Standard acceptance/rejection criteria for TFT module.

11.1 Inspection condition

Ambient conditions:

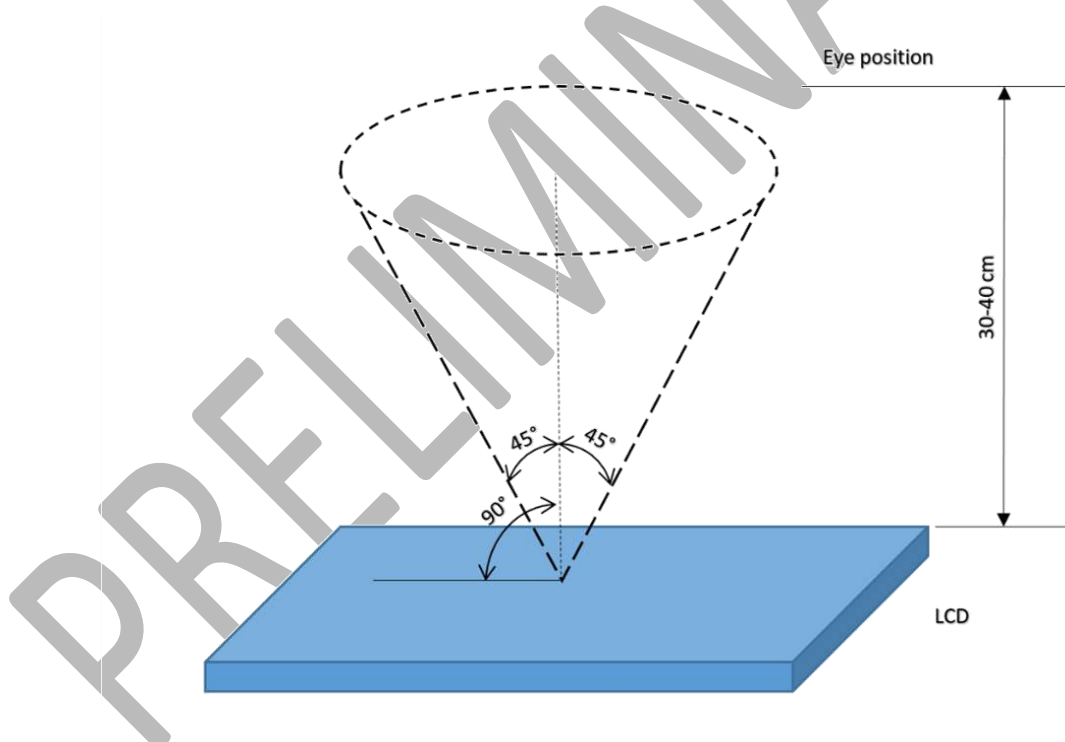
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

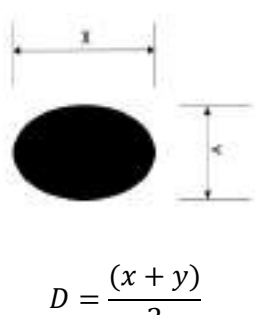
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



11.2 Inspection standard

Item	Criterion																		
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ *Spots density: 10 mm <table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>D ≤ 0.15 mm</td><td>Ignored</td></tr><tr><td>0.15 mm < D ≤ 0.30 mm</td><td>N ≤ 3</td></tr><tr><td>0.3mm < D</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"		Average Diameter	Qualified Qty	D ≤ 0.15 mm	Ignored	0.15 mm < D ≤ 0.30 mm	N ≤ 3	0.3mm < D	Not allowed								
3.5" ≤ Size ≤ 5"																			
Average Diameter	Qualified Qty																		
D ≤ 0.15 mm	Ignored																		
0.15 mm < D ≤ 0.30 mm	N ≤ 3																		
0.3mm < D	Not allowed																		
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <table><tr><th colspan="3">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>W ≤ 0.03</td><td>Ignored</td></tr><tr><td>L ≤ 3.0</td><td>0.03 < W ≤ 0.05</td><td>2</td></tr><tr><td>L ≤ 3.0</td><td>0.05 < W ≤ 0.1</td><td>1</td></tr><tr><td>3.0 < L</td><td>0.1 < W</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"			Length/mm	Width/mm	Qualified Qty	-	W ≤ 0.03	Ignored	L ≤ 3.0	0.03 < W ≤ 0.05	2	L ≤ 3.0	0.05 < W ≤ 0.1	1	3.0 < L	0.1 < W	Not allowed
3.5" ≤ Size ≤ 5"																			
Length/mm	Width/mm	Qualified Qty																	
-	W ≤ 0.03	Ignored																	
L ≤ 3.0	0.03 < W ≤ 0.05	2																	
L ≤ 3.0	0.05 < W ≤ 0.1	1																	
3.0 < L	0.1 < W	Not allowed																	
Bright/Dark Dots	<table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>N ≤ 1</td></tr><tr><td>Dark Dots</td><td>N ≤ 2</td></tr><tr><td>Total Bright and Dark Dots</td><td>N ≤ 3</td></tr></table>	3.5" ≤ Size ≤ 5"		item	Qualified Qty	Bright Dots	N ≤ 1	Dark Dots	N ≤ 2	Total Bright and Dark Dots	N ≤ 3								
3.5" ≤ Size ≤ 5"																			
item	Qualified Qty																		
Bright Dots	N ≤ 1																		
Dark Dots	N ≤ 2																		
Total Bright and Dark Dots	N ≤ 3																		

Item	Criterion
Clear spots	Size < 5"
	Average Diameter
	Qualified Qty
	D < 0.2 mm
	Ignored
	0.2 mm < D < 0.3 mm
	3
Polarizer bubbles	0.3 mm < D < 0.5 mm
	2
	0.5 mm < D
	0
	*Spots density: 10 mm
	3.5" ≤ Size ≤ 5"
	Average Diameter
	Qualified Qty
	D ≤ 0.2 mm
	Ignored
	0.2 mm < D ≤ 0.3 mm
	2
	0.3 mm < D ≤ 0.5 mm
	1
	0.5 mm < D
	0
	Total Q'ty
	3

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 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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 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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RVT43HLBNWC00-B

EVE4 IPS 4.3" LCD TFT Datasheet

Rev.0.1

2020-12-29

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	4.3	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	120.38 x 79.20 x 10.30	mm
Active Area (W × H)	95.04 × 53.86	mm
Pixel Pitch (W × H)	0.198 × 0.198	mm
Resolution	480 × 272 (RGB)	/
Brightness	850	cd/m ²
Color Depth	16.7 M	/
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	ILI2132A	/
Supply Voltage for Module	3.3	V
Supply Voltage for Backlight	5.0 (TYP.)	V
Bonding Technology	Optical Bonding	/
Weight	95	g

Note 1: RoHS compliant

Note 2: LCM weight tolerance: ± 5%.

REVISION RECORD

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

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1 MODULE CLASSIFICATION INFORMATION

RV	T	43	H	L	B	N	W	C	00	B
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.

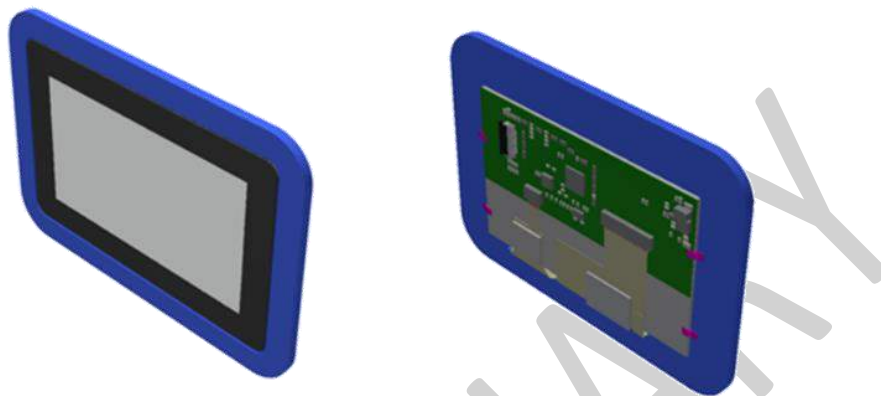
1.	BRAND	RV – Riverdi
2.	PRODUCT TYPE	T – TFT Standard
3.	DISPLAY SIZE	43 – 4.3”
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	L – 480 x 272 px
6.	INTERFACE	B – SPI/QSPI
7.	FRAME	N – No Frame
8.	BACKLIGHT TYPE	W – LED White
9.	TOUCH PANEL	C – With Capacitive Touch Panel
10.	VERSION	00 – (00-99)
11.	BONDING TECHNOLOGY	B – Optical Bonding

2 UxTOUCH ASSEMBLY

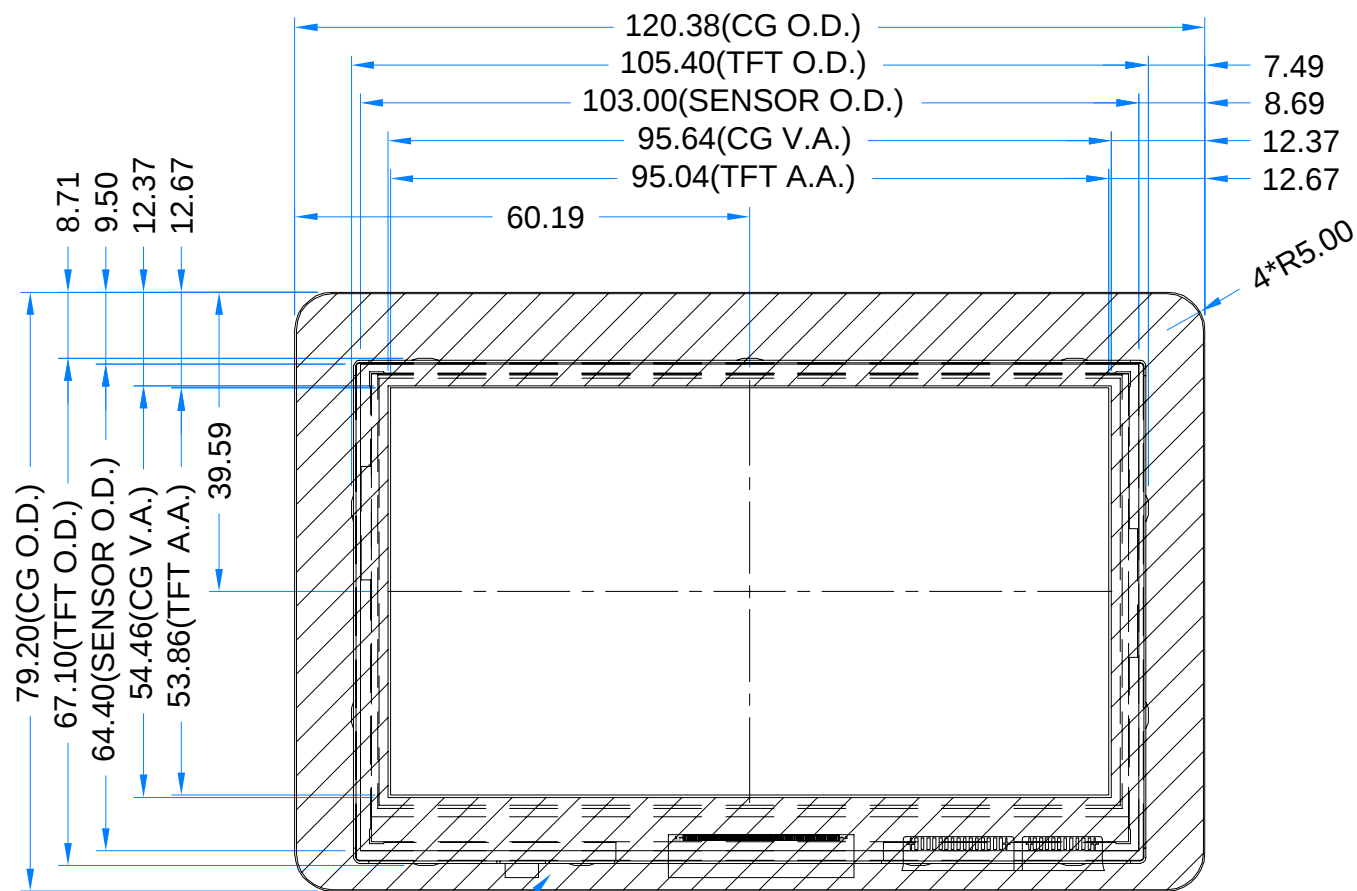
UxTouch are LCD TFT displays with specially designed projected capacitive touch panels. UxTouch display can be mounted without any additional holes in the housing. Our standard UxTouch displays include double-sided adhesive tape (DST) to stick TFT easily to the housing.

UxTouch models with double-side adhesive tape can be mounted by fastening the glass to the housing.

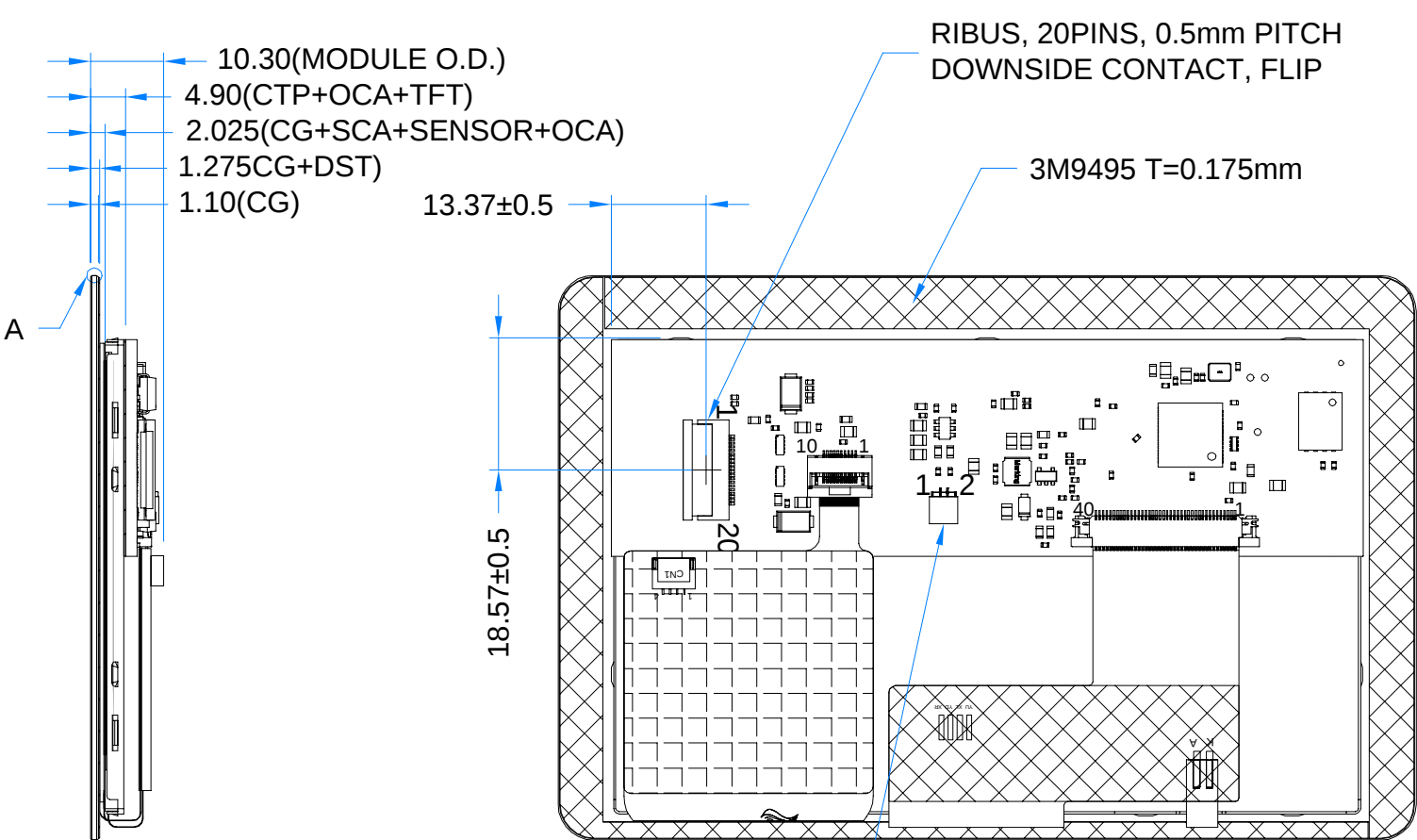
Figure 1. General view of the module



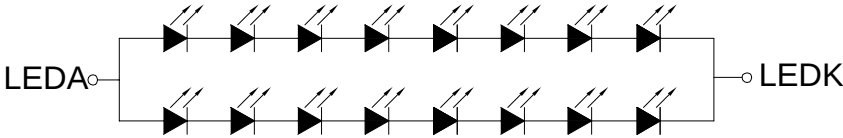
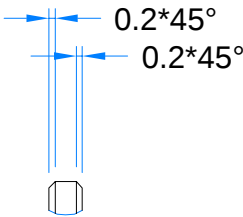
Revision:	Changes:	Date:
1.0	Initial Case	2020.12.14



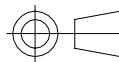
BLACK MASK PRINTING
COLOR: RAL9005



DETAIL A
SCALE 4:1



LED Diagram Circuit

TFT NOTES: 1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS 2. RESOLUTION: 480x272 3. VIEWING ANGLE: FREE 4. SURFACE LUMINANCE: 850 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. OPTICAL BONDING 2. OPERATING TEMPERATURE: -20°C ~ 70°C 3. STORAGE TEMPERATURE: -30°C ~ 80°C 4. WITHOUT INDIVIDUAL TOLERANCE: ±0.3mm 5. RoHS3 COMPLIANT	PN: RVT43HLBNWC00-B				
			SN:				
			DRAWN: M.Natywa	2020.12.14		1:1.00	
				2020.12.30		[mm]	
ES France - Département Composants & Modules - 127 rue de Buzenval BP 26 - 92380 Garches Tél. 01 47 95 99 84 - Fax. 01 47 01 16 22 - e-mail: comp@es-france.com - Site Web: www.es-france.com					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	VIN	-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	-	% 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	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	178	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

6 BACKLIGHT ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Backlight	BLVDD	3.0	5.0	6.0	V	
Current drawn from BLVDD @5.0V	I _{BLVDD=5.0V}	TBD	230	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	110	TBD	mA	50% of backlight, Note 1
Current drawn from BLVDD @3.3V	I _{BLVDD=3.3V}	TBD	385	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@3.3V	I _{BLVDD=3.3V}	TBD	175	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	$\theta=0^{\circ}$ $\phi=0^{\circ}$ Ta=25 °C	-	30	40	ms	FIG 2.	4
Contrast Ratio		Cr		640	800	-	---	FIG 3.	1
Luminance Uniformity		δ WHITE		-	75	-	%	FIG 3.	3
Surface Luminance		Lv		-	850	-	cd/m ²	FIG 3.	2
Viewing Angle Range		θ	$\phi = 90^{\circ}$	70	80	-	deg	FIG 4.	6
			$\phi = 270^{\circ}$	70	80	-	deg	FIG 4.	
			$\phi = 0^{\circ}$	70	80	-	deg	FIG 4.	
			$\phi = 180^{\circ}$	70	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	$\theta=0^{\circ}$ $\phi=0^{\circ}$ Ta=25 °C	0.579	0.619	0.659	FIG 3.	5	
		y		0.290	0.330	0.370			
	Green	x		0.346	0.386	0.426			
		y		0.539	0.579	0.619			
	Blue	x		0.070	0.110	0.150			
		y		0.091	0.131	0.171			
	White	x		0.280	0.320	0.360			
		y		0.305	0.345	0.384			

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 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 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 (x, y) chromaticity the test data is based on TOPCON's BM-5 photo detector.

Figure 2. The definition of response time

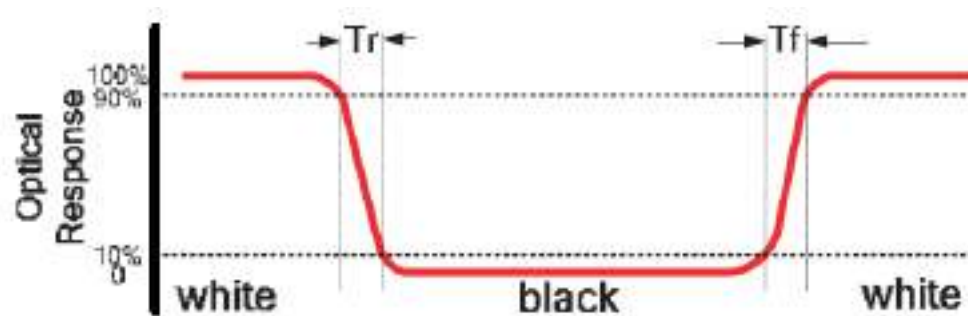
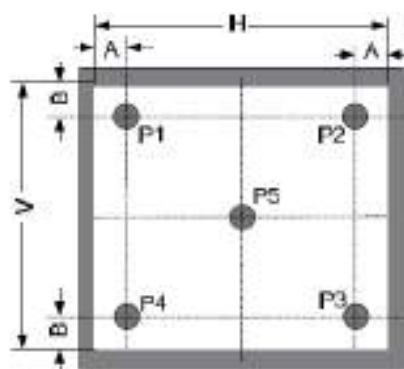


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

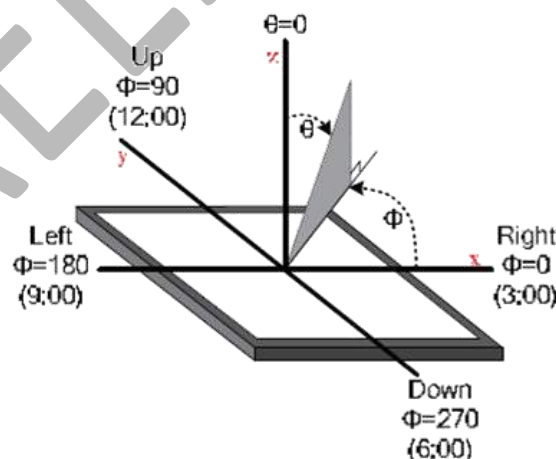
B: 5mm

H,V: Active Area

Light spot size $\phi=5\text{mm}$, 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 INTERFACE DESCRIPTION

8.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

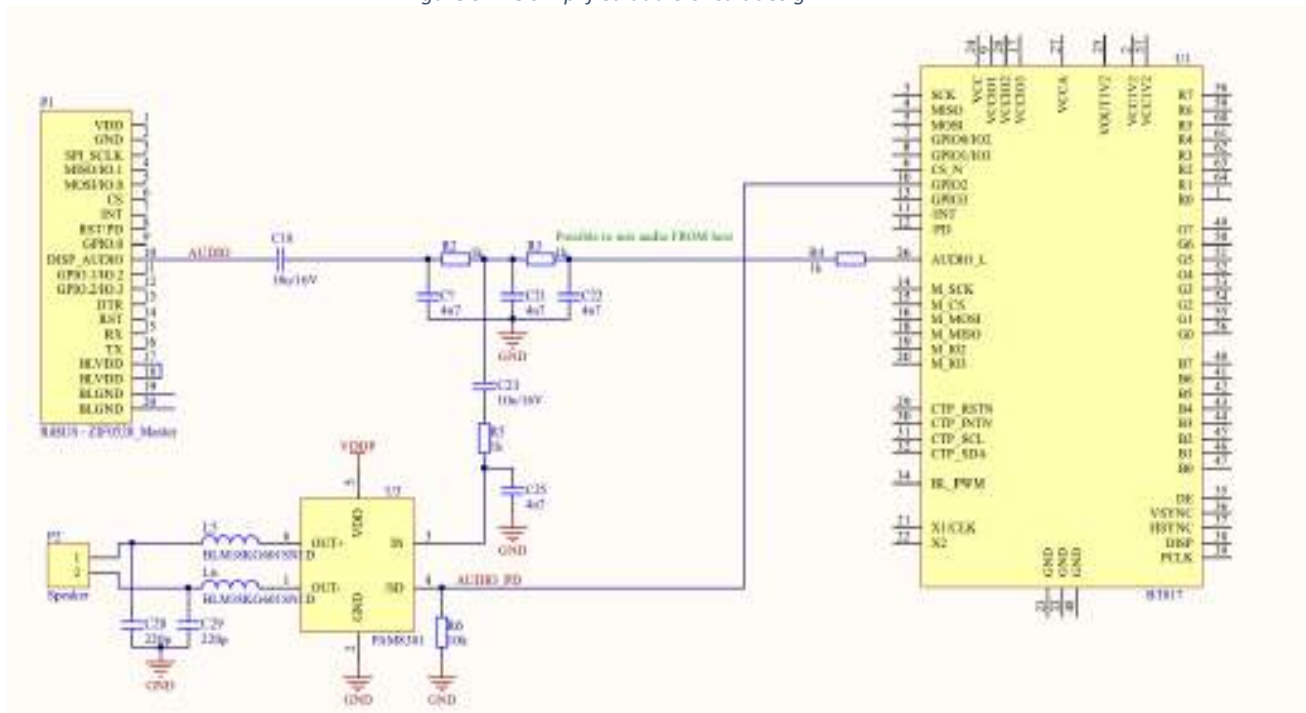
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil "+" terminal	Note 1
2	SPEAKER -	Speaker coil "-" terminal	

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. By standard, the EVE4 board is equipped with the separate 256Mb Flash memory chip, which allows to show up to 270 full resolution (480 * 272 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

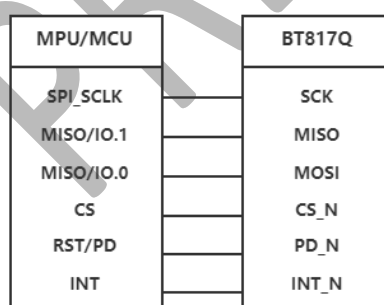
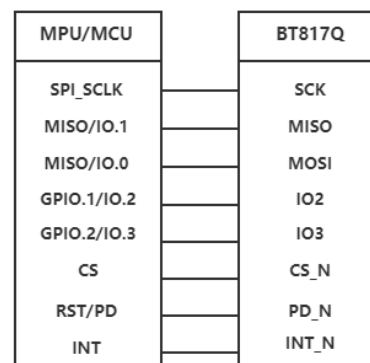


Figure 7. QSPI interface connection



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

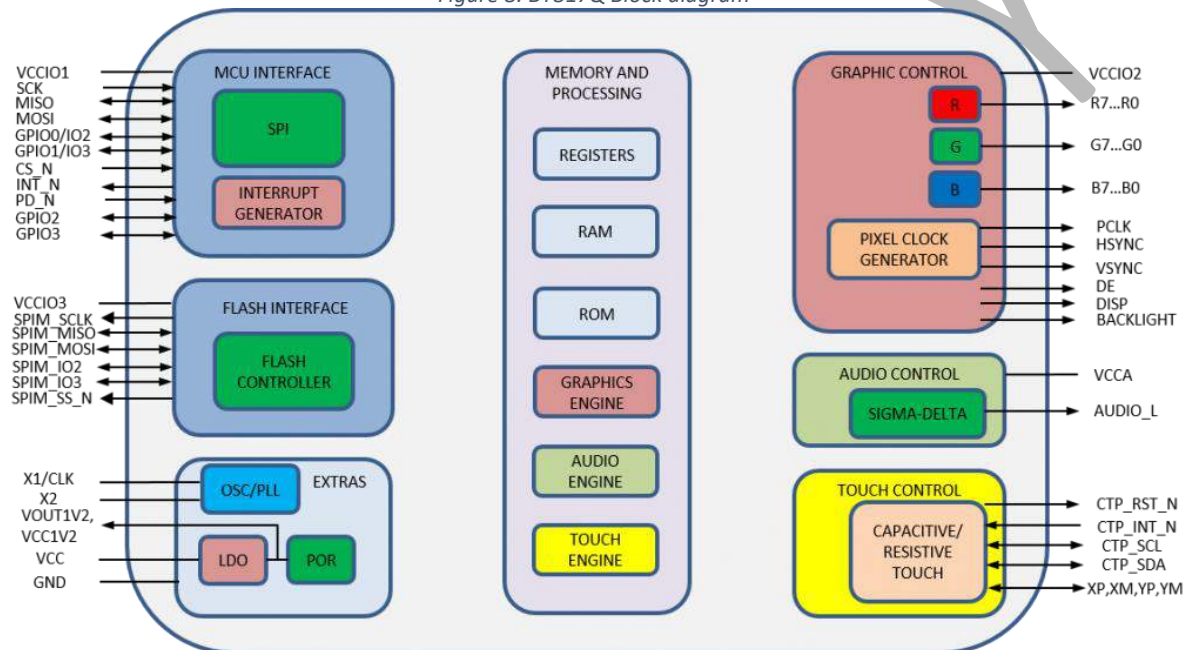
Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

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.

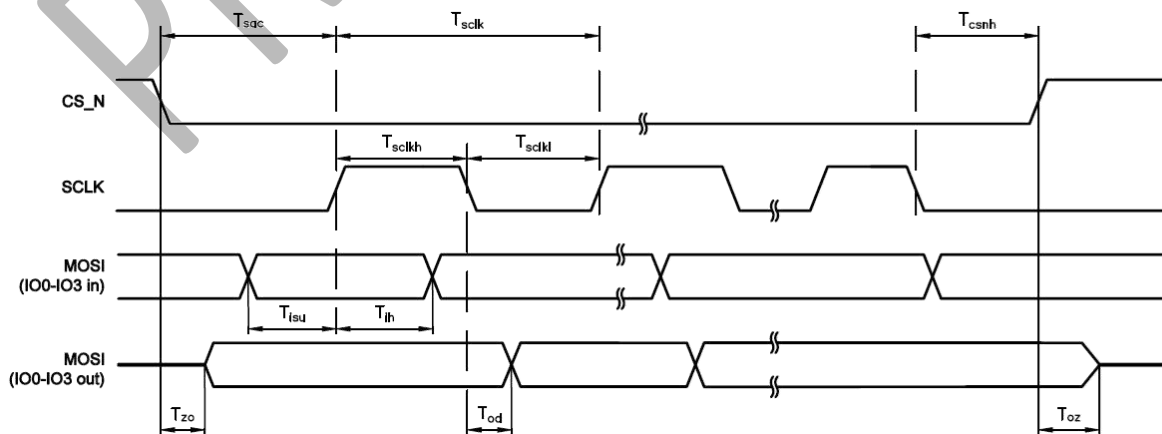
9.2 Block Diagram

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.

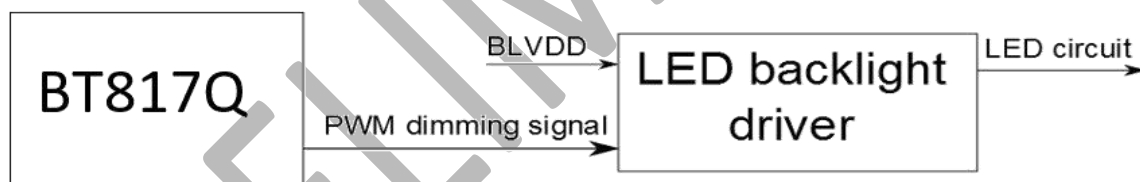
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

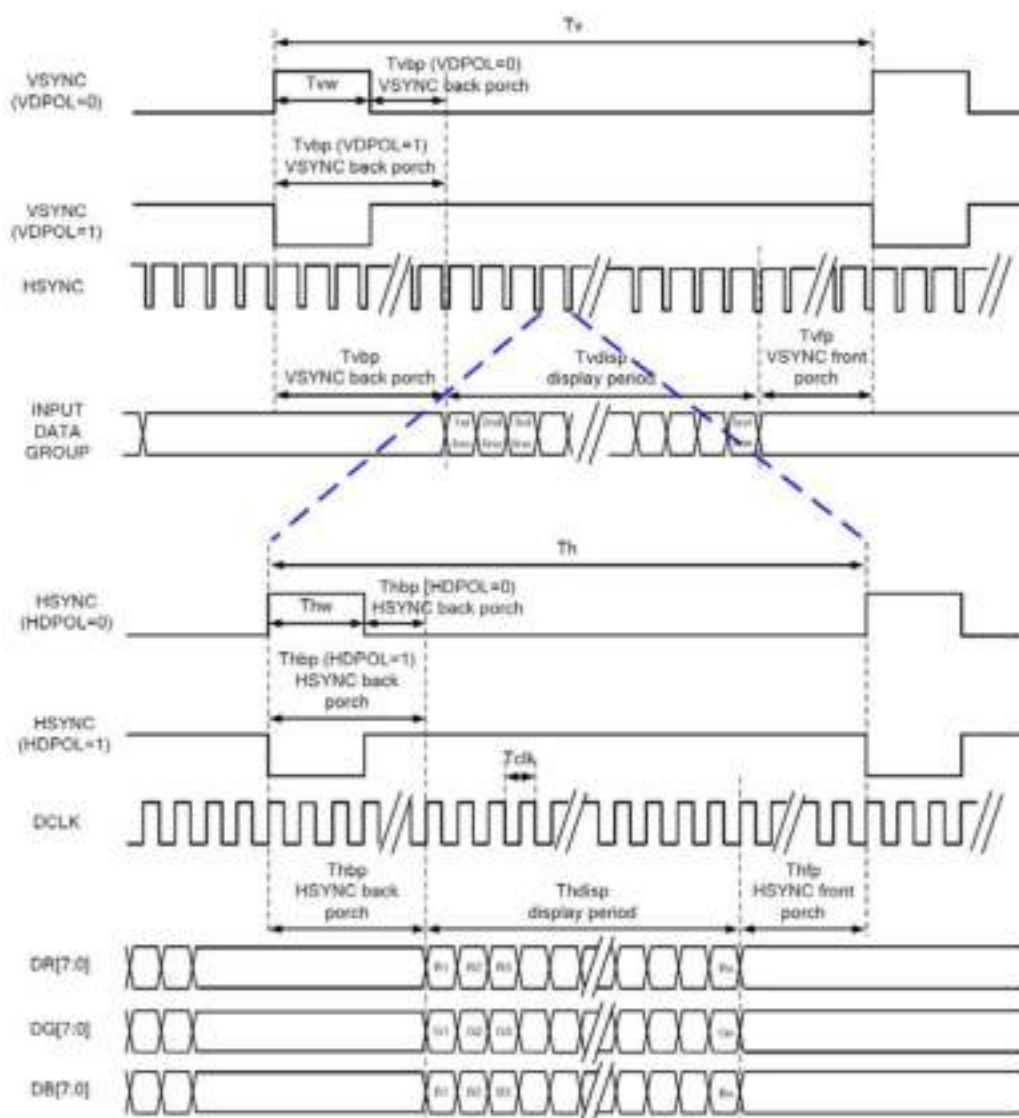
10.1 RGB mode

RGB MODE SELECTION	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

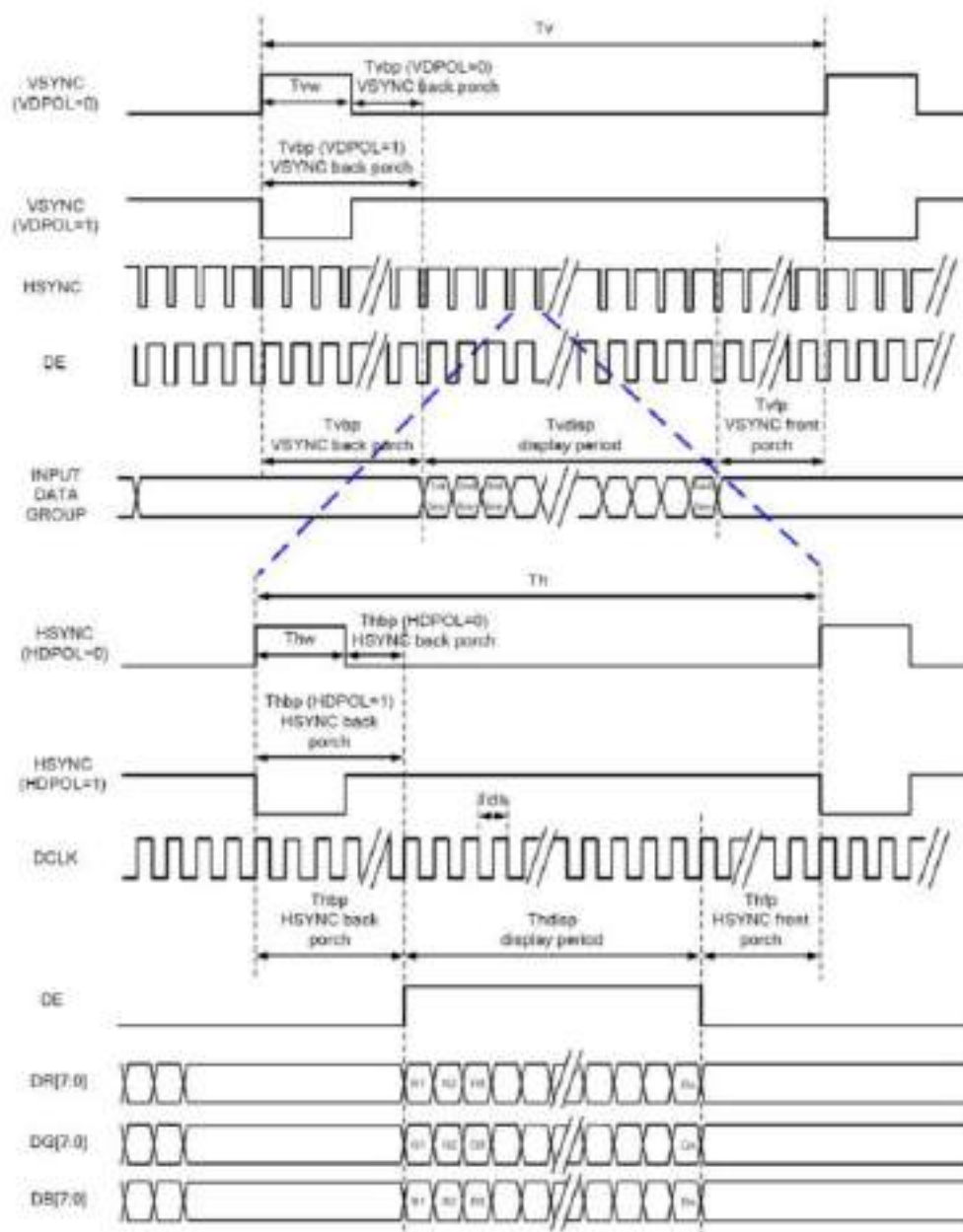
Note. "Input" means these signals are driven by host side.

10.2 Timing diagram and input setup timing setting

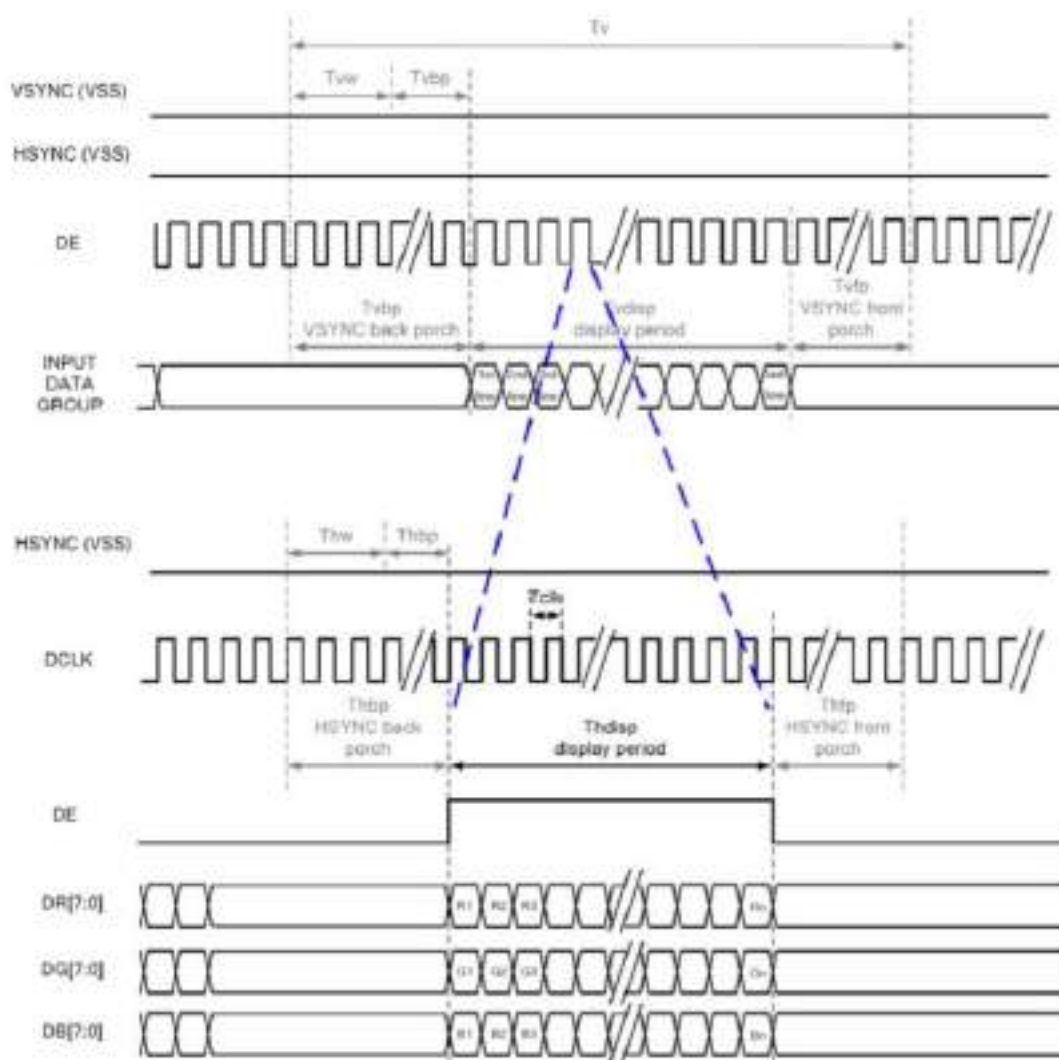
10.2.1 SYNC mode timing diagram



10.2.2 SYNC-DE mode timing diagram



10.2.3 DE mode timing diagram



10.3 Parallel 24-bit RGB input timing table

Parallel 24-bit RGB input Timing (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25 °C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK Frequency	Fclk	8	9	12	MHz	
DCLK Period	Tclk	83	111	125	ns	
HSYNC	Period Time	Th	485	531	598	DCLK
	Display Period	Thdisp	480			DCLK
	Back Porch	Thbp	3	43	43	DCLK By H_BLANKING setting
	Front Porch	Thfp	2	8	75	DCLK
	Pluse Width	Thw	2	4	43	DCLK
VSYNC	Period Time	Tv	276	292	321	HSYNC
	Display Period	Tvdisp	272			HSYNC
	Back Porch	Tvbp	2	12	12	HSYNC By V_BLANKING setting
	Front Porch	Tvfp	2	8	37	HSYNC
	Pluse Width	Tvw	2	4	12	HSYNC

Note. It's necessary to keep Tvbp=12 and Thbp=43 in sync mode. DE mode is unnecessary to keep it.

11 CAPACITIVE TOUCH SCREEN PANEL SPECIFICATIONS

11.1 Mechanical characteristics

DESCRIPTION	SPECIFICATION	REMARK
Touch Panel Size	4.3 inch	UxTouch
Outline Dimension of CTP	120.38 mm x 79.20 mm	UxTouch
Product Thickness	2.15 mm	UxTouch
Glass Thickness	1.1 mm	UxTouch
CTP View Area	96.54 mm x 55.36 mm	UxTouch
Sensor Active Area	98.00 mm x 56.50 mm	UxTouch
Structure type	Glass + Glass	UxTouch
Surface Hardness	7H	UxTouch

11.2 Electrical characteristics

DESCRIPTION	SPECIFICATION	NOTE
Power Consumption (IDD)	Active Mode	91 mA
	Sleep Mode	10 mA
Linearity	+/-1.5mm	
Controller	ILI2132A	
Resolution	480 x 272	

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:

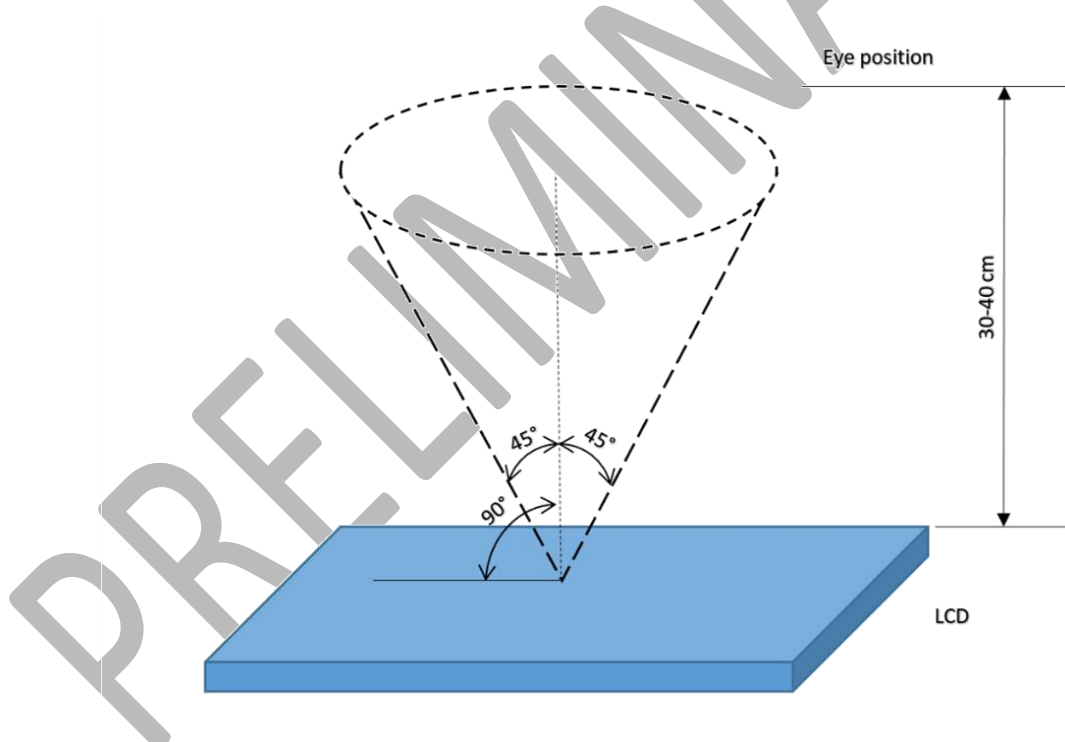
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

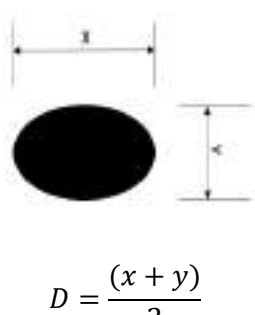
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



13.2 Inspection standard

Item	Criterion																		
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ *Spots density: 10 mm <table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>$D \leq 0.15 \text{ mm}$</td><td>Ignored</td></tr><tr><td>$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$</td><td>$N \leq 3$</td></tr><tr><td>$0.3\text{mm} < D$</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"		Average Diameter	Qualified Qty	$D \leq 0.15 \text{ mm}$	Ignored	$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$	$N \leq 3$	$0.3\text{mm} < D$	Not allowed								
3.5" ≤ Size ≤ 5"																			
Average Diameter	Qualified Qty																		
$D \leq 0.15 \text{ mm}$	Ignored																		
$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$	$N \leq 3$																		
$0.3\text{mm} < D$	Not allowed																		
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <table><tr><th colspan="3">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>$W \leq 0.03$</td><td>Ignored</td></tr><tr><td>$L \leq 3.0$</td><td>$0.03 < W \leq 0.05$</td><td>2</td></tr><tr><td>$L \leq 3.0$</td><td>$0.05 < W \leq 0.1$</td><td>1</td></tr><tr><td>$3.0 < L$</td><td>$0.1 < W$</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"			Length/mm	Width/mm	Qualified Qty	-	$W \leq 0.03$	Ignored	$L \leq 3.0$	$0.03 < W \leq 0.05$	2	$L \leq 3.0$	$0.05 < W \leq 0.1$	1	$3.0 < L$	$0.1 < W$	Not allowed
3.5" ≤ Size ≤ 5"																			
Length/mm	Width/mm	Qualified Qty																	
-	$W \leq 0.03$	Ignored																	
$L \leq 3.0$	$0.03 < W \leq 0.05$	2																	
$L \leq 3.0$	$0.05 < W \leq 0.1$	1																	
$3.0 < L$	$0.1 < W$	Not allowed																	
Bright/Dark Dots	<table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>$N \leq 1$</td></tr><tr><td>Dark Dots</td><td>$N \leq 2$</td></tr><tr><td>Total Bright and Dark Dots</td><td>$N \leq 3$</td></tr></table>	3.5" ≤ Size ≤ 5"		item	Qualified Qty	Bright Dots	$N \leq 1$	Dark Dots	$N \leq 2$	Total Bright and Dark Dots	$N \leq 3$								
3.5" ≤ Size ≤ 5"																			
item	Qualified Qty																		
Bright Dots	$N \leq 1$																		
Dark Dots	$N \leq 2$																		
Total Bright and Dark Dots	$N \leq 3$																		

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
	*Spots density: 10 mm		
Polarizer bubbles	3.5" ≤ Size ≤ 5"		
	Average Diameter		Qualified Qty
	D ≤ 0.2 mm		Ignored
	0.2 mm < D ≤ 0.3 mm		2
	0.3 mm < D ≤ 0.5mm		1
	0.5 mm < D		0
	Total Q'ty		3
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
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

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 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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 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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RVT43HLBNWC00

EVE4 IPS 4.3" LCD TFT Datasheet

Rev.0.1

2020-12-29

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	4.3	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	120.38 x 79.20 x 10.73	mm
Active Area (W × H)	95.04 × 53.86	mm
Pixel Pitch (W × H)	0.198 × 0.198	mm
Resolution	480 × 272 (RGB)	/
Brightness	800	cd/m ²
Color Depth	16.7 M	/
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	ILI2132A	/
Supply Voltage for Module	3.3	V
Supply Voltage for Backlight	5.0 (TYP.)	V
Weight	97	g

Note 1: RoHS compliant

Note 2: LCM weight tolerance: ± 5%.

REVISION RECORD

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

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1 MODULE CLASSIFICATION INFORMATION

RV	T	43	H	L	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	43 – 4.3”
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	L – 480 x 272 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 RVT43HLBNWC00-B, which is superior in optical performance and does not require any extra support.

Figure 1. Example of using the support brackets



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	VIN	-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	-	% 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	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	172	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

6 BACKLIGHT ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Backlight	BLVDD	3.0	5.0	6.0	V	
Current drawn from BLVDD @5.0V	I _{BLVDD=5.0V}	TBD	230	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	110	TBD	mA	50% of backlight, Note 1
Current drawn from BLVDD @3.3V	I _{BLVDD=3.3V}	TBD	385	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@3.3V	I _{BLVDD=3.3V}	TBD	175	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	$\theta=0^{\circ}$ $\phi=0^{\circ}$ Ta=25 °C	-	30	40	ms	FIG 2.	4
Contrast Ratio		Cr		640	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	$\phi = 90^{\circ}$	70	80	-	deg	FIG 4.	6
			$\phi = 270^{\circ}$	70	80	-	deg	FIG 4.	
			$\phi = 0^{\circ}$	70	80	-	deg	FIG 4.	
			$\phi = 180^{\circ}$	70	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	$\theta=0^{\circ}$ $\phi=0^{\circ}$ Ta=25 °C	0.579	0.619	0.659	FIG 3.	5	
		y		0.290	0.330	0.370			
	Green	x		0.346	0.386	0.426			
		y		0.539	0.579	0.619			
	Blue	x		0.070	0.110	0.150			
		y		0.091	0.131	0.171			
	White	x		0.280	0.320	0.360			
		y		0.305	0.345	0.384			

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 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 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 (x, y) chromaticity the test data is based on TOPCON's BM-5 photo detector.

Figure 2. The definition of response time

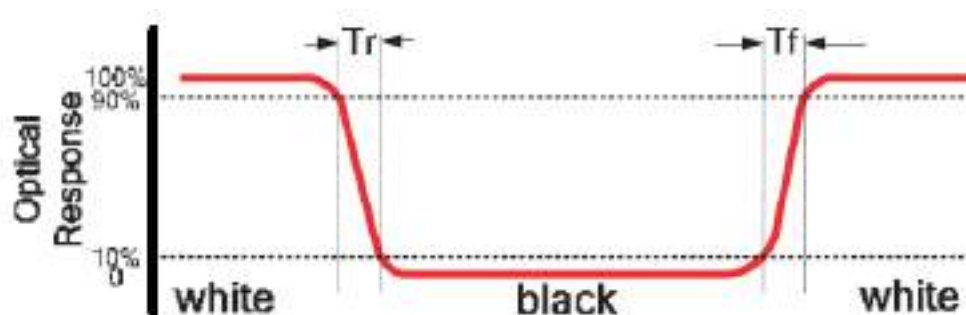


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

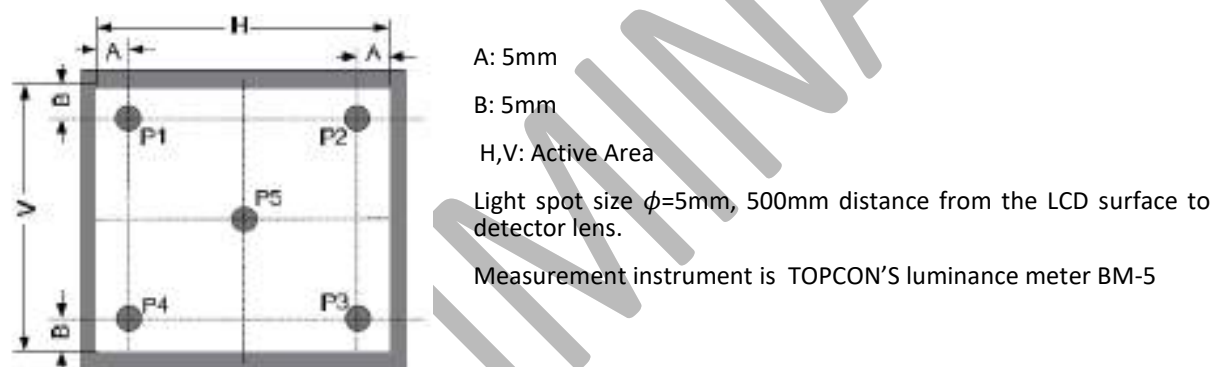
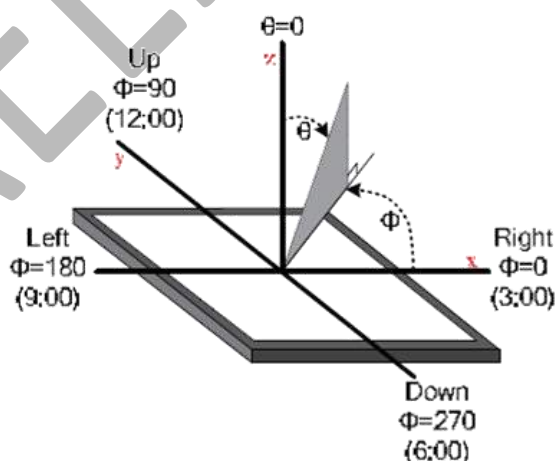


Figure 4. The definition of viewing angle



8 INTERFACE DESCRIPTION

8.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

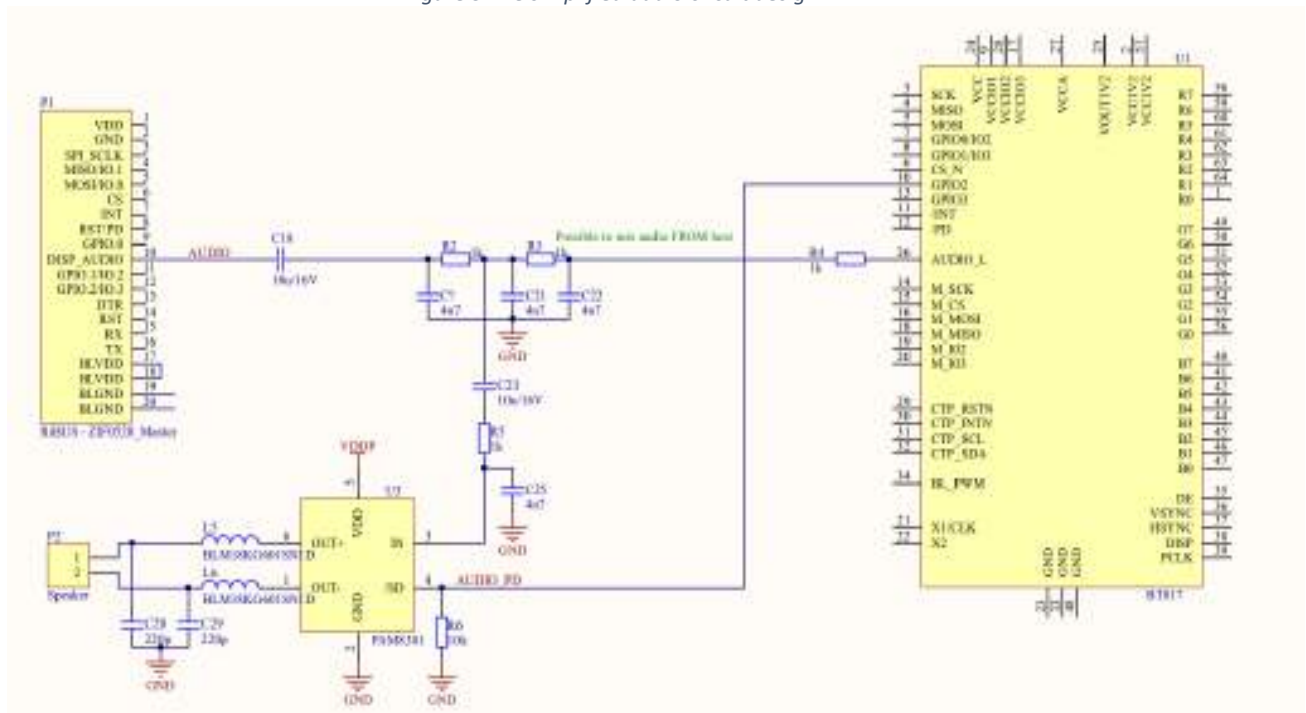
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil "+" terminal	Note 1
2	SPEAKER -	Speaker coil "-" terminal	

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. By standard, the EVE4 board is equipped with the separate 256Mb Flash memory chip, which allows to show up to 270 full resolution (480 * 272 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

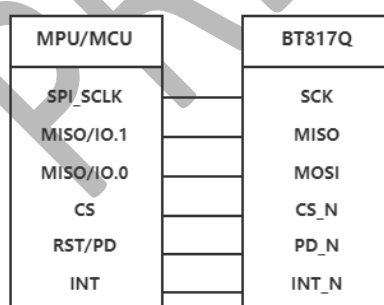
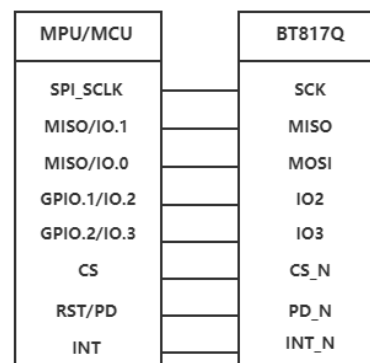


Figure 7. QSPI interface connection



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

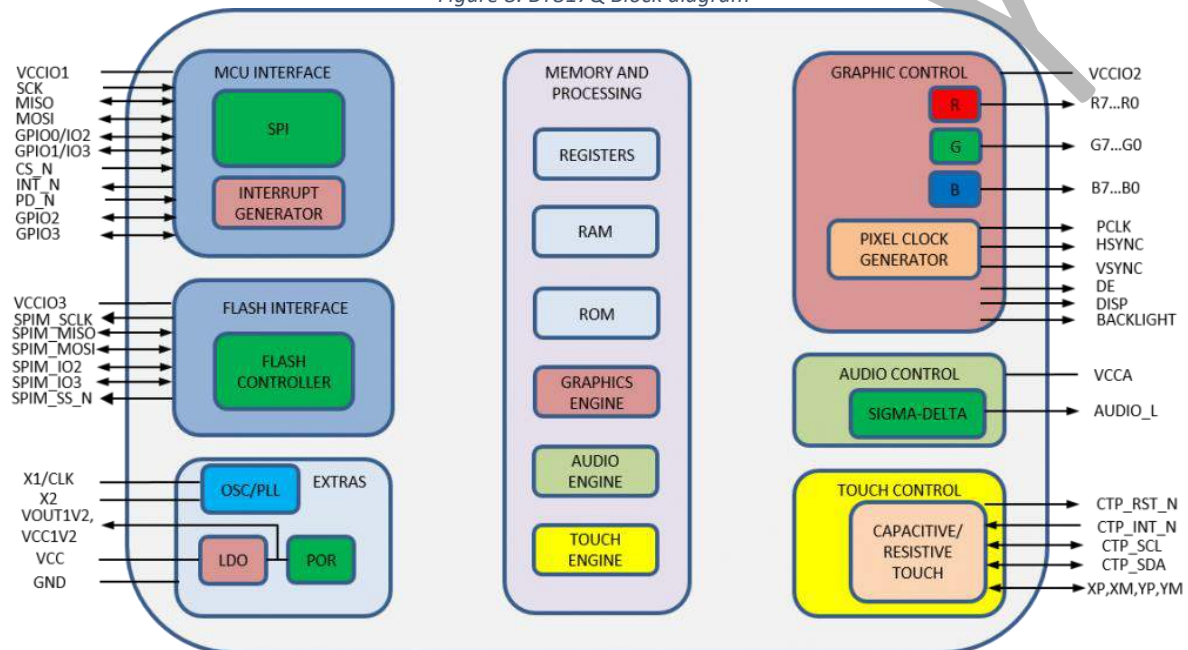
Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

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.

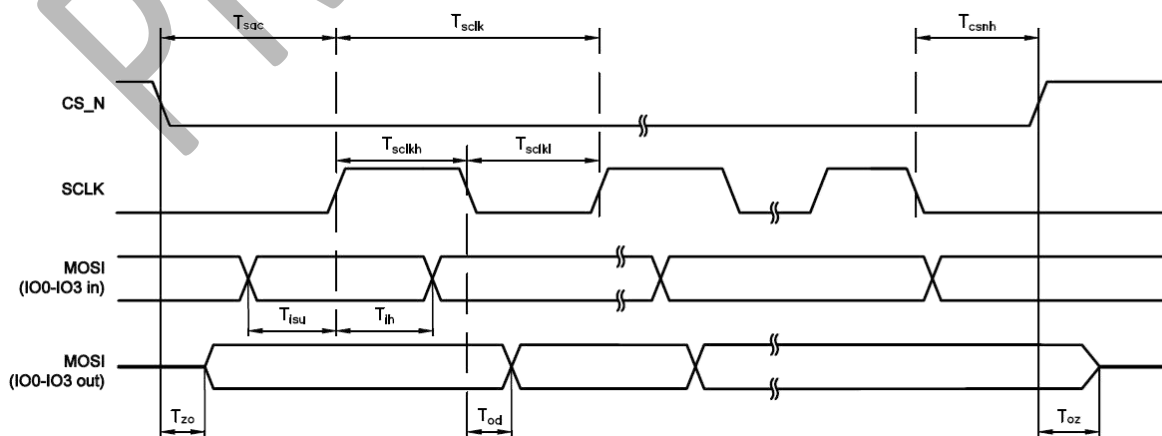
9.2 Block Diagram

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.

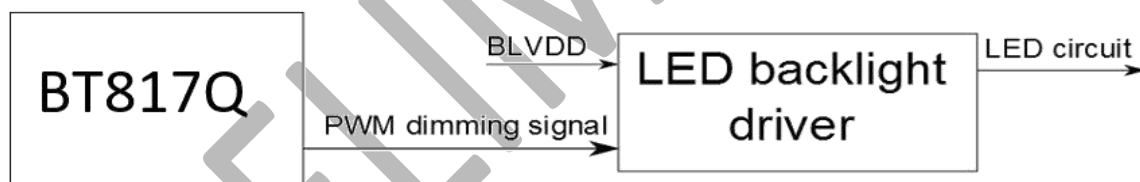
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T_{sclk}	SPI clock period	33.3		33.3		33.3		ns
T_{sckl}	SPI clock low duration	13		13		13		ns
T_{sckh}	SPI clock high duration	13		13		13		ns
T_{sac}	SPI access time	4		3.5		3		ns
T_{isu}	Input Setup	4		3.5		3	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

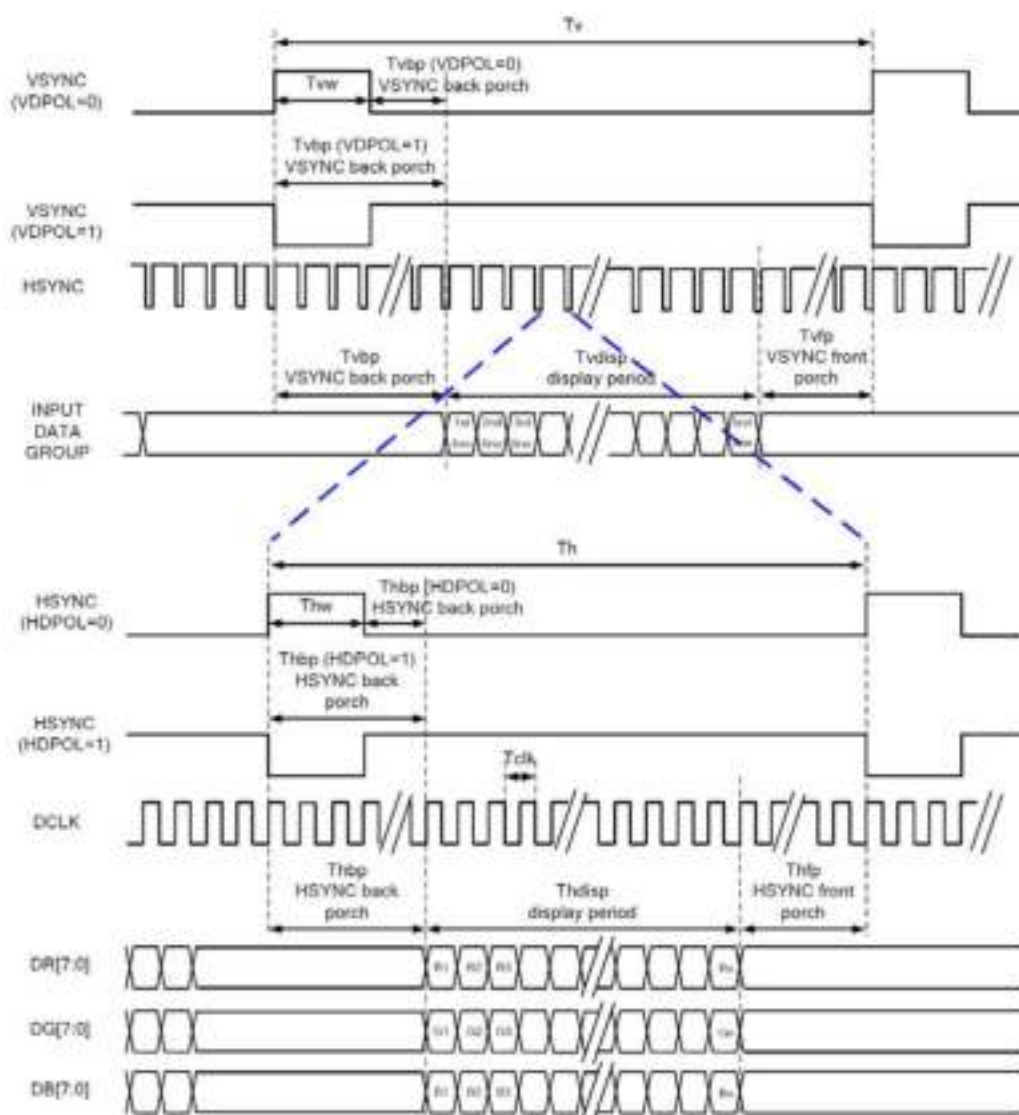
10.1 RGB mode

RGB MODE SELECTION	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

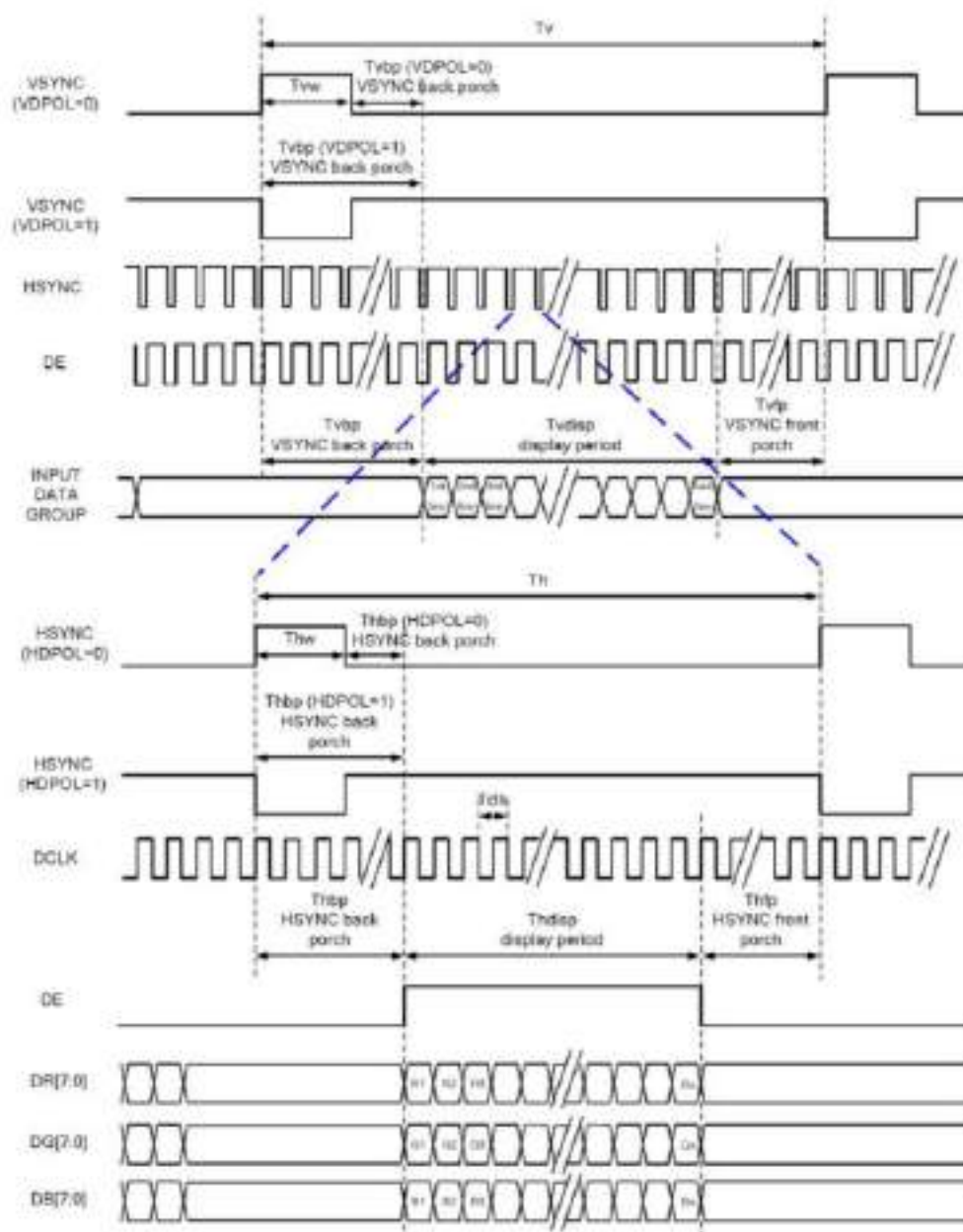
Note. "Input" means these signals are driven by host side.

10.2 Timing diagram and input setup timing setting

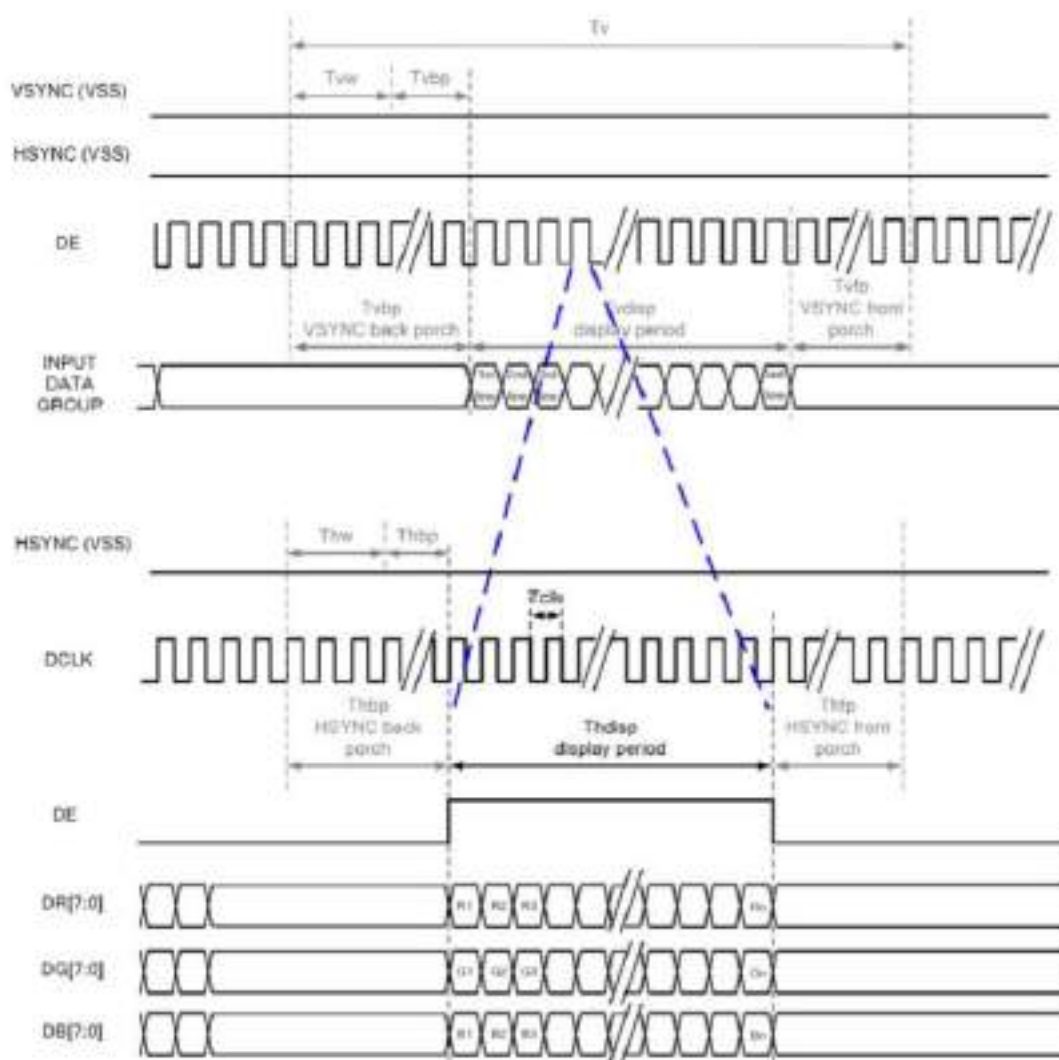
10.2.1 SYNC mode timing diagram



10.2.2 SYNC-DE mode timing diagram



10.2.3 DE mode timing diagram



10.3 Parallel 24-bit RGB input timing table

Parallel 24-bit RGB input Timing (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25 °C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK Frequency	Fclk	8	9	12	MHz	
DCLK Period	Tclk	83	111	125	ns	
HSYNC	Period Time	Th	485	531	598	DCLK
	Display Period	Thdisp	480			DCLK
	Back Porch	Thbp	3	43	43	DCLK By H_BLANKING setting
	Front Porch	Thfp	2	8	75	DCLK
	Pulse Width	Thw	2	4	43	DCLK
VSYNC	Period Time	Tv	276	292	321	HSYNC
	Display Period	Tvdisp	272			HSYNC
	Back Porch	Tvbp	2	12	12	HSYNC By V_BLANKING setting
	Front Porch	Tvfp	2	8	37	HSYNC
	Pulse Width	Tvw	2	4	12	HSYNC

Note. It's necessary to keep Tvbp=12 and Thbp=43 in sync mode. It is unnecessary to keep these values in DE mode.

11 CAPACITIVE TOUCH SCREEN PANEL SPECIFICATIONS

11.1 Mechanical characteristics

DESCRIPTION	SPECIFICATION	REMARK
Touch Panel Size	4.3 inch	UxTouch
Outline Dimension of CTP	120.38 mm x 79.20 mm	UxTouch
Product Thickness	2.15 mm	UxTouch
Glass Thickness	1.1 mm	UxTouch
CTP View Area	96.54 mm x 55.36 mm	UxTouch
Sensor Active Area	98.00 mm x 56.50 mm	UxTouch
Structure type	Glass + Glass	UxTouch
Surface Hardness	7H	UxTouch

11.2 Electrical characteristics

DESCRIPTION	SPECIFICATION	NOTE
Power Consumption (IDD)	Active Mode	91 mA
	Sleep Mode	10 mA
Linearity	+/-1.5mm	
Controller	ILI2132A	
Resolution	480 x 272	

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:

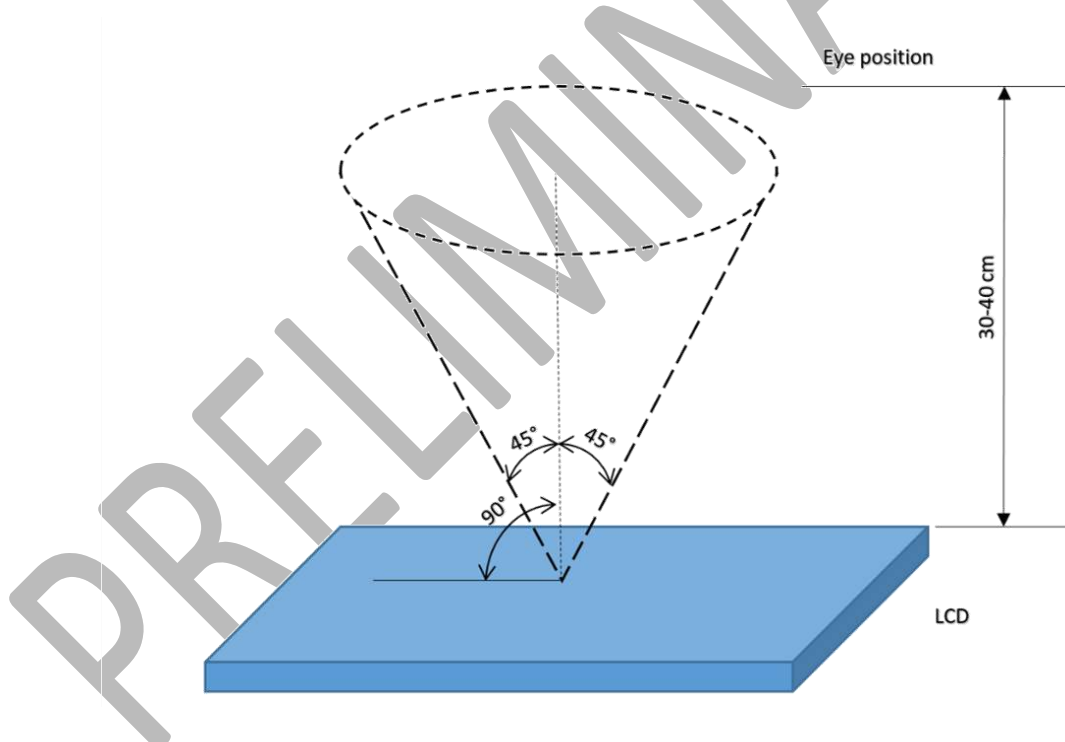
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

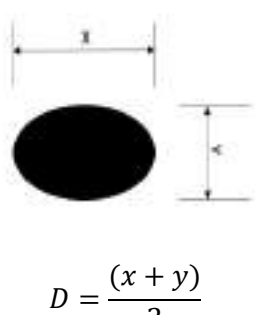
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



13.2 Inspection standard

Item	Criterion																		
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ *Spots density: 10 mm <table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>D ≤ 0.15 mm</td><td>Ignored</td></tr><tr><td>0.15 mm < D ≤ 0.30 mm</td><td>N ≤ 3</td></tr><tr><td>0.3mm < D</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"		Average Diameter	Qualified Qty	D ≤ 0.15 mm	Ignored	0.15 mm < D ≤ 0.30 mm	N ≤ 3	0.3mm < D	Not allowed								
3.5" ≤ Size ≤ 5"																			
Average Diameter	Qualified Qty																		
D ≤ 0.15 mm	Ignored																		
0.15 mm < D ≤ 0.30 mm	N ≤ 3																		
0.3mm < D	Not allowed																		
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <table><tr><th colspan="3">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>W ≤ 0.03</td><td>Ignored</td></tr><tr><td>L ≤ 3.0</td><td>0.03 < W ≤ 0.05</td><td>2</td></tr><tr><td>L ≤ 3.0</td><td>0.05 < W ≤ 0.1</td><td>1</td></tr><tr><td>3.0 < L</td><td>0.1 < W</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"			Length/mm	Width/mm	Qualified Qty	-	W ≤ 0.03	Ignored	L ≤ 3.0	0.03 < W ≤ 0.05	2	L ≤ 3.0	0.05 < W ≤ 0.1	1	3.0 < L	0.1 < W	Not allowed
3.5" ≤ Size ≤ 5"																			
Length/mm	Width/mm	Qualified Qty																	
-	W ≤ 0.03	Ignored																	
L ≤ 3.0	0.03 < W ≤ 0.05	2																	
L ≤ 3.0	0.05 < W ≤ 0.1	1																	
3.0 < L	0.1 < W	Not allowed																	
Bright/Dark Dots	<table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>N ≤ 1</td></tr><tr><td>Dark Dots</td><td>N ≤ 2</td></tr><tr><td>Total Bright and Dark Dots</td><td>N ≤ 3</td></tr></table>	3.5" ≤ Size ≤ 5"		item	Qualified Qty	Bright Dots	N ≤ 1	Dark Dots	N ≤ 2	Total Bright and Dark Dots	N ≤ 3								
3.5" ≤ Size ≤ 5"																			
item	Qualified Qty																		
Bright Dots	N ≤ 1																		
Dark Dots	N ≤ 2																		
Total Bright and Dark Dots	N ≤ 3																		

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
*Spots density: 10 mm	
Polarizer bubbles	3.5" ≤ Size ≤ 5"
	Average Diameter
	Qualified Qty
	D ≤ 0.2 mm
	Ignored
	0.2 mm < D ≤ 0.3 mm
	2
	0.3 mm < D ≤ 0.5 mm
	1
	0.5 mm < D
	0
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
Touch panel White line Scratch	Size < 5"
	Length
	Width
	Qualified Qty
	-
	W < 0.02
	Ignored
	L < 3.0
	0.02 < W < 0.05
	L < 2.5
	0.05 < W < 0.08
	-
	0.08 < W
	2
	0

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 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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 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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RVT43HLBNWN00

EVE4 IPS 4.3" LCD TFT Datasheet

Rev.0.1

2020-01-18

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	4.3	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	105.50 x 67.20 x 7.87	mm
Active Area (W × H)	95.04 × 53.86	mm
Pixel Pitch (W × H)	0.198 × 0.198	mm
Resolution	480 × 272 (RGB)	/
Brightness	1000	cd/m ²
Color Depth	16.7 M	/
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 (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	

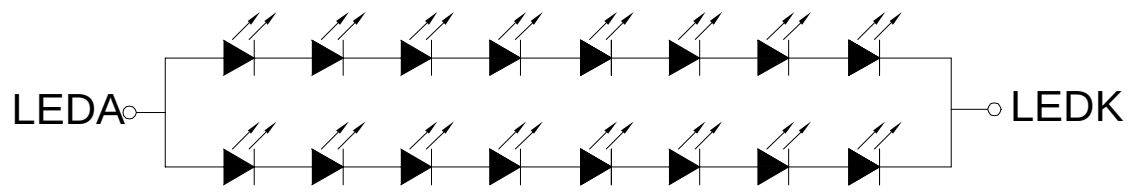
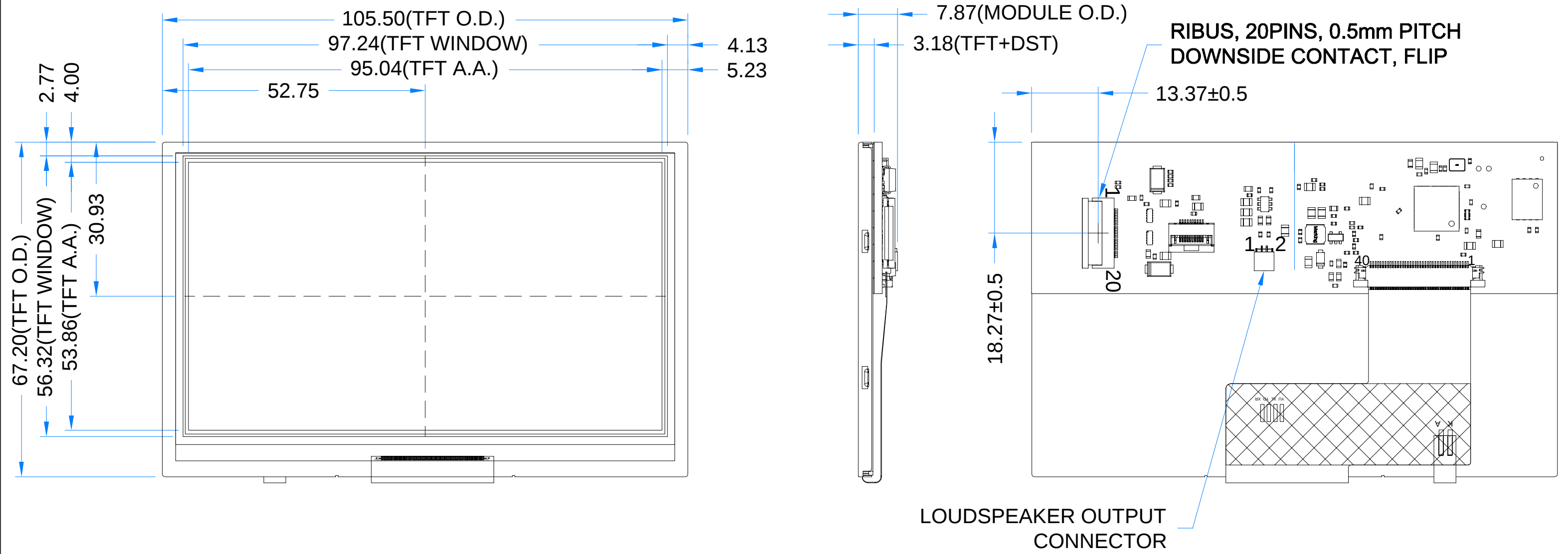
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1 MODULE CLASSIFICATION INFORMATION

RV	T	43	H	L	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	43 – 4.3”
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	L – 480 x 272 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)



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	VIN	-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	-	% 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).

4 ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	172	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

5 BACKLIGHT ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Backlight	BLVDD	3.0	5.0	6.0	V	
Current drawn from BLVDD @5.0V	I _{BLVDD=5.0V}	TBD	230	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	110	TBD	mA	50% of backlight, Note 1
Current drawn from BLVDD @3.3V	I _{BLVDD=3.3V}	TBD	385	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@3.3V	I _{BLVDD=3.3V}	TBD	175	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.

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	$\theta=0^{\circ}$ $\phi=0^{\circ}$ Ta=25 °C	-	30	40	ms	FIG 2.	4
Contrast Ratio		Cr		640	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	$\phi = 90^{\circ}$	70	80	-	deg	FIG 4.	6
			$\phi = 270^{\circ}$	70	80	-	deg	FIG 4.	
			$\phi = 0^{\circ}$	70	80	-	deg	FIG 4.	
			$\phi = 180^{\circ}$	70	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	$\theta=0^{\circ}$ $\phi=0^{\circ}$ Ta=25 °C	0.579	0.619	0.659	FIG 3.	5	
		y		0.290	0.330	0.370			
	Green	x		0.346	0.386	0.426			
		y		0.539	0.579	0.619			
	Blue	x		0.070	0.110	0.150			
		y		0.091	0.131	0.171			
	White	x		0.280	0.320	0.360			
		y		0.305	0.345	0.384			

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 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 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 (x, y) chromaticity the test data is based on TOPCON's BM-5 photo detector.

Figure 2. The definition of response time

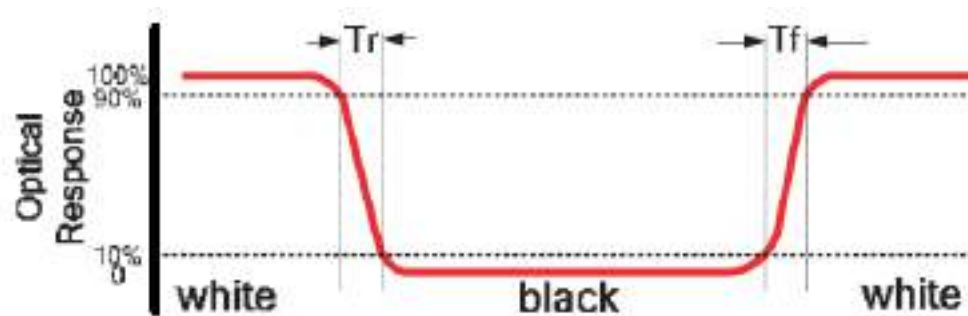
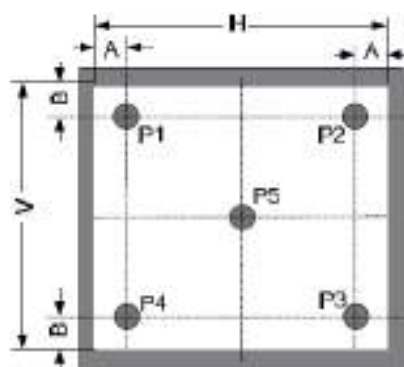


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

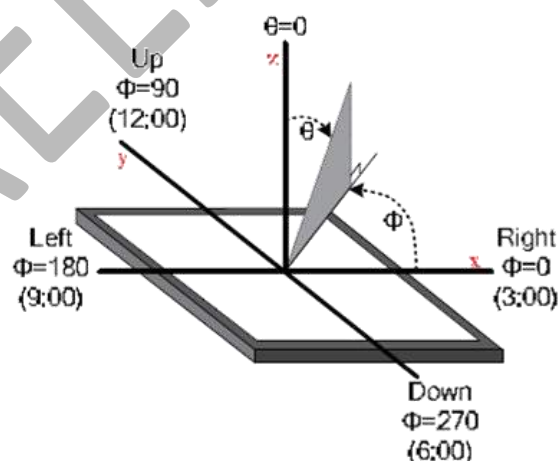
B: 5mm

H,V: Active Area

Light spot size $\phi=5\text{mm}$, 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



7 INTERFACE DESCRIPTION

7.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

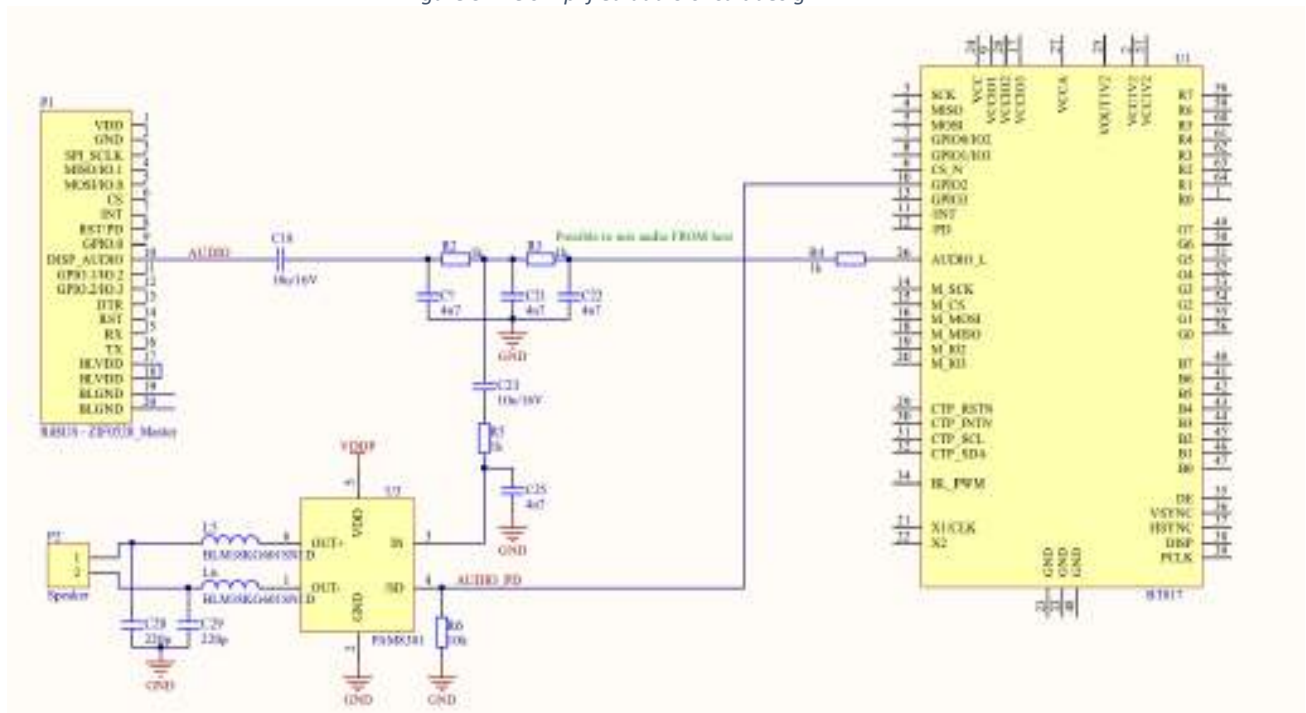
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil "+" terminal	Note 1
2	SPEAKER -	Speaker coil "-" terminal	

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. By standard, the EVE4 board is equipped with the separate 256Mb Flash memory chip, which allows to show up to 270 full resolution (480 * 272 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

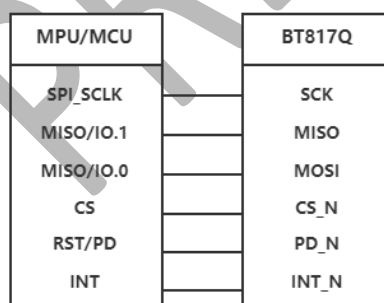
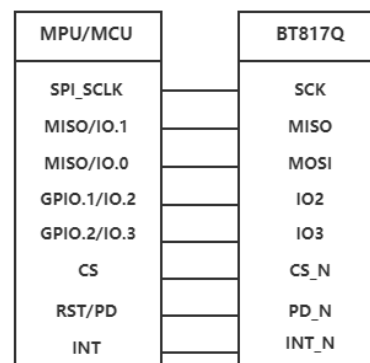


Figure 7. QSPI interface connection



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

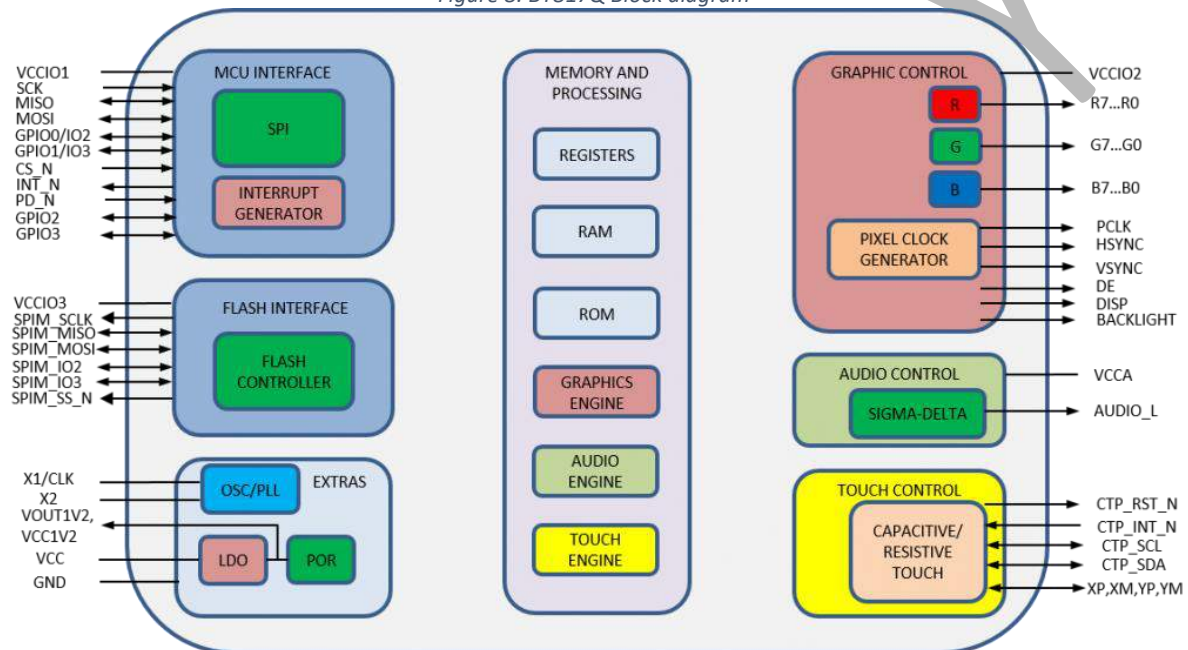
Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

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.

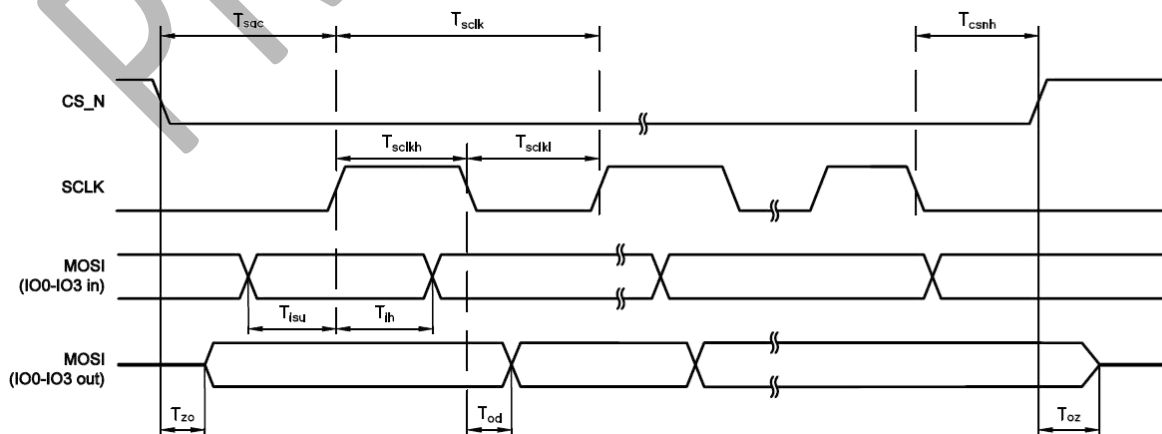
8.2 Block Diagram

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.

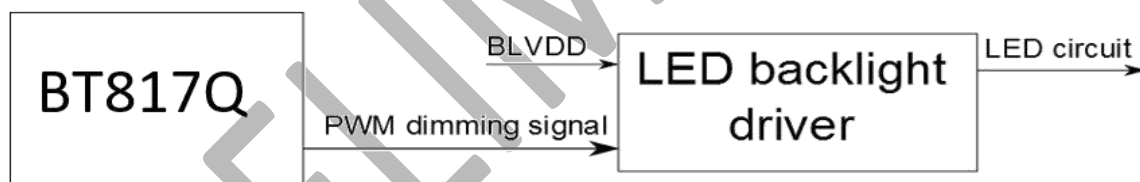
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T_{sclk}	SPI clock period	33.3		33.3		33.3		ns
T_{sckl}	SPI clock low duration	13		13		13		ns
T_{sckh}	SPI clock high duration	13		13		13		ns
T_{sac}	SPI access time	4		3.5		3		ns
T_{isu}	Input Setup	4		3.5		3	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

9 TIMING CHARACTERISTICS

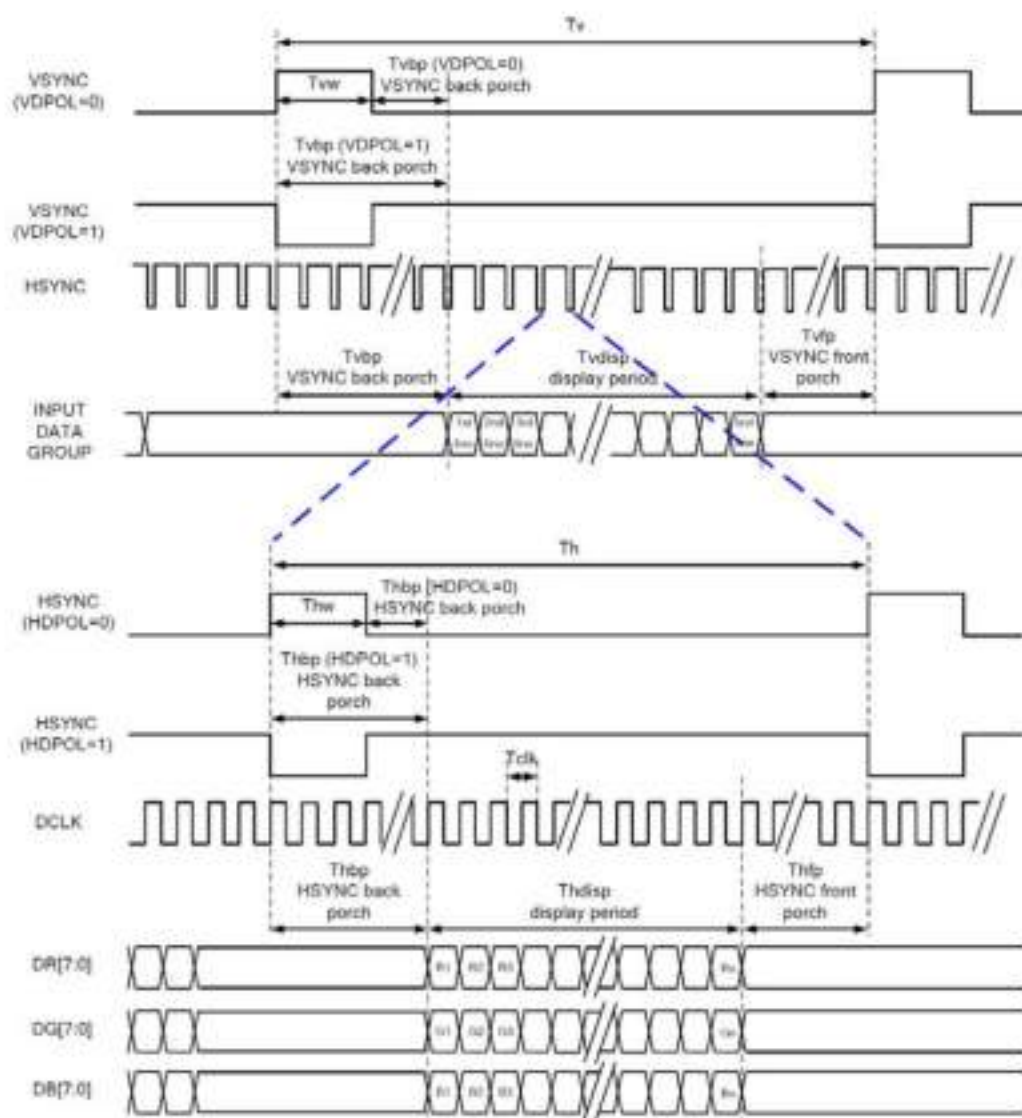
9.1 RGB mode

RGB MODE SELECTION	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input
SYNC Mode	Input	Input	Input	GND
DE Mode	Input	GND	GND	Input

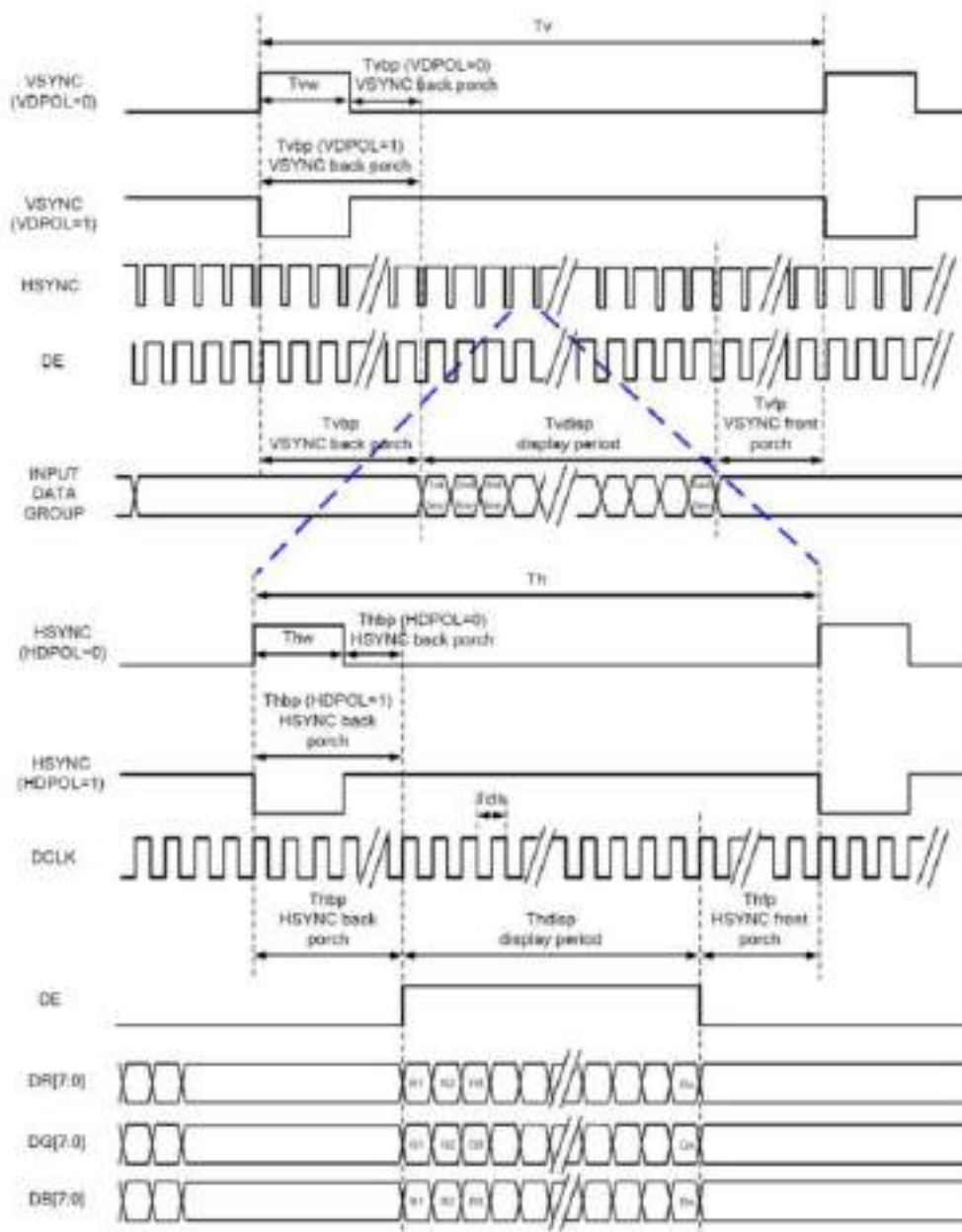
Note. "Input" means these signals are driven by host side.

9.2 Timing diagram and input setup timing setting

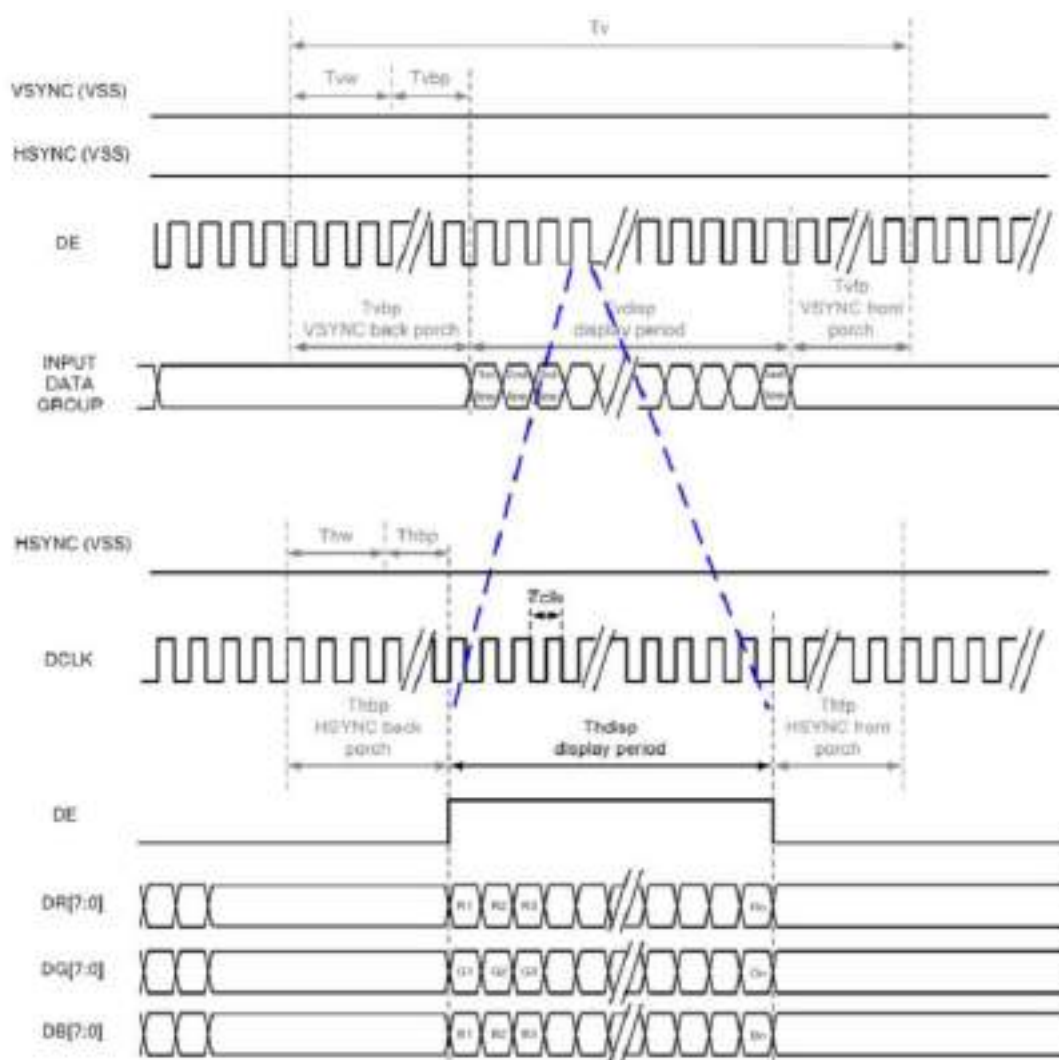
9.2.1 SYNC mode timing diagram



9.2.2 SYNC-DE mode timing diagram



9.2.3 DE mode timing diagram



9.3 Parallel 24-bit RGB input timing table

Parallel 24-bit RGB input Timing (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25 °C)

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
DCLK Frequency	Fclk	8	9	12	MHz	
DCLK Period	Tclk	83	111	125	ns	
HSYNC	Period Time	Th	485	531	598	DCLK
	Display Period	Thdisp	480			DCLK
	Back Porch	Thbp	3	43	43	DCLK By H_BLANKING setting
	Front Porch	Thfp	2	8	75	DCLK
	Pulse Width	Thw	2	4	43	DCLK
VSYNC	Period Time	Tv	276	292	321	HSYNC
	Display Period	Tvdisp	272			HSYNC
	Back Porch	Tvbp	2	12	12	HSYNC By V_BLANKING setting
	Front Porch	Tvfp	2	8	37	HSYNC
	Pulse Width	Tvw	2	4	12	HSYNC

Note. It's necessary to keep Tvbp=12 and Thbp=43 in sync mode. It is unnecessary to keep these values in DE mode.

10 INITIALIZATION CODE

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

11 INSPECTION

Standard acceptance/rejection criteria for TFT module.

11.1 Inspection condition

Ambient conditions:

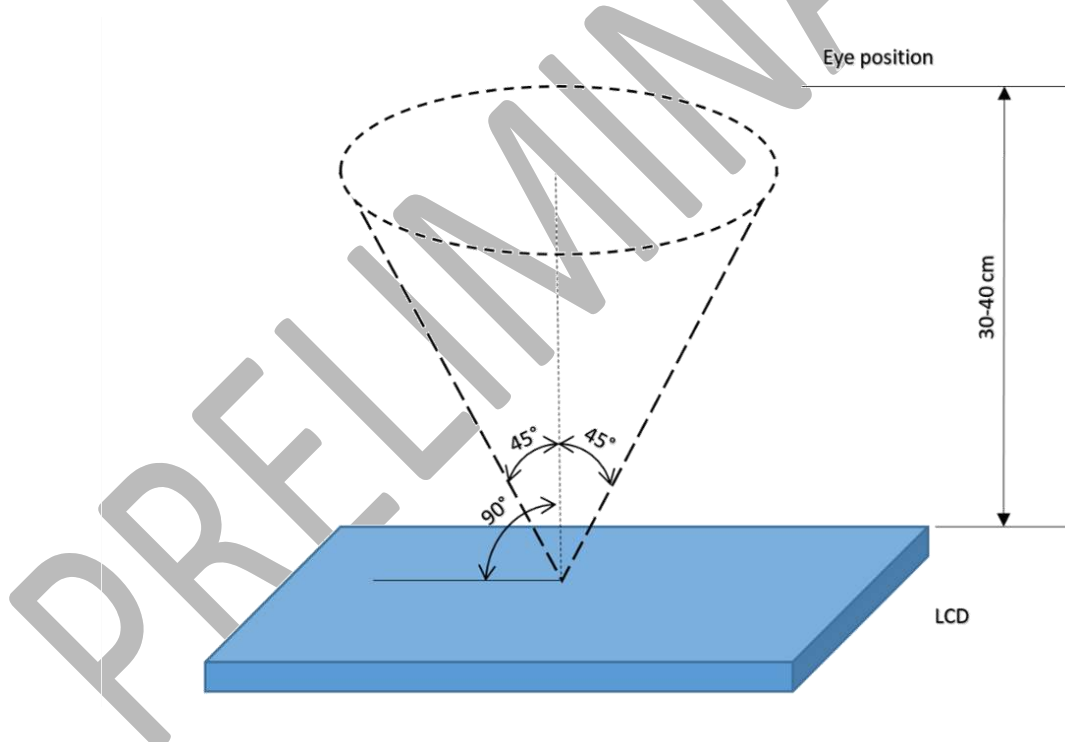
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

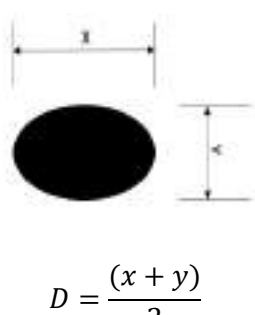
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



11.2 Inspection standard

Item	Criterion																		
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ *Spots density: 10 mm <table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>$D \leq 0.15 \text{ mm}$</td><td>Ignored</td></tr><tr><td>$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$</td><td>$N \leq 3$</td></tr><tr><td>$0.3\text{mm} < D$</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"		Average Diameter	Qualified Qty	$D \leq 0.15 \text{ mm}$	Ignored	$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$	$N \leq 3$	$0.3\text{mm} < D$	Not allowed								
3.5" ≤ Size ≤ 5"																			
Average Diameter	Qualified Qty																		
$D \leq 0.15 \text{ mm}$	Ignored																		
$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$	$N \leq 3$																		
$0.3\text{mm} < D$	Not allowed																		
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <table><tr><th colspan="3">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>$W \leq 0.03$</td><td>Ignored</td></tr><tr><td>$L \leq 3.0$</td><td>$0.03 < W \leq 0.05$</td><td>2</td></tr><tr><td>$L \leq 3.0$</td><td>$0.05 < W \leq 0.1$</td><td>1</td></tr><tr><td>$3.0 < L$</td><td>$0.1 < W$</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"			Length/mm	Width/mm	Qualified Qty	-	$W \leq 0.03$	Ignored	$L \leq 3.0$	$0.03 < W \leq 0.05$	2	$L \leq 3.0$	$0.05 < W \leq 0.1$	1	$3.0 < L$	$0.1 < W$	Not allowed
3.5" ≤ Size ≤ 5"																			
Length/mm	Width/mm	Qualified Qty																	
-	$W \leq 0.03$	Ignored																	
$L \leq 3.0$	$0.03 < W \leq 0.05$	2																	
$L \leq 3.0$	$0.05 < W \leq 0.1$	1																	
$3.0 < L$	$0.1 < W$	Not allowed																	
Bright/Dark Dots	<table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>$N \leq 1$</td></tr><tr><td>Dark Dots</td><td>$N \leq 2$</td></tr><tr><td>Total Bright and Dark Dots</td><td>$N \leq 3$</td></tr></table>	3.5" ≤ Size ≤ 5"		item	Qualified Qty	Bright Dots	$N \leq 1$	Dark Dots	$N \leq 2$	Total Bright and Dark Dots	$N \leq 3$								
3.5" ≤ Size ≤ 5"																			
item	Qualified Qty																		
Bright Dots	$N \leq 1$																		
Dark Dots	$N \leq 2$																		
Total Bright and Dark Dots	$N \leq 3$																		

Item	Criterion
Clear spots	Size < 5"
	Average Diameter
	Qualified Qty
	D < 0.2 mm
	Ignored
	0.2 mm < D < 0.3 mm
Polarizer bubbles	3
	0.3 mm < D < 0.5 mm
	2
	0.5 mm < D
	0
	*Spots density: 10 mm
Polarizer bubbles	3.5" ≤ Size ≤ 5"
	Average Diameter
	Qualified Qty
	D ≤ 0.2 mm
	Ignored
	0.2 mm < D ≤ 0.3 mm
Polarizer bubbles	2
	0.3 mm < D ≤ 0.5 mm
	1
	0.5 mm < D
	0
	Total Q'ty
	3

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 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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 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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RVT50HQBFWN00

EVE4 IPS 5.0" LCD TFT Datasheet

Rev.0.1

2020-01-18

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	5.0	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	137.50 × 76.6 × 8.40	mm
Active Area (W × H)	108.0 × 64.8	mm
Pixel Pitch (W × H)	0.135 × 0.135	mm
Resolution	800 × 480 (RGB)	/
Brightness	1000	cd/m ²
Color Depth	16.7 M	/
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 (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	

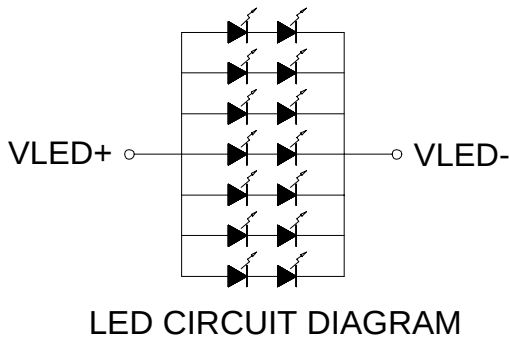
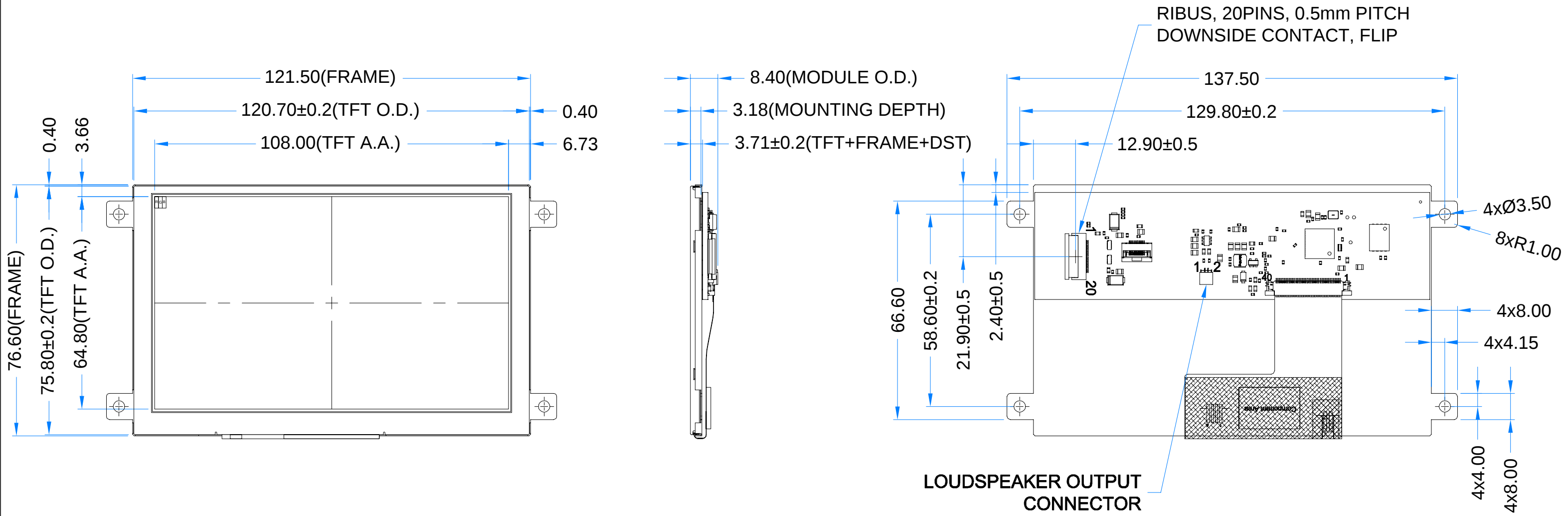
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1 MODULE CLASSIFICATION INFORMATION

RV	T	50	H	Q	B	F	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	50 – 5.0”
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	Q – 800 x 480 px
6.	INTERFACE	B – SPI/QSPI
7.	FRAME	F – With Frame
8.	BACKLIGHT TYPE	W – LED White
9.	TOUCH PANEL	N – Without Touch Panel
10.	VERSION	00 – (00-99)



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	VIN	-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	-	% 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).

4 ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	203	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

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	362	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	173	TBD	mA	50% of backlight, Note 1
Current drawn from BLVDD @3.3V	I _{BLVDD=3.3V}	TBD	622	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@3.3V	I _{BLVDD=3.3V}	TBD	273	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.

6 ELECTRO-OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	-	30	-	ms	FIG 2.	4
Contrast Ratio	Cr		-	1000	-	---	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	$\phi = 90^\circ$	-	80	-	deg	FIG 4.	6
		$\phi = 270^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 0^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 180^\circ$	-	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	0.575	0.615	0.655	FIG 3.		5
		y	0.296	0.336	0.376			
	Green	x	0.352	0.392	0.432			
		y	0.512	0.552	0.592			
	Blue	x	0.100	0.140	0.180			
		y	0.085	0.125	0.165			
	White	x	0.274	0.316	0.358			
		y	0.295	0.336	0.378			

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 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 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 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

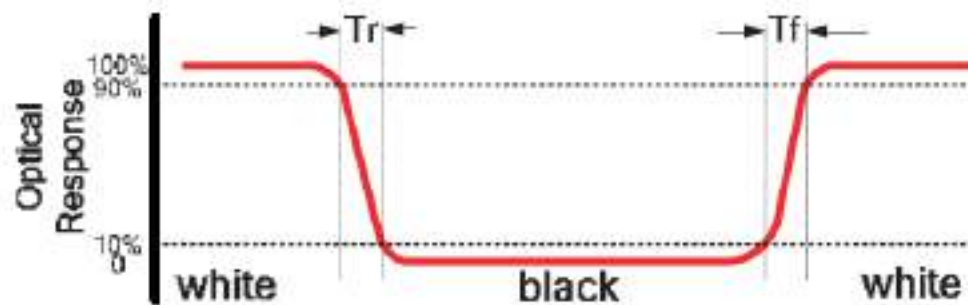
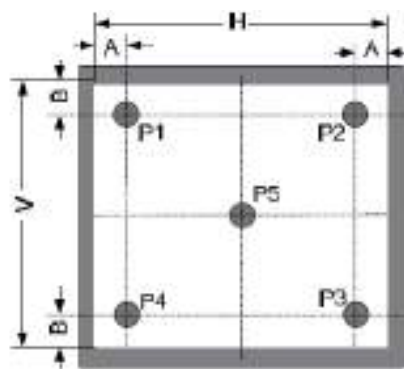


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

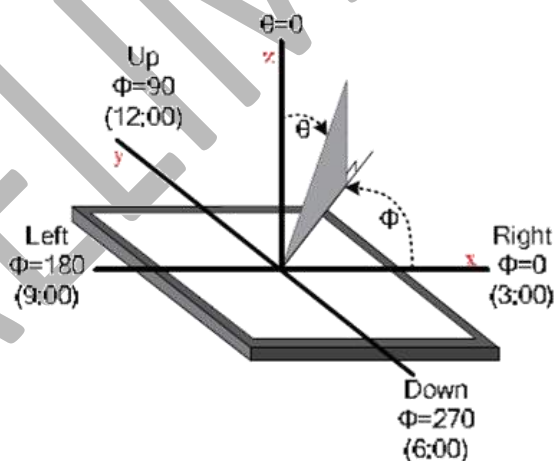
B: 5mm

H,V: Active Area

Light spot size $\phi=5\text{mm}$, 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



7 INTERFACE DESCRIPTION

7.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

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

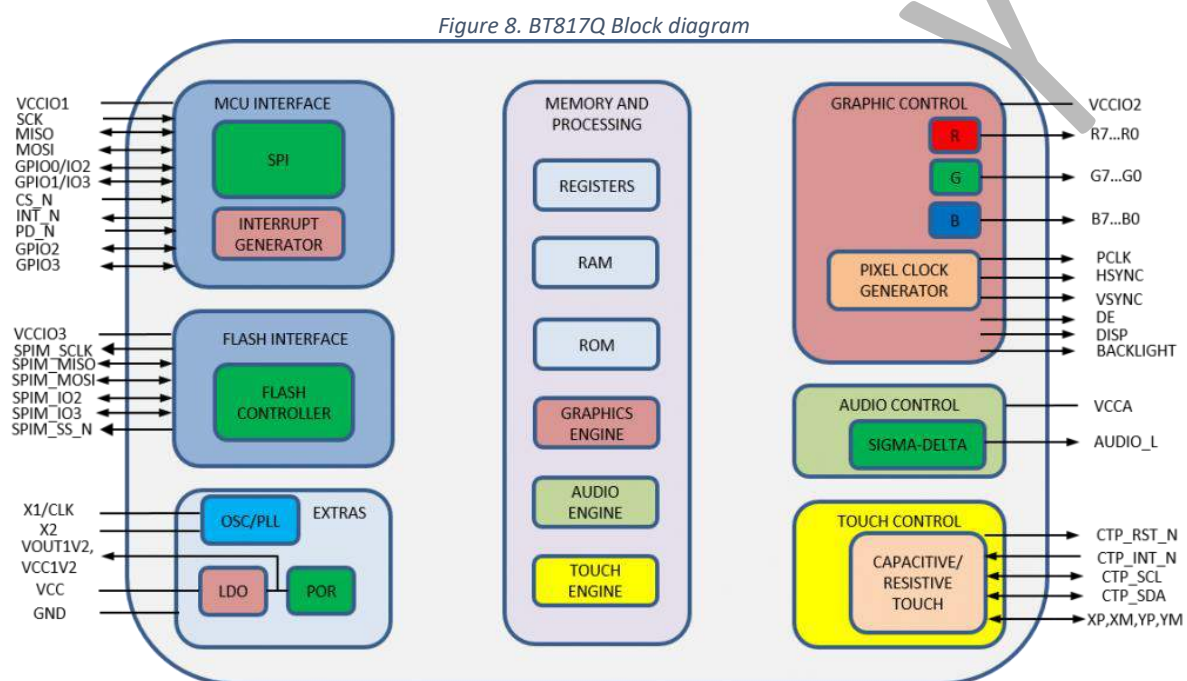
ES France - Département Composants & Modules - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 84 - Fax. 01 47 01 16 22 - e-mail: comp@es-france.com - Site Web: www.es-france.com

Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

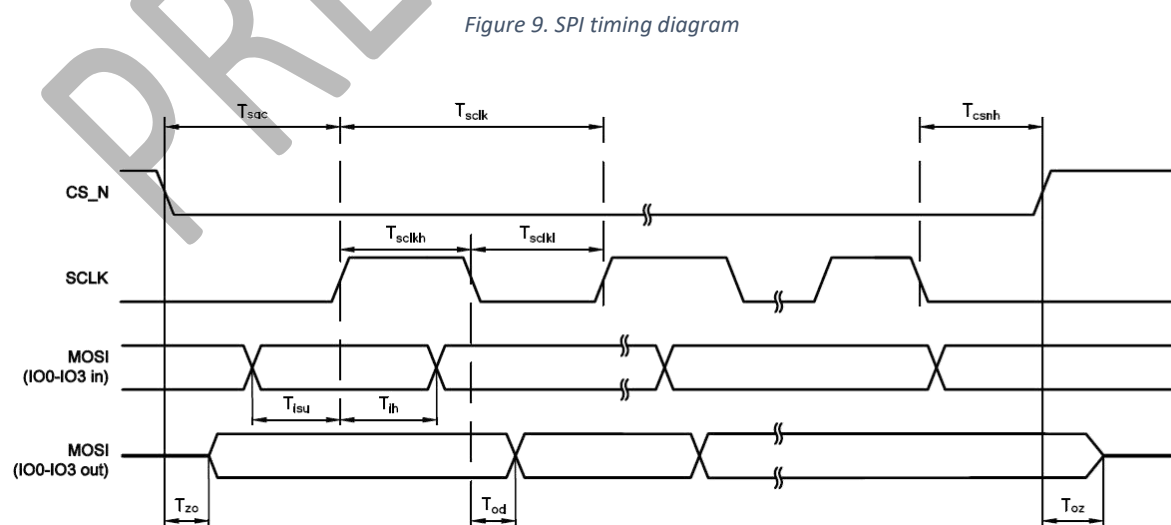
QSPI Interface – the QSPI slave interface operates up to 30MHz (It depends on EVE 4 system clock frequency and will be verified in Riverdi lab). Only SPI mode 0 is supported. The QSPI can be configured as a SPI slave in SINGLE, DUAL or QUAD channel modes.

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



8.3 Host interface SPI mode 0



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

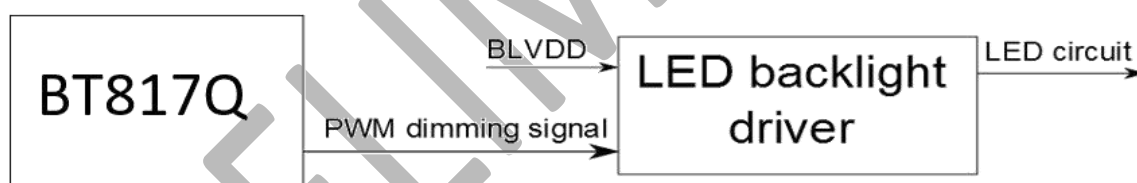
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

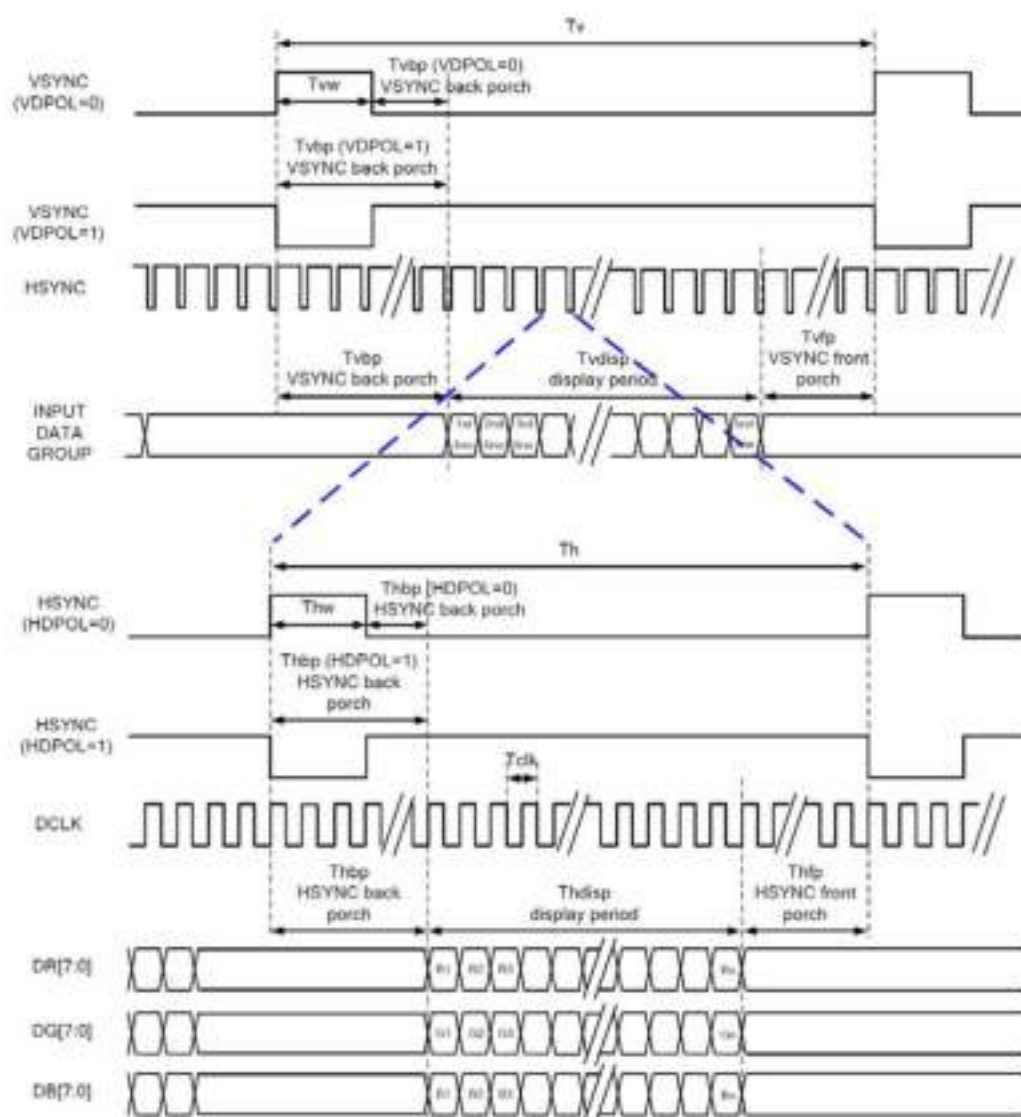
9 TIMING CHARACTERISTICS

9.1 RGB mode

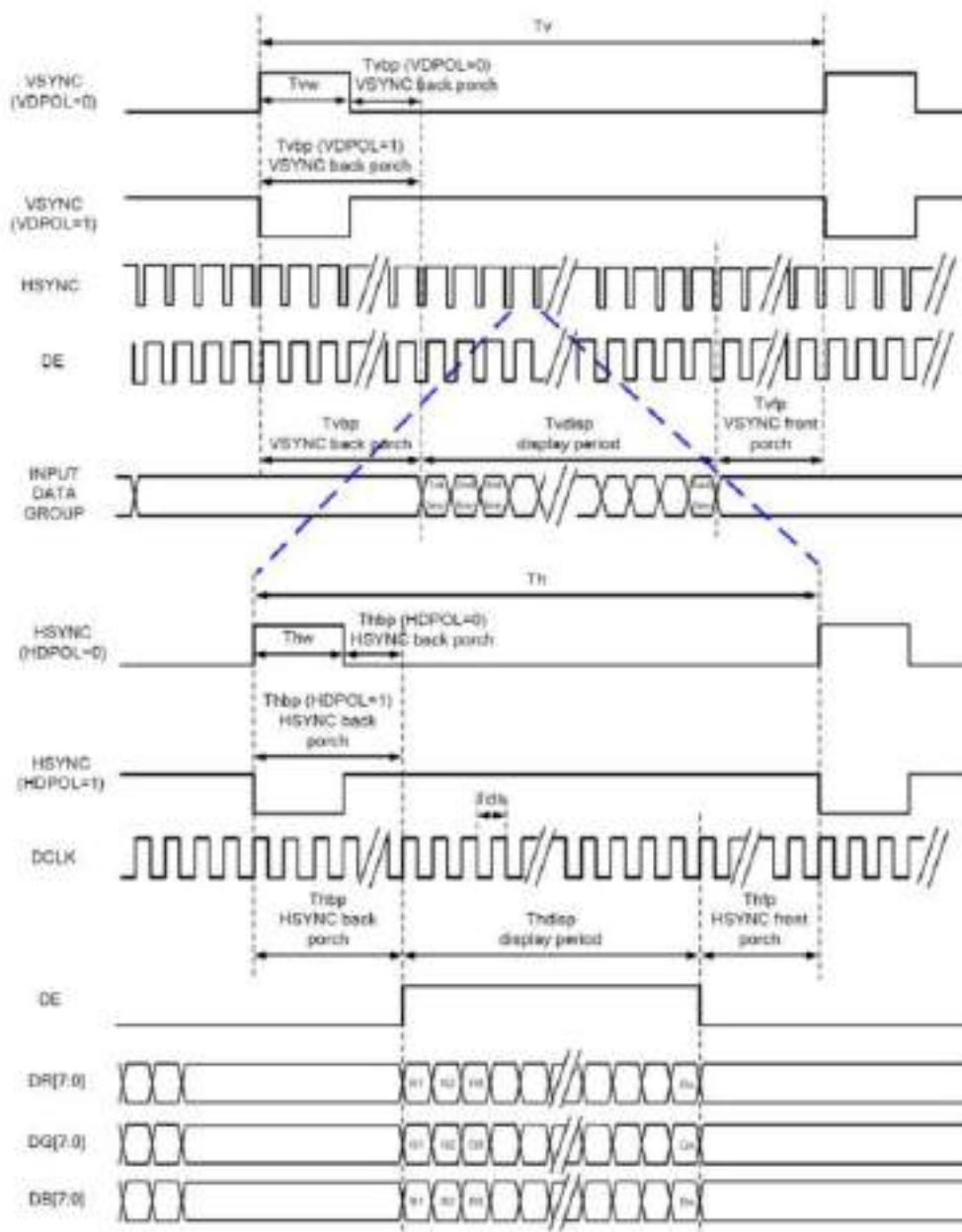
RGB MODE	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input

9.2 System bus timing for RGB interface

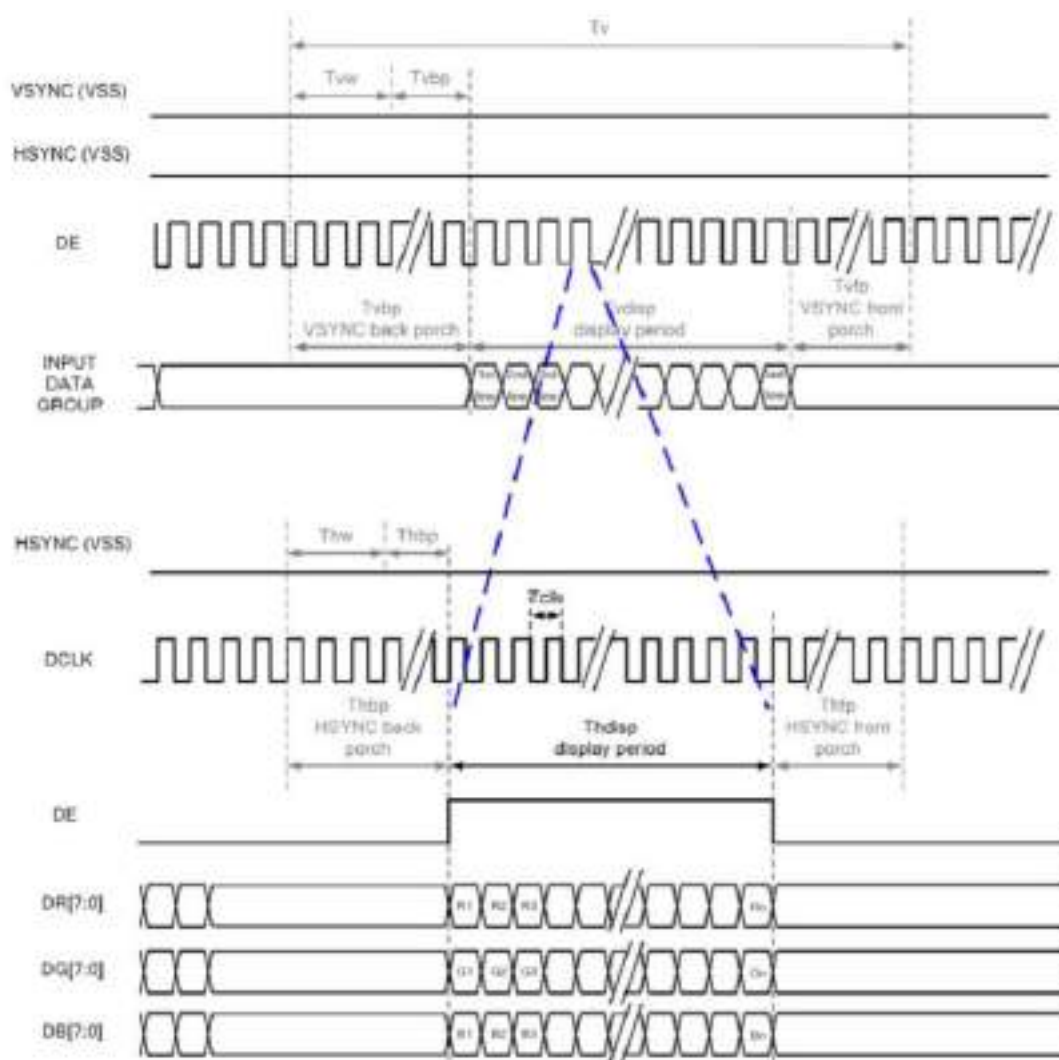
9.2.1 SYNC Mode



9.2.2 SYNC-DE Mode



9.2.3 DE Mode



9.3 Parallel 24-bit RGB input timing table

Parallel 24-bit RGB input Timing (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25 °C)

PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT
DCLK Frequency		F_{clk}	23	25	27	MHz
HSYNC	Period Time	T_h	808	816	896	DCLK
	Display Period	T_{hdisp}	800			DCLK
	Hsync Back Porch	T_{hbp}	4	8	48	DCLK
	Hsync Front Porch	T_{hfp}	4	8	48	DCLK
	Hsync Pluse Width	T_{hw}	2	4	8	DCLK
VSYNC	Period Time	T_v	488	496	504	HSYNC
	Display Period	T_{vdisp}	480			HSYNC
	Vsync Back Porch	T_{vbp}	4	8	12	HSYNC
	Vsync Front Porch	T_{vfp}	4	8	12	HSYNC
	Vsync Pluse Width	T_{vw}	2	4	8	HSYNC

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:

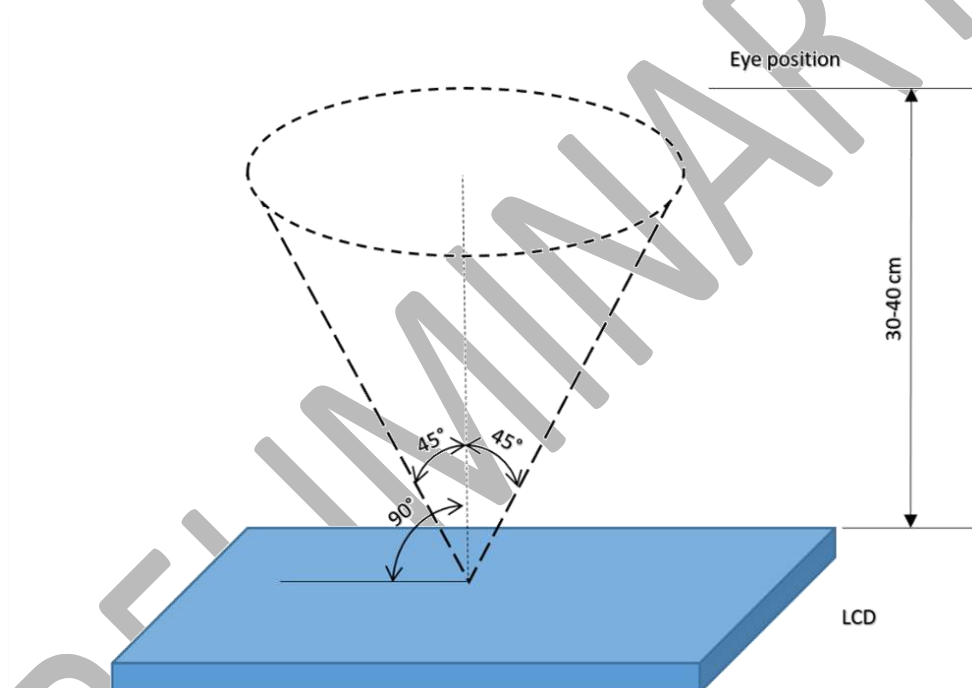
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

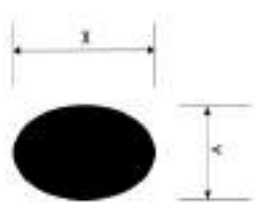
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



11.2 Inspection standard

Item	Criterion																		
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ *Spots density: 10 mm <table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>D ≤ 0.15 mm</td><td>Ignored</td></tr><tr><td>0.15 mm < D ≤ 0.30 mm</td><td>N ≤ 3</td></tr><tr><td>0.3mm < D</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"		Average Diameter	Qualified Qty	D ≤ 0.15 mm	Ignored	0.15 mm < D ≤ 0.30 mm	N ≤ 3	0.3mm < D	Not allowed								
3.5" ≤ Size ≤ 5"																			
Average Diameter	Qualified Qty																		
D ≤ 0.15 mm	Ignored																		
0.15 mm < D ≤ 0.30 mm	N ≤ 3																		
0.3mm < D	Not allowed																		
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <table><tr><th colspan="3">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>W ≤ 0.03</td><td>Ignored</td></tr><tr><td>L ≤ 3.0</td><td>0.03 < W ≤ 0.05</td><td>2</td></tr><tr><td>L ≤ 3.0</td><td>0.05 < W ≤ 0.1</td><td>1</td></tr><tr><td>3.0 < L</td><td>0.1 < W</td><td>Not allowed</td></tr></table>	3.5" ≤ Size ≤ 5"			Length/mm	Width/mm	Qualified Qty	-	W ≤ 0.03	Ignored	L ≤ 3.0	0.03 < W ≤ 0.05	2	L ≤ 3.0	0.05 < W ≤ 0.1	1	3.0 < L	0.1 < W	Not allowed
3.5" ≤ Size ≤ 5"																			
Length/mm	Width/mm	Qualified Qty																	
-	W ≤ 0.03	Ignored																	
L ≤ 3.0	0.03 < W ≤ 0.05	2																	
L ≤ 3.0	0.05 < W ≤ 0.1	1																	
3.0 < L	0.1 < W	Not allowed																	
Bright/Dark Dots	<table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>N ≤ 1</td></tr><tr><td>Dark Dots</td><td>N ≤ 2</td></tr><tr><td>Total Bright and Dark Dots</td><td>N ≤ 3</td></tr></table>	3.5" ≤ Size ≤ 5"		item	Qualified Qty	Bright Dots	N ≤ 1	Dark Dots	N ≤ 2	Total Bright and Dark Dots	N ≤ 3								
3.5" ≤ Size ≤ 5"																			
item	Qualified Qty																		
Bright Dots	N ≤ 1																		
Dark Dots	N ≤ 2																		
Total Bright and Dark Dots	N ≤ 3																		

Item	Criterion												
Clear spots	<table><tr><th colspan="2">Size >= 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></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>	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
	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	<table><tr><th colspan="2">Size >= 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>D < 0.25 mm</td><td>Ignored</td></tr><tr><td>0.25 mm < D < 0.5 mm</td><td>3</td></tr><tr><td>0.5 mm < D</td><td>0</td></tr></table>	Size >= 5"		Average Diameter	Qualified Qty	D < 0.25 mm	Ignored	0.25 mm < D < 0.5 mm	3	0.5 mm < D	0		
	Size >= 5"												
	Average Diameter	Qualified Qty											
	D < 0.25 mm	Ignored											
	0.25 mm < D < 0.5 mm	3											
	0.5 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	Humidity 40 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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 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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RVT50HQBNWC00-B

EVE4 IPS 5.0" LCD TFT Datasheet

Rev.0.1

2020-12-29

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	5.0	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	136.00 × 92.80 × 11.73	mm
Active Area (W × H)	108.0 × 64.8	mm
Pixel Pitch (W × H)	0.135 × 0.135	mm
Resolution	800 × 480 (RGB)	/
Brightness	850	cd/m ²
Color Depth	16.7 M	/
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	ILI2132A	/
Supply Voltage for Module	3.3	V
Supply Voltage for Backlight	5.0 (TYP.)	V
Bonding Technology	Optical Bonding	/
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	

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1 MODULE CLASSIFICATION INFORMATION

RV	T	50	H	Q	B	N	W	C	00	B
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.

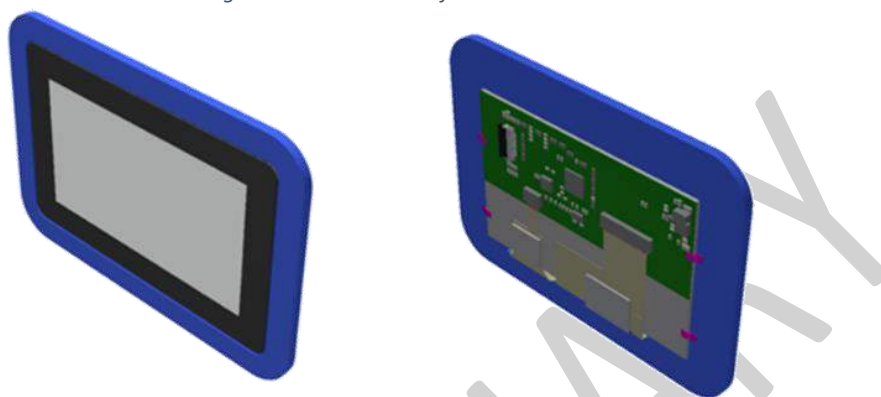
1.	BRAND	RV – Riverdi
2.	PRODUCT TYPE	T – TFT Standard
3.	DISPLAY SIZE	50 – 5.0"
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	Q – 800 x 480 px
6.	INTERFACE	B – SPI/QSPI
7.	FRAME	N – No Frame
8.	BACKLIGHT TYPE	W – LED White
9.	TOUCH PANEL	C – With Capacitive Touch Panel
10.	VERSION	00 – (00-99)
11.	BONDING TECHNOLOGY	B – Optical Bonding

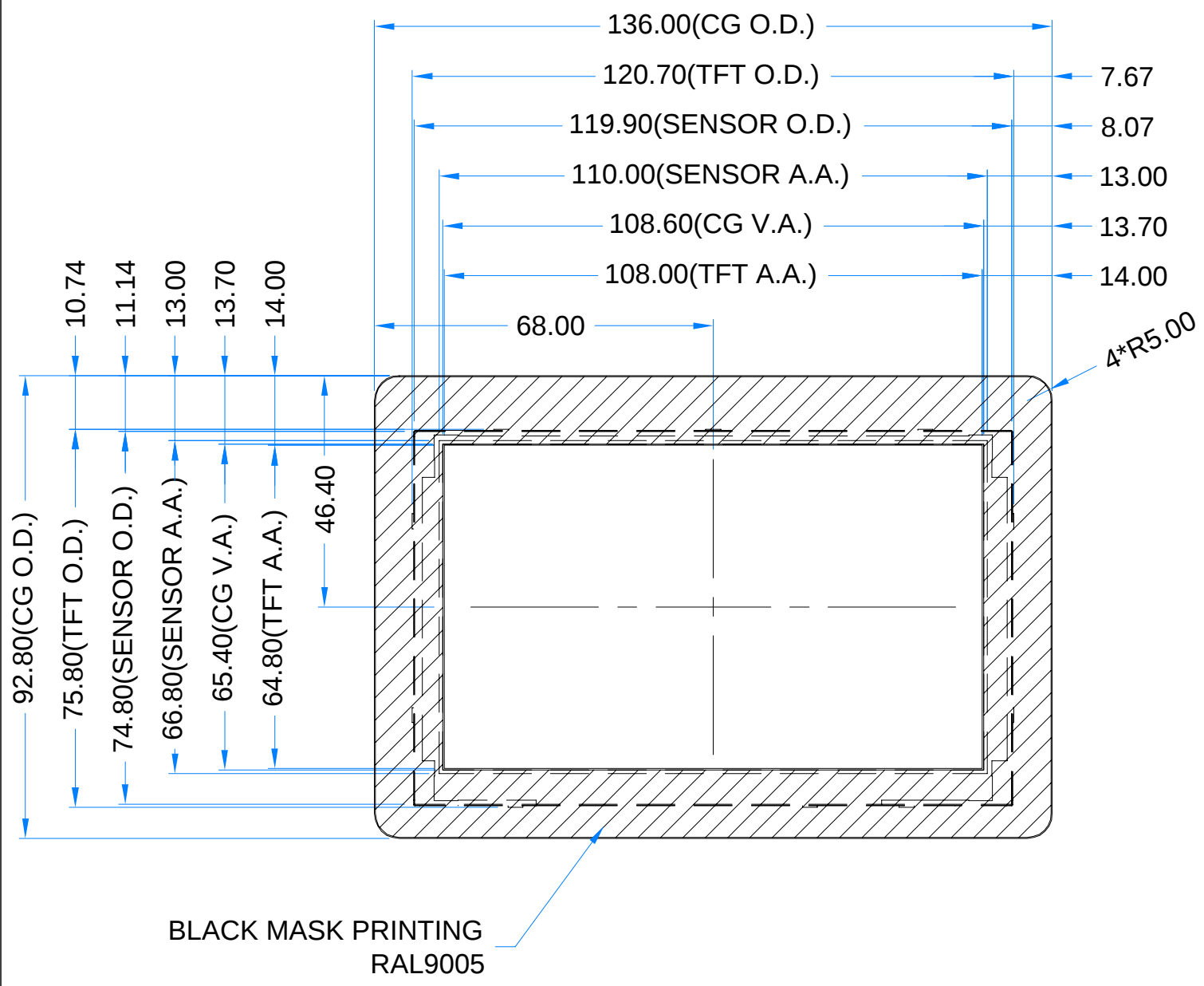
2 UxTOUCH ASSEMBLY

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.

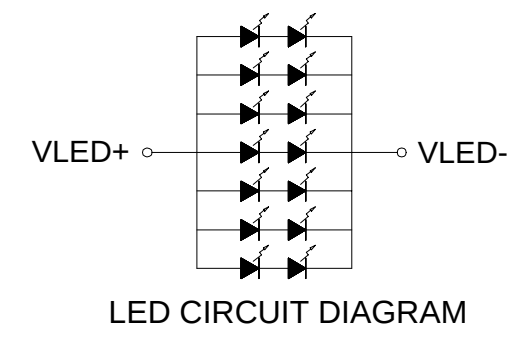
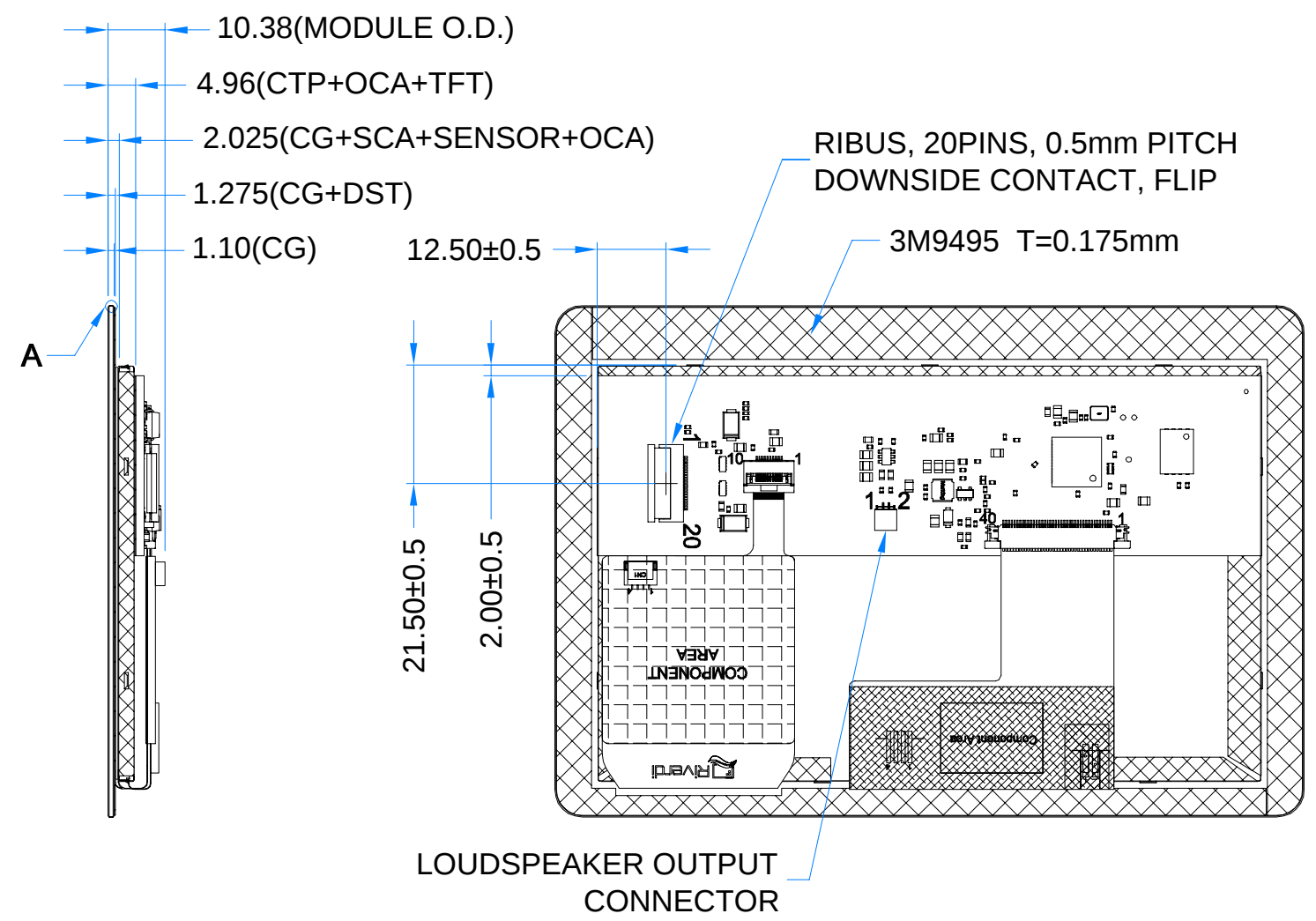
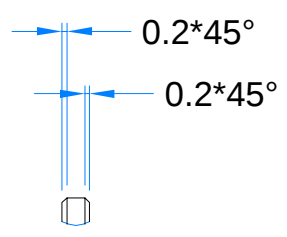
UxTouch models with double-side adhesive tape can be mounted by fastening the glass to the housing.

Figure 1. General view of the module





DETAIL A
SCALE 4:1



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	VIN	-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	-	% 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	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	210	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

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	410	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	180	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

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	-	30	-	ms	FIG 2.	4
Contrast Ratio	Cr		-	1000	-	---	FIG 3.	1
Luminance Uniformity	δ WHITE		-	75	-	%	FIG 3.	3
Surface Luminance	Lv		-	850	-	cd/m ²	FIG 3.	2
Viewing Angle Range	θ	$\phi = 90^\circ$	-	80	-	deg	FIG 4.	6
		$\phi = 270^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 0^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 180^\circ$	-	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	0.575	0.615	0.655	FIG 3.		5
		y	0.296	0.336	0.376			
	Green	x	0.352	0.392	0.432			
		y	0.512	0.552	0.592			
	Blue	x	0.100	0.140	0.180			
		y	0.085	0.125	0.165			
	White	x	0.274	0.316	0.358			
		y	0.295	0.336	0.378			

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 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 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 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

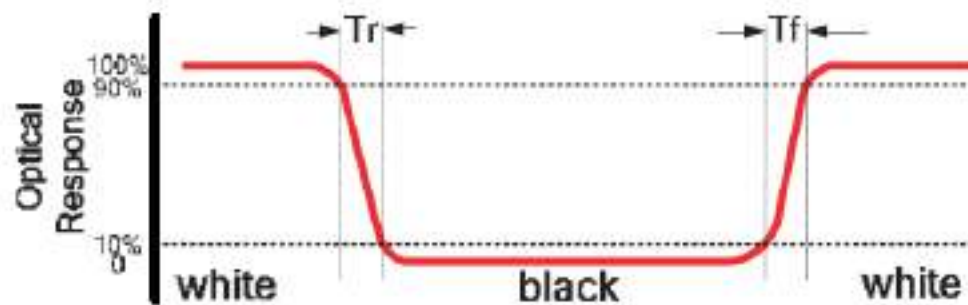
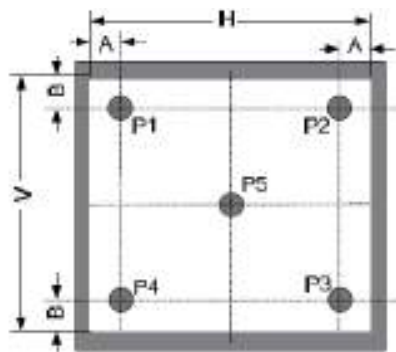


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

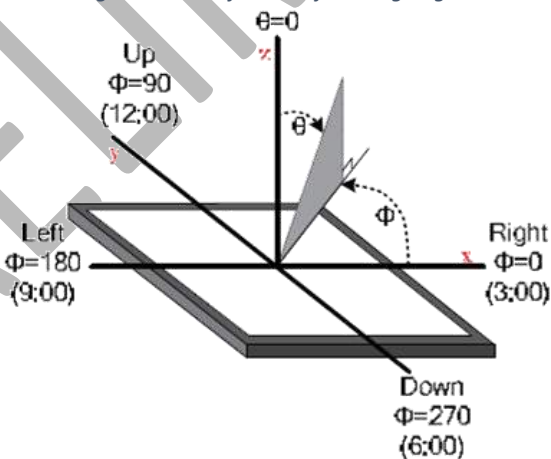
B: 5mm

H,V: Active Area

Light spot size $\phi=5\text{mm}$, 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 INTERFACE DESCRIPTION

8.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

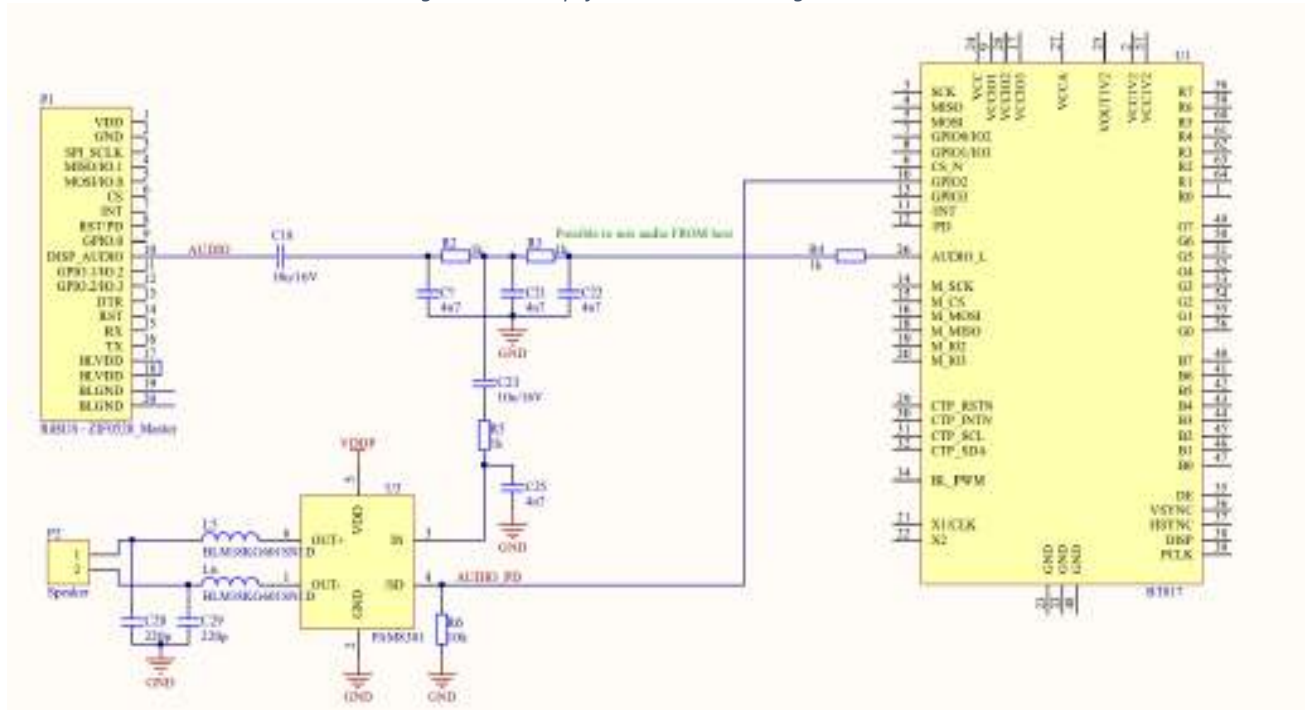
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil "+" terminal	Note 1
2	SPEAKER -	Speaker coil "-" terminal	

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. By standard, the EVE4 board is equipped with the separate 512Mb flash memory chip, which allows to show up to 460 full resolution (800 * 480 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

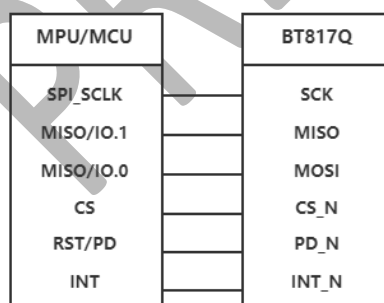
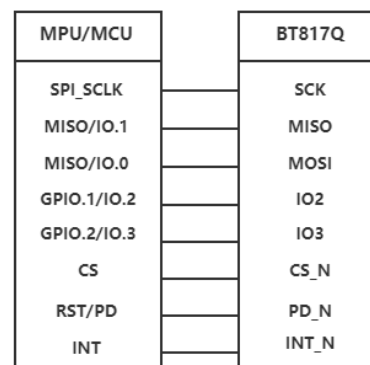


Figure 7. QSPI interface connection



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

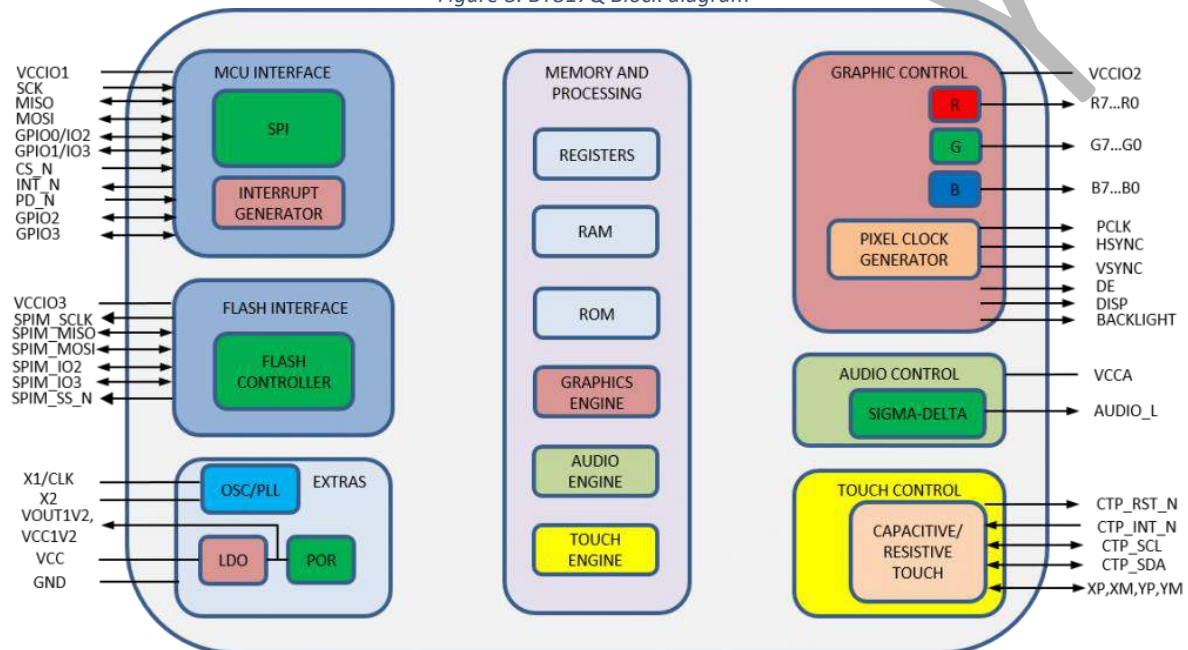
Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

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.

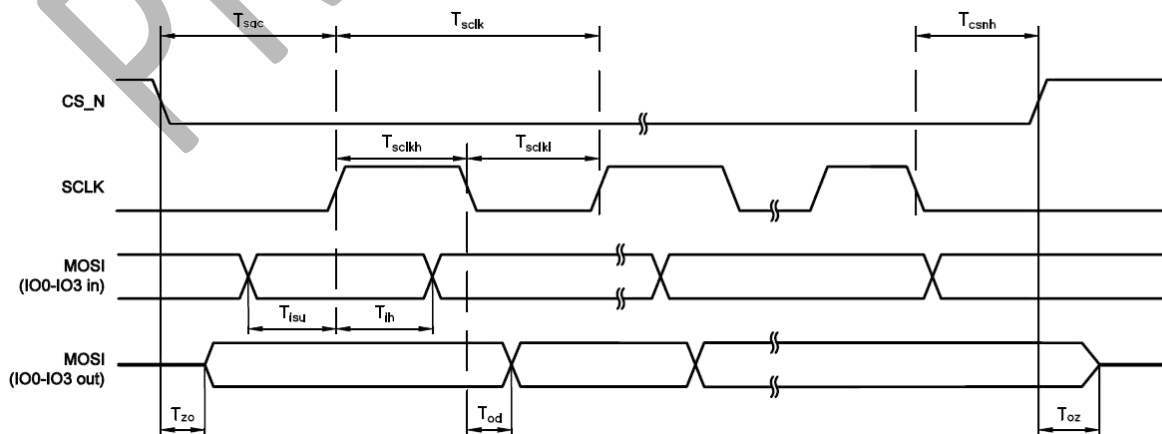
9.2 Block Diagram

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.

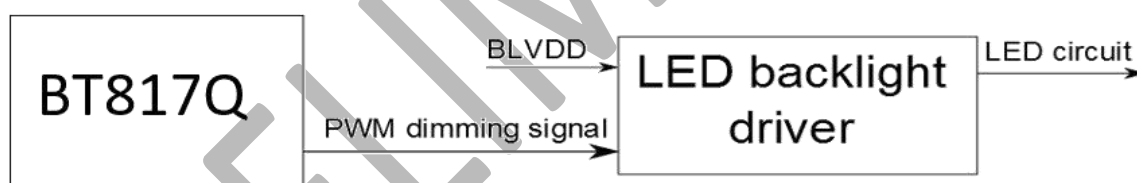
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

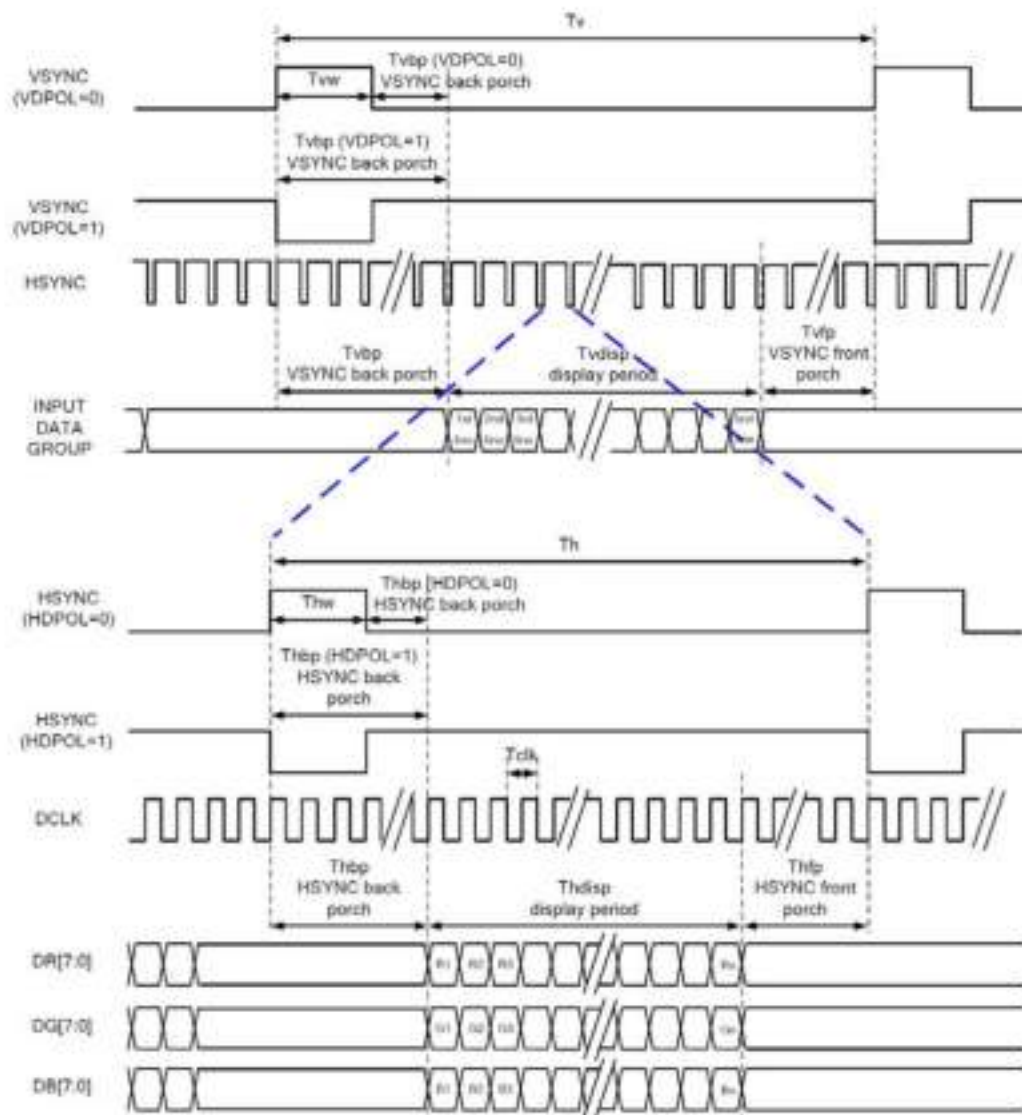
10 TIMING CHARACTERISTICS

10.1 RGB mode

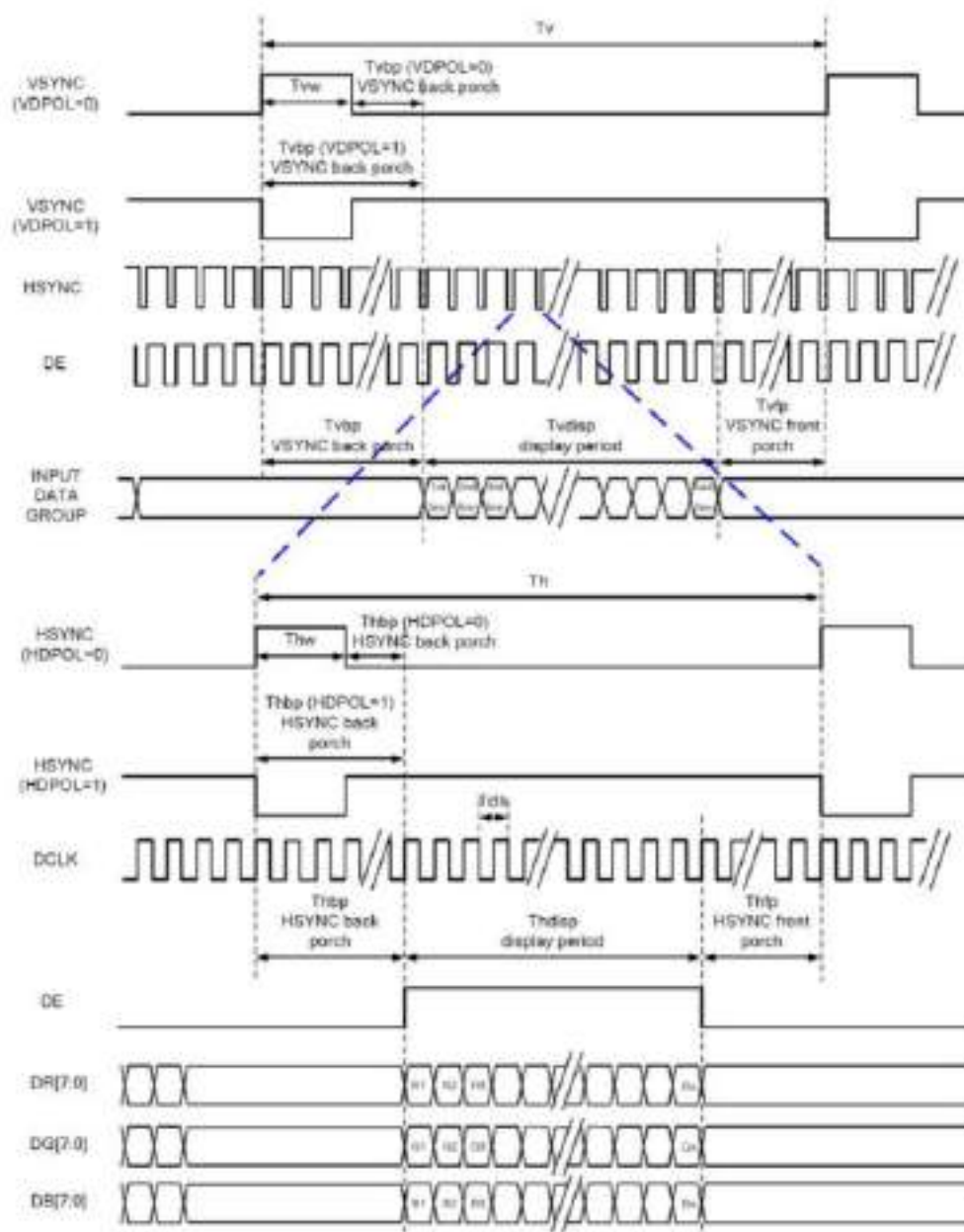
RGB MODE	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input

10.2 System bus timing for RGB interface

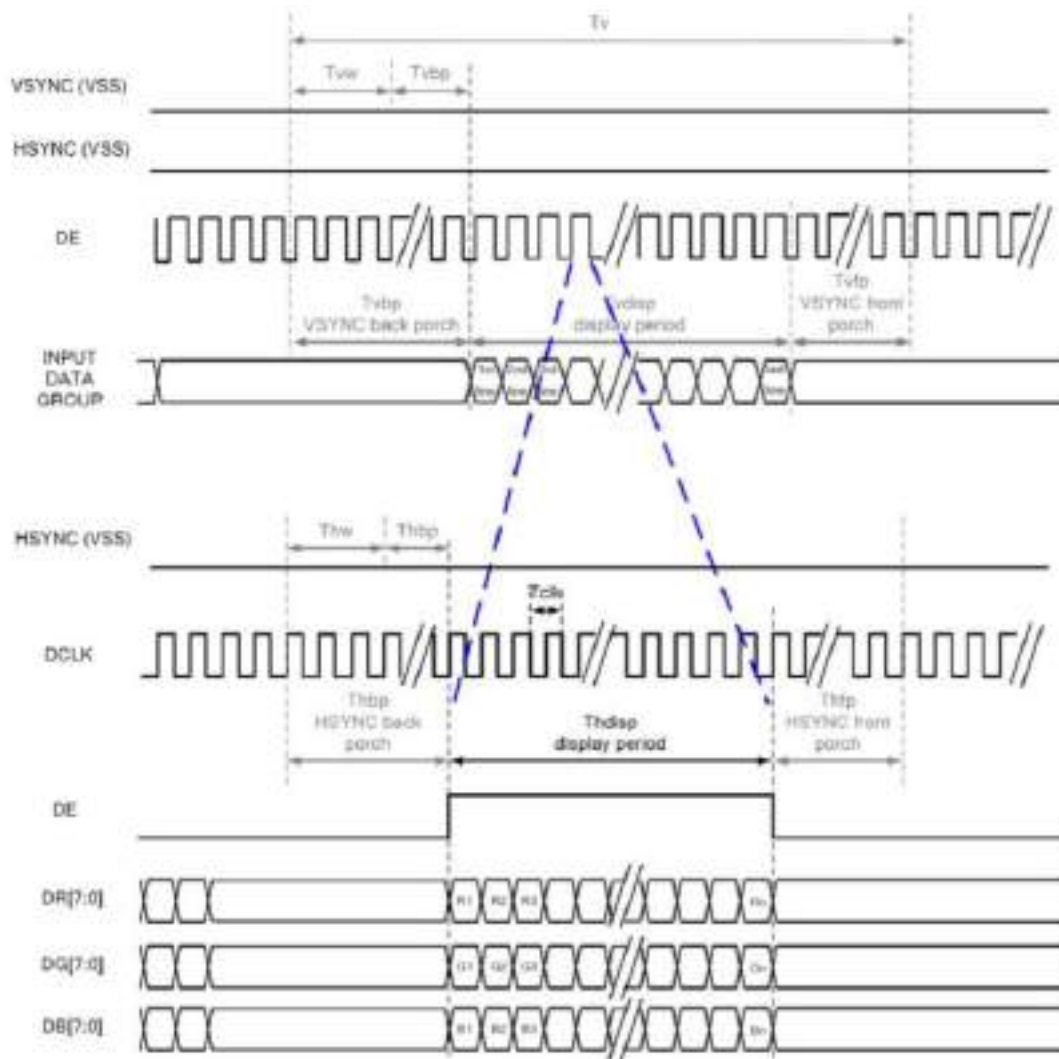
10.2.1 SYNC Mode



10.2.2 SYNC-DE Mode



10.2.3 DE Mode



10.3 Parallel 24-bit RGB input timing table

Parallel 24-bit RGB input Timing (PVDD = VDD = VDDI = 3.3V, AGND = 0V, $T_a = 25^\circ\text{C}$)

PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT
DCLK Frequency		F_{clk}	23	25	27	MHz
HSYNC	Period Time	T_h	808	816	896	DCLK
	Display Period	T_{hdisp}	800			DCLK
	Hsync Back Porch	T_{hbp}	4	8	48	DCLK
	Hsync Front Porch	T_{hfp}	4	8	48	DCLK
	Hsync Pluse Width	T_{hw}	2	4	8	DCLK
VSYNC	Period Time	T_v	488	496	504	HSYNC
	Display Period	T_{vdisp}	480			HSYNC
	Vsync Back Porch	T_{vbp}	4	8	12	HSYNC
	Vsync Front Porch	T_{vfp}	4	8	12	HSYNC
	Vsync Pluse Width	T_{vw}	2	4	8	HSYNC

11 CAPACITIVE TOUCH SCREEN PANEL SPECIFICATIONS

11.1 Mechanical characteristics

DESCRIPTION	SPECIFICATION	REMARK
Touch Panel Size	5.0 inch	UxTouch
Outline Dimension of CTP	136.00 mm x 92.80 mm	UxTouch
Product Thickness	2.45 mm	UxTouch
Glass Thickness	1.1 mm	UxTouch
CTP View Area	108.60 mm x 65.40 mm	UxTouch
Sensor Active Area	110.00 mm x 66.80 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	800 x 480		

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:

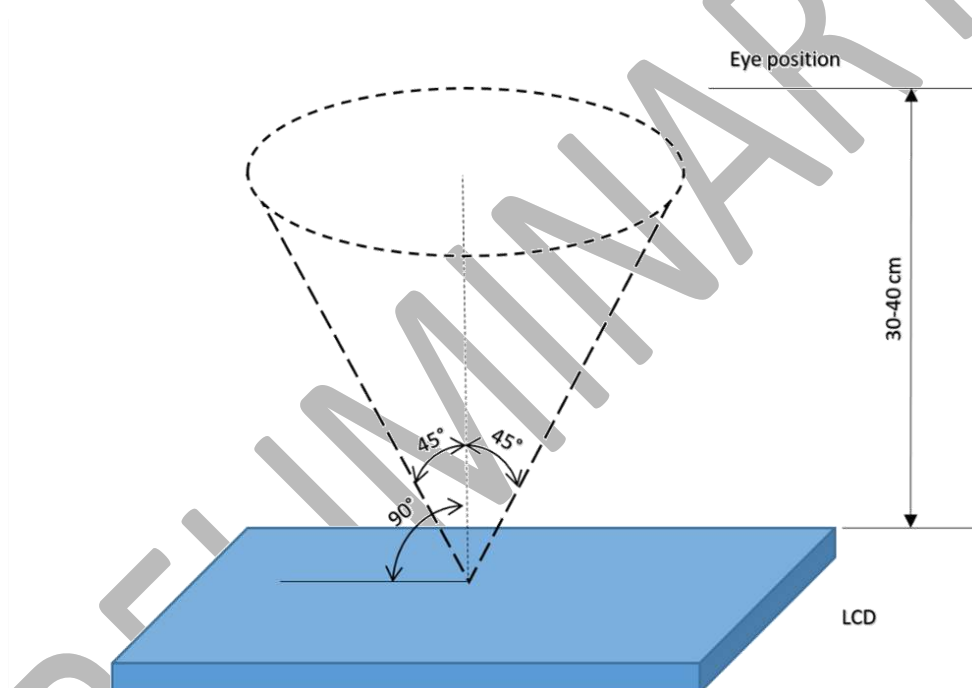
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp non-directive (300 to 700 lux)

Viewing distance:

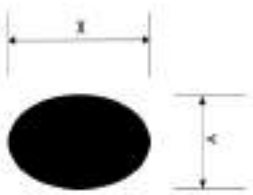
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



13.2 Inspection standard

Item	Criterion																		
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ <table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>$D \leq 0.15 \text{ mm}$</td><td>Ignored</td></tr><tr><td>$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$</td><td>$N \leq 3$</td></tr><tr><td>$0.3\text{mm} < D$</td><td>Not allowed</td></tr></table> *Spots density: 10 mm	3.5" ≤ Size ≤ 5"		Average Diameter	Qualified Qty	$D \leq 0.15 \text{ mm}$	Ignored	$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$	$N \leq 3$	$0.3\text{mm} < D$	Not allowed								
3.5" ≤ Size ≤ 5"																			
Average Diameter	Qualified Qty																		
$D \leq 0.15 \text{ mm}$	Ignored																		
$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$	$N \leq 3$																		
$0.3\text{mm} < D$	Not allowed																		
LCD black spots, white spots, light leakage (line Type)	 <table><tr><th colspan="3">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>$W \leq 0.03$</td><td>Ignored</td></tr><tr><td>$L \leq 3.0$</td><td>$0.03 < W \leq 0.05$</td><td>2</td></tr><tr><td>$L \leq 3.0$</td><td>$0.05 < W \leq 0.1$</td><td>1</td></tr><tr><td>$3.0 < L$</td><td>$0.1 < W$</td><td>Not allowed</td></tr></table> *Spots density: 10 mm	3.5" ≤ Size ≤ 5"			Length/mm	Width/mm	Qualified Qty	-	$W \leq 0.03$	Ignored	$L \leq 3.0$	$0.03 < W \leq 0.05$	2	$L \leq 3.0$	$0.05 < W \leq 0.1$	1	$3.0 < L$	$0.1 < W$	Not allowed
3.5" ≤ Size ≤ 5"																			
Length/mm	Width/mm	Qualified Qty																	
-	$W \leq 0.03$	Ignored																	
$L \leq 3.0$	$0.03 < W \leq 0.05$	2																	
$L \leq 3.0$	$0.05 < W \leq 0.1$	1																	
$3.0 < L$	$0.1 < W$	Not allowed																	
Bright/Dark Dots	<table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>$N \leq 1$</td></tr><tr><td>Dark Dots</td><td>$N \leq 2$</td></tr><tr><td>Total Bright and Dark Dots</td><td>$N \leq 3$</td></tr></table>	3.5" ≤ Size ≤ 5"		Item	Qualified Qty	Bright Dots	$N \leq 1$	Dark Dots	$N \leq 2$	Total Bright and Dark Dots	$N \leq 3$								
3.5" ≤ Size ≤ 5"																			
Item	Qualified Qty																		
Bright Dots	$N \leq 1$																		
Dark Dots	$N \leq 2$																		
Total Bright and Dark Dots	$N \leq 3$																		

Item	Criterion																		
Clear spots	<table><tr><th colspan="3">Size >= 5"</th></tr><tr><td colspan="2">Average Diameter</td><td>Qualified Qty</td></tr><tr><td colspan="2">D < 0.2 mm</td><td>Ignored</td></tr><tr><td colspan="2">0.2 mm < D < 0.3 mm</td><td>4</td></tr><tr><td colspan="2">0.3 mm < D < 0.5 mm</td><td>2</td></tr><tr><td colspan="2">0.5 mm < D</td><td>0</td></tr></table>	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
	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	<table><tr><th colspan="3">Size >= 5"</th></tr><tr><td colspan="2">Average Diameter</td><td>Qualified Qty</td></tr><tr><td colspan="2">D < 0.25 mm</td><td>Ignored</td></tr><tr><td colspan="2">0.25 mm < D < 0.5 mm</td><td>3</td></tr><tr><td colspan="2">0.5 mm < D</td><td>0</td></tr></table>	Size >= 5"			Average Diameter		Qualified Qty	D < 0.25 mm		Ignored	0.25 mm < D < 0.5 mm		3	0.5 mm < D		0			
	Size >= 5"																		
	Average Diameter		Qualified Qty																
	D < 0.25 mm		Ignored																
	0.25 mm < D < 0.5 mm		3																
	0.5 mm < D		0																
Touch panel spot	<table><tr><th colspan="3">Size >= 5"</th></tr><tr><td colspan="2">Average Diameter</td><td>Qualified Qty</td></tr><tr><td colspan="2">D < 0.25 mm</td><td>Ignored</td></tr><tr><td colspan="2">0.25 mm < D < 0.5 mm</td><td>4</td></tr><tr><td colspan="2">0.5 mm < D</td><td>0</td></tr></table>	Size >= 5"			Average Diameter		Qualified Qty	D < 0.25 mm		Ignored	0.25 mm < D < 0.5 mm		4	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	<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>	Size >= 5"			Length	Width	Qualified Qty	-	W < 0.03	Ignored	L < 5.0	0.03 < W < 0.05	2	-	0.05 < 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																	

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 °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	Damp Proof Test	40 °C, 90 %RH/120 hours	
8	Vibration Test	Frequency: 10 ÷ 55 Hz; Stroke: 1.5 mm; Sweep: 10Hz ÷ 55Hz ÷ 10Hz; 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 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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RVT50HQBNWC00

EVE4 IPS 5.0" LCD TFT Datasheet

Rev.0.1

2020-12-29

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	5.0	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	136.00 × 92.80 × 11.73	mm
Active Area (W × H)	108.0 × 64.8	mm
Pixel Pitch (W × H)	0.135 × 0.135	mm
Resolution	800 × 480 (RGB)	/
Brightness	800	cd/m ²
Color Depth	16.7 M	/
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	ILI2132A	/
Supply Voltage for Module	3.3	V
Supply Voltage for Backlight	5.0 (TYP.)	V
Weight	115	g

Note 1: RoHS compliant

Note 2: LCM weight tolerance: ± 5%.

REVISION RECORD

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

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1 MODULE CLASSIFICATION INFORMATION

RV	T	50	H	Q	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	50 – 5.0”
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	Q – 800 x 480 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

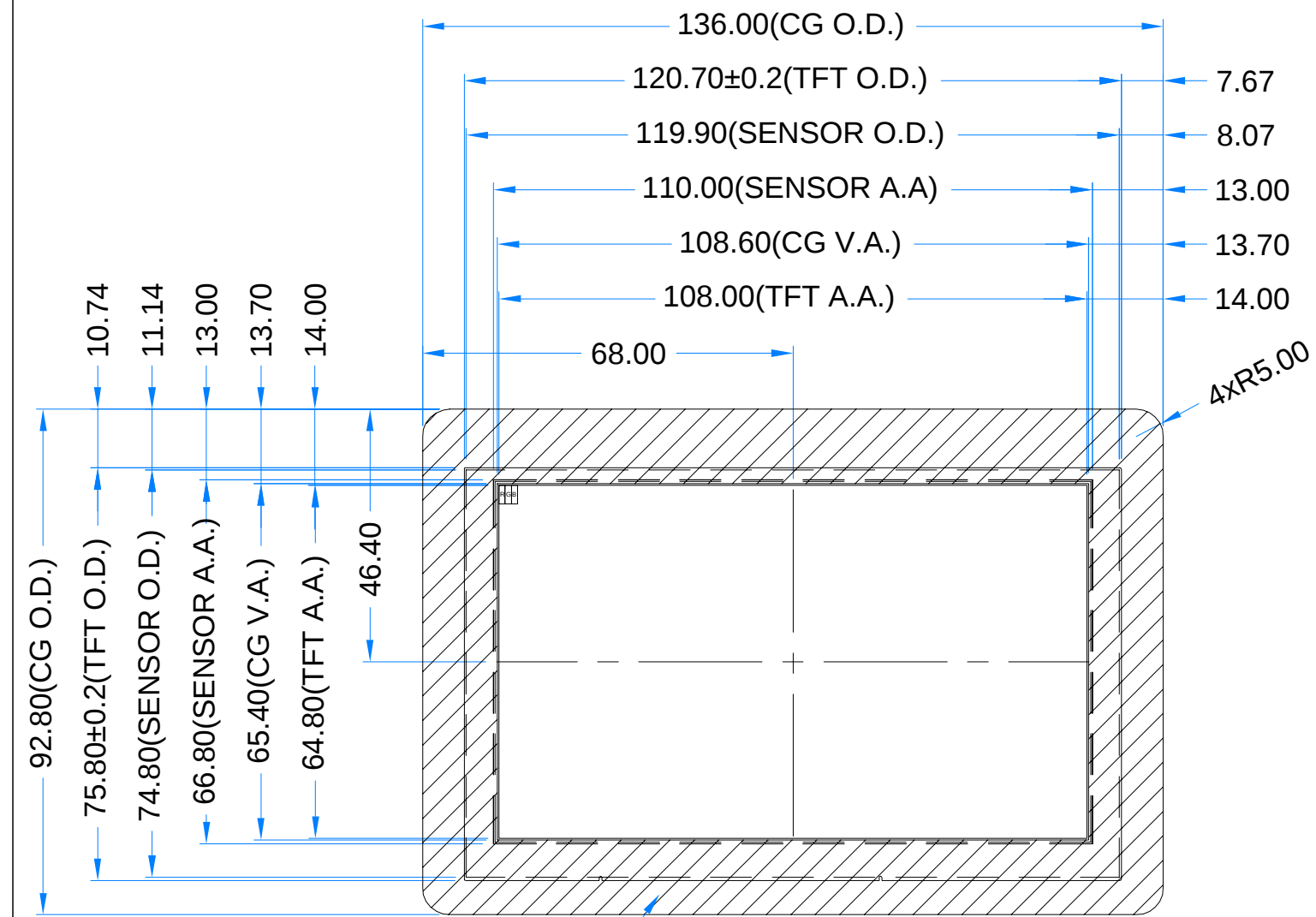
UxTouch are LCD TFT displays with specially designed projected capacitive touch panels. UxTouch display can be mounted without any additional holes in the housing. Our standard UxTouch displays include double-sided adhesive tape (DST) to stick TFT easily to the housing.

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 RVT50HQBNWC00-B, which is superior in optical performance and does not require any extra support.

Figure 1. Example of using the support brackets

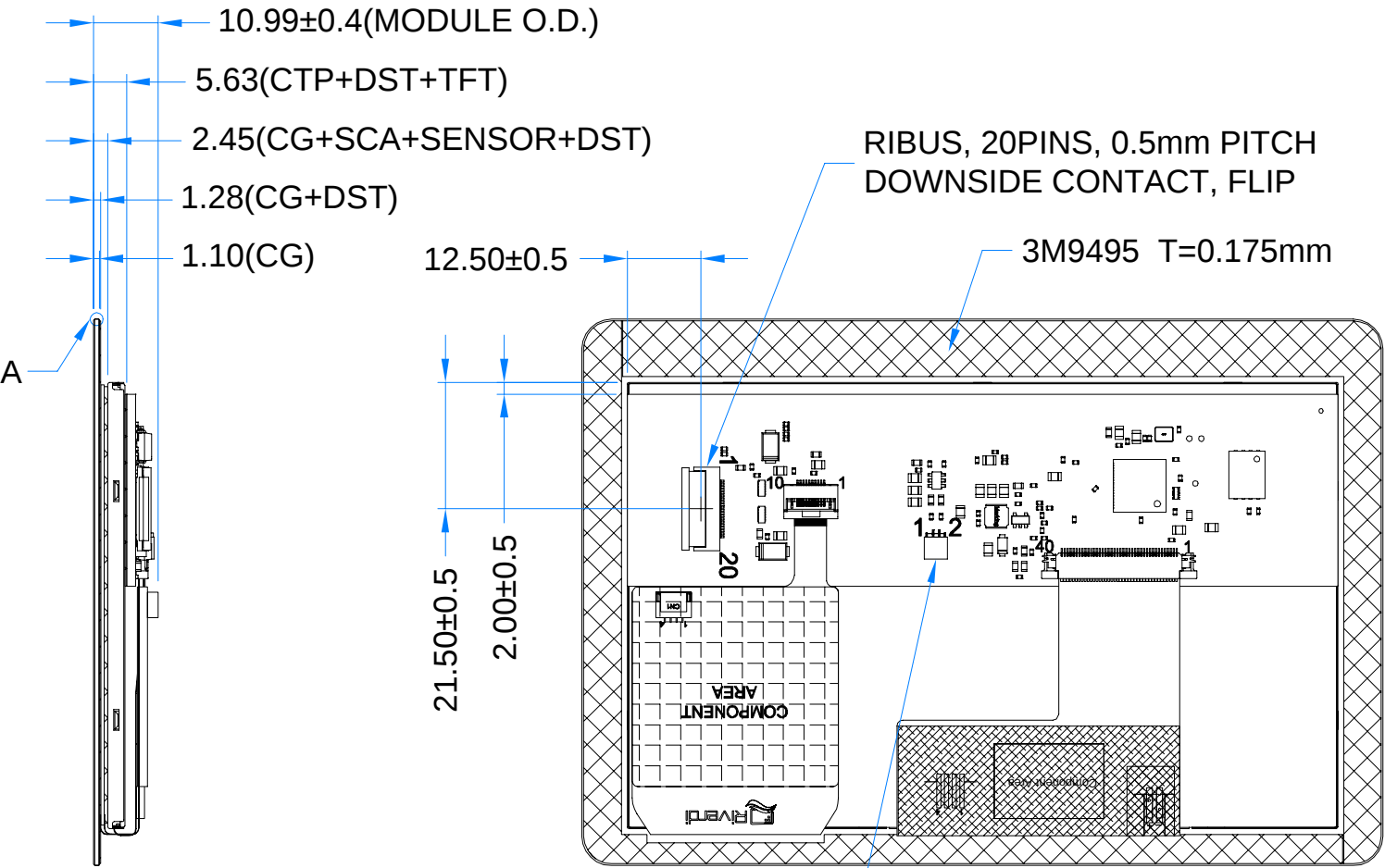
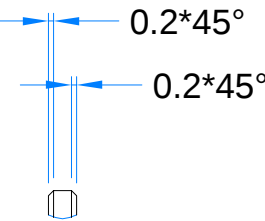


Revision:	Changes:	Date:
1.0	Initial Case	2020.12.09

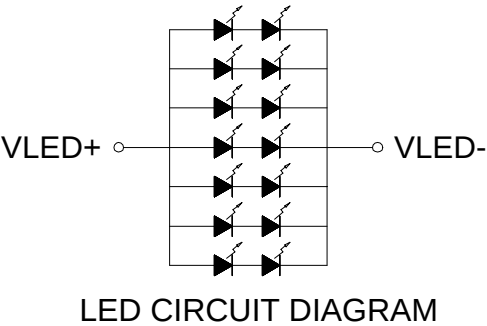


BLACK MASK PRINTING
RAL9005

DETAIL A
SCALE 4:1



LOUDSPEAKER OUTPUT
CONNECTOR



LCD NOTES:

1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS
2. RESOLUTION: 800x480
3. VIEWING ANGLE: FREE
4. SURFACE LUMINANCE: 800 cd/m²
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: RVT50HQBNC00

SN:

DRAWN: M.Natywa

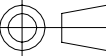


2020.12.03

1:1.19

2020.12.09

[mm]



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	VIN	-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	-	% 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	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	210	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

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	410	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	180	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

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	-	30	-	ms	FIG 2.	4
Contrast Ratio	Cr		-	1000	-	---	FIG 3.	1
Luminance Uniformity	δ WHITE		-	75	-	%	FIG 3.	3
Surface Luminance	Lv		756	800	-	cd/m ²	FIG 3.	2
Viewing Angle Range	θ	$\phi = 90^\circ$	-	80	-	deg	FIG 4.	6
		$\phi = 270^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 0^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 180^\circ$	-	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	0.575	0.615	0.655	FIG 3.		5
		y	0.296	0.336	0.376			
	Green	x	0.352	0.392	0.432			
		y	0.512	0.552	0.592			
	Blue	x	0.100	0.140	0.180			
		y	0.085	0.125	0.165			
	White	x	0.274	0.316	0.358			
		y	0.295	0.336	0.378			

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 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 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 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

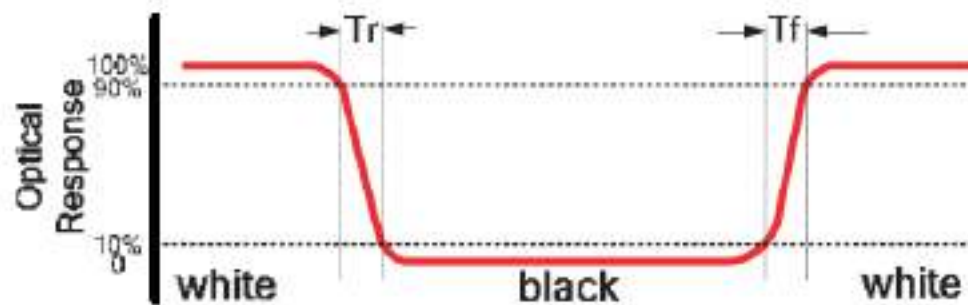
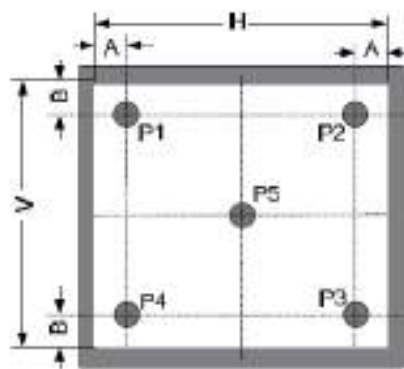


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

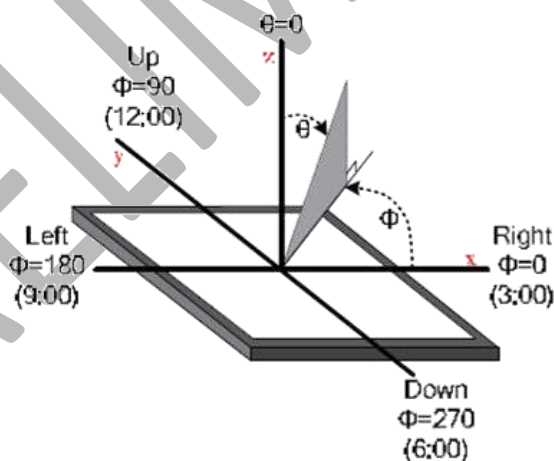
B: 5mm

H,V: Active Area

Light spot size $\phi=5\text{mm}$, 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 INTERFACE DESCRIPTION

8.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

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.

9 BT817Q CONTROLLER SPECIFICATION

9.1 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

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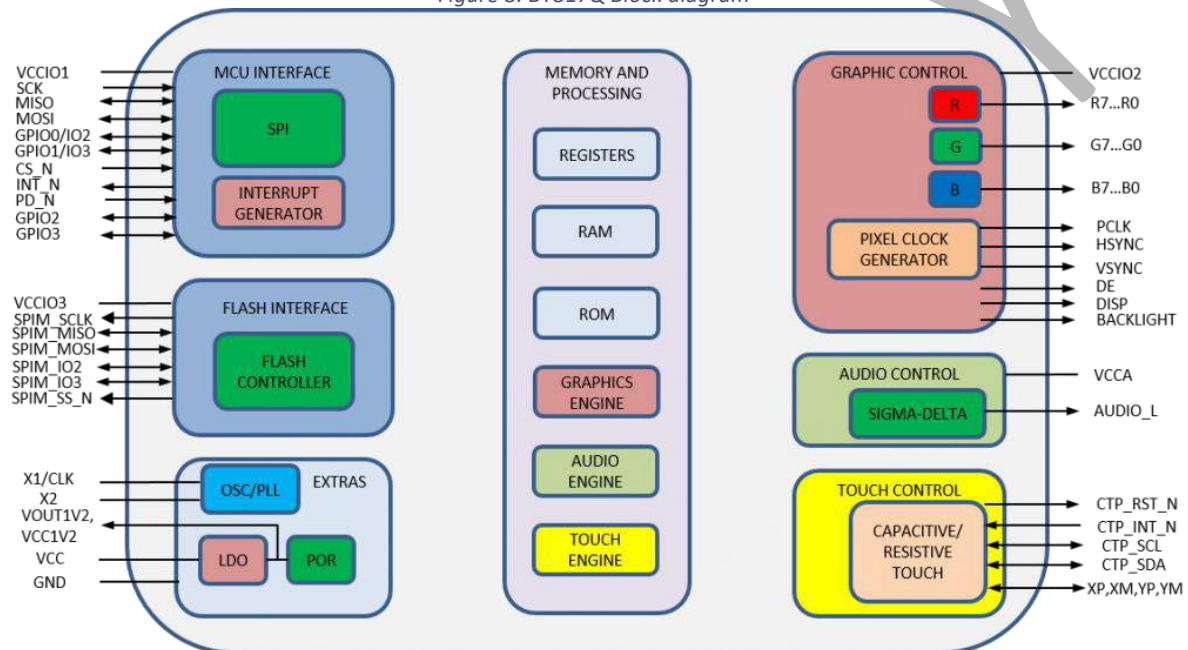
Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

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.

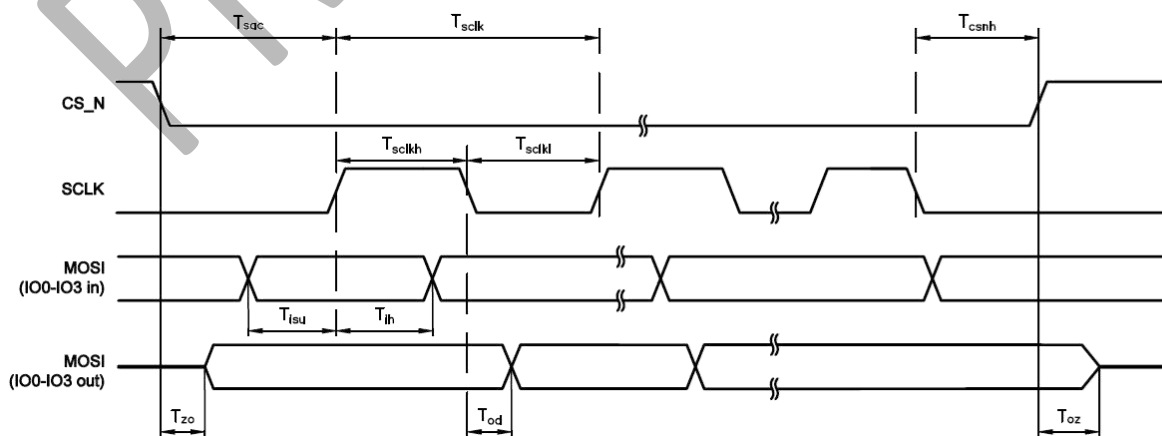
9.2 Block Diagram

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.

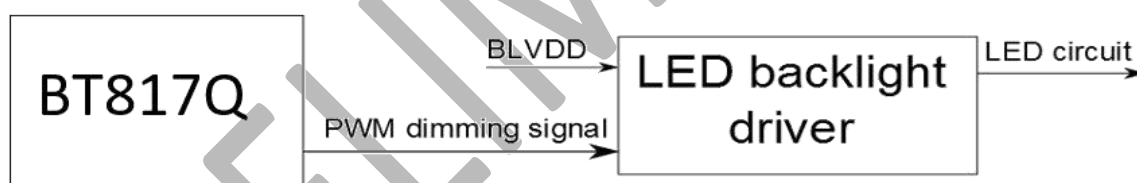
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

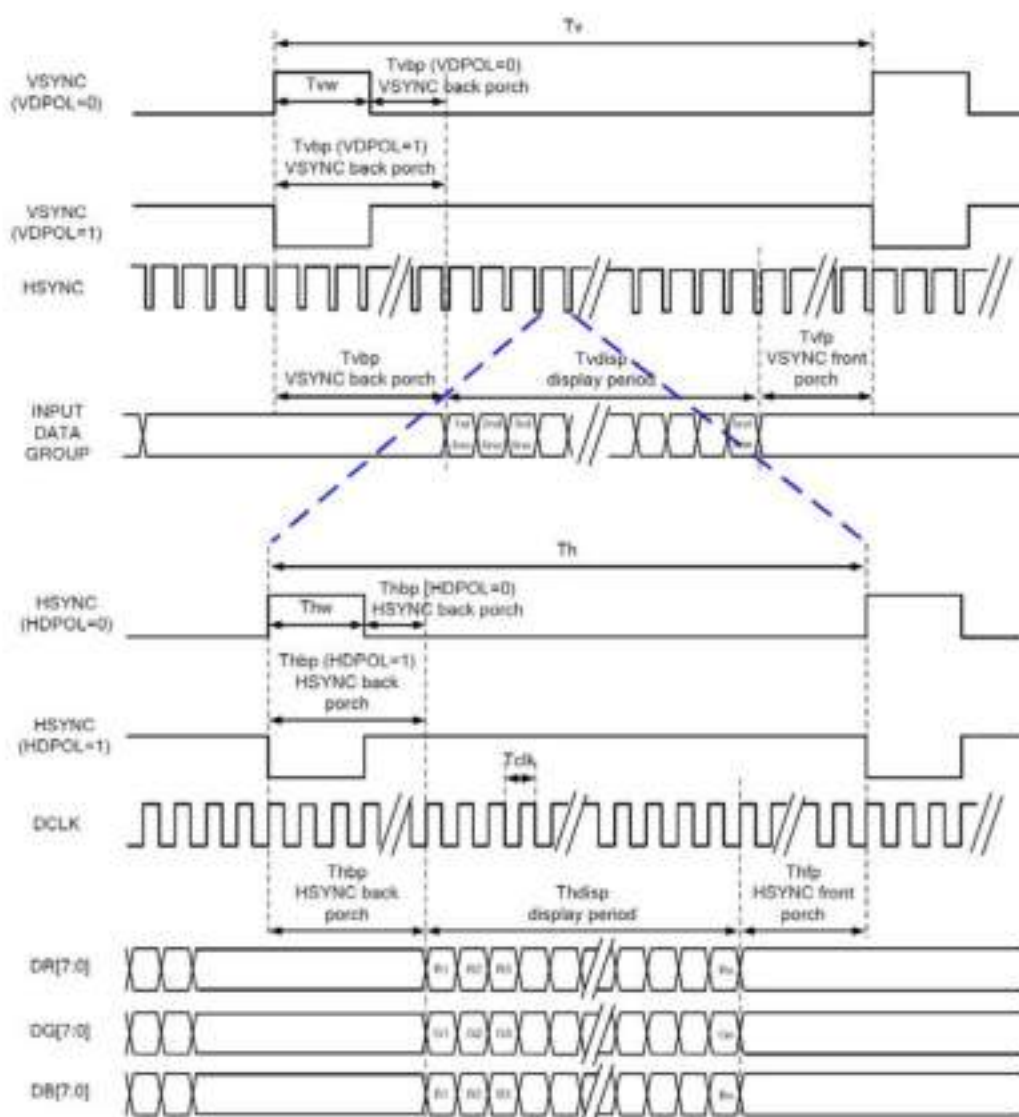
10 TIMING CHARACTERISTICS

10.1 RGB mode

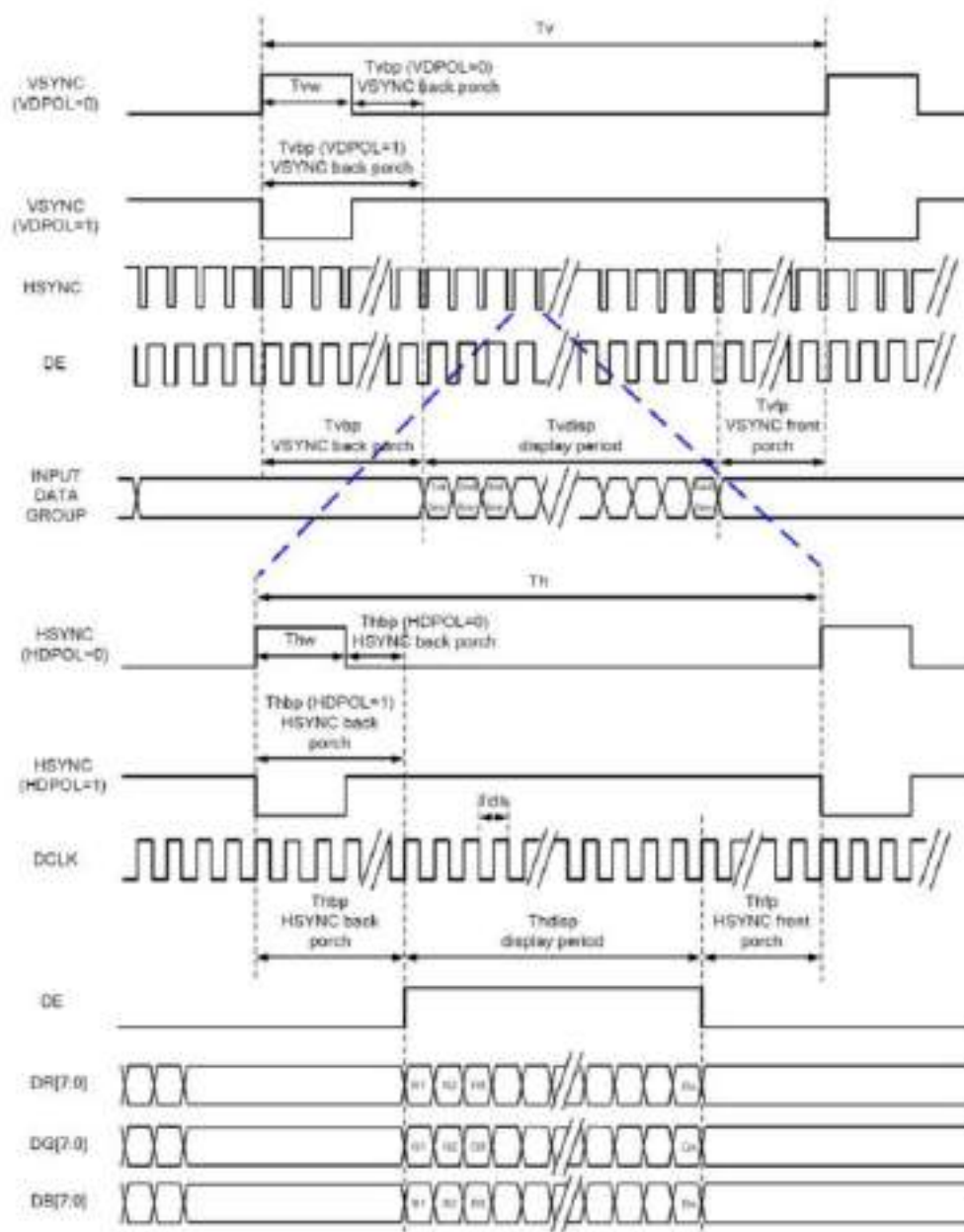
RGB MODE	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input

10.2 System bus timing for RGB interface

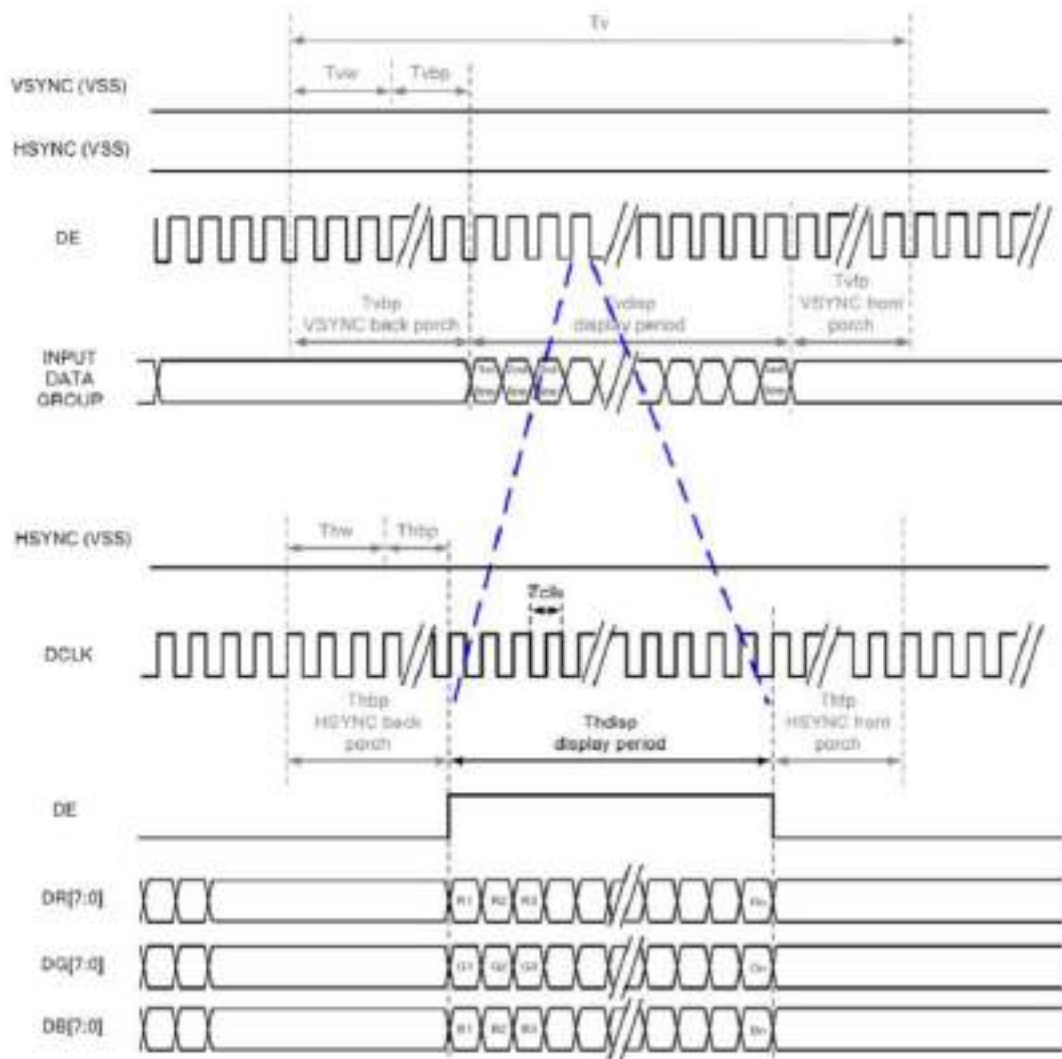
10.2.1 SYNC Mode



10.2.2 SYNC-DE Mode



10.2.3 DE Mode



10.3 Parallel 24-bit RGB input timing table

Parallel 24-bit RGB input Timing (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25 °C)

PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT
DCLK Frequency		F_{clk}	23	25	27	MHz
HSYNC	Period Time	T_h	808	816	896	DCLK
	Display Period	T_{hdisp}	800			DCLK
	Hsync Back Porch	T_{hbp}	4	8	48	DCLK
	Hsync Front Porch	T_{hfp}	4	8	48	DCLK
	Hsync Pluse Width	T_{hw}	2	4	8	DCLK
VSYNC	Period Time	T_v	488	496	504	HSYNC
	Display Period	T_{vdisp}	480			HSYNC
	Vsync Back Porch	T_{vbp}	4	8	12	HSYNC
	Vsync Front Porch	T_{vfp}	4	8	12	HSYNC
	Vsync Pluse Width	T_{vw}	2	4	8	HSYNC

11 CAPACITIVE TOUCH SCREEN PANEL SPECIFICATIONS

11.1 Mechanical characteristics

DESCRIPTION	SPECIFICATION	REMARK
Touch Panel Size	5.0 inch	UxTouch
Outline Dimension of CTP	136.00 mm x 92.80 mm	UxTouch
Product Thickness	2.45 mm	UxTouch
Glass Thickness	1.1 mm	UxTouch
CTP View Area	108.60 mm x 65.40 mm	UxTouch
Sensor Active Area	110.00 mm x 66.80 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	+/-1.5mm		
Controller	ILI2132A		
Resolution	800 x 480		

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:

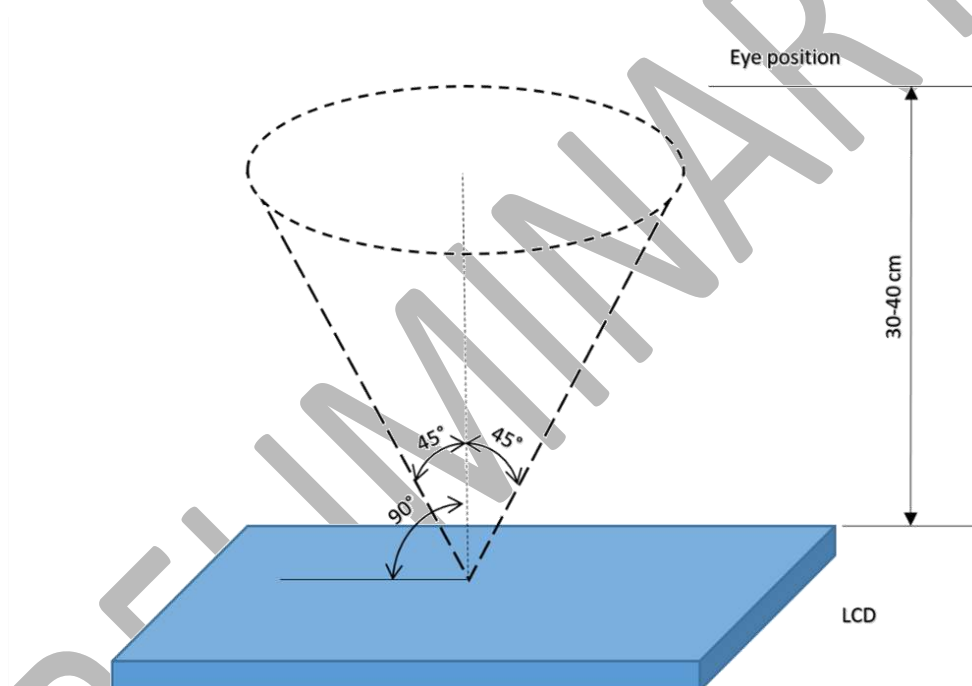
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

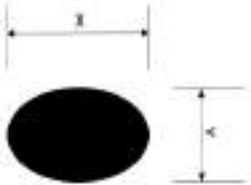
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



13.2 Inspection standard

Item	Criterion																		
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ <table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>$D \leq 0.15 \text{ mm}$</td><td>Ignored</td></tr><tr><td>$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$</td><td>$N \leq 3$</td></tr><tr><td>$0.3\text{mm} < D$</td><td>Not allowed</td></tr></table> *Spots density: 10 mm	3.5" ≤ Size ≤ 5"		Average Diameter	Qualified Qty	$D \leq 0.15 \text{ mm}$	Ignored	$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$	$N \leq 3$	$0.3\text{mm} < D$	Not allowed								
3.5" ≤ Size ≤ 5"																			
Average Diameter	Qualified Qty																		
$D \leq 0.15 \text{ mm}$	Ignored																		
$0.15 \text{ mm} < D \leq 0.30 \text{ mm}$	$N \leq 3$																		
$0.3\text{mm} < D$	Not allowed																		
LCD black spots, white spots, light leakage (line Type)	 <table><tr><th colspan="3">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>$W \leq 0.03$</td><td>Ignored</td></tr><tr><td>$L \leq 3.0$</td><td>$0.03 < W \leq 0.05$</td><td>2</td></tr><tr><td>$L \leq 3.0$</td><td>$0.05 < W \leq 0.1$</td><td>1</td></tr><tr><td>$3.0 < L$</td><td>$0.1 < W$</td><td>Not allowed</td></tr></table> *Spots density: 10 mm	3.5" ≤ Size ≤ 5"			Length/mm	Width/mm	Qualified Qty	-	$W \leq 0.03$	Ignored	$L \leq 3.0$	$0.03 < W \leq 0.05$	2	$L \leq 3.0$	$0.05 < W \leq 0.1$	1	$3.0 < L$	$0.1 < W$	Not allowed
3.5" ≤ Size ≤ 5"																			
Length/mm	Width/mm	Qualified Qty																	
-	$W \leq 0.03$	Ignored																	
$L \leq 3.0$	$0.03 < W \leq 0.05$	2																	
$L \leq 3.0$	$0.05 < W \leq 0.1$	1																	
$3.0 < L$	$0.1 < W$	Not allowed																	
Bright/Dark Dots	<table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>$N \leq 1$</td></tr><tr><td>Dark Dots</td><td>$N \leq 2$</td></tr><tr><td>Total Bright and Dark Dots</td><td>$N \leq 3$</td></tr></table>	3.5" ≤ Size ≤ 5"		item	Qualified Qty	Bright Dots	$N \leq 1$	Dark Dots	$N \leq 2$	Total Bright and Dark Dots	$N \leq 3$								
3.5" ≤ Size ≤ 5"																			
item	Qualified Qty																		
Bright Dots	$N \leq 1$																		
Dark Dots	$N \leq 2$																		
Total Bright and Dark Dots	$N \leq 3$																		

Item	Criterion																		
Clear spots	<table><tr><th colspan="3">Size >= 5"</th></tr><tr><td colspan="2">Average Diameter</td><td>Qualified Qty</td></tr><tr><td colspan="2">D < 0.2 mm</td><td>Ignored</td></tr><tr><td colspan="2">0.2 mm < D < 0.3 mm</td><td>4</td></tr><tr><td colspan="2">0.3 mm < D < 0.5 mm</td><td>2</td></tr><tr><td colspan="2">0.5 mm < D</td><td>0</td></tr></table>	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
	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	<table><tr><th colspan="3">Size >= 5"</th></tr><tr><td colspan="2">Average Diameter</td><td>Qualified Qty</td></tr><tr><td colspan="2">D < 0.25 mm</td><td>Ignored</td></tr><tr><td colspan="2">0.25 mm < D < 0.5 mm</td><td>3</td></tr><tr><td colspan="2">0.5 mm < D</td><td>0</td></tr></table>	Size >= 5"			Average Diameter		Qualified Qty	D < 0.25 mm		Ignored	0.25 mm < D < 0.5 mm		3	0.5 mm < D		0			
	Size >= 5"																		
	Average Diameter		Qualified Qty																
	D < 0.25 mm		Ignored																
	0.25 mm < D < 0.5 mm		3																
	0.5 mm < D		0																
Touch panel spot	<table><tr><th colspan="3">Size >= 5"</th></tr><tr><td colspan="2">Average Diameter</td><td>Qualified Qty</td></tr><tr><td colspan="2">D < 0.25 mm</td><td>Ignored</td></tr><tr><td colspan="2">0.25 mm < D < 0.5 mm</td><td>4</td></tr><tr><td colspan="2">0.5 mm < D</td><td>0</td></tr></table>	Size >= 5"			Average Diameter		Qualified Qty	D < 0.25 mm		Ignored	0.25 mm < D < 0.5 mm		4	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	<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>	Size >= 5"			Length	Width	Qualified Qty	-	W < 0.03	Ignored	L < 5.0	0.03 < W < 0.05	2	-	0.05 < 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																	

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 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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 cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

15 LEGAL INFORMATION

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RVT50HQBNWN00

EVE4 IPS 5.0" LCD TFT Datasheet

Rev.0.1

2020-01-18

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally black/IPS	/
Size	5.0	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	120.70 × 75.80 × 7.87	mm
Active Area (W × H)	108.0 × 64.8	mm
Pixel Pitch (W × H)	0.135 × 0.135	mm
Resolution	800 × 480 (RGB)	/
Brightness	1000	cd/m ²
Color Depth	16.7 M	/
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 (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

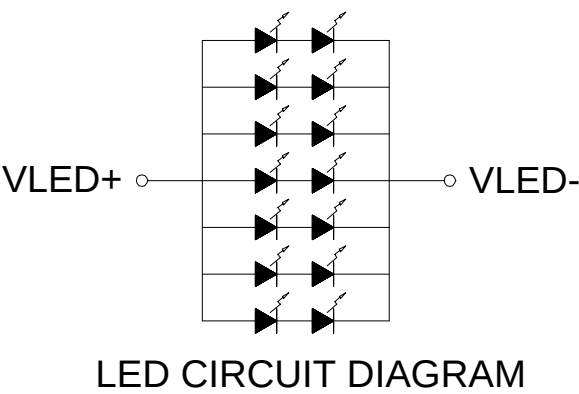
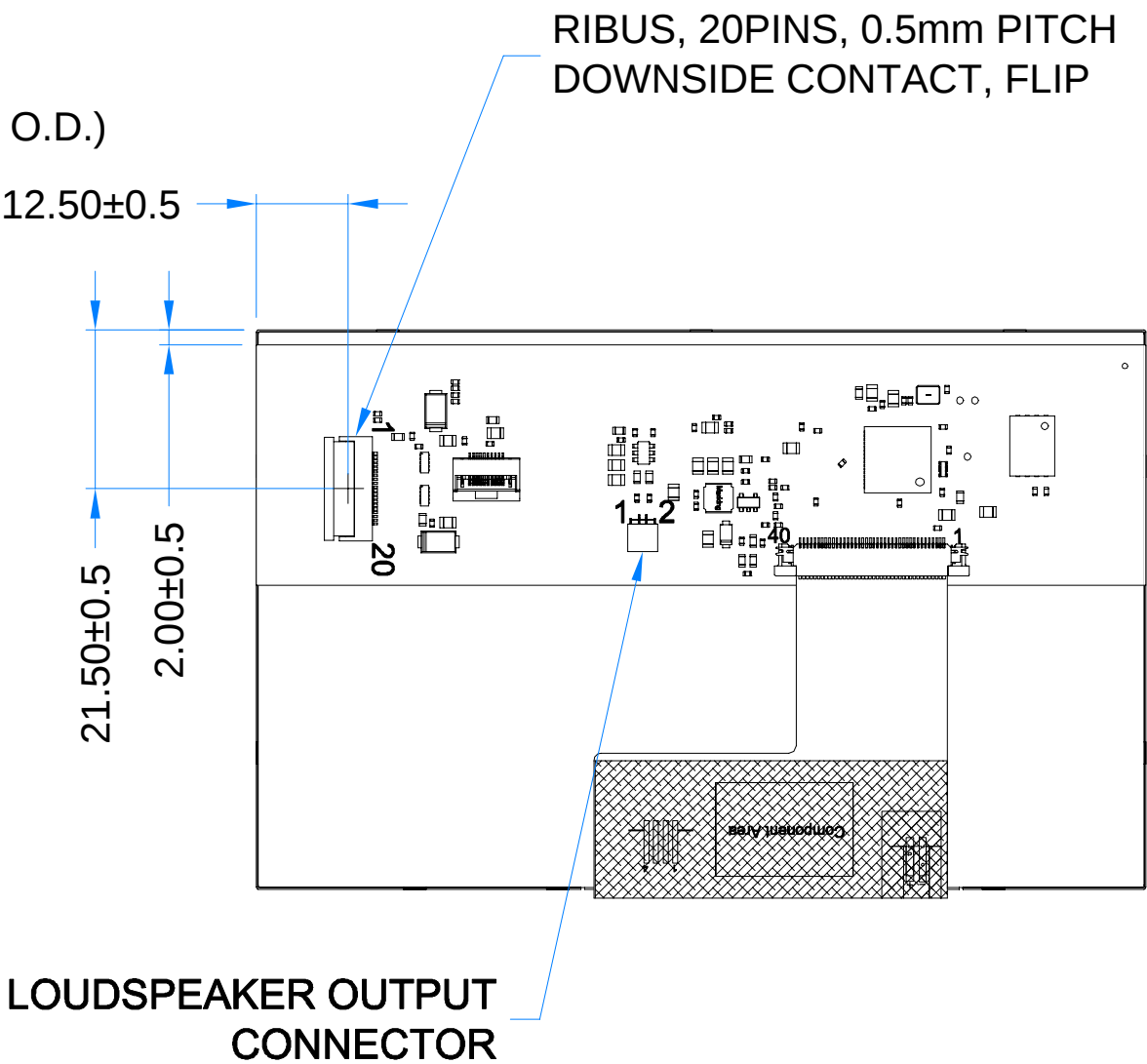
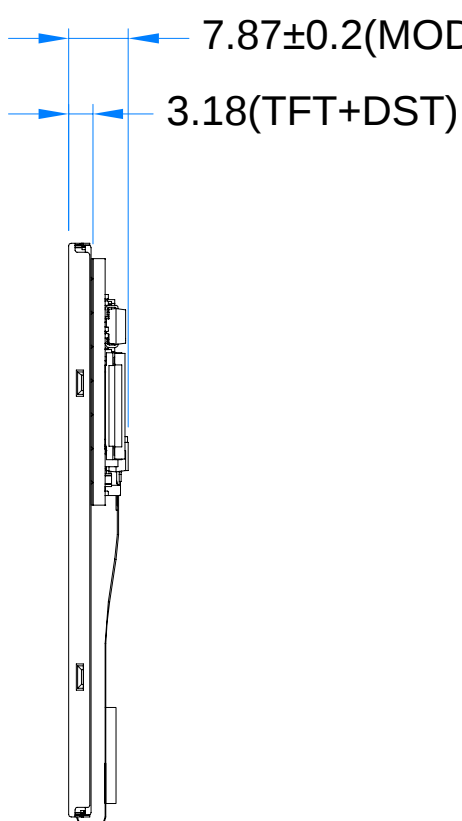
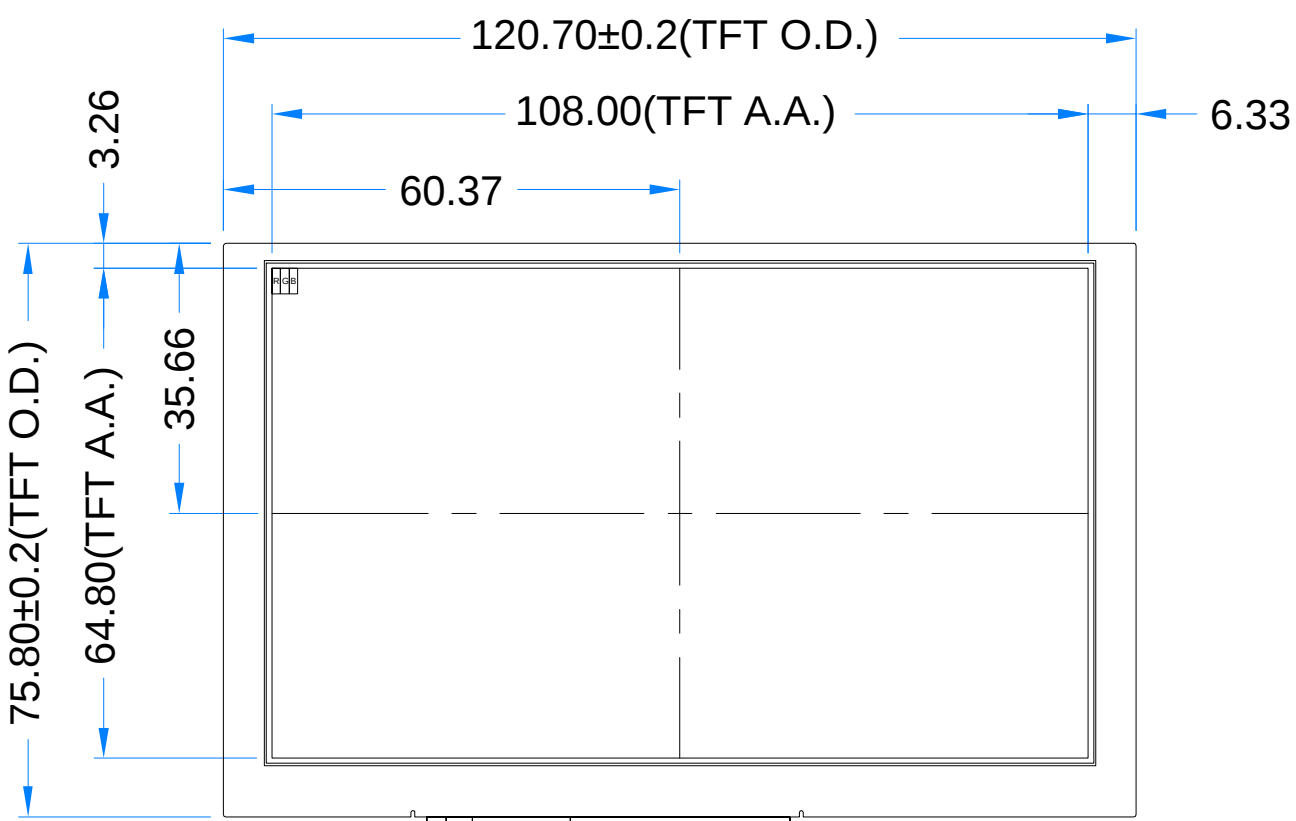
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1 MODULE CLASSIFICATION INFORMATION

RV	T	50	H	Q	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	50 – 5.0”
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	Q – 800 x 480 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)

Revision:	Changes:	Date:
1.0	Initial Case	2020.12.09



LCD NOTES: 1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS 2. RESOLUTION: 800x480 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: RVT50HQBWNW00			
		SN:			
		DRAWN: M.Natywa	2020.12.03	1:1.00	
			2020.12.09	[mm]	
ES France - Département Composants & Modules - 127 rue de Buzenval BP 26 - 92380 Garches Tél. 01 47 95 99 84 - Fax. 01 47 01 16 22 - e-mail: comp@es-france.com - Site Web: www.es-france.com				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	VIN	-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	-	% 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).

4 ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Supply Voltage for Module	VDD	3.0	3.3	3.6	V	
Current drawn from VDD	I _{VDD}	TBD	203	TBD	mA	Note 1
Input Voltage "H" Level	V _{IH}	2.0	TBD	3.3	V	Note 1
Input Voltage "L" Level	V _{IL}	0	TBD	0.8	V	Note 1

Note 1. These values will be announced after the samples have been tested.

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	362	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@5.0V	I _{BLVDD=5.0 V}	TBD	173	TBD	mA	50% of backlight, Note 1
Current drawn from BLVDD @3.3V	I _{BLVDD=3.3V}	TBD	622	TBD	mA	100% of backlight, Note 1
Current drawn from BLVDD@3.3V	I _{BLVDD=3.3V}	TBD	273	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.

6 ELECTRO-OPTICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REMARK	NOTE
Response Time	Tr+Tf	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	-	30	-	ms	FIG 2.	4
Contrast Ratio	Cr		-	1000	-	---	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	$\phi = 90^\circ$	-	80	-	deg	FIG 4.	6
		$\phi = 270^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 0^\circ$	-	80	-	deg	FIG 4.	
		$\phi = 180^\circ$	-	80	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	0.575	0.615	0.655	FIG 3.		5
		y	0.296	0.336	0.376			
	Green	x	0.352	0.392	0.432			
		y	0.512	0.552	0.592			
	Blue	x	0.100	0.140	0.180			
		y	0.085	0.125	0.165			
	White	x	0.274	0.316	0.358			
		y	0.295	0.336	0.378			

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 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 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 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

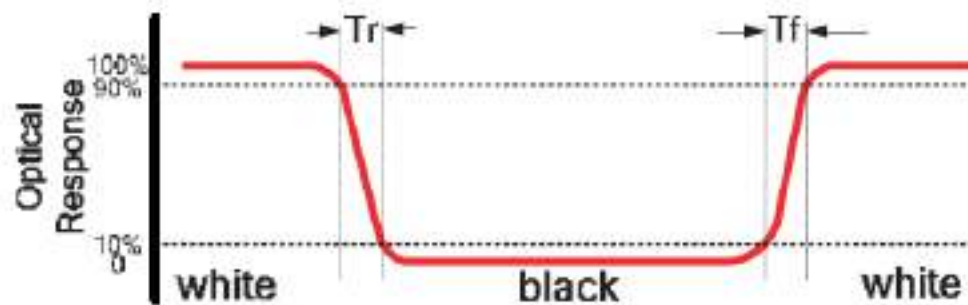
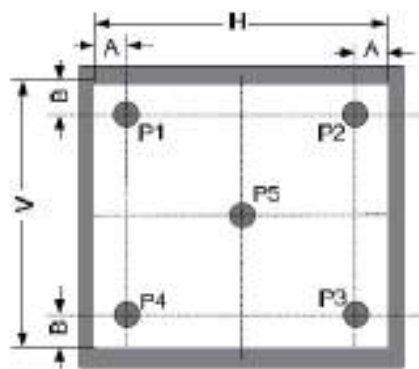


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

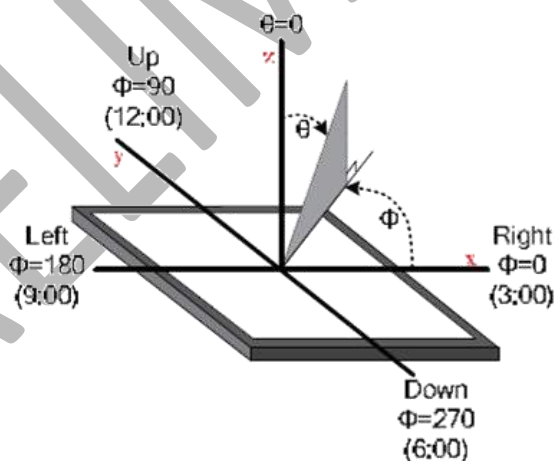
B: 5mm

H,V: Active Area

Light spot size $\phi=5\text{mm}$, 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



7 INTERFACE DESCRIPTION

7.1 P1 connector- RIBUS description

PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	VDD	Supply voltage for module: 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 Pulled UP	
8	RST/PD	Reset / Power down signal, Active Low, Internally 47k Pulled 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

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.

[illegible]

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

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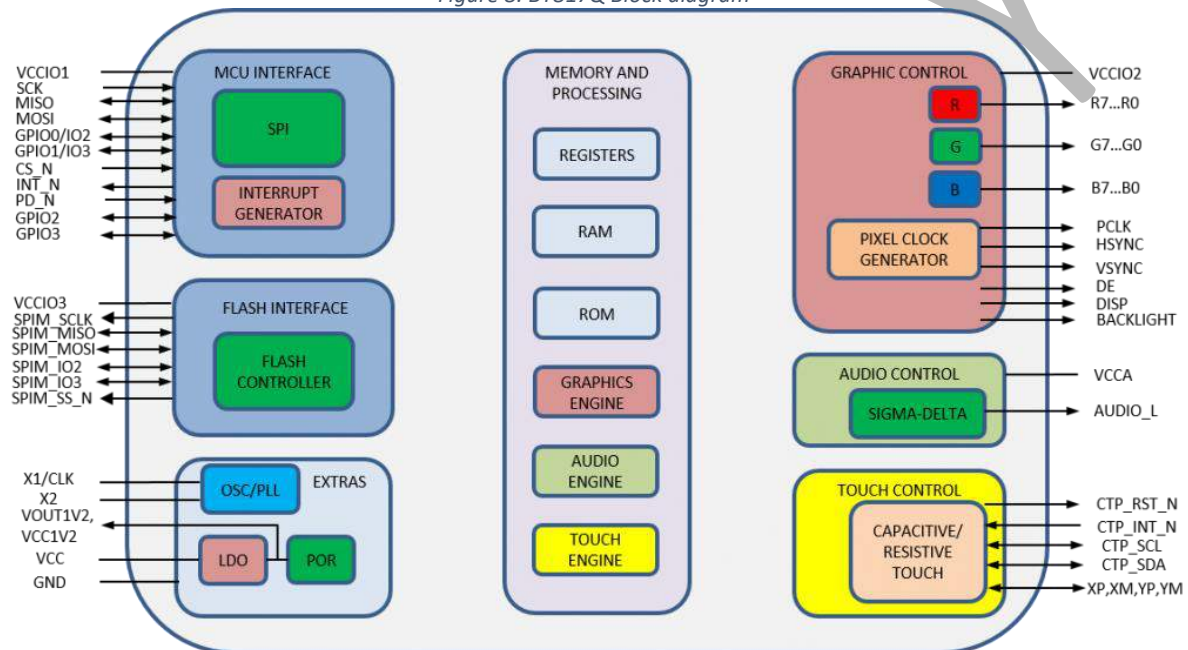
Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

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.

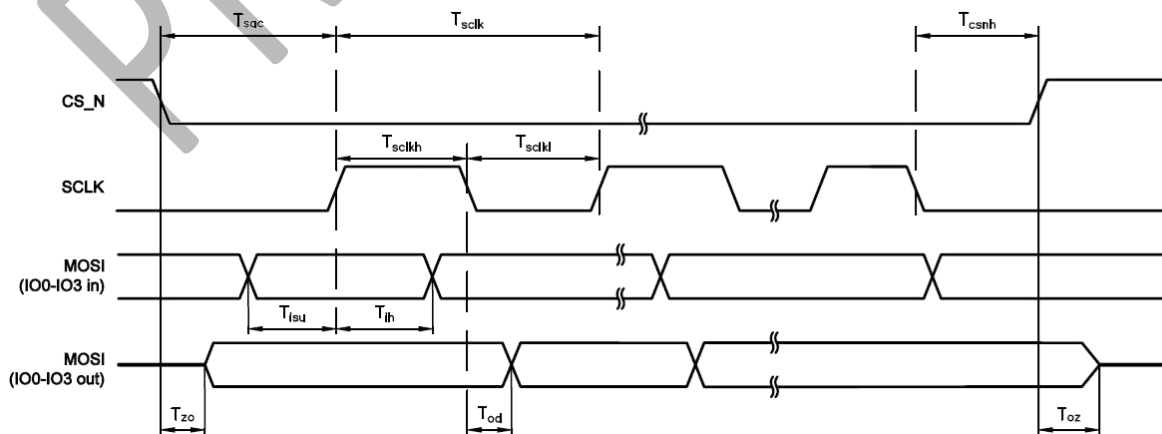
8.2 Block Diagram

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.

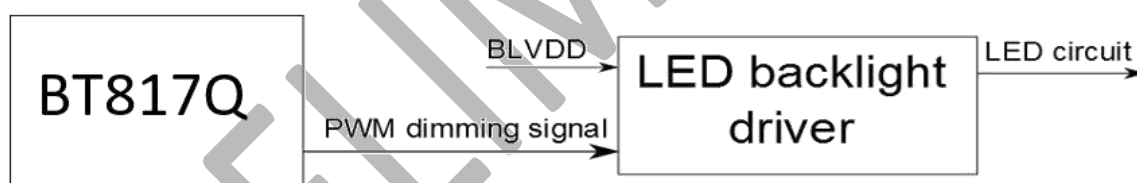
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

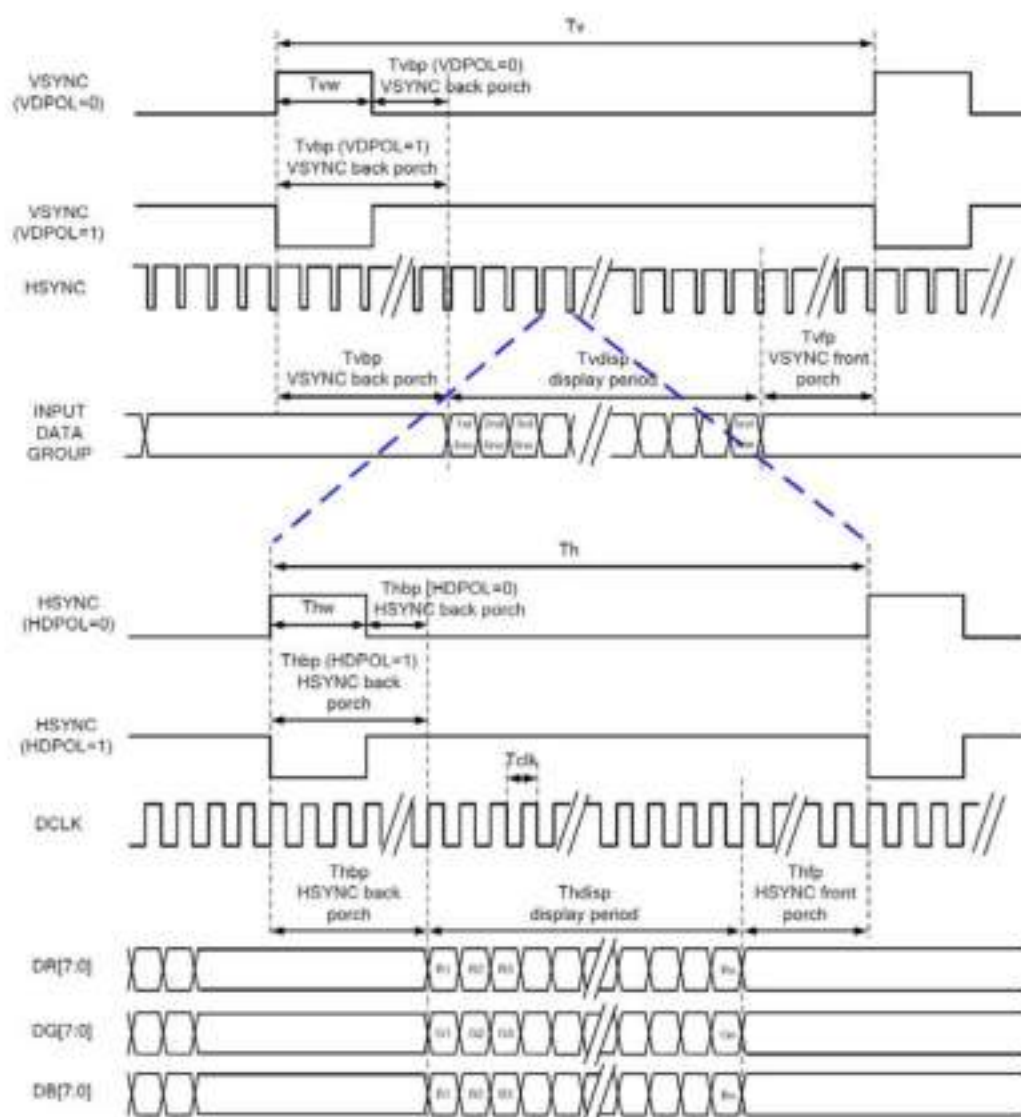
9 TIMING CHARACTERISTICS

9.1 RGB mode

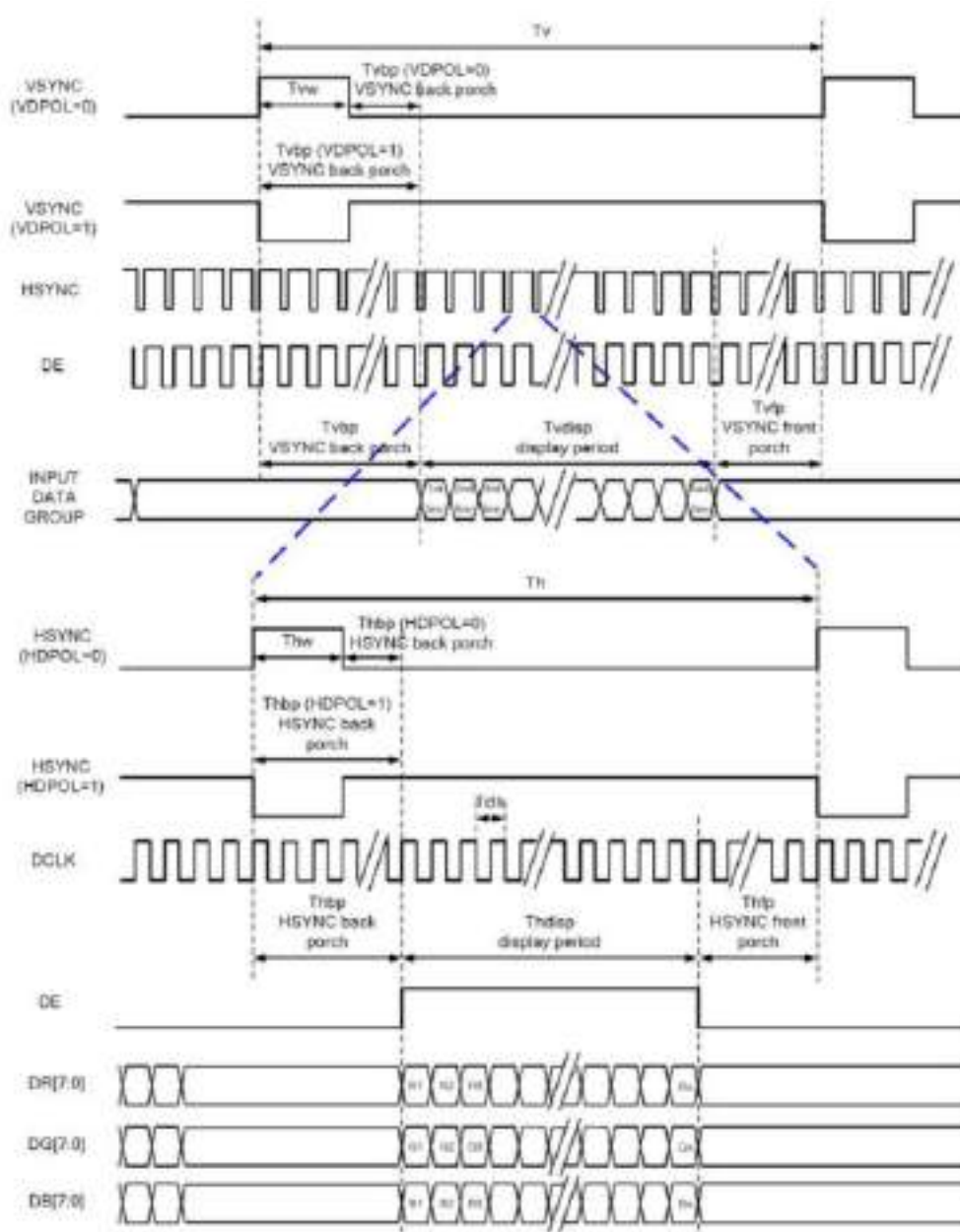
RGB MODE	DCLK	HSYNC	VSYNC	DE
SYNC-DE Mode	Input	Input	Input	Input

9.2 System bus timing for RGB interface

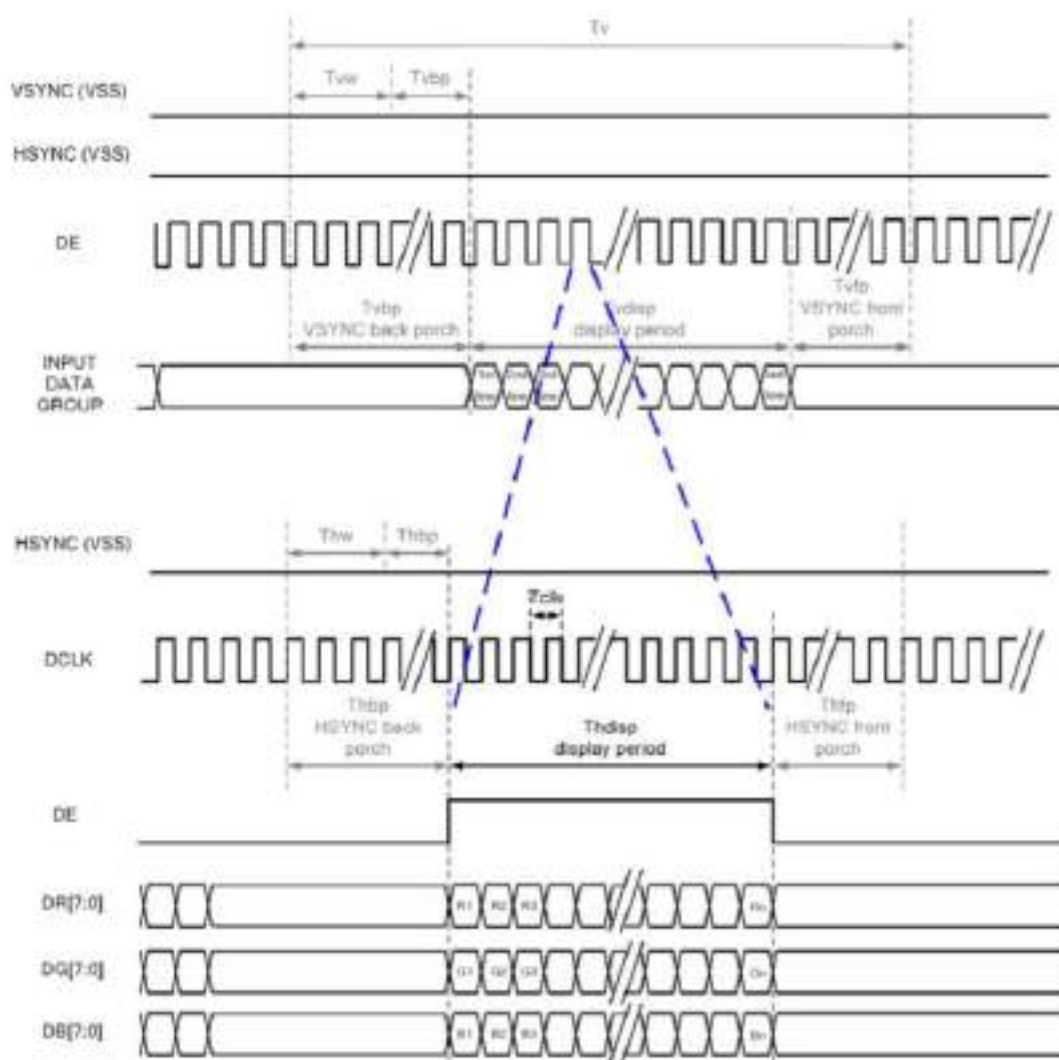
9.2.1 SYNC Mode



9.2.2 SYNC-DE Mode



9.2.3 DE Mode



9.3 Parallel 24-bit RGB input timing table

Parallel 24-bit RGB input Timing (PVDD=VDD=VDDI=3.3V, AGND=0V, Ta=25 °C)

PARAMETER		SYMBOL	MIN	TYP	MAX	UNIT
DCLK Frequency		F_{clk}	23	25	27	MHz
HSYNC	Period Time	T_h	808	816	896	DCLK
	Display Period	T_{hdisp}	800			DCLK
	Hsync Back Porch	T_{hbp}	4	8	48	DCLK
	Hsync Front Porch	T_{hfp}	4	8	48	DCLK
	Hsync Pluse Width	T_{hw}	2	4	8	DCLK
VSYNC	Period Time	T_v	488	496	504	HSYNC
	Display Period	T_{vdisp}	480			HSYNC
	Vsync Back Porch	T_{vbp}	4	8	12	HSYNC
	Vsync Front Porch	T_{vfp}	4	8	12	HSYNC
	Vsync Pluse Width	T_{vw}	2	4	8	HSYNC

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:

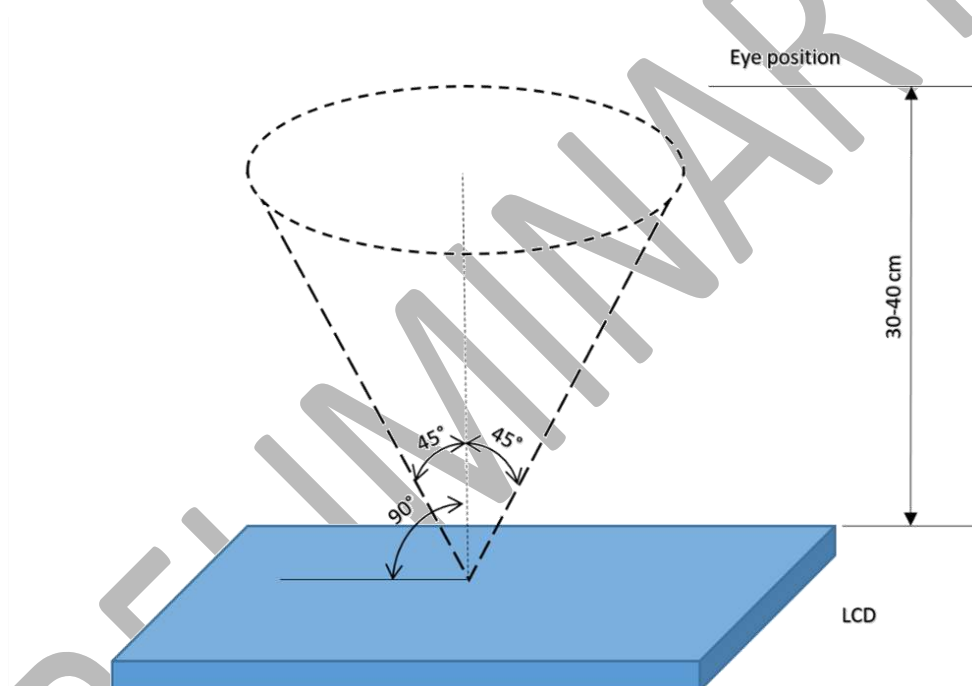
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

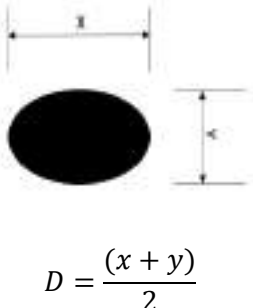
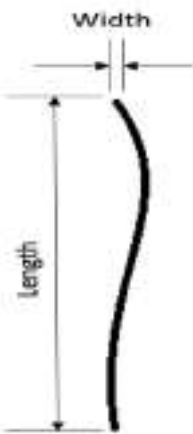
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



11.2 Inspection standard

Item	Criterion																		
Black spots, white spots, light leakage, Foreign Particle (round Type)	 <table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>D ≤ 0.15 mm</td><td>Ignored</td></tr><tr><td>0.15 mm < D ≤ 0.30 mm</td><td>N ≤ 3</td></tr><tr><td>0.3mm < D</td><td>Not allowed</td></tr></table> *Spots density: 10 mm	3.5" ≤ Size ≤ 5"		Average Diameter	Qualified Qty	D ≤ 0.15 mm	Ignored	0.15 mm < D ≤ 0.30 mm	N ≤ 3	0.3mm < D	Not allowed								
3.5" ≤ Size ≤ 5"																			
Average Diameter	Qualified Qty																		
D ≤ 0.15 mm	Ignored																		
0.15 mm < D ≤ 0.30 mm	N ≤ 3																		
0.3mm < D	Not allowed																		
LCD black spots, white spots, light leakage (line Type)	 <table><tr><th colspan="3">3.5" ≤ Size ≤ 5"</th></tr><tr><th>Length/mm</th><th>Width/mm</th><th>Qualified Qty</th></tr><tr><td>-</td><td>W ≤ 0.03</td><td>Ignored</td></tr><tr><td>L ≤ 3.0</td><td>0.03 < W ≤ 0.05</td><td>2</td></tr><tr><td>L ≤ 3.0</td><td>0.05 < W ≤ 0.1</td><td>1</td></tr><tr><td>3.0 < L</td><td>0.1 < W</td><td>Not allowed</td></tr></table> *Spots density: 10 mm	3.5" ≤ Size ≤ 5"			Length/mm	Width/mm	Qualified Qty	-	W ≤ 0.03	Ignored	L ≤ 3.0	0.03 < W ≤ 0.05	2	L ≤ 3.0	0.05 < W ≤ 0.1	1	3.0 < L	0.1 < W	Not allowed
3.5" ≤ Size ≤ 5"																			
Length/mm	Width/mm	Qualified Qty																	
-	W ≤ 0.03	Ignored																	
L ≤ 3.0	0.03 < W ≤ 0.05	2																	
L ≤ 3.0	0.05 < W ≤ 0.1	1																	
3.0 < L	0.1 < W	Not allowed																	
Bright/Dark Dots	<table><tr><th colspan="2">3.5" ≤ Size ≤ 5"</th></tr><tr><th>item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>N ≤ 1</td></tr><tr><td>Dark Dots</td><td>N ≤ 2</td></tr><tr><td>Total Bright and Dark Dots</td><td>N ≤ 3</td></tr></table>	3.5" ≤ Size ≤ 5"		item	Qualified Qty	Bright Dots	N ≤ 1	Dark Dots	N ≤ 2	Total Bright and Dark Dots	N ≤ 3								
3.5" ≤ Size ≤ 5"																			
item	Qualified Qty																		
Bright Dots	N ≤ 1																		
Dark Dots	N ≤ 2																		
Total Bright and Dark Dots	N ≤ 3																		

Item	Criterion												
Clear spots	<table><tr><th colspan="2">Size >= 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></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>	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
	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	<table><tr><th colspan="2">Size >= 5"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>D < 0.25 mm</td><td>Ignored</td></tr><tr><td>0.25 mm < D < 0.5 mm</td><td>3</td></tr><tr><td>0.5 mm < D</td><td>0</td></tr></table>	Size >= 5"		Average Diameter	Qualified Qty	D < 0.25 mm	Ignored	0.25 mm < D < 0.5 mm	3	0.5 mm < D	0		
	Size >= 5"												
	Average Diameter	Qualified Qty											
	D < 0.25 mm	Ignored											
	0.25 mm < D < 0.5 mm	3											
	0.5 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	Humidity 40 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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 cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

13 LEGAL INFORMATION

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RVT70HSBFWN00

EVE4 IPS 7.0" LCD TFT Datasheet

Rev.0.1

2020-01-18

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally Black/IPS	/
Size	7.0	Inch
Viewing Direction	Free	/
Outside Dimensions (W × H × D)	181.60 x 100.60 x 11.09	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	HiBUS, 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

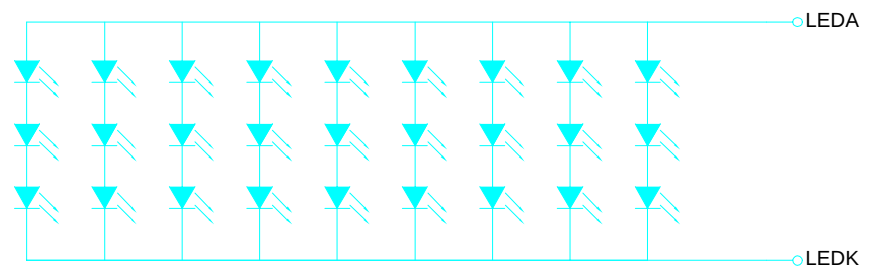
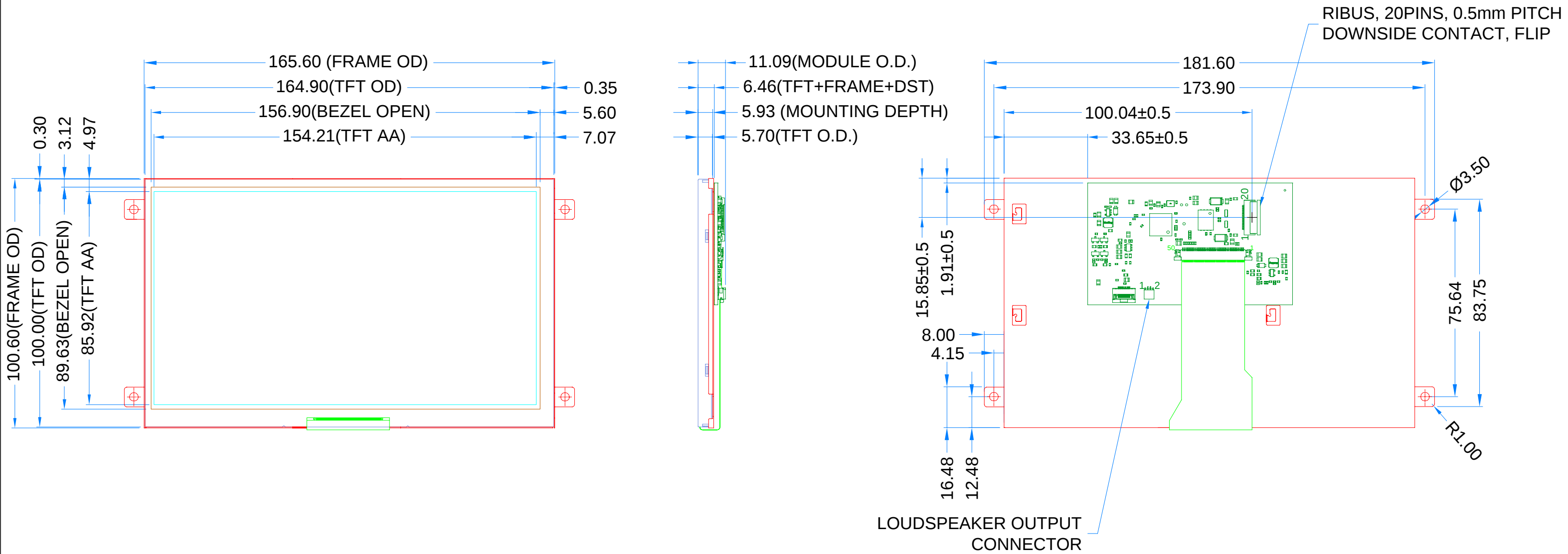
REVISION RECORD.....	2
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1 MODULE CLASSIFICATION INFORMATION

RV	T	70	H	S	B	F	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	F – With Frame
8.	BACKLIGHT TYPE	W – LED White
9.	TOUCH PANEL	N – Without Touch Panel
10.	VERSION	00 – (00-99)

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: RVT70HSBFWN00				
		SN:				
		DRAWN: M.Natywa		2020.12.01	1:1.52	
				2020.12.09	[mm]	
			ISO A3	P. 1 of 1		

ES France - Département Composants & Modules - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 84 - Fax. 01 47 01 16 22 - e-mail: comp@es-france.com - Site Web: www.es-france.com

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.

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	$\theta=0^\circ$ $\Phi=0^\circ$ 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	$\Phi = 90^\circ$	-	85	-	deg	FIG 4.	6
			$\Phi = 270^\circ$	-	85	-	deg	FIG 4.	
			$\Phi = 0^\circ$	-	85	-	deg	FIG 4.	
			$\Phi = 180^\circ$	-	85	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	$\theta=0^\circ$ $\Phi=0^\circ$ 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.

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

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 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 (x, y) chromaticity the test data is based on TOPCON's BM-5 photo detector.

Figure 2. The definition of response time

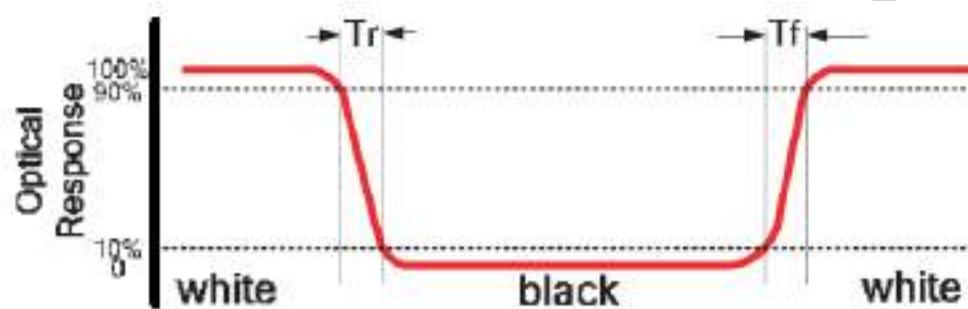


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

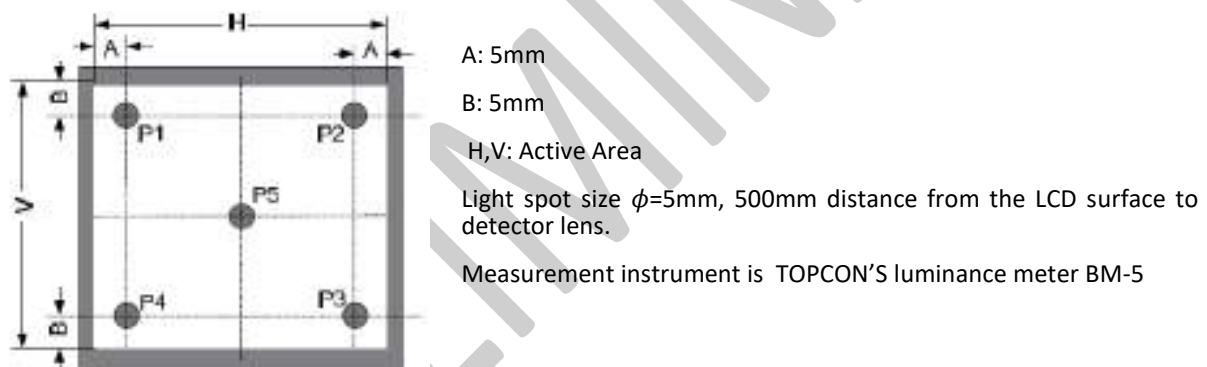
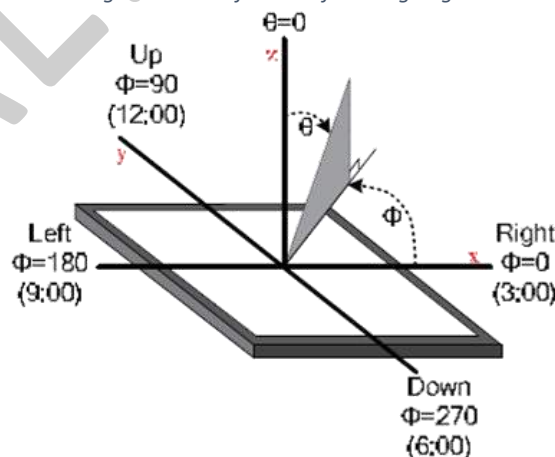


Figure 4. The definition of viewing angle



7 INTERFACES DESCRIPTION

7.1 P1 connector 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:

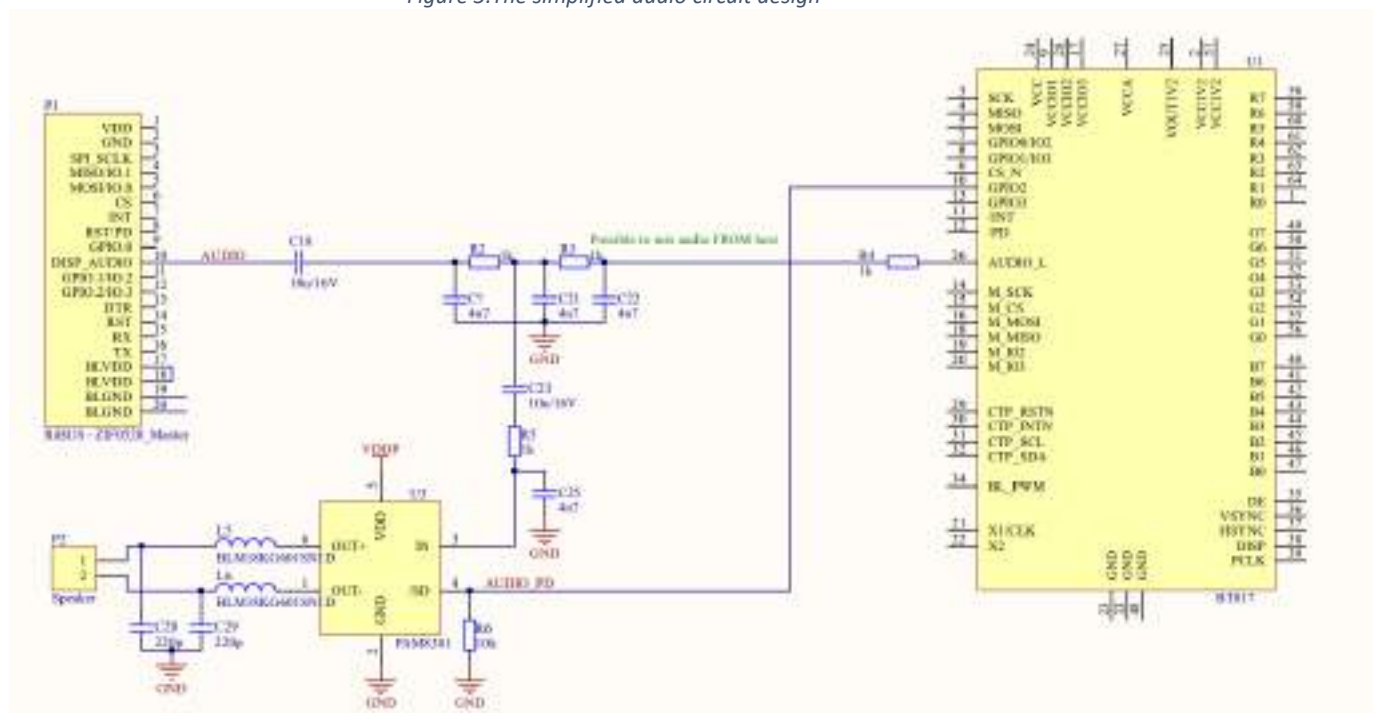
1. To play sounds from BT817Q on internal amplifier U3.
2. To play sounds from host on internal amplifier U3.
3. To play sounds from BT817Q on external amplifier.

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.

+-

+

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

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

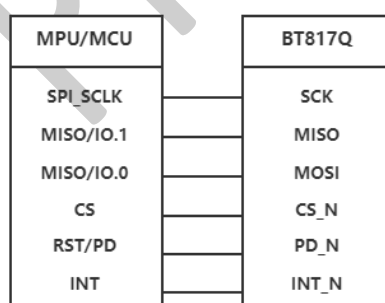
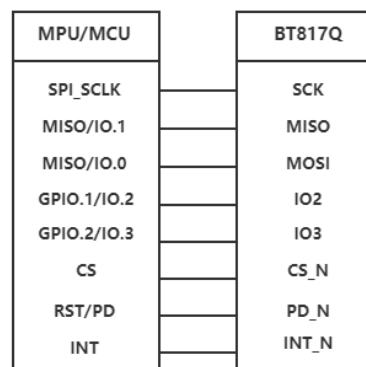


Figure 7. QSPI interface connection



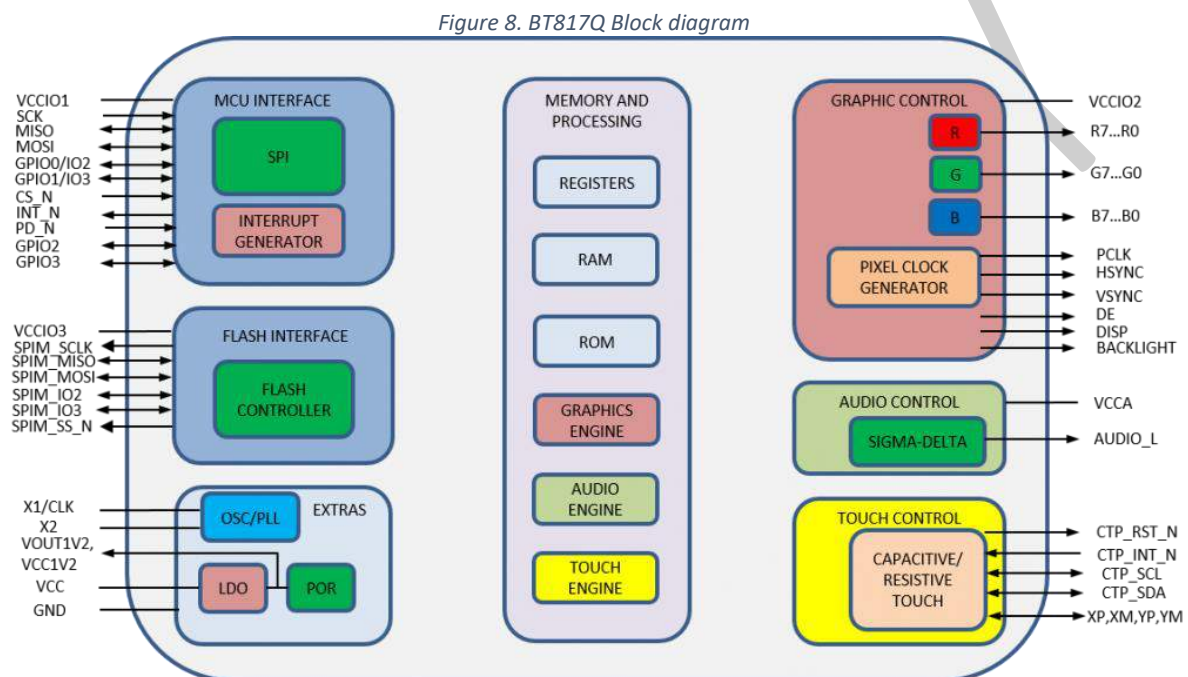
SPI Interface – the SPI slave interface operates up to 30MHz (It depends on EVE4 system clock frequency and needs verification in Riverdi lab).

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

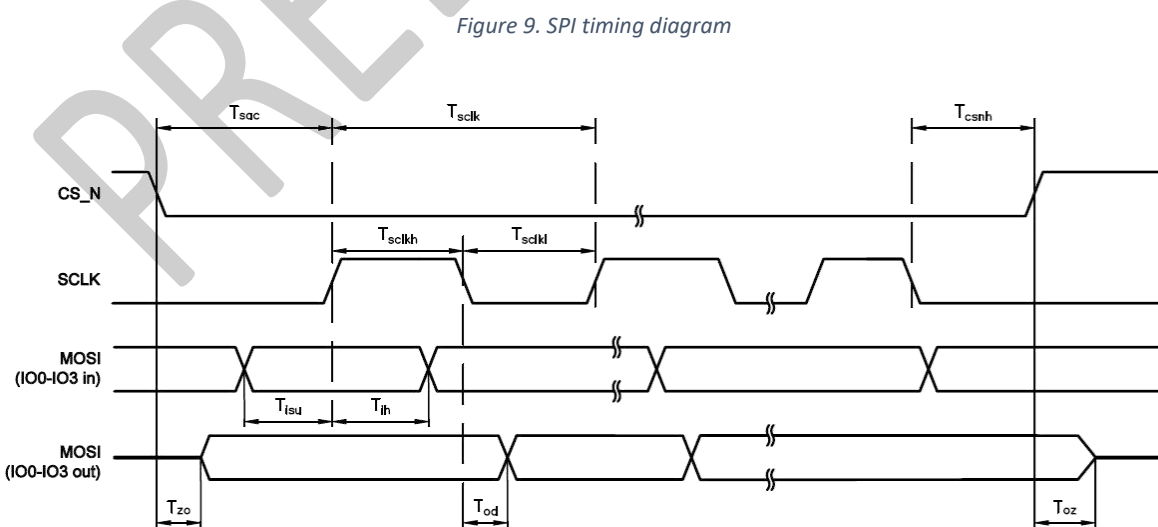
QSPI Interface – the QSPI slave interface operates up to 30MHz (It depends on EVE 4 system clock frequency and will be verified in Riverdi lab). Only SPI mode 0 is supported. The QSPI can be configured as a SPI slave in SINGLE, DUAL or QUAD channel modes.

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



8.3 Host interface SPI mode 0



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

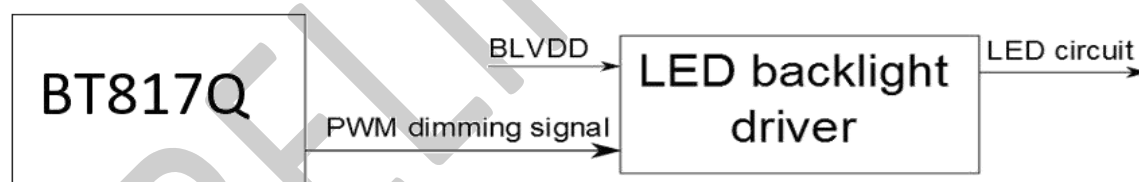
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

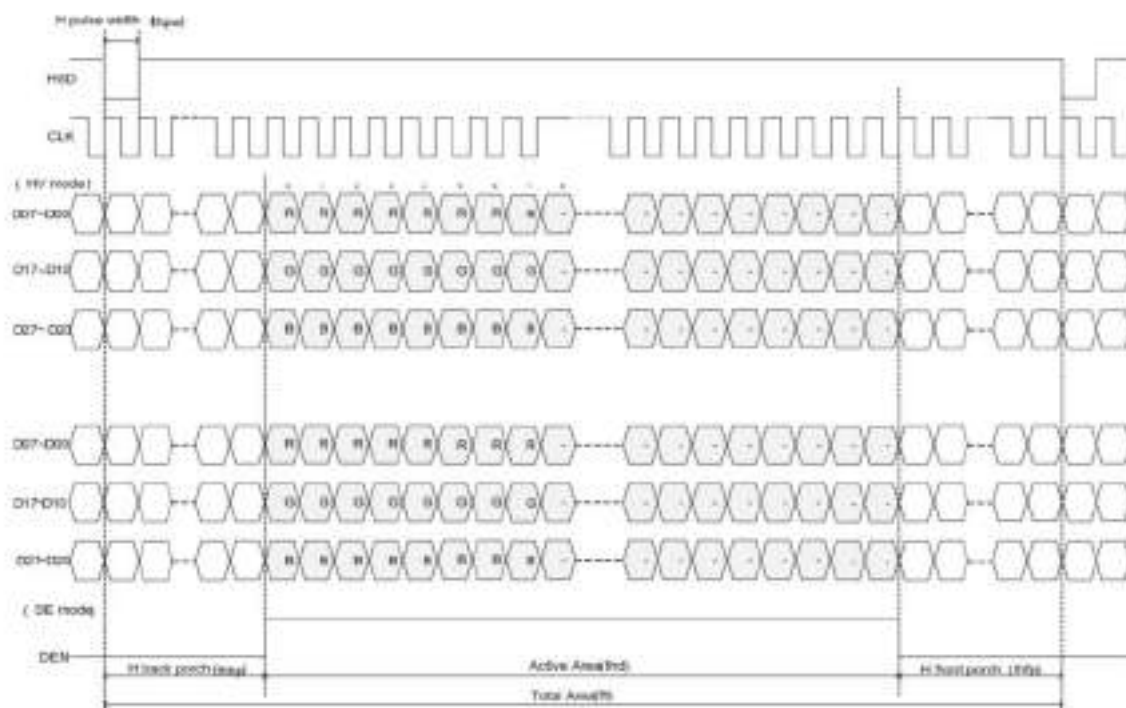
Figure 10. Backlight driver block diagram



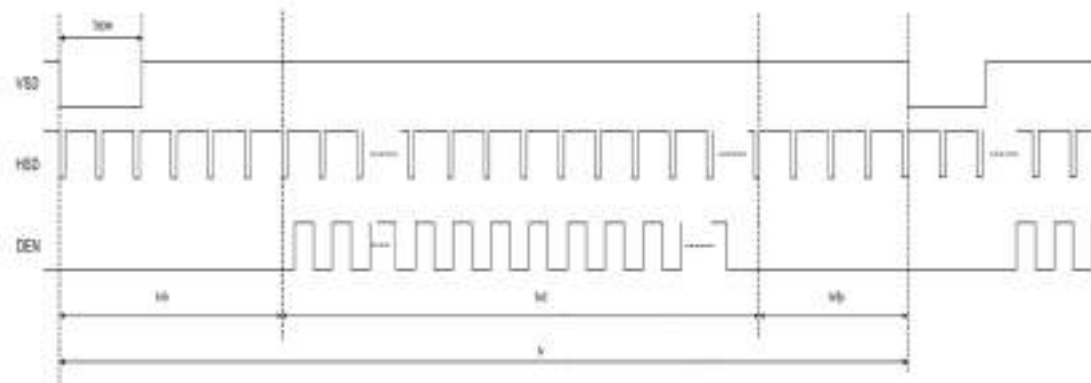
The LED backlight driver used in this module does not burst the LED current. Therefore, it does not generate audible noises on the output capacitor. It is equipped with soft start subsystem, which increases LED life time, as LED current peaks are reduced significantly.

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
VSNC period time	t_v	610	635	800	H
VSNC 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
VSNC period time	t_v	624	635	750	H
VSNC pulse width	t_{vpw}	1	-	20	H
VSNC back porch	t_{vb}	23	23	23	H
VSNC front porch	t_{vfp}	1	12	127	H

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:

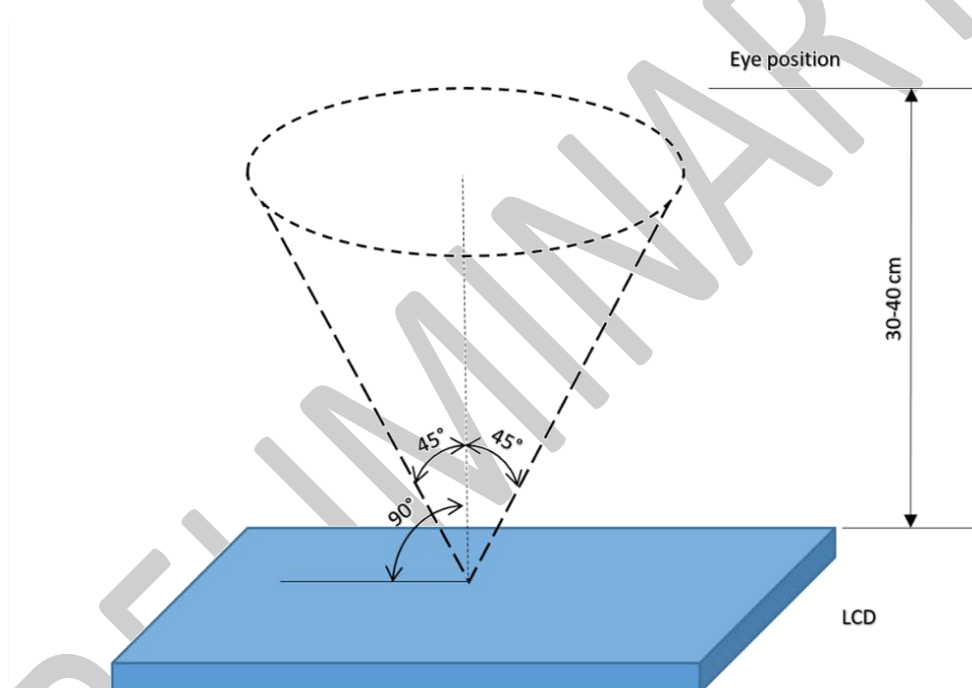
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

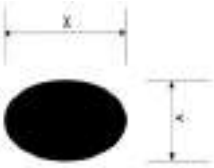
35 $\pm$ 5 cm between inspector bare eye and LCD.

Viewing Angle:

U/D: 45°/45°, L/R: 45°/45°



11.2 Inspection standard

Item	Criterion															
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ *Spots density: 10 mm <table><tr><th colspan="2">Size = 7"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>$D \leq 0.2 \text{ mm}$</td><td>Ignored</td></tr><tr><td>$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$</td><td>$N \leq 3$</td></tr><tr><td>$0.5 \text{ mm} < D$</td><td>Not allowed</td></tr></table>	Size = 7"		Average Diameter	Qualified Qty	$D \leq 0.2 \text{ mm}$	Ignored	$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$	$N \leq 3$	$0.5 \text{ mm} < D$	Not allowed					
Size = 7"																
Average Diameter	Qualified Qty															
$D \leq 0.2 \text{ mm}$	Ignored															
$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$	$N \leq 3$															
$0.5 \text{ mm} < D$	Not allowed															
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <table><tr><th colspan="3">Size = 7"</th></tr><tr><th>Length</th><th>Width</th><th>Qualified Qty</th></tr><tr><td>-</td><td>$W \leq 0.05$</td><td>Ignored</td></tr><tr><td>$L \leq 5.0$</td><td>$0.05 < W \leq 0.1$</td><td>3</td></tr><tr><td>$5.0 < L$</td><td>$0.10 < W$</td><td>Not allowed</td></tr></table>	Size = 7"			Length	Width	Qualified Qty	-	$W \leq 0.05$	Ignored	$L \leq 5.0$	$0.05 < W \leq 0.1$	3	$5.0 < L$	$0.10 < W$	Not allowed
Size = 7"																
Length	Width	Qualified Qty														
-	$W \leq 0.05$	Ignored														
$L \leq 5.0$	$0.05 < W \leq 0.1$	3														
$5.0 < L$	$0.10 < W$	Not allowed														
Bright/Dark Dots	<table><tr><th colspan="2">Size = 7"</th></tr><tr><th>Item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>$N \leq 2$</td></tr><tr><td>Dark Dots</td><td>$N \leq 3$</td></tr><tr><td>Total Bright and Dark Dots</td><td>$N \leq 4$</td></tr></table>	Size = 7"		Item	Qualified Qty	Bright Dots	$N \leq 2$	Dark Dots	$N \leq 3$	Total Bright and Dark Dots	$N \leq 4$					
Size = 7"																
Item	Qualified Qty															
Bright Dots	$N \leq 2$															
Dark Dots	$N \leq 3$															
Total Bright and Dark Dots	$N \leq 4$															

Item	Criterion
Clear spots	Size $\geq 5''$
	Average Diameter
	Qualified Qty
	$D < 0.2 \text{ mm}$
	Ignored
	$0.2 \text{ mm} < D < 0.3 \text{ mm}$
Polarizer bubbles	4
	$0.3 \text{ mm} < D < 0.5 \text{ mm}$
	2
	$0.5 \text{ mm} < D$
	0
	*Spots density: 10 mm
Polarizer bubbles	Size = 7.0''
	Average Diameter
	Qualified Qty
	$D \leq 0.2 \text{ mm}$
	Ignored
	$0.2 \text{ mm} < D \leq 0.5 \text{ mm}$
Polarizer bubbles	2
	$0.5 \text{ mm} < D$
	1

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

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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RVT70HSBNWC00-B

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	850	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
Bonding Technology	Optical Bonding	/
Weight	226	g

Note 1: RoHS compliant

Note 2: LCM weight tolerance: ± 5%.

REVISION RECORD

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

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1 MODULE CLASSIFICATION INFORMATION

RV	T	70	H	S	B	N	W	C	00	B
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.

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)
11.	BONDING TECHNOLOGY	B – Optical Bonding

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.

Figure 1. General view of the module



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	$\theta=0^\circ$ $\Phi=0^\circ$ 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		-	850	-	cd/m ²	FIG 3.	2
Viewing Angle Range	θ	$\Phi = 90^\circ$	-	85	-	deg	FIG 4.	6
		$\Phi = 270^\circ$	-	85	-	deg	FIG 4.	
		$\Phi = 0^\circ$	-	85	-	deg	FIG 4.	
		$\Phi = 180^\circ$	-	85	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	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.

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

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 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 (x, y) chromaticity the test data is based on TOPCON's BM-5 photo detector.

Figure 2. The definition of response time

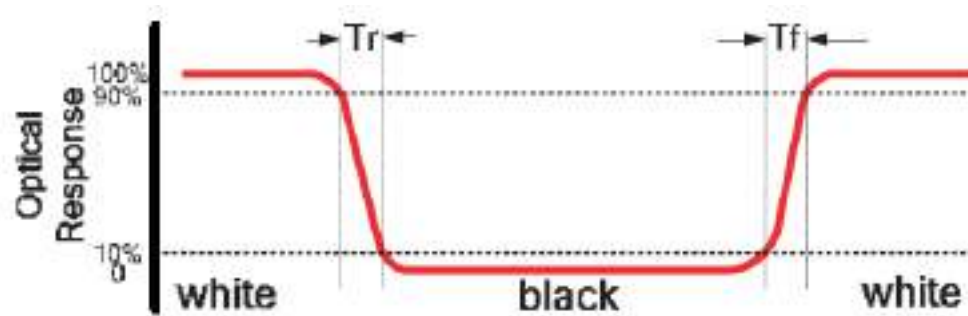


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

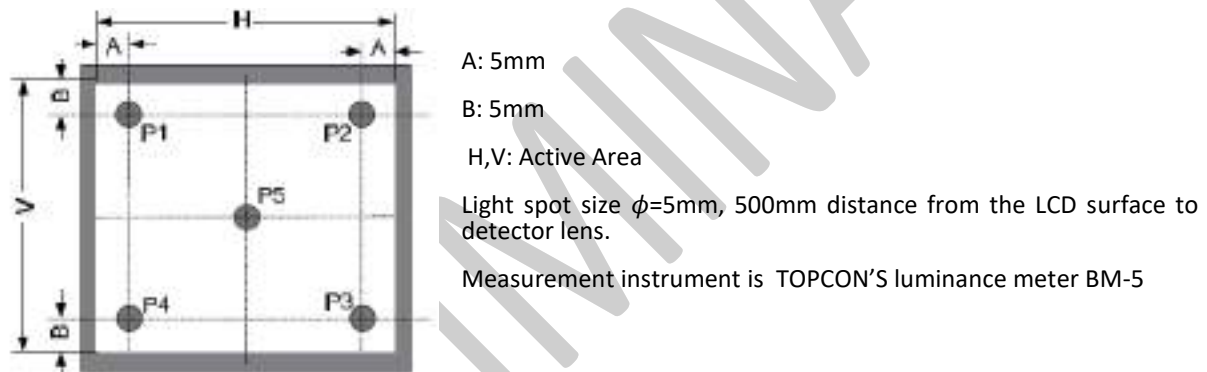
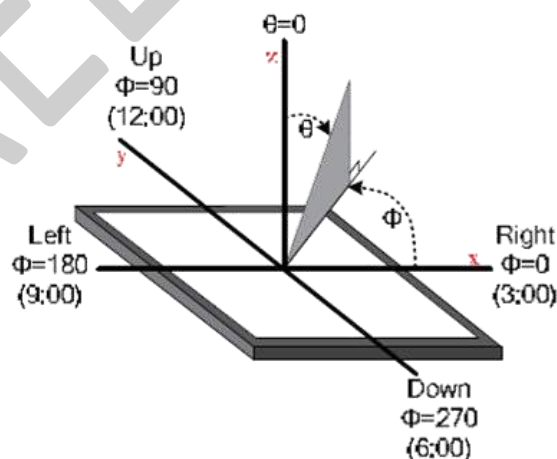


Figure 4. The definition of viewing angle



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.

9 BT817Q CONTROLLER SPECIFICATION

9.1 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

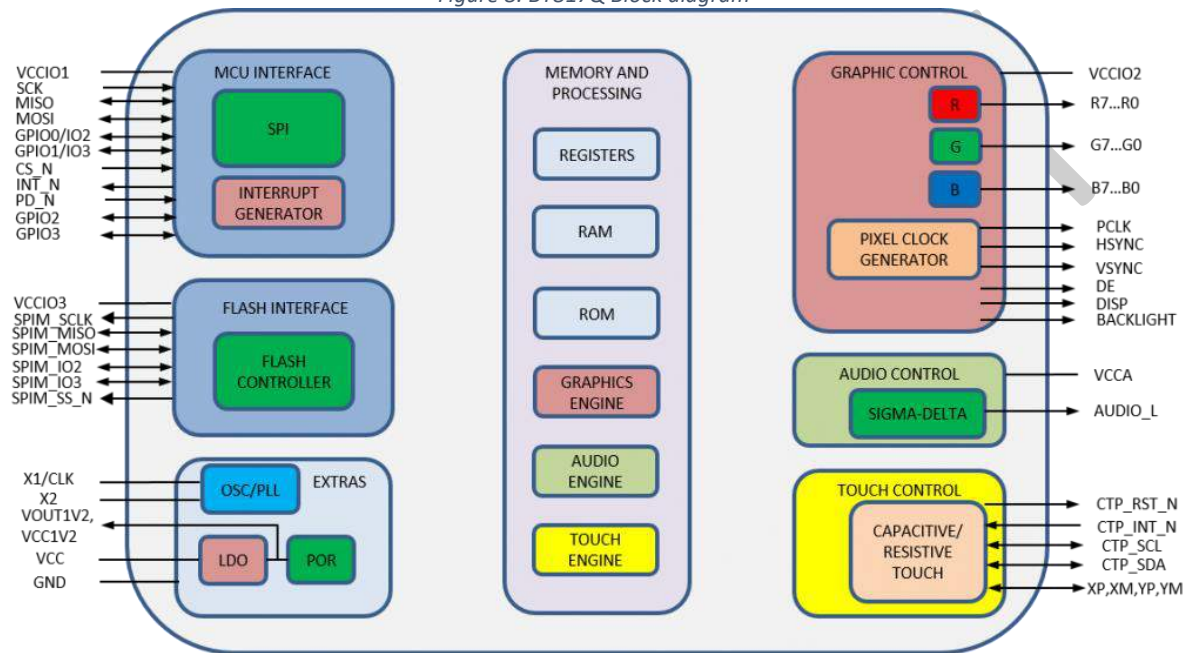
ES France - Département Composants & Modules - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 84 - Fax. 01 47 01 16 22 - e-mail: comp@es-france.com - Site Web: www.es-france.com

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.

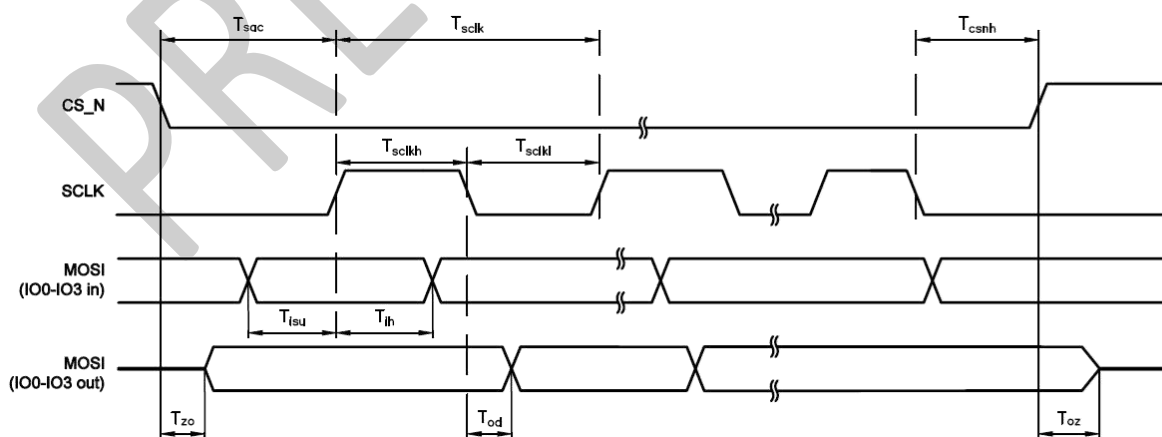
9.2 Block Diagram

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.

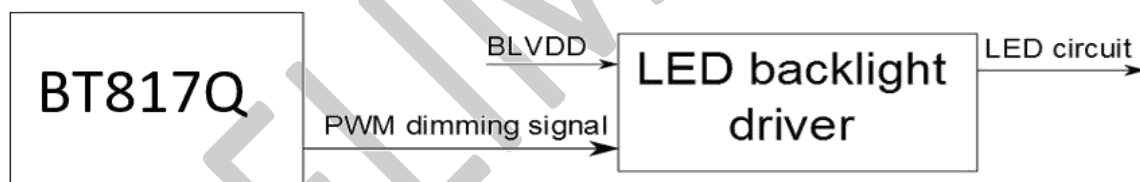
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

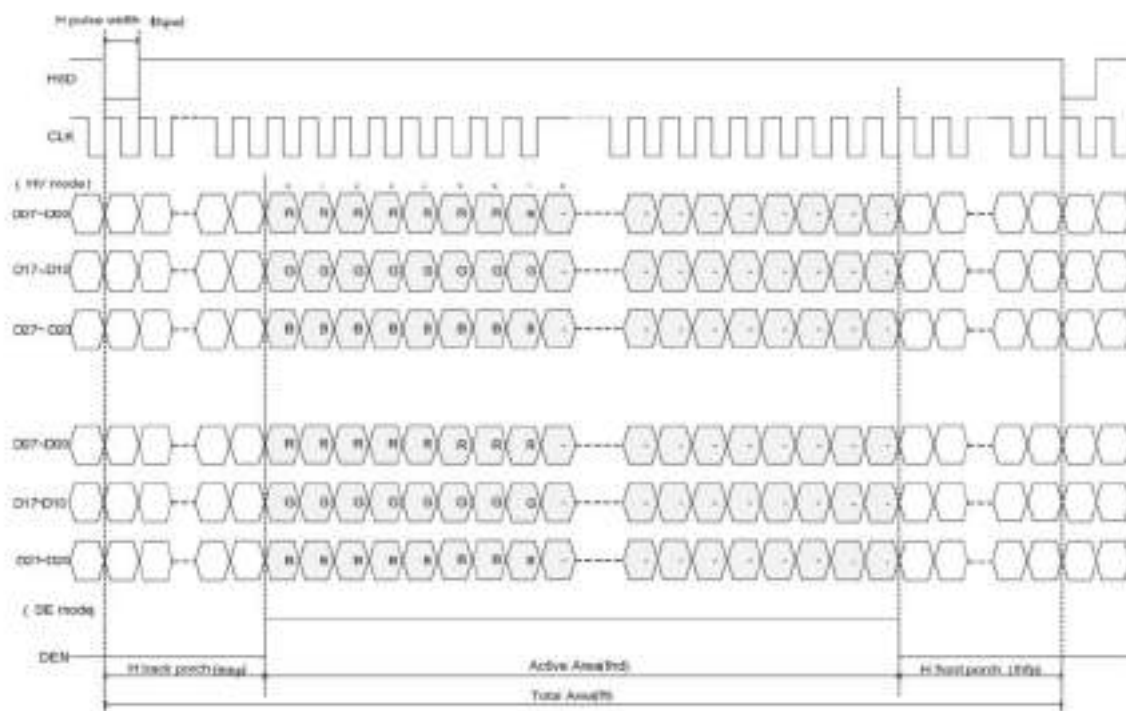
Figure 10. Backlight driver block diagram



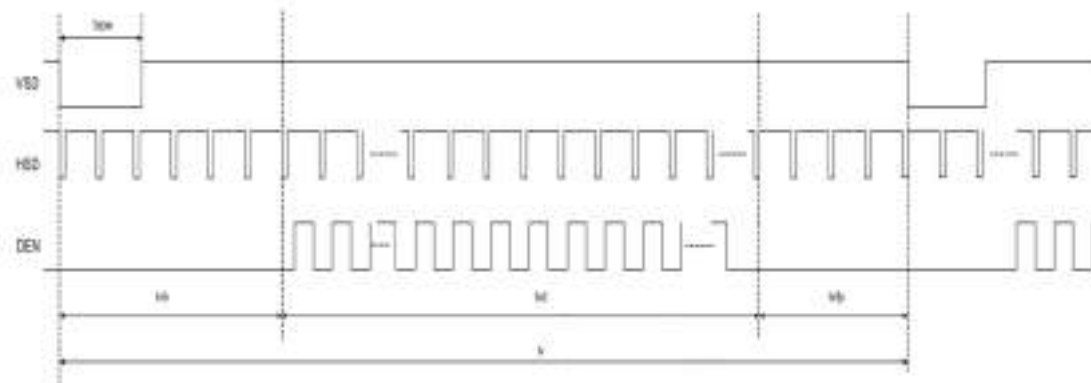
The LED backlight driver used in this module does not burst the LED current. Therefore, it does not generate audible noises on the output capacitor. It is equipped with soft start subsystem, which increases LED life time, as LED current peaks are reduced significantly.

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
VSNC period time	t_v	610	635	800	H
VSNC 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
VSNC period time	t_v	624	635	750	H
VSNC pulse width	t_{vpw}	1	-	20	H
VSNC back porch	t_{vb}	23	23	23	H
VSNC 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
	Sleep Mode	10 mA
Linearity	+/- 1.5 mm	Note 1
Controller	ILI2132A	Note 1
Resolution	1024x 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:

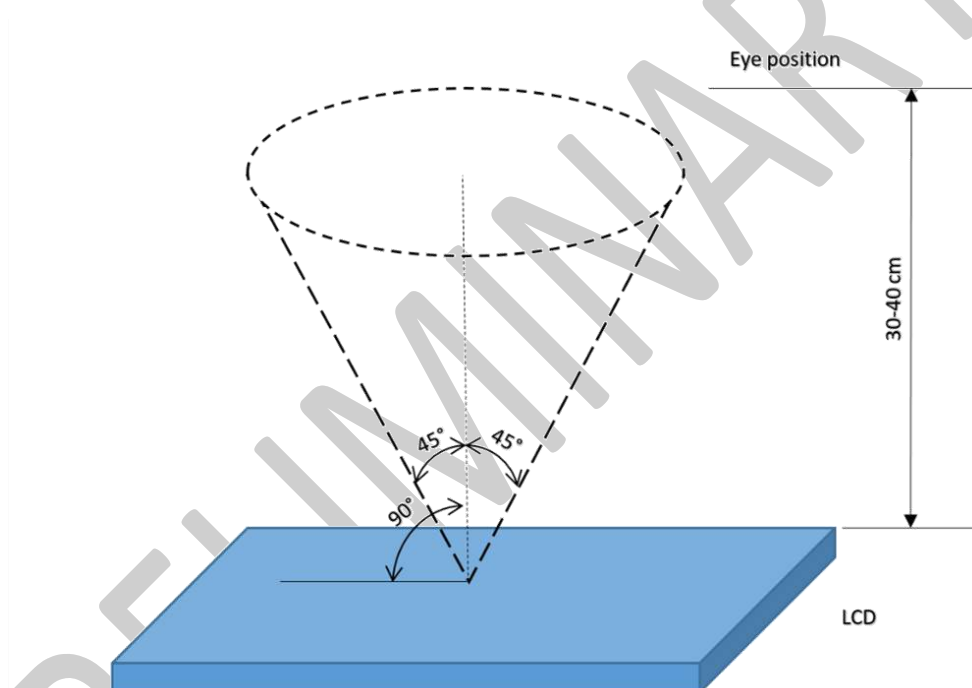
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

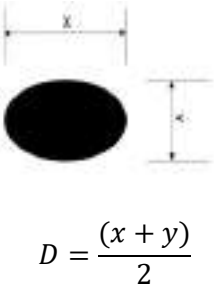
35 $\pm$ 5 cm between inspector bare eye and LCD.

Viewing Angle:

U/D: 45°/45°, L/R: 45°/45°



13.2 Inspection standard

Item	Criterion															
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ *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>$D \leq 0.2 \text{ mm}$</td><td>Ignored</td></tr><tr><td>$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$</td><td>$N \leq 3$</td></tr><tr><td>$0.5 \text{ mm} < D$</td><td>Not allowed</td></tr></table>	Size = 7"		Average Diameter	Qualified Qty	$D \leq 0.2 \text{ mm}$	Ignored	$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$	$N \leq 3$	$0.5 \text{ mm} < D$	Not allowed					
Size = 7"																
Average Diameter	Qualified Qty															
$D \leq 0.2 \text{ mm}$	Ignored															
$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$	$N \leq 3$															
$0.5 \text{ mm} < D$	Not allowed															
LCD black spots, white spots, light leakage (line Type)	 *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>$W \leq 0.05$</td><td>Ignored</td></tr><tr><td>$L \leq 5.0$</td><td>$0.05 < W \leq 0.1$</td><td>3</td></tr><tr><td>$5.0 < L$</td><td>$0.10 < W$</td><td>Not allowed</td></tr></table>	Size = 7"			Length	Width	Qualified Qty	-	$W \leq 0.05$	Ignored	$L \leq 5.0$	$0.05 < W \leq 0.1$	3	$5.0 < L$	$0.10 < W$	Not allowed
Size = 7"																
Length	Width	Qualified Qty														
-	$W \leq 0.05$	Ignored														
$L \leq 5.0$	$0.05 < W \leq 0.1$	3														
$5.0 < L$	$0.10 < W$	Not allowed														
Bright/Dark Dots	<table><tr><th colspan="2">Size = 7"</th></tr><tr><td>item</td><td>Qualified Qty</td></tr><tr><td>Bright Dots</td><td>$N \leq 2$</td></tr><tr><td>Dark Dots</td><td>$N \leq 3$</td></tr><tr><td>Total Bright and Dark Dots</td><td>$N \leq 4$</td></tr></table>	Size = 7"		item	Qualified Qty	Bright Dots	$N \leq 2$	Dark Dots	$N \leq 3$	Total Bright and Dark Dots	$N \leq 4$					
Size = 7"																
item	Qualified Qty															
Bright Dots	$N \leq 2$															
Dark Dots	$N \leq 3$															
Total Bright and Dark Dots	$N \leq 4$															

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		
Polarizer bubbles	Size = 7.0"		
	Average Diameter		Qualified Qty
	D ≤ 0.2 mm		Ignored
	0.2 mm < D ≤ 0.5 mm		2
	0.5 mm < D		1
Touch panel spots	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 / 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 °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	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.

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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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	HiBUS, 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	

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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

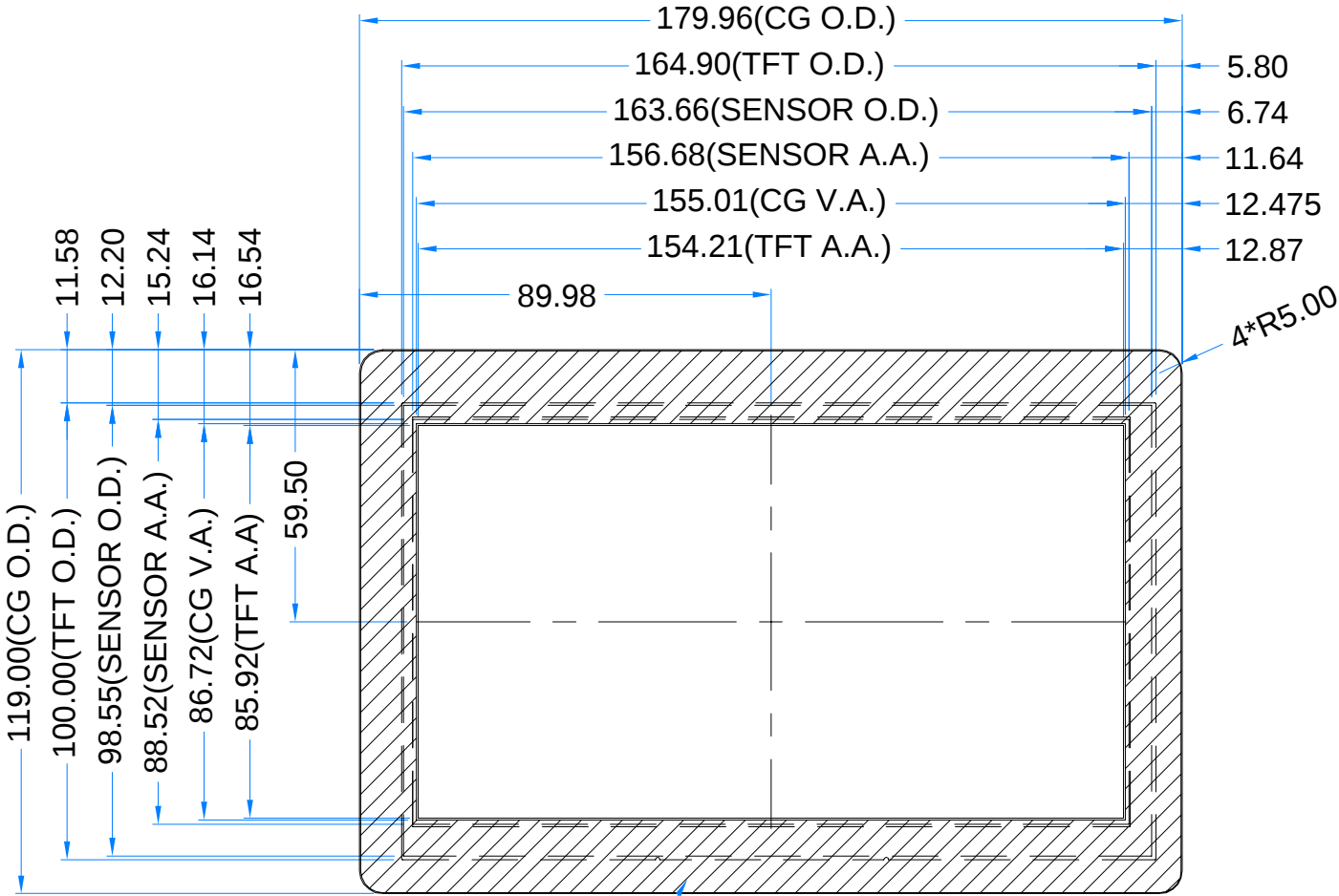
UxTouch are LCD TFT displays with specially designed projected capacitive touch panels. UxTouch display can be mounted without any additional holes in the housing. Our standard UxTouch displays include double-sided adhesive tape (DST) to stick TFT easily to the housing.

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

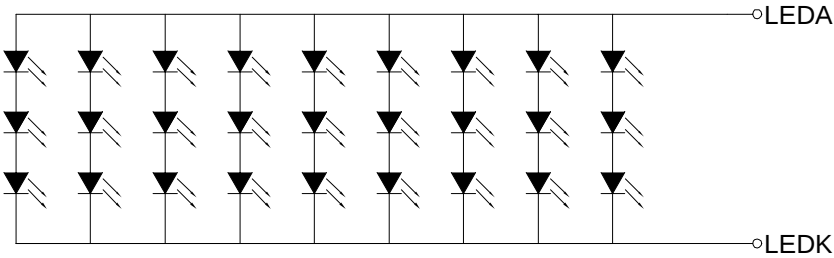
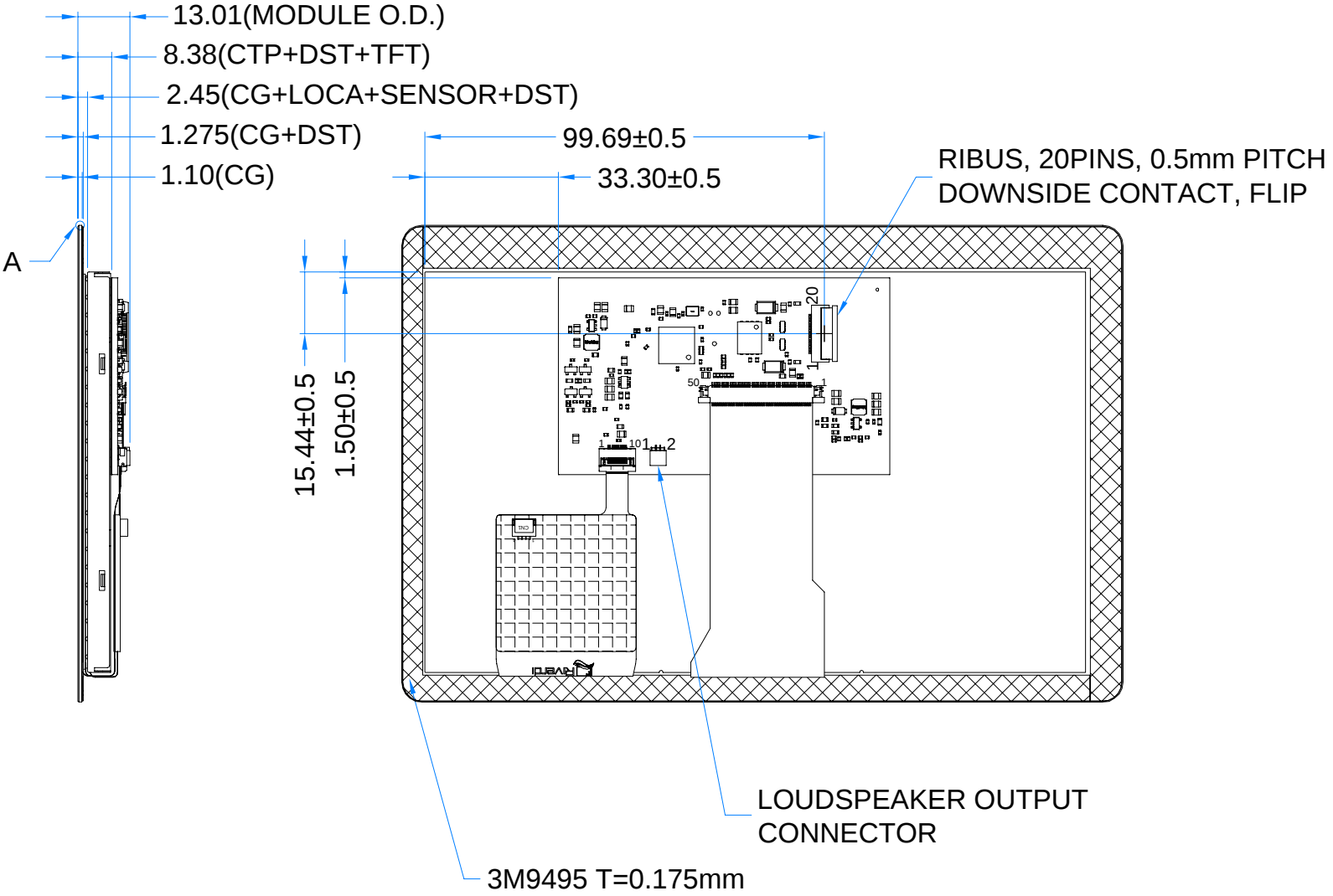
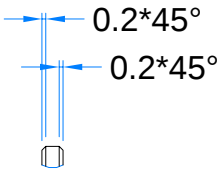


Revision:	Changes:	Date:
1.0	Initial Case	2020.12.09



BLACK MASK PRINTING
RAL9005

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/m²
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:

DRAWN: M.Natywa

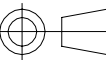


2020.11.30

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2020.12.09

[mm]



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	$\theta=0^\circ$ $\Phi=0^\circ$ 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	$\Phi = 90^\circ$	-	85	-	deg	FIG 4.	6
			$\Phi = 270^\circ$	-	85	-	deg	FIG 4.	
			$\Phi = 0^\circ$	-	85	-	deg	FIG 4.	
			$\Phi = 180^\circ$	-	85	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	$\theta=0^\circ$ $\Phi=0^\circ$ 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.

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

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 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 (x, y) chromaticity the test data is based on TOPCON's BM-5 photo detector.

Figure 2. The definition of response time

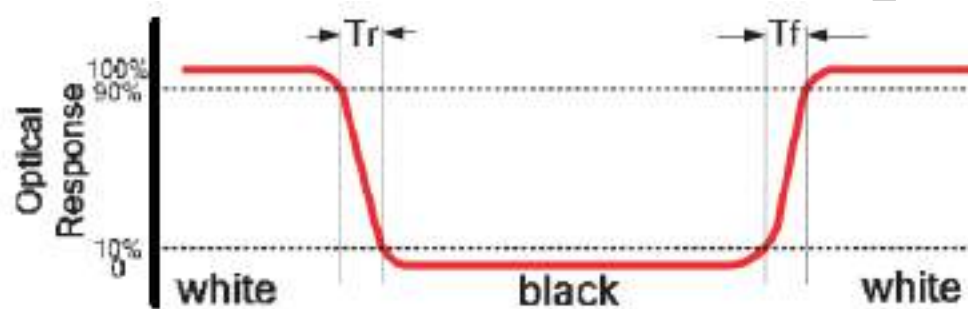


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

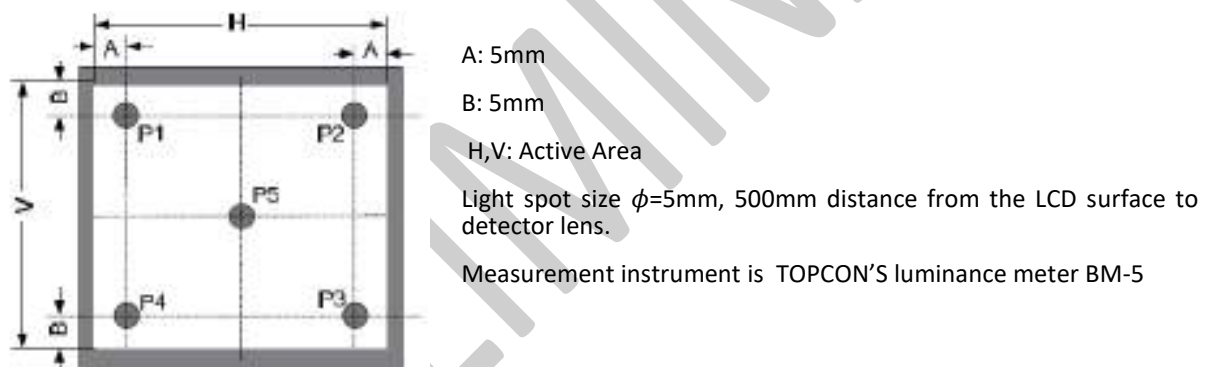
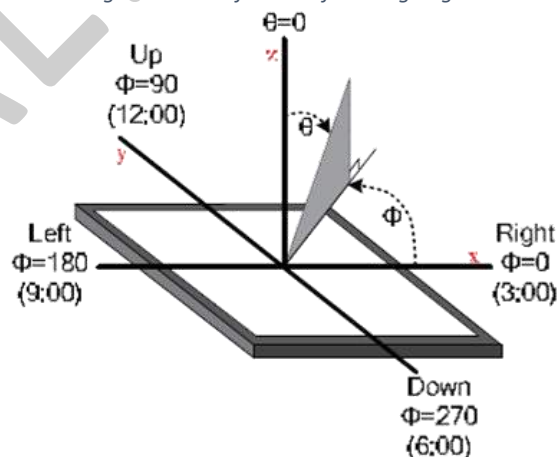


Figure 4. The definition of viewing angle



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

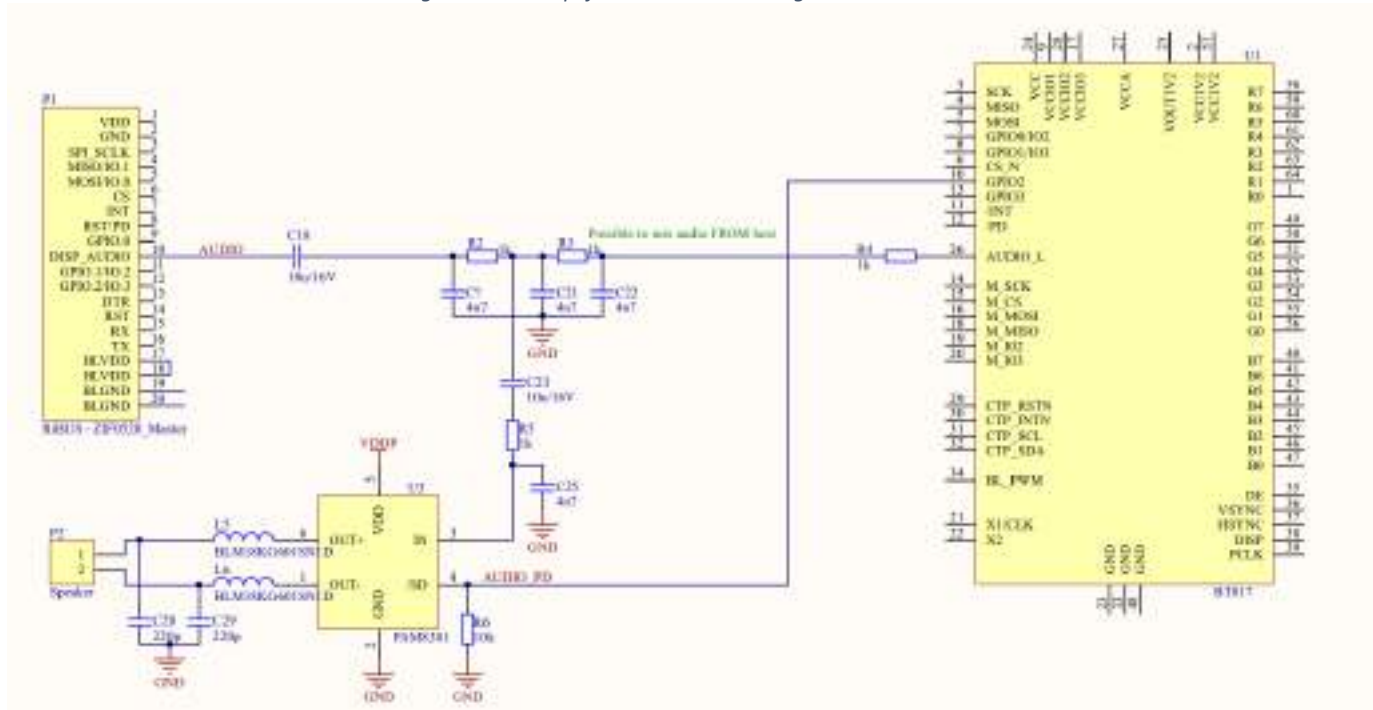
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil “+” terminal	Note 1
2	SPEAKER -	Speaker coil “-” terminal	

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

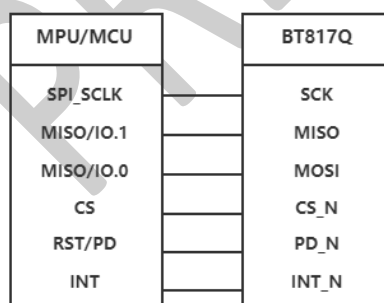
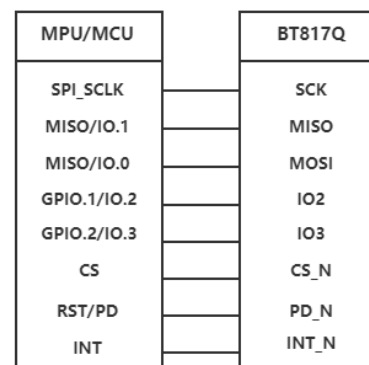


Figure 7. QSPI interface connection



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

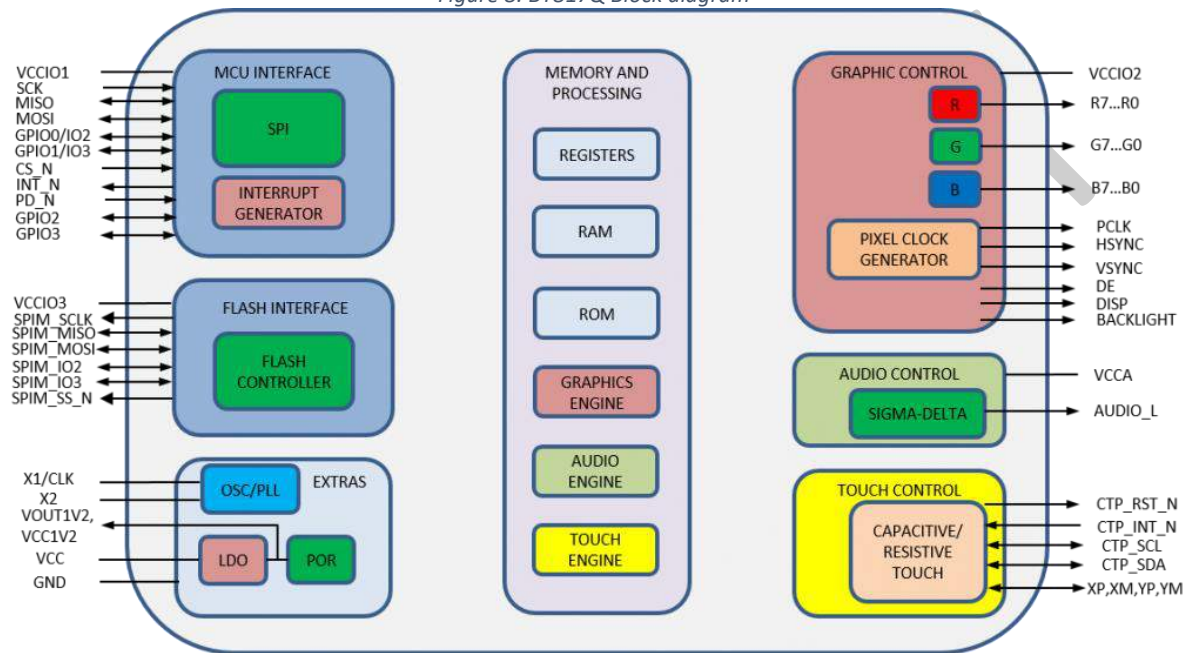
Only SPI mode 0 is supported. The SPI interface is selected by default.

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.

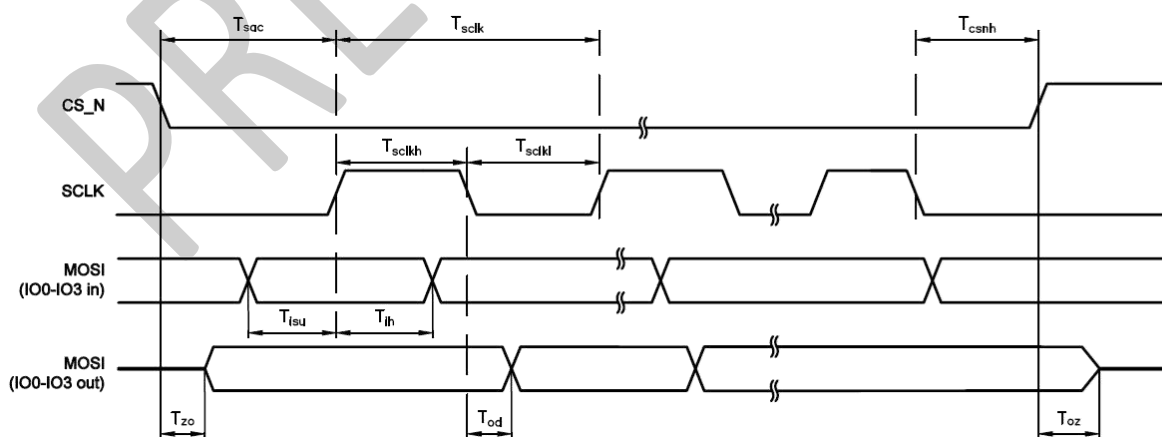
9.2 Block Diagram

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.

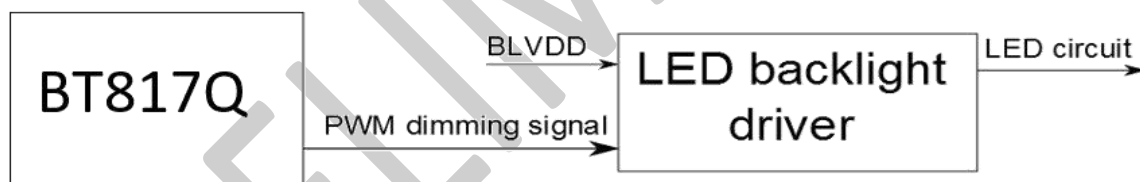
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

10.3 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
VSNC period time	t_v	610	635	800	H
VSNC 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
VSNC period time	t_v	624	635	750	H
VSNC pulse width	t_{vpw}	1	-	20	H
VSNC back porch	t_{vb}	23	23	23	H
VSNC 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
	Sleep Mode	10 mA
Linearity	+/-1.5 mm	Note 1
Controller	ILI2132A	Note 1
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:

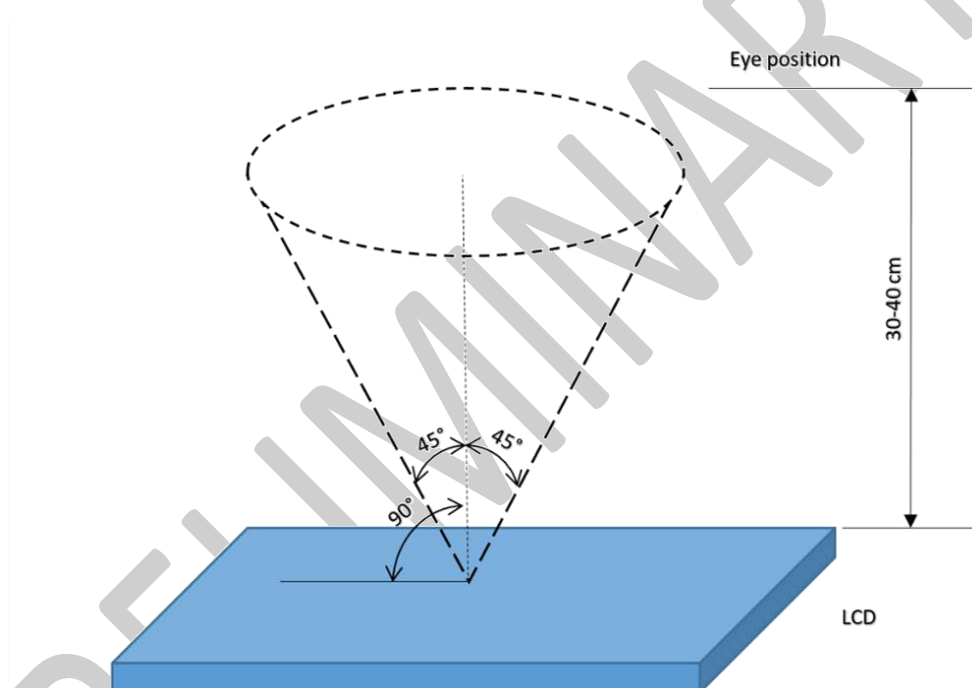
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

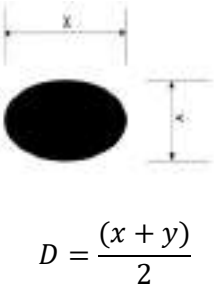
35 ± 5 cm between inspector bare eye and LCD.

Viewing Angle:

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



13.2 Inspection standard

Item	Criterion															
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ *Spots density: 10 mm <table><tr><th colspan="2">Size = 7"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>$D \leq 0.2 \text{ mm}$</td><td>Ignored</td></tr><tr><td>$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$</td><td>$N \leq 3$</td></tr><tr><td>$0.5 \text{ mm} < D$</td><td>Not allowed</td></tr></table>	Size = 7"		Average Diameter	Qualified Qty	$D \leq 0.2 \text{ mm}$	Ignored	$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$	$N \leq 3$	$0.5 \text{ mm} < D$	Not allowed					
Size = 7"																
Average Diameter	Qualified Qty															
$D \leq 0.2 \text{ mm}$	Ignored															
$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$	$N \leq 3$															
$0.5 \text{ mm} < D$	Not allowed															
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <table><tr><th colspan="3">Size = 7"</th></tr><tr><th>Length</th><th>Width</th><th>Qualified Qty</th></tr><tr><td>-</td><td>$W \leq 0.05$</td><td>Ignored</td></tr><tr><td>$L \leq 5.0$</td><td>$0.05 < W \leq 0.1$</td><td>3</td></tr><tr><td>$5.0 < L$</td><td>$0.10 < W$</td><td>Not allowed</td></tr></table>	Size = 7"			Length	Width	Qualified Qty	-	$W \leq 0.05$	Ignored	$L \leq 5.0$	$0.05 < W \leq 0.1$	3	$5.0 < L$	$0.10 < W$	Not allowed
Size = 7"																
Length	Width	Qualified Qty														
-	$W \leq 0.05$	Ignored														
$L \leq 5.0$	$0.05 < W \leq 0.1$	3														
$5.0 < L$	$0.10 < W$	Not allowed														
Bright/Dark Dots	<table><tr><th colspan="2">Size = 7"</th></tr><tr><th>Item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>$N \leq 2$</td></tr><tr><td>Dark Dots</td><td>$N \leq 3$</td></tr><tr><td>Total Bright and Dark Dots</td><td>$N \leq 4$</td></tr></table>	Size = 7"		Item	Qualified Qty	Bright Dots	$N \leq 2$	Dark Dots	$N \leq 3$	Total Bright and Dark Dots	$N \leq 4$					
Size = 7"																
Item	Qualified Qty															
Bright Dots	$N \leq 2$															
Dark Dots	$N \leq 3$															
Total Bright and Dark Dots	$N \leq 4$															

Item	Criterion												
Clear spots	Size $\geq 5''$ <table><tr><th>Average Diameter</th><th>Qualified Qty</th></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>	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		
	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 = 7.0'' <table><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>D ≤ 0.2 mm</td><td>Ignored</td></tr><tr><td>0.2 mm $< D \leq 0.5$ mm</td><td>2</td></tr><tr><td>0.5 mm $< D$</td><td>1</td></tr></table>	Average Diameter	Qualified Qty	D ≤ 0.2 mm	Ignored	0.2 mm $< D \leq 0.5$ mm	2	0.5 mm $< D$	1				
	Average Diameter	Qualified Qty											
	D ≤ 0.2 mm	Ignored											
	0.2 mm $< D \leq 0.5$ mm	2											
	0.5 mm $< D$	1											
Touch panel spots	Size $\geq 5''$ <table><tr><th>Average Diameter</th><th>Qualified Qty</th></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>	Average Diameter	Qualified Qty	D < 0.25 mm	Ignored	0.25 mm $< D < 0.5$ mm	4	0.5 mm $< D$	0				
	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 $\geq 5''$ <table><tr><th>Length</th><th>Width</th><th>Qualified Qty</th></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>	Length	Width	Qualified Qty	-	W < 0.03	Ignored	L < 5.0	0.03 $< W < 0.05$	2	-	0.05 $< W$	0
	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 / 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 °C, 90 %RH, 120 hours	Note 1
6	Thermal Cycling Test (No operation)	-20 °C for 30 min, 70 °C 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.

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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RVT70HSBNWN00

EVE4 IPS 7.0" LCD TFT Datasheet

Rev.0.1

2020-01-18

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

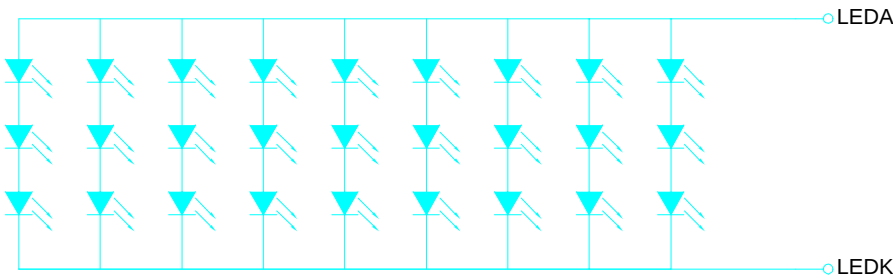
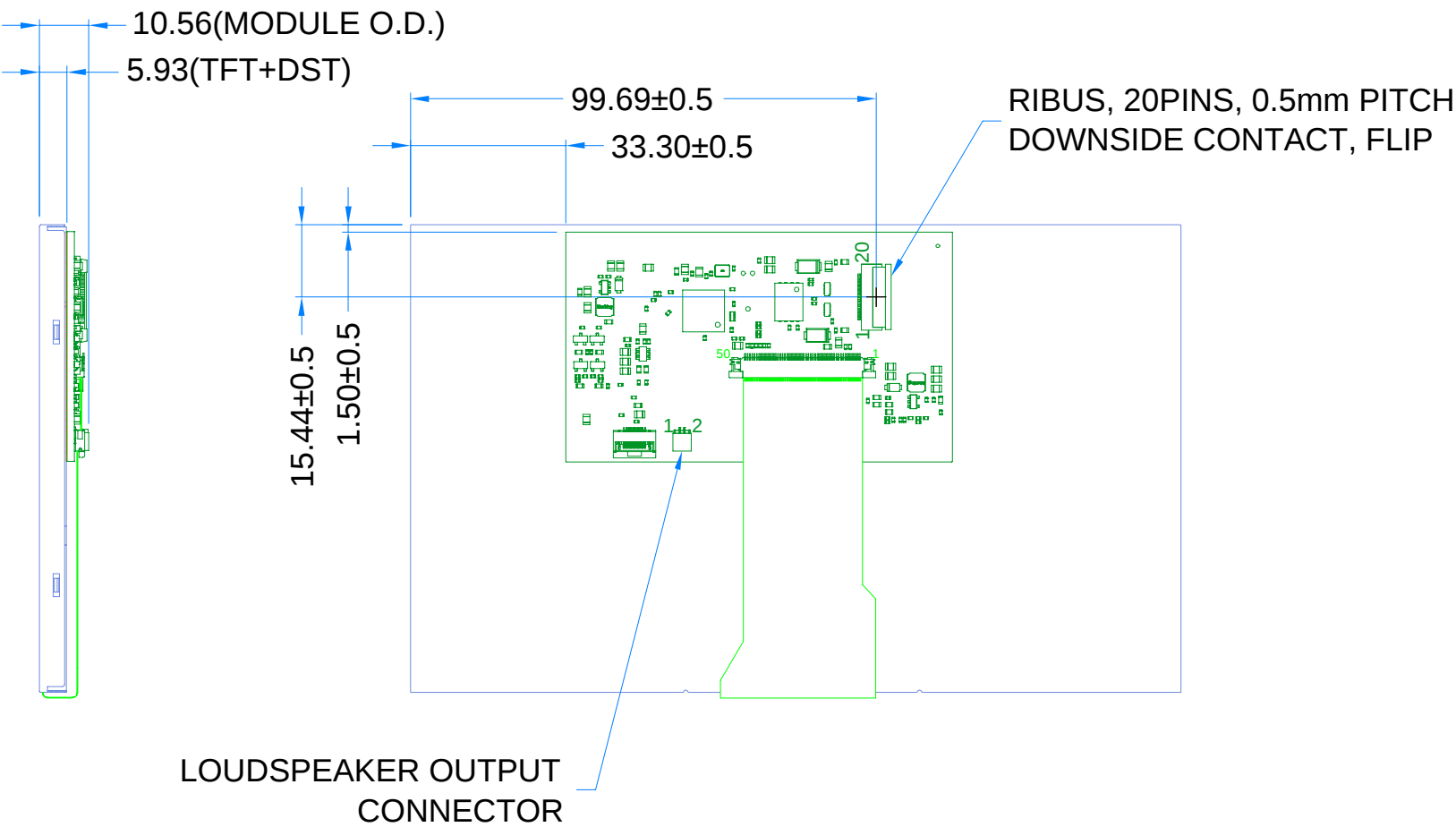
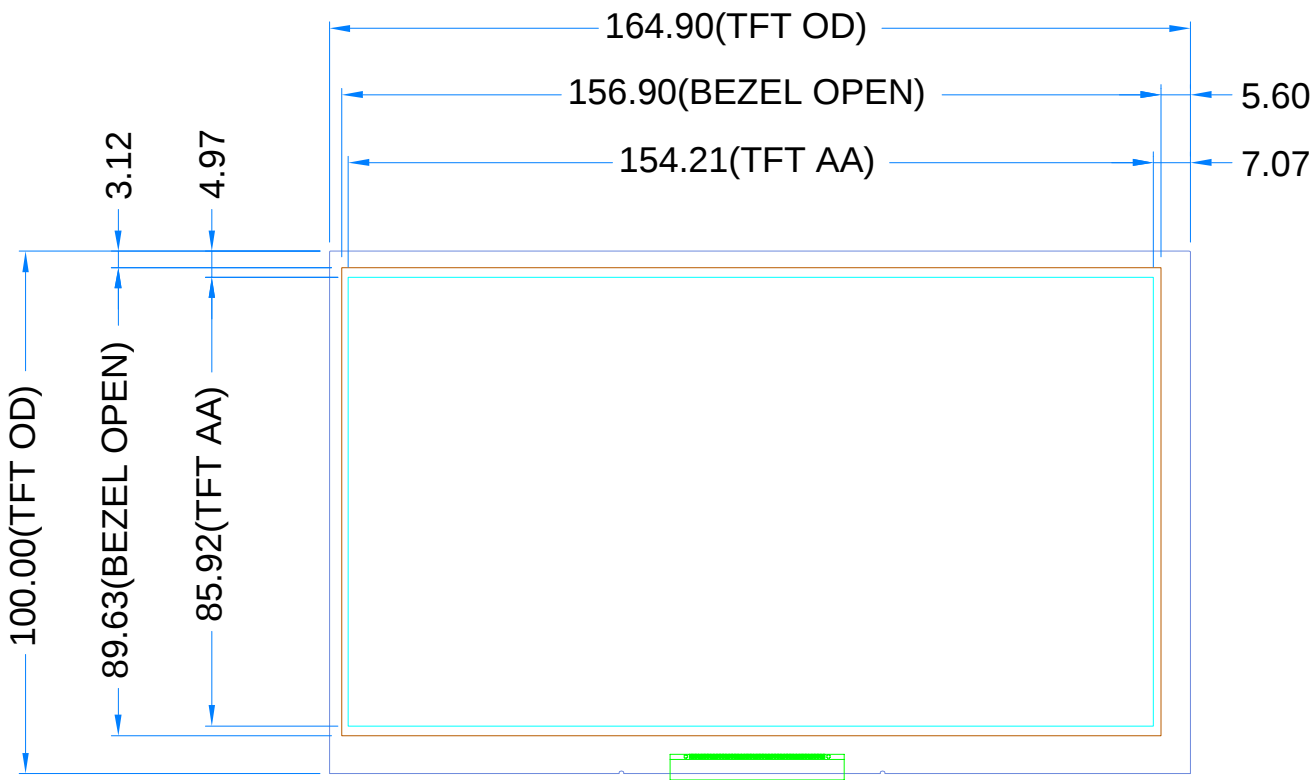
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1 MODULE CLASSIFICATION INFORMATION

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)

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:					
		DRAWN: M.Natywa					
				2020.12.01	1:1.45		
				2020.12.09	[mm]		
						ISO A3	P. 1 of 1

ES France - Département Composants & Modules - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 84 - Fax. 01 47 01 16 22 - e-mail: comp@es-france.com - Site Web: www.es-france.com

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.

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	$\theta=0^\circ$ $\Phi=0^\circ$ 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	$\Phi = 90^\circ$	-	85	-	deg	FIG 4.	6
			$\Phi = 270^\circ$	-	85	-	deg	FIG 4.	
			$\Phi = 0^\circ$	-	85	-	deg	FIG 4.	
			$\Phi = 180^\circ$	-	85	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Red	x	$\theta=0^\circ$ $\Phi=0^\circ$ 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.

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

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 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 (x, y) chromaticity the test data is based on TOPCON's BM-5 photo detector.

Figure 2. The definition of response time

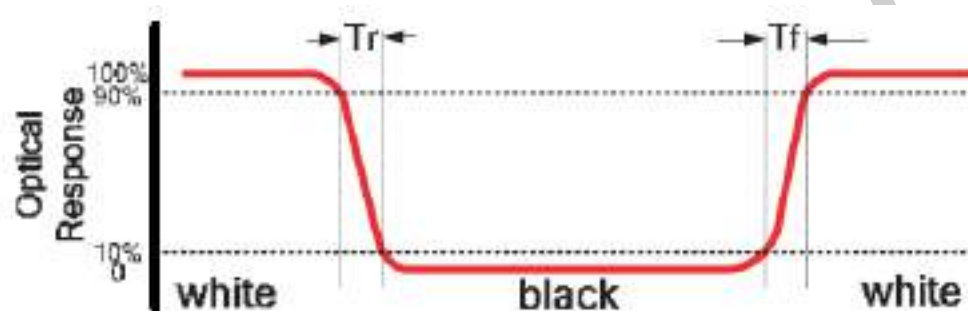


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

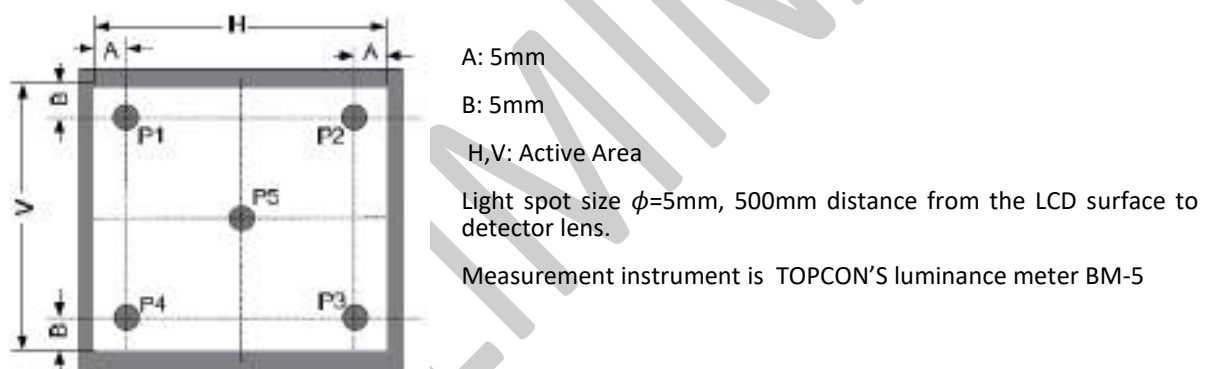
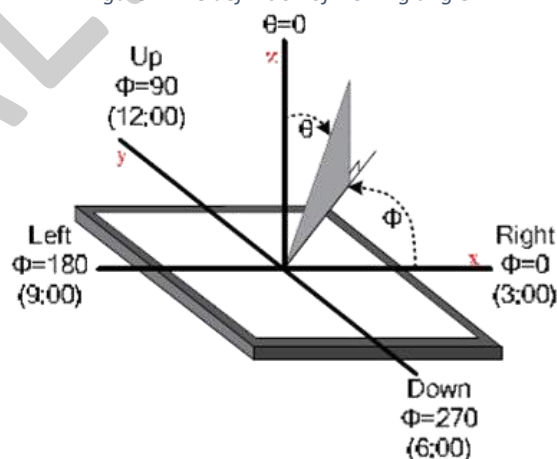


Figure 4. The definition of viewing angle



7 INTERFACES DESCRIPTION

7.1 P1 connector 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

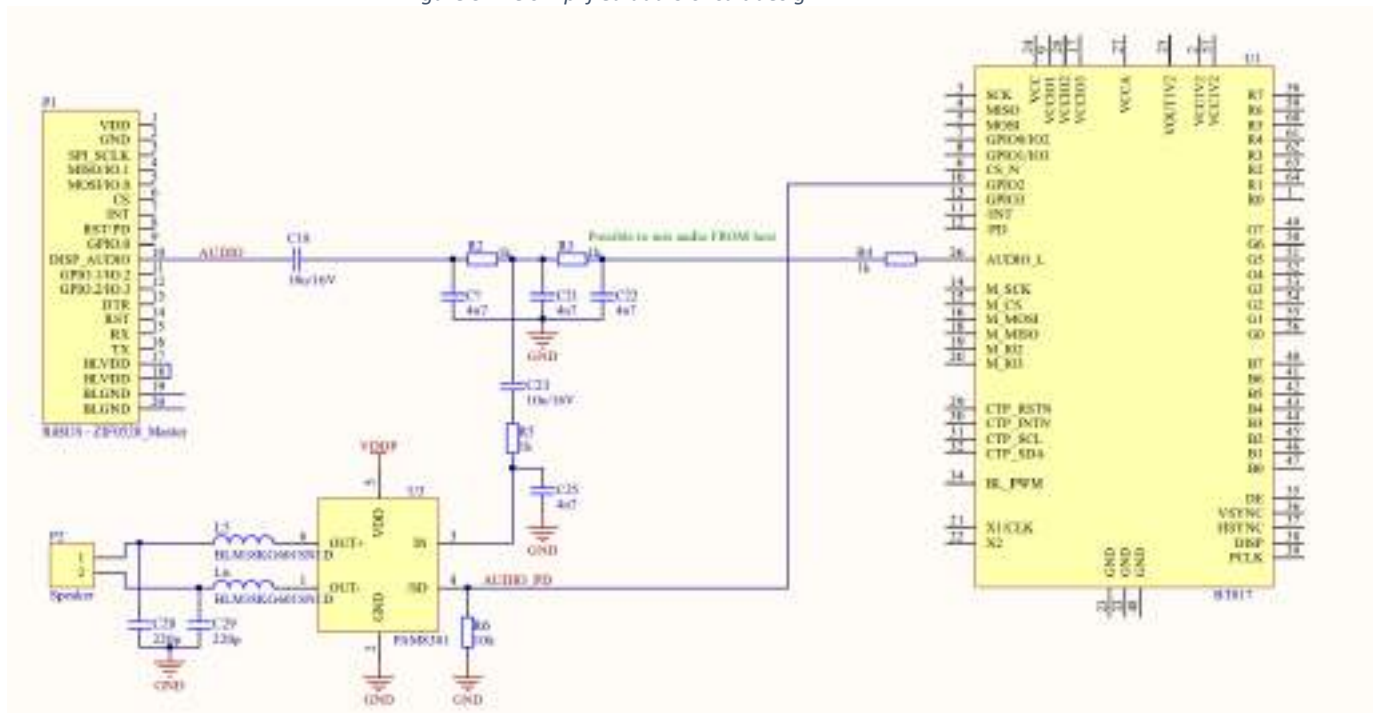
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil “+” terminal	Note 1
2	SPEAKER -	Speaker coil “-” terminal	

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.

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

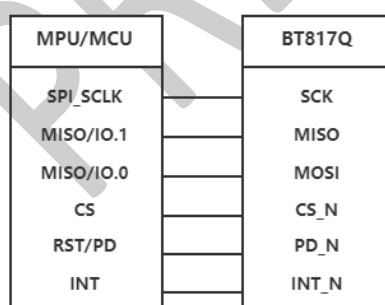
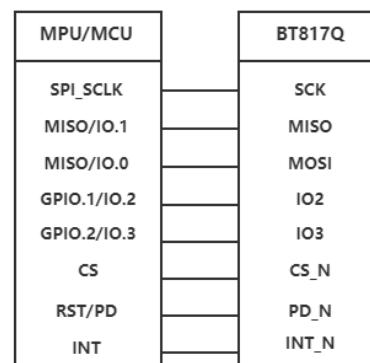


Figure 7. QSPI interface connection



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

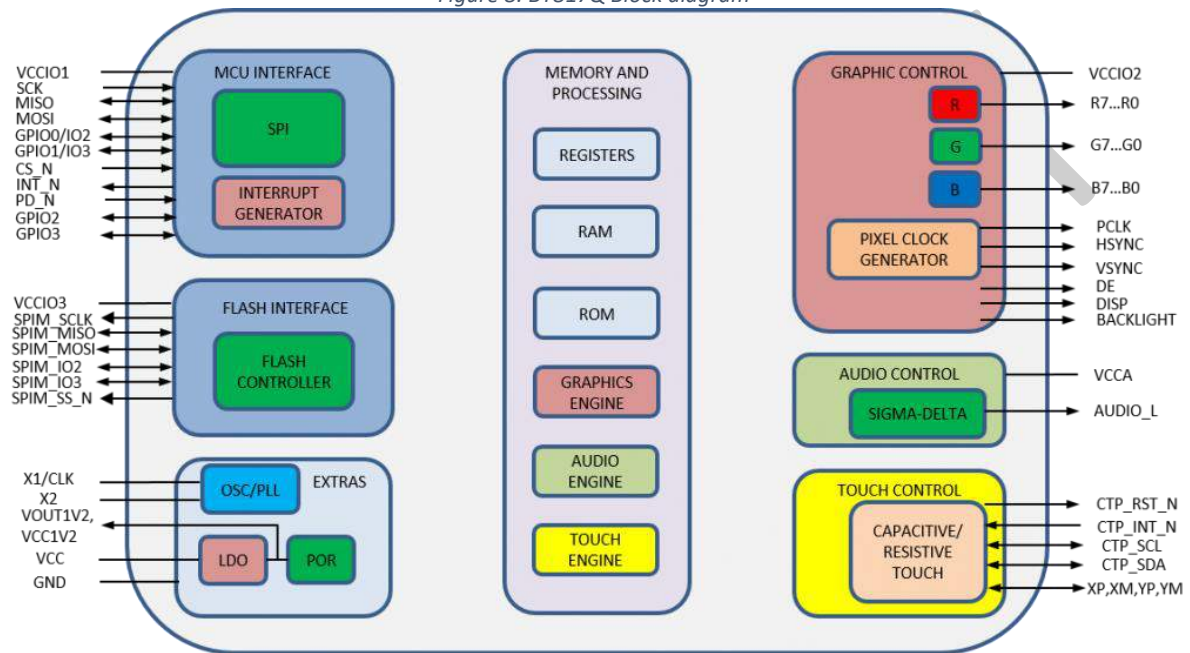
Only SPI mode 0 is supported. The SPI interface is selected by default.

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.

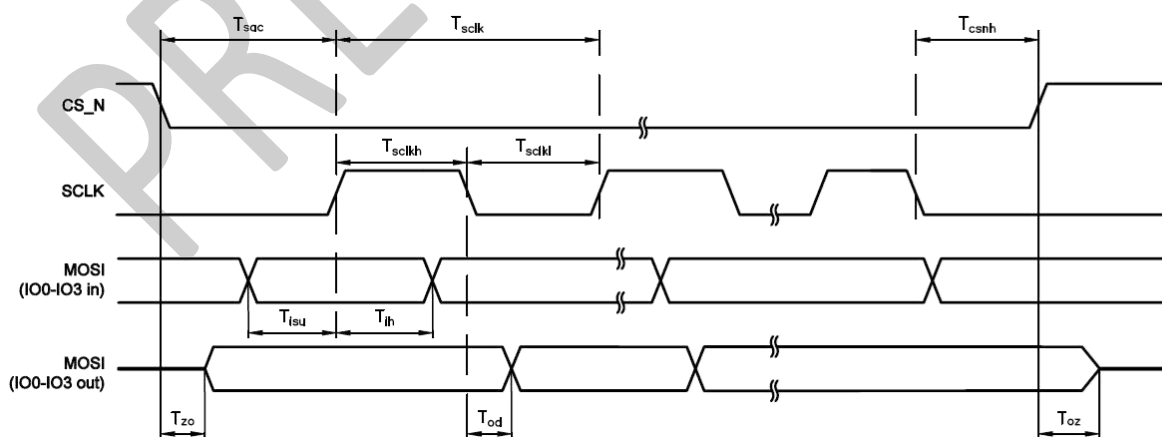
8.2 Block Diagram

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.

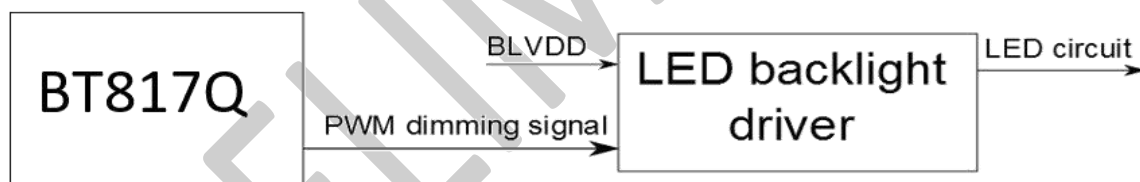
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

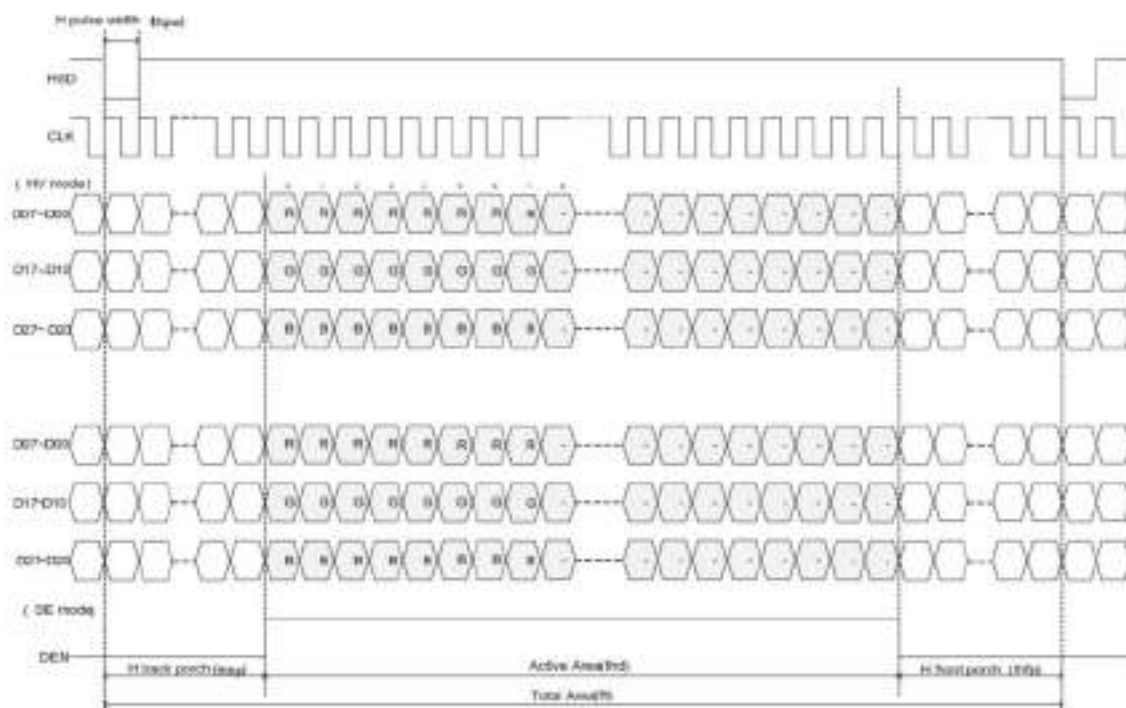
Figure 10. Backlight driver block diagram



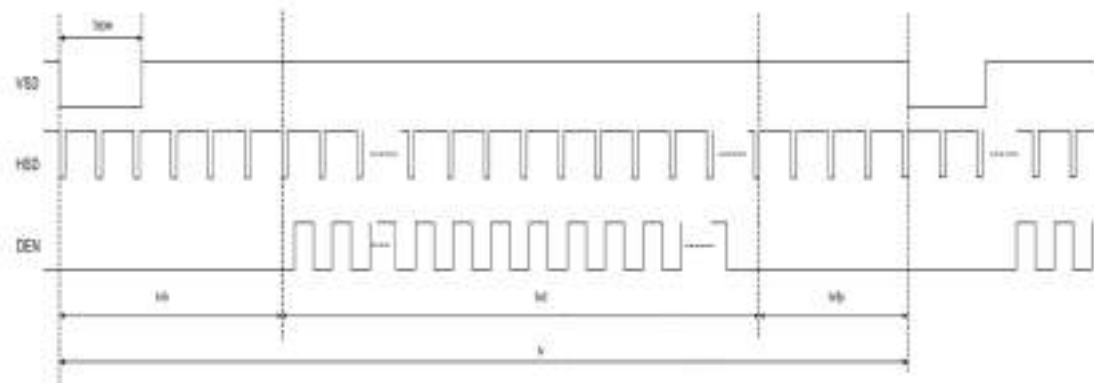
The LED backlight driver used in this module does not burst the LED current. Therefore, it does not generate audible noises on the output capacitor. It is equipped with soft start subsystem, which increases LED life time, as LED current peaks are reduced significantly.

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
VSNC period time	t_v	610	635	800	H
VSNC 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
VSNC period time	t_v	624	635	750	H
VSNC pulse width	t_{vpw}	1	-	20	H
VSNC back porch	t_{vb}	23	23	23	H
VSNC front porch	t_{vfp}	1	12	127	H

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:

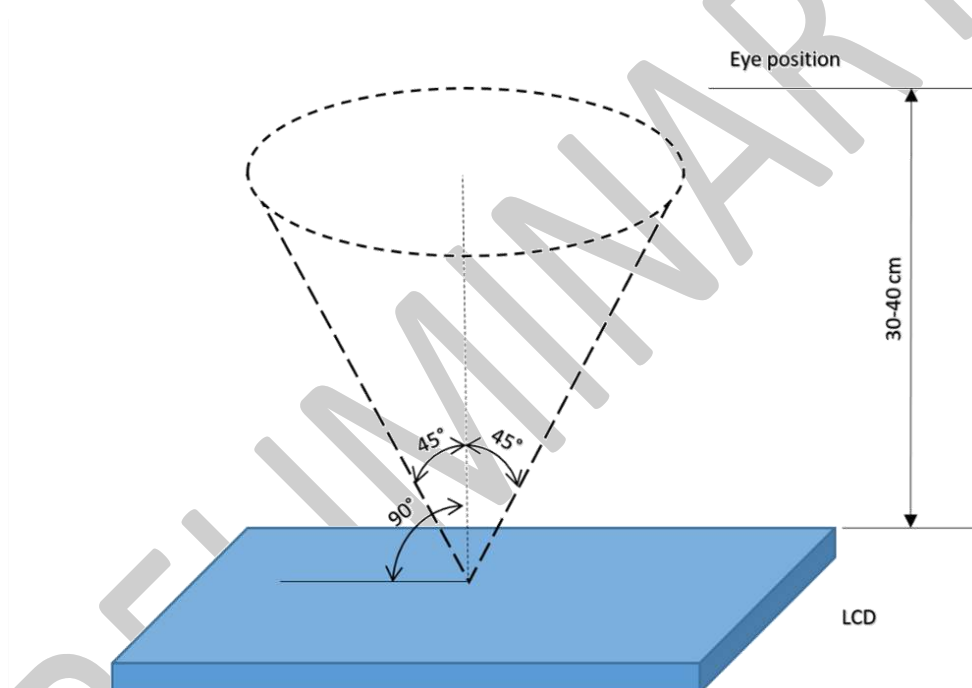
- Temperature: 25 ± 2 °C
- Humidity: (60 ± 10) %RH
- Illumination: Single fluorescent lamp, non-directive (300 to 700 lux)

Viewing distance:

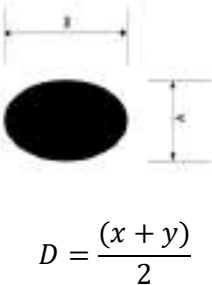
35 $\pm$ 5 cm between inspector bare eye and LCD.

Viewing Angle:

U/D: 45°/45°, L/R: 45°/45°



11.2 Inspection standard

Item	Criterion															
Black spots, white spots, light leakage, Foreign Particle (round Type)	$D = \frac{(x + y)}{2}$ *Spots density: 10 mm <table><tr><th colspan="2">Size = 7"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>$D \leq 0.2 \text{ mm}$</td><td>Ignored</td></tr><tr><td>$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$</td><td>$N \leq 3$</td></tr><tr><td>$0.5 \text{ mm} < D$</td><td>Not allowed</td></tr></table>	Size = 7"		Average Diameter	Qualified Qty	$D \leq 0.2 \text{ mm}$	Ignored	$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$	$N \leq 3$	$0.5 \text{ mm} < D$	Not allowed					
Size = 7"																
Average Diameter	Qualified Qty															
$D \leq 0.2 \text{ mm}$	Ignored															
$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$	$N \leq 3$															
$0.5 \text{ mm} < D$	Not allowed															
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <table><tr><th colspan="3">Size = 7"</th></tr><tr><th>Length</th><th>Width</th><th>Qualified Qty</th></tr><tr><td>-</td><td>$W \leq 0.05$</td><td>Ignored</td></tr><tr><td>$L \leq 5.0$</td><td>$0.05 < W \leq 0.1$</td><td>3</td></tr><tr><td>$5.0 < L$</td><td>$0.10 < W$</td><td>Not allowed</td></tr></table>	Size = 7"			Length	Width	Qualified Qty	-	$W \leq 0.05$	Ignored	$L \leq 5.0$	$0.05 < W \leq 0.1$	3	$5.0 < L$	$0.10 < W$	Not allowed
Size = 7"																
Length	Width	Qualified Qty														
-	$W \leq 0.05$	Ignored														
$L \leq 5.0$	$0.05 < W \leq 0.1$	3														
$5.0 < L$	$0.10 < W$	Not allowed														
Bright/Dark Dots	<table><tr><th colspan="2">Size = 7"</th></tr><tr><th>Item</th><th>Qualified Qty</th></tr><tr><td>Bright Dots</td><td>$N \leq 2$</td></tr><tr><td>Dark Dots</td><td>$N \leq 3$</td></tr><tr><td>Total Bright and Dark Dots</td><td>$N \leq 4$</td></tr></table>	Size = 7"		Item	Qualified Qty	Bright Dots	$N \leq 2$	Dark Dots	$N \leq 3$	Total Bright and Dark Dots	$N \leq 4$					
Size = 7"																
Item	Qualified Qty															
Bright Dots	$N \leq 2$															
Dark Dots	$N \leq 3$															
Total Bright and Dark Dots	$N \leq 4$															

Item	Criterion
Clear spots	Size $\geq 5''$
	Average Diameter
	Qualified Qty
	$D < 0.2 \text{ mm}$
	Ignored
	$0.2 \text{ mm} < D < 0.3 \text{ mm}$
Polarizer bubbles	4
	$0.3 \text{ mm} < D < 0.5 \text{ mm}$
	2
	$0.5 \text{ mm} < D$
	0
	*Spots density: 10 mm
Polarizer bubbles	Size = 7.0''
	Average Diameter
	Qualified Qty
	$D \leq 0.2 \text{ mm}$
	Ignored
	$0.2 \text{ mm} < D \leq 0.5 \text{ mm}$
	2
	$0.5 \text{ mm} < D$
	1

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

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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RVT101HVBNC00-B

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	850	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	7.0 ÷ 12.0	V
Bonding technology	Optical Bonding	/
Weight	260	g

Note 1: RoHS compliant

Note 2: LCM weight tolerance: ± 5%.

REVISION RECORD

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

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1 MODULE CLASSIFICATION INFORMATION

RV	T	101	H	V	B	N	W	C	00	B
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.

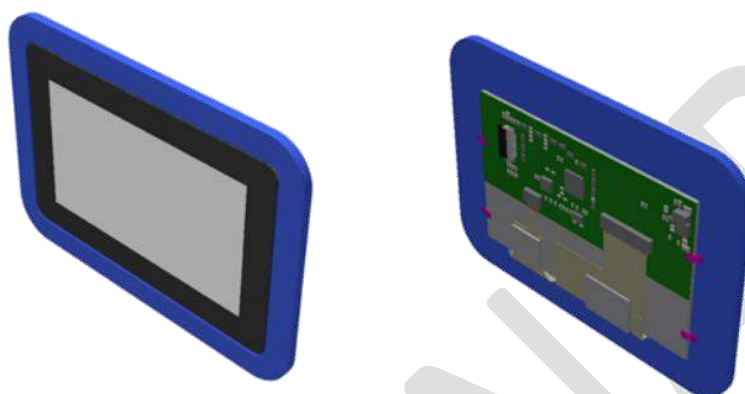
1.	BRAND	RV – Riverdi
2.	PRODUCT TYPE	T – TFT Standard
3.	DISPLAY SIZE	101 – 10.1"
4.	MODEL SERIAL NO.	H – High Brightness, IPS
5.	RESOLUTION	V – 1280 x 800 px
6.	INTERFACE	B – SPI/QSPI
7.	FRAME	N – No Frame
8.	BACKLIGHT TYPE	W – LED White
9.	TOUCH PANEL	C – With Touch Panel
10.	VERSION	00 – (00-99)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

2 UxTOUCH ASSEMBLY

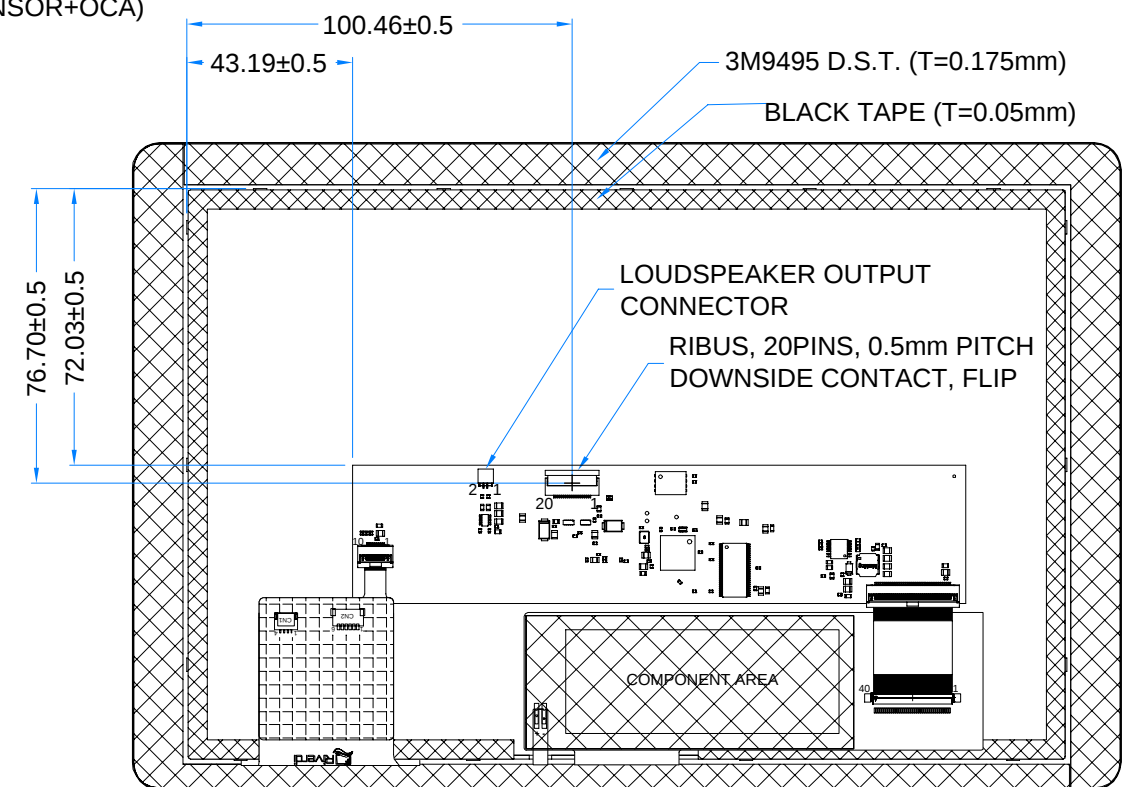
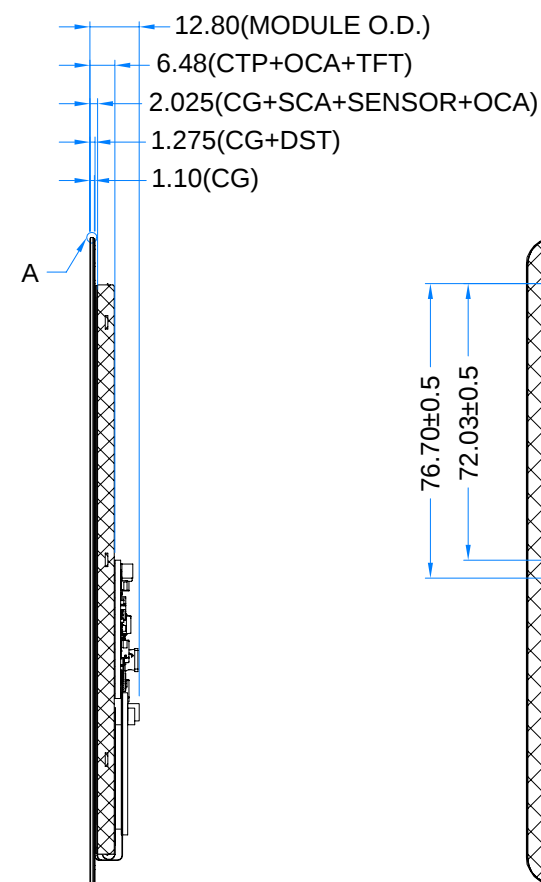
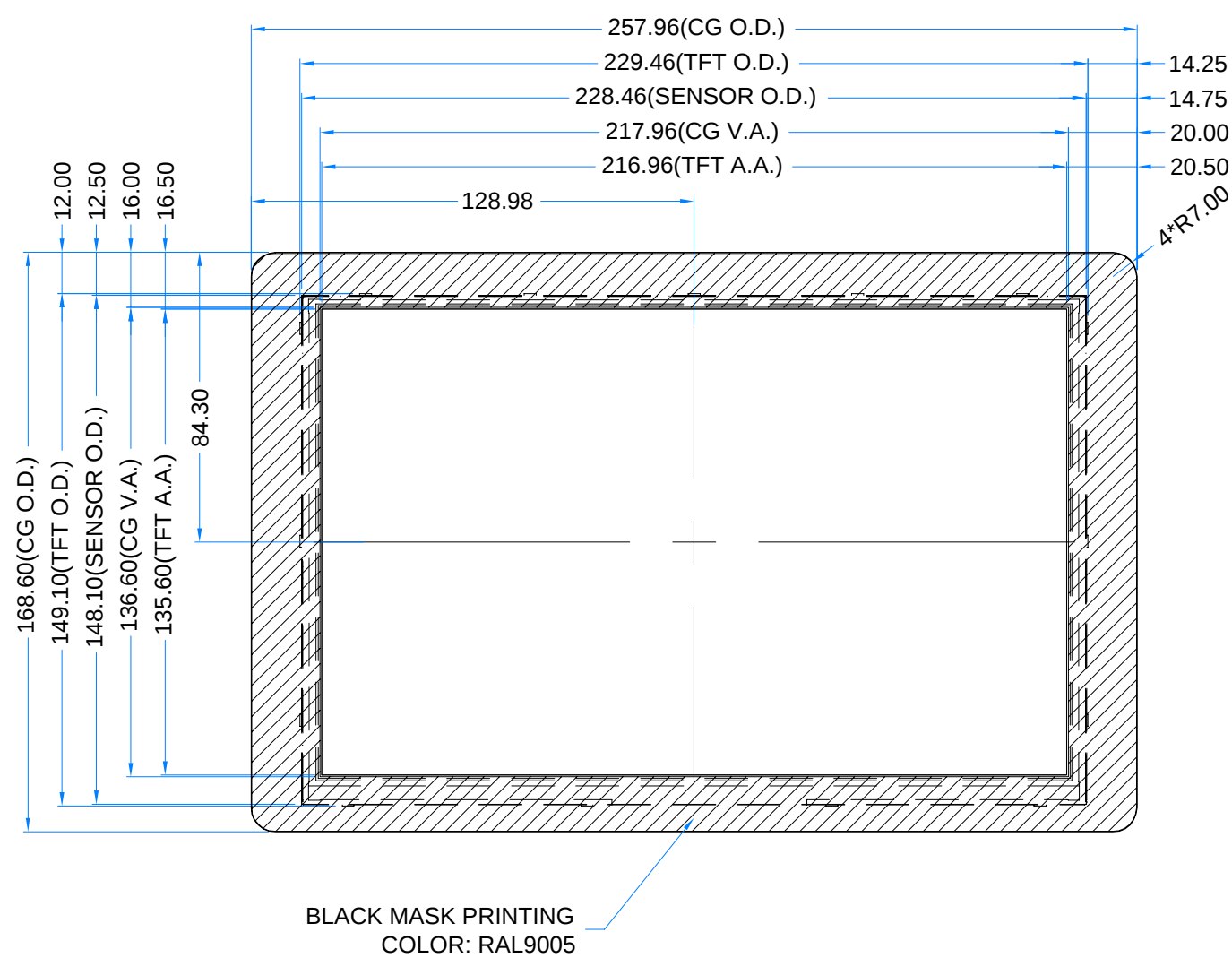
UxTouch are LCD TFT displays with specially designed projected capacitive touch panels. UxTouch display can be mounted without any additional holes in the housing. Our standard UxTouch displays include double-sided adhesive tape (DST) to stick TFT easily to the housing.

UxTouch models with double-side adhesive tape can be mounted by fastening the glass to the housing.

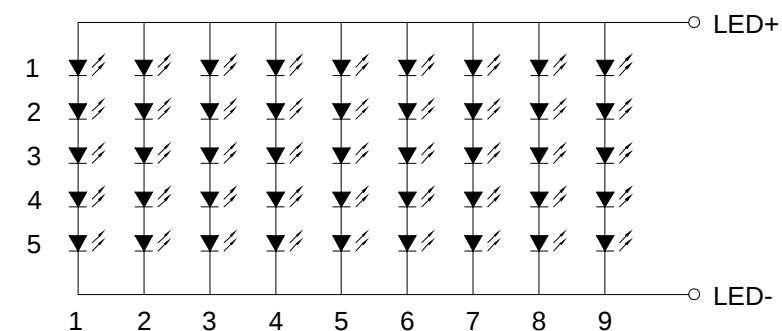
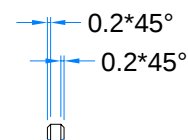
Figure 1. General view of the module



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: 1280x800
3. VIEWING ANGLE: FREE
4. SURFACE LUMINANCE: 850 cd/m²
5. DRIVING IC ON THE BOARD: BT817Q
6. INTERFACE: SPI/QSPI
7. SUPPLY VOLTAGE FOR MODULE: 3.3 V
8. SUPPLY VOLTAGE FOR BACKLIGHT: 7.0 ÷ 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 PIXELS FOR TFT
2. OPTICAL BONDING
3. OPERATING TEMPERATURE: -20°C ~ 70°C
4. STORAGE TEMPERATURE: -30°C ~ 80°C
5. WITHOUT INDIVIDUAL TOLERANCE: ±0.3mm
6. RoHS3 COMPLIANT

PN: RVT101HVBNC00-B

SN:

DRAWN: M.Natywa



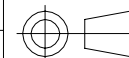
2020.11.26

2020.12.09

1:1.97

[mm]

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	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 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.

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=3.3 V}	TBD	1367	TBD	mA	
Current drawn from BLVDD@7.0V	I _{BLVDD=5.0 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	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	-	25	35	ms	FIG 2.	4
Contrast Ratio	Cr		800	1000	-	---	FIG 3.	1
Luminance Uniformity	δ WHITE		-	75	-	%	FIG 3.	3
Surface Luminance	Lv		-	850	-	cd/m ²	FIG 3.	2
Viewing Angle Range	θ	$\phi = 90^\circ$	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 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

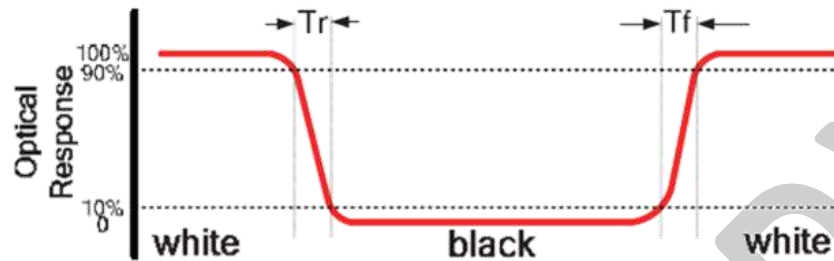


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

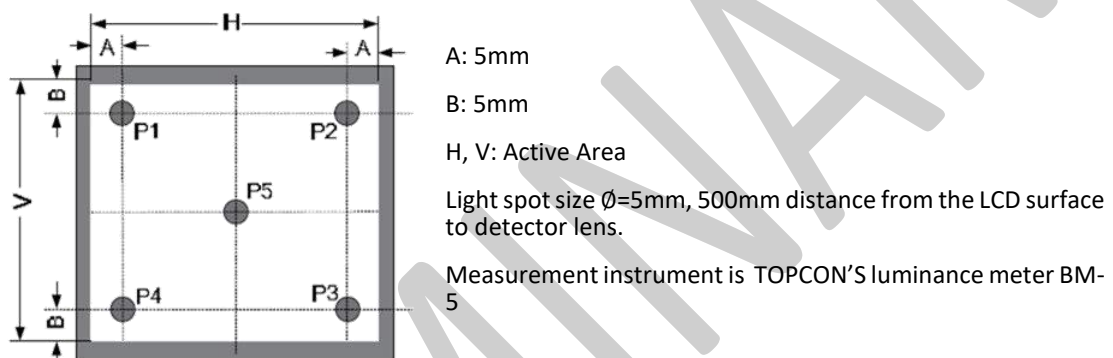
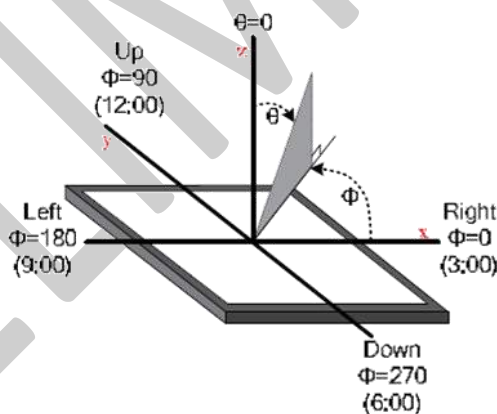


Figure 4. The definition of viewing angle



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

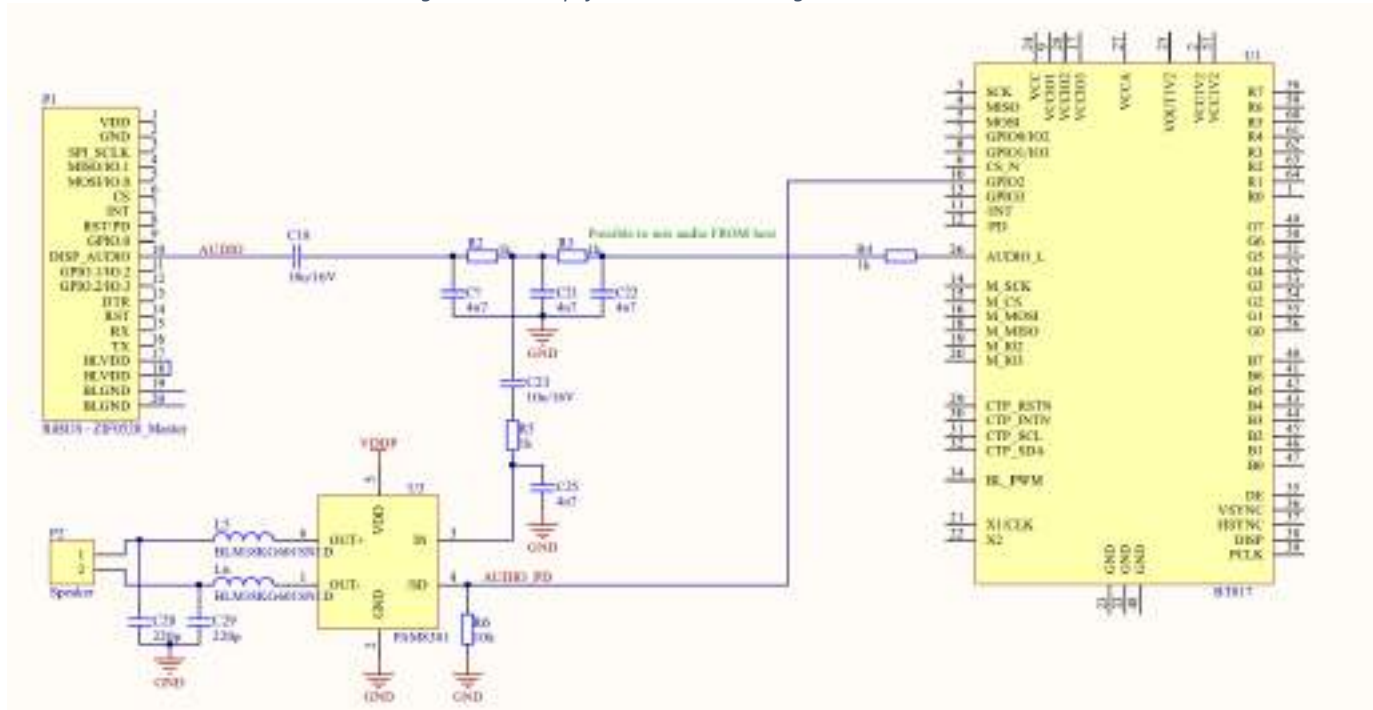
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil "+" terminal	Note 1
2	SPEAKER -	Speaker coil "-" terminal	

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 RVT101HVBNC00 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

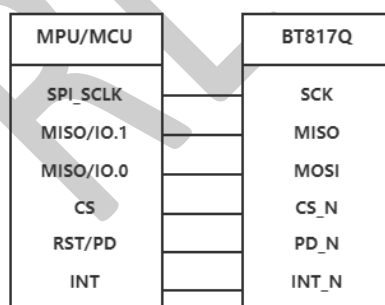
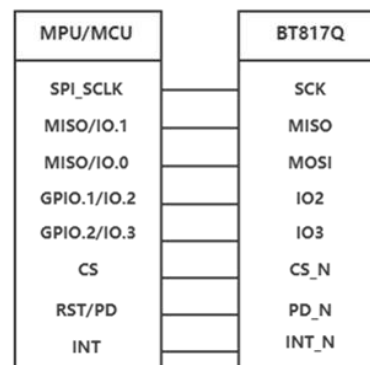


Figure 7. QSPI interface connection



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.

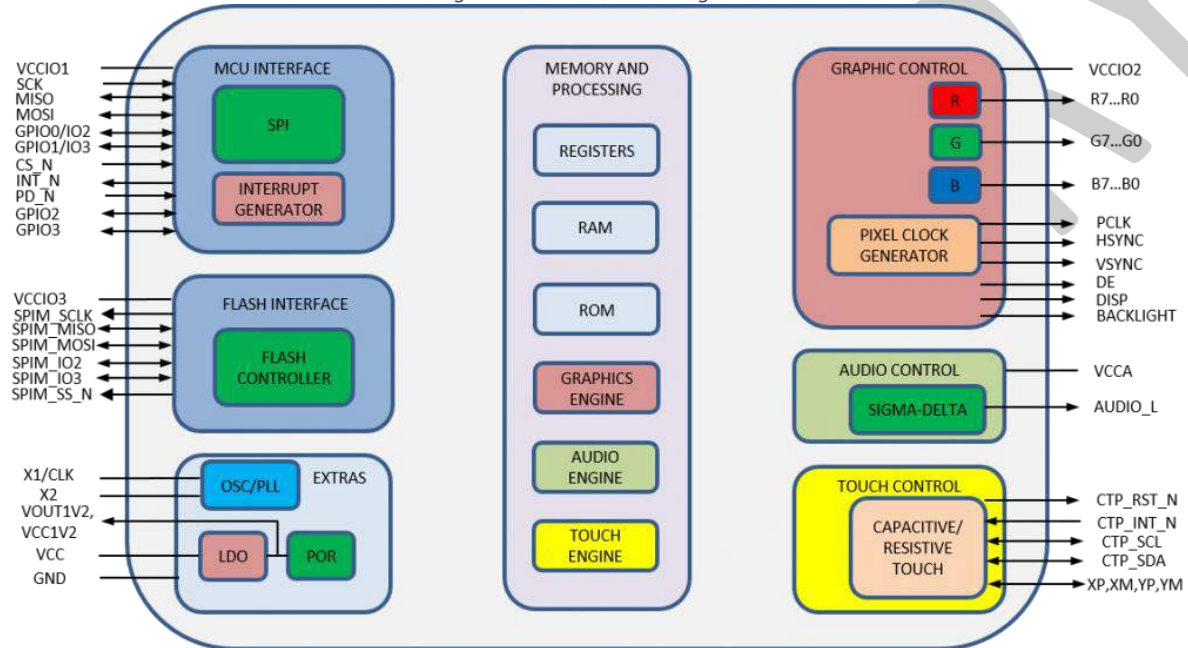
QSPI Interface – the QSPI slave interface operates up to 30MHz (It depends on EVE 4 system clock frequency and will be verified in Riverdi lab). Only SPI mode 0 is supported.

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.

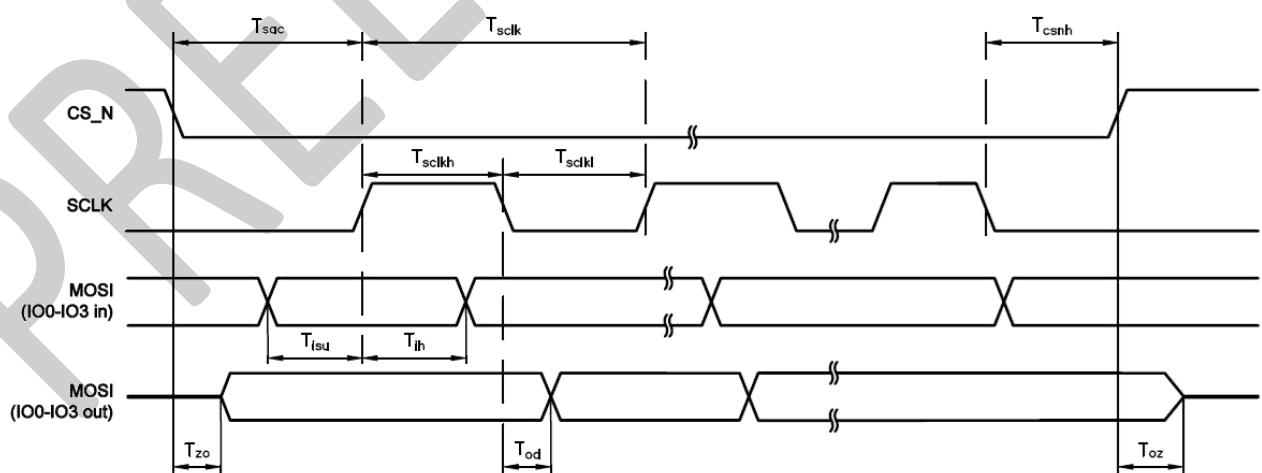
9.2 Block Diagram

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.

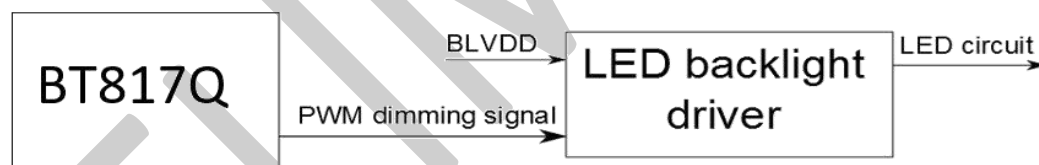
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

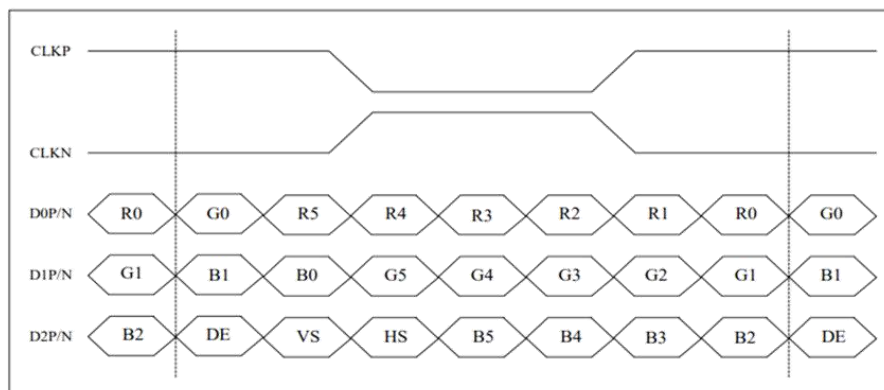


The LED backlight driver used in this module does not burst the LED current. Therefore, it does not generate audible noises on the output capacitor. It is equipped with soft start subsystem, which increases LED life time, as LED current peaks are reduced significantly.

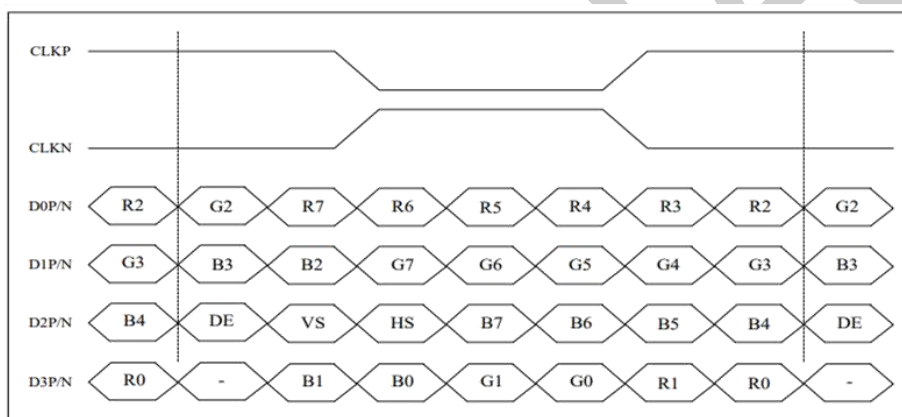
10 TIMING CHARACTERISTICS

10.1 LVDS interface characteristic

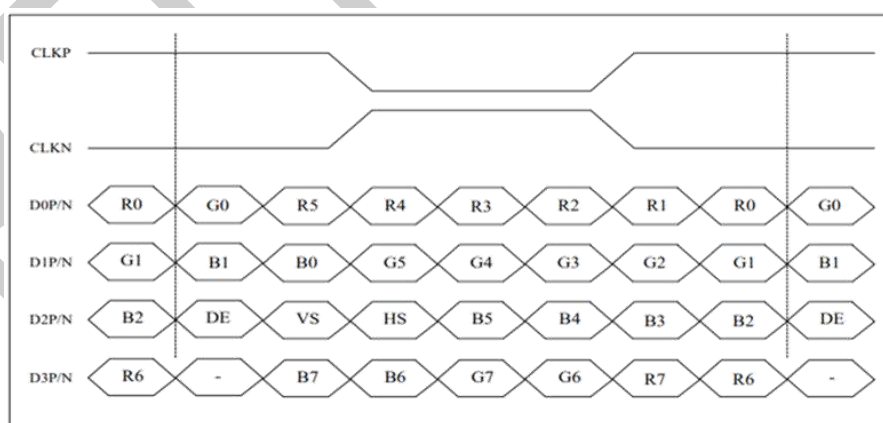
6-bit LVDS input (LVBIT=L, LVFMT=H OR L)



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 Pulse Width	T _{HPW}	1	-	40	Tc
Hsync Back Porch (with pulse width)	T _{HBP}	88	88	88	DCLK
Hsync Front Porch	T _{HFP}	12	72	132	DCLK
VSNC Period Time	T _V	824	838	872	H
Vertical Display area	T _{VD}	800			H
Vsync Pulse Width	T _{VW}	1	-	20	H
Vsync Back Porch (with pulse 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:

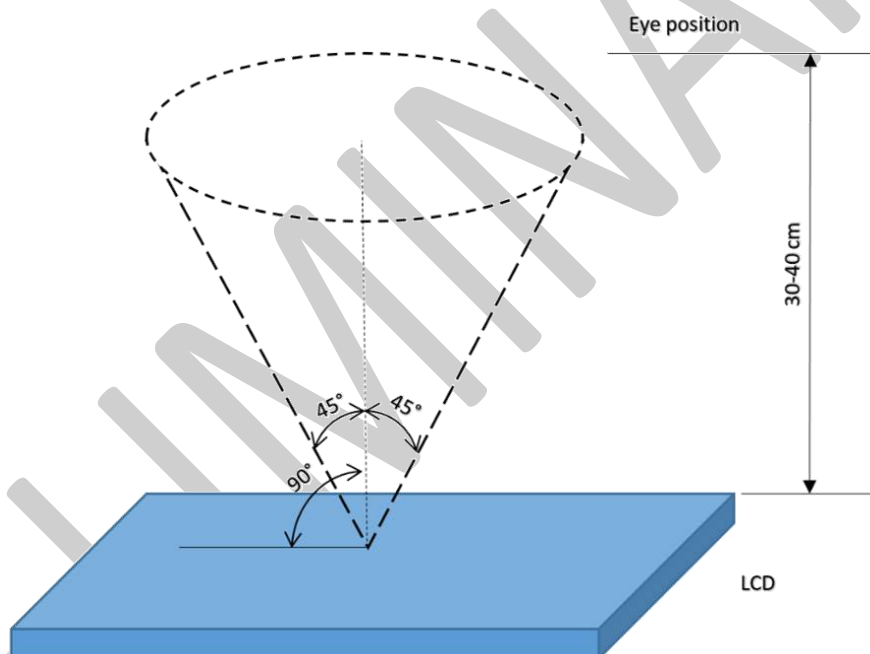
- Temperature: $25 \pm 2^{\circ}\text{C}$
- Humidity: $(60 \pm 10)\% \text{ RH}$
- Illumination: Single fluorescent lamp non-directive (300 to 700 lux)

Viewing distance:

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

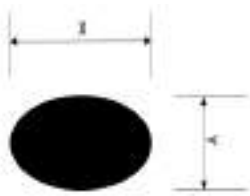
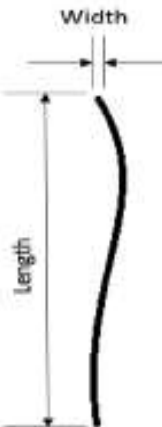
Viewing Angle:

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



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><th colspan="2">Size = 10.1"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></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>	Size = 10.1"		Average Diameter	Qualified Qty	D ≤ 0.2 mm	Ignored	0.2 mm < D ≤ 0.3 mm	N ≤ 4	0.5mm < D	N = 0					
Size = 10.1"																
Average Diameter	Qualified Qty															
D ≤ 0.2 mm	Ignored															
0.2 mm < D ≤ 0.3 mm	N ≤ 4															
0.5mm < D	N = 0															
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <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>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>	Size = 10.1"			Length	Width	Qualified Qty	-	W ≤ 0.05	Ignored	L ≤ 5.0	0.05 < W ≤ 0.1	N ≤ 3	5.0 < L	0.10 < W or 5.0 < L	N = 0
Size = 10.1"																
Length	Width	Qualified Qty														
-	W ≤ 0.05	Ignored														
L ≤ 5.0	0.05 < W ≤ 0.1	N ≤ 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															

Item	Criterion
Clear spots	Size $\geq 5''$
	Average Diameter
	D < 0.2 mm
	0.2 mm < D < 0.3 mm
	0.3 mm < D < 0.5 mm
	0.5 mm < D
*Spots density: 10 mm	
Touch panel spot	Size $\geq 5''$
	Average Diameter
	D < 0.25 mm
	0.25 mm < D < 0.5 mm
	0.5 mm < D
Touch panel white line Scratch	Size $\geq 5''$
	Length
	Width
	Qualified Qty
	-
	L < 5.0
	0.03 < W < 0.05
	0.05 < W

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	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.

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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RVT101HVBNC00

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	

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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

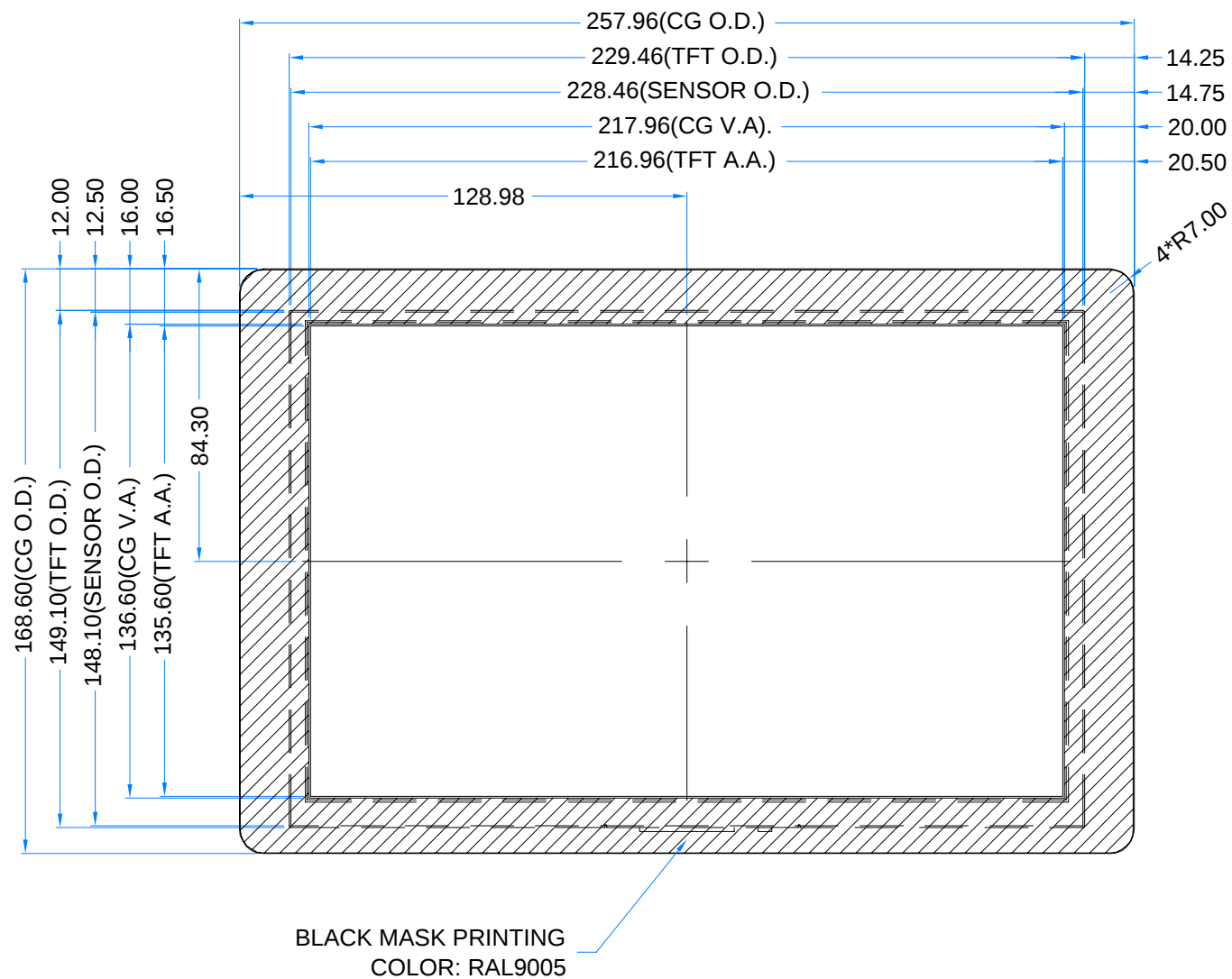
UxTouch are LCD TFT displays with specially designed projected capacitive touch panels. UxTouch display can be mounted without any additional holes in the housing. Our standard UxTouch displays include double-sided adhesive tape (DST) to stick TFT easily to the housing.

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 RVT101HVBNC00-B, which is superior in optical performance and does not require any extra support.

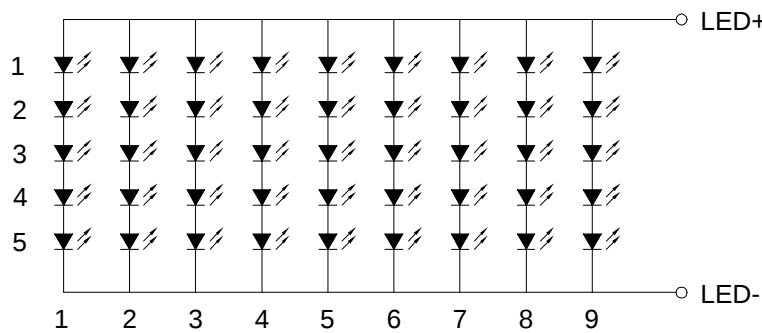
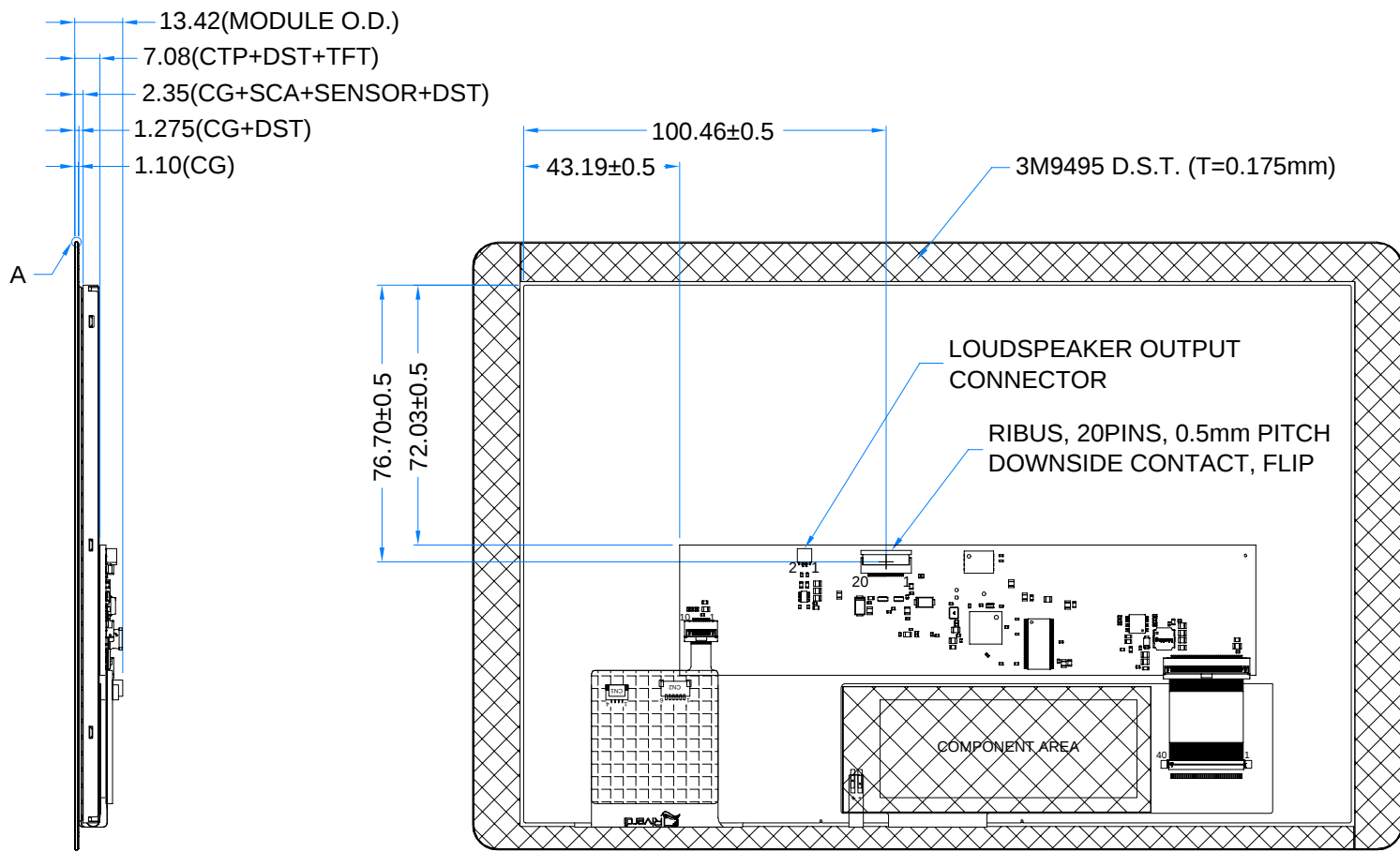
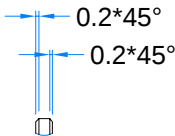
Figure 1. Example of using the support brackets



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: 1280x800
3. VIEWING ANGLE: FREE
4. SURFACE LUMINANCE: 800 cd/m²
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 PIXEL 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: RVT101HVBNC00

SN:

DRAWN: M.Natywa



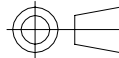
2020.11.26

1:1.97

2020.12.09

[mm]

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	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 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.

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=5.0V}	TBD	1367	TBD	mA	
Current drawn from BLVDD@7.0V	I _{BLVDD=7.0V}	TBD	858	TBD	mA	
Current drawn from BLVDD @9.0V	I _{BLVDD=9.0V}	TBD	667	TBD	mA	
Current drawn from BLVDD@12.0V	I _{BLVDD=12.0V}	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	$\theta=0^\circ$ $\phi=0^\circ$ $T_a=25^\circ\text{C}$	-	25	35	ms	FIG 2.	4
Contrast Ratio	Cr		800	1000	-	---	FIG 3.	1
Luminance Uniformity	δ WHITE		-	75	-	%	FIG 3.	3
Surface Luminance	Lv		-	800	-	cd/m ²	FIG 3.	2
Viewing Angle Range	θ	$\phi = 90^\circ$	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 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

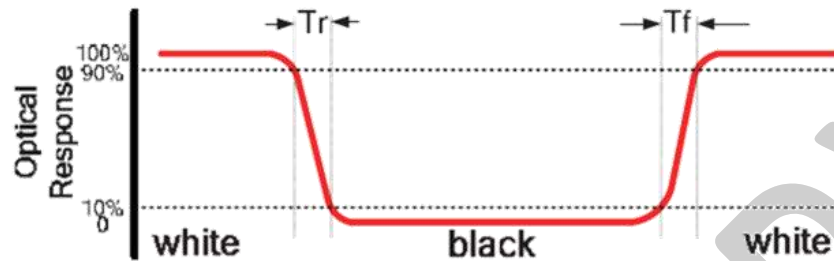
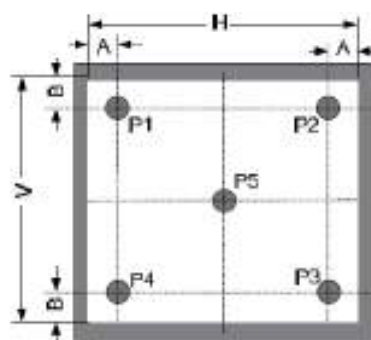


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

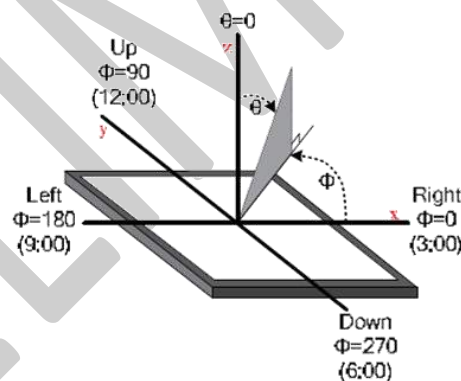
B: 5mm

H, V: Active Area

Light spot size $\varnothing=5\text{mm}$, 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

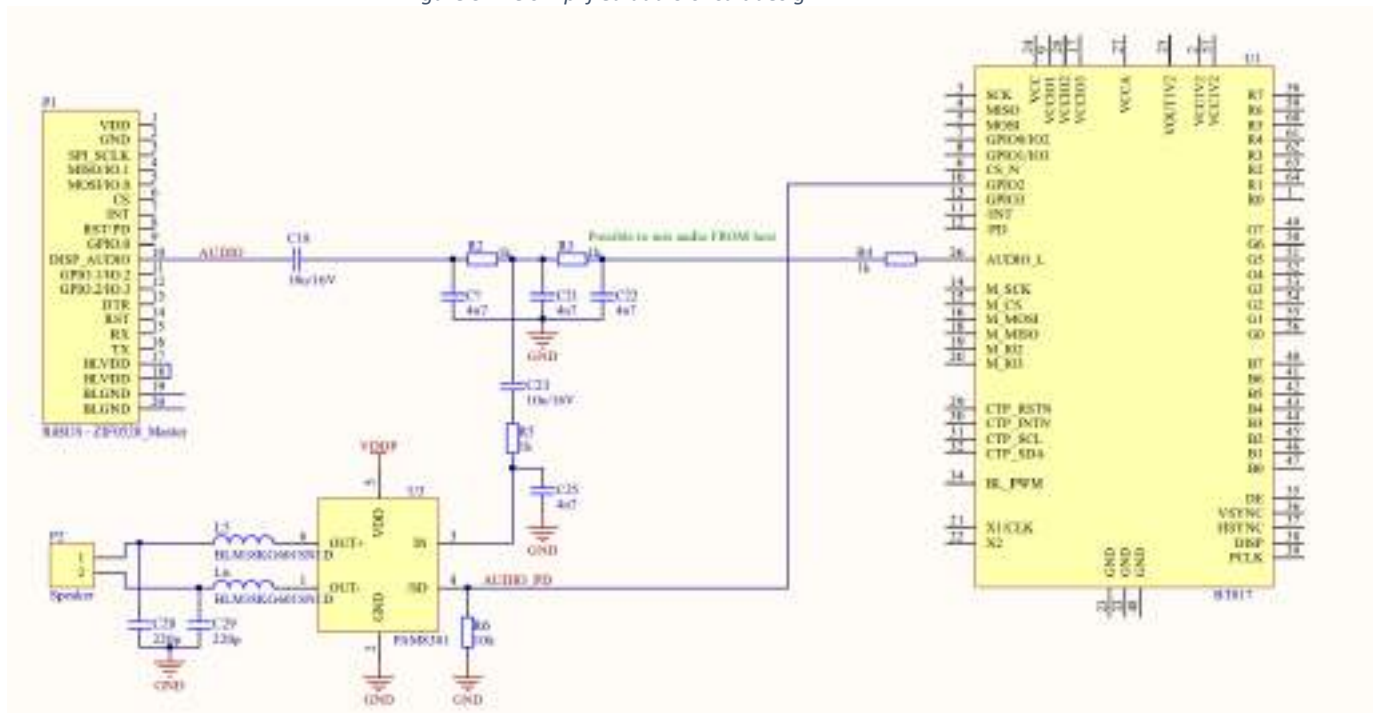
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil "+" terminal	Note 1
2	SPEAKER -	Speaker coil "-" terminal	

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 RVT101HVBNC00 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

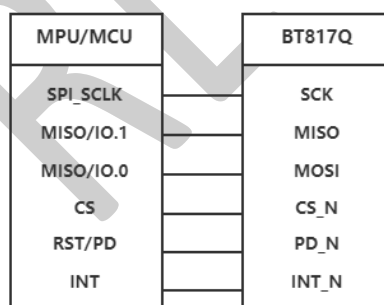
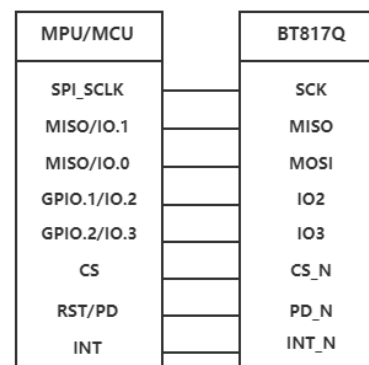


Figure 7. QSPI interface connection



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.

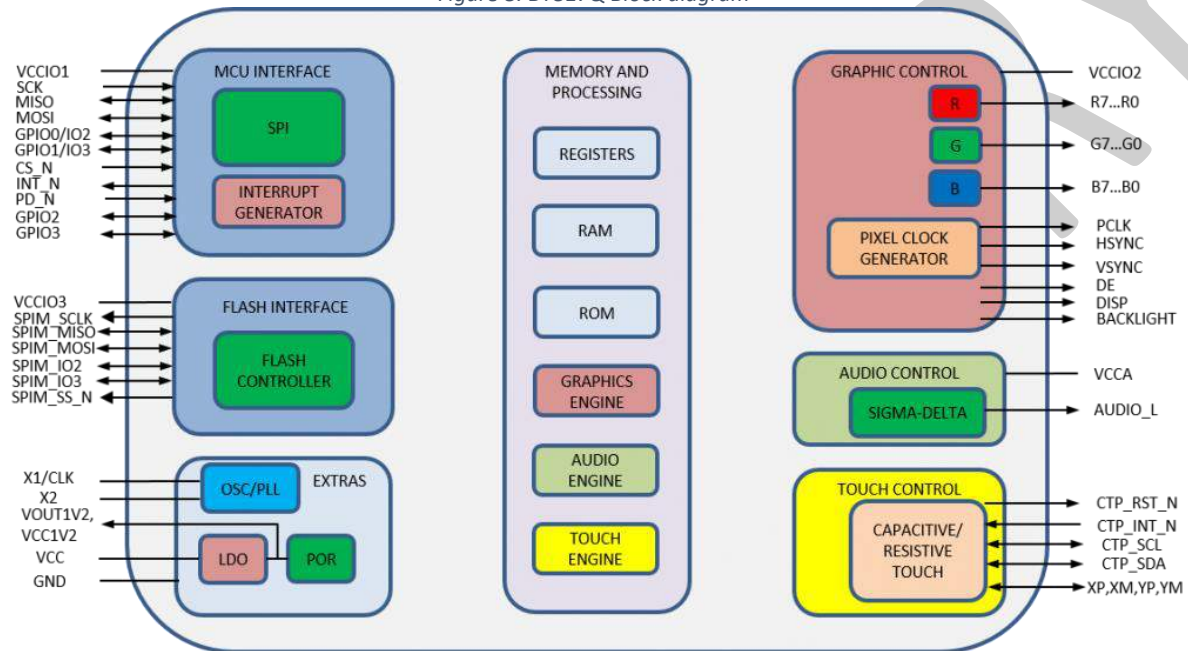
QSPI Interface – the QSPI slave interface operates up to 30MHz (It depends on EVE 4 system clock frequency and will be verified in Riverdi lab). Only SPI mode 0 is supported.

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.

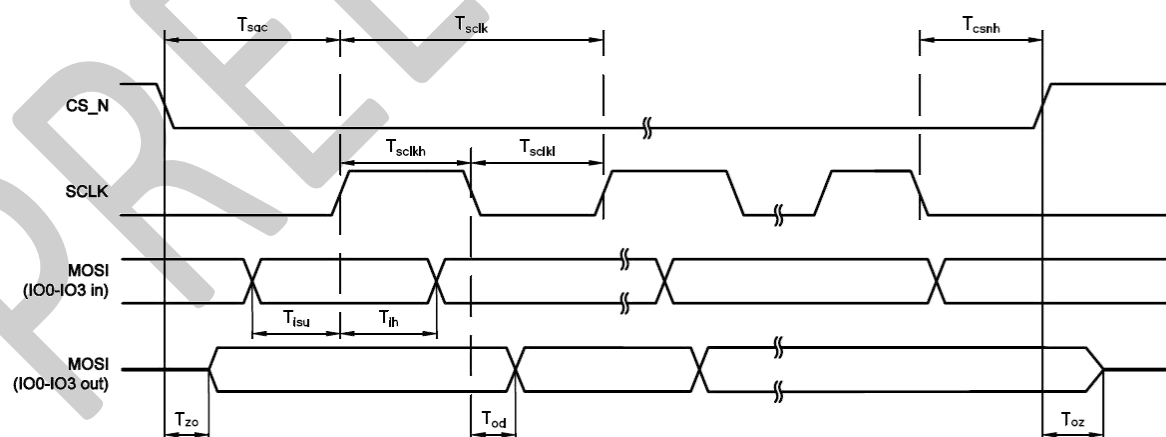
9.2 Block Diagram

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.

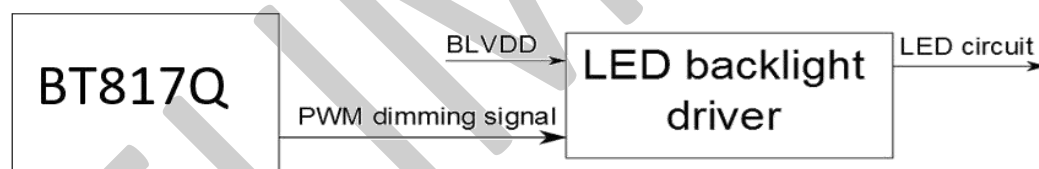
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

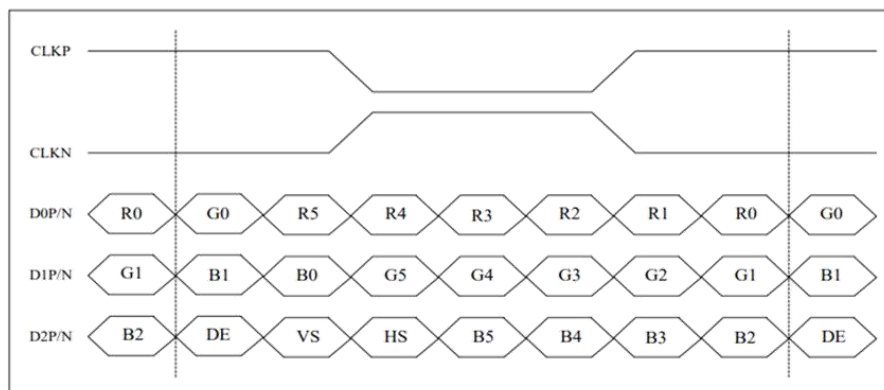


The LED backlight driver used in this module does not burst the LED current. Therefore, it does not generate audible noises on the output capacitor. It is equipped with soft start subsystem, which increases LED life time, as LED current peaks are reduced significantly.

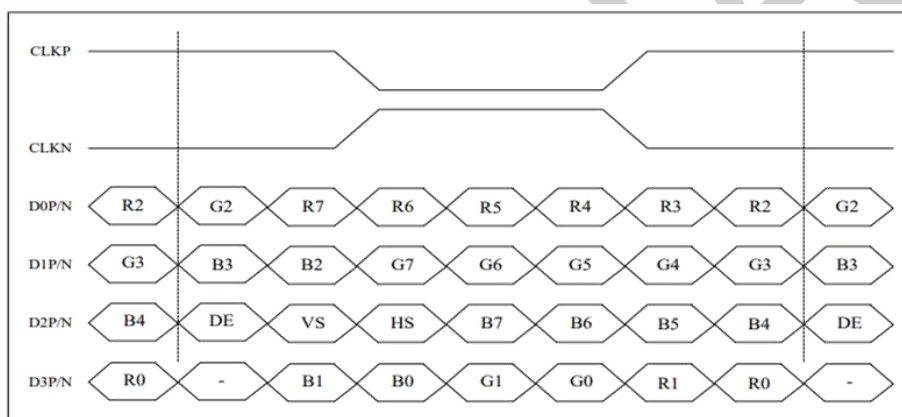
10 TIMING CHARACTERISTICS

10.1 LVDS interface characteristic

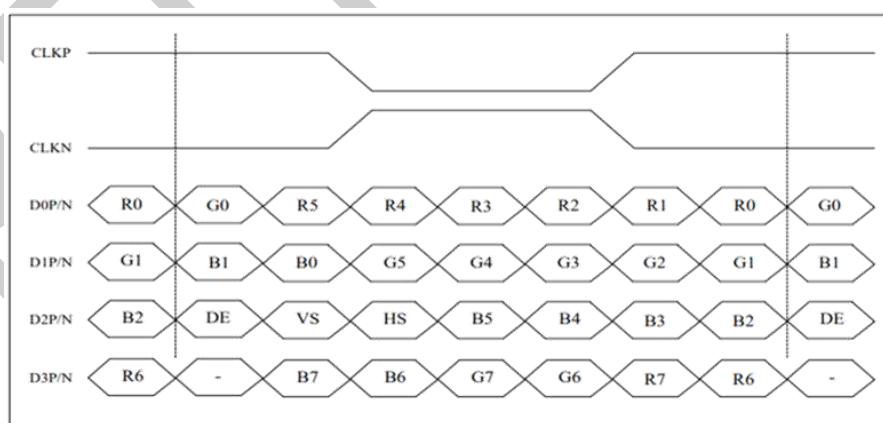
6-bit LVDS input (LVBIT=L, LVFMT=H OR L)



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
VSNC 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:

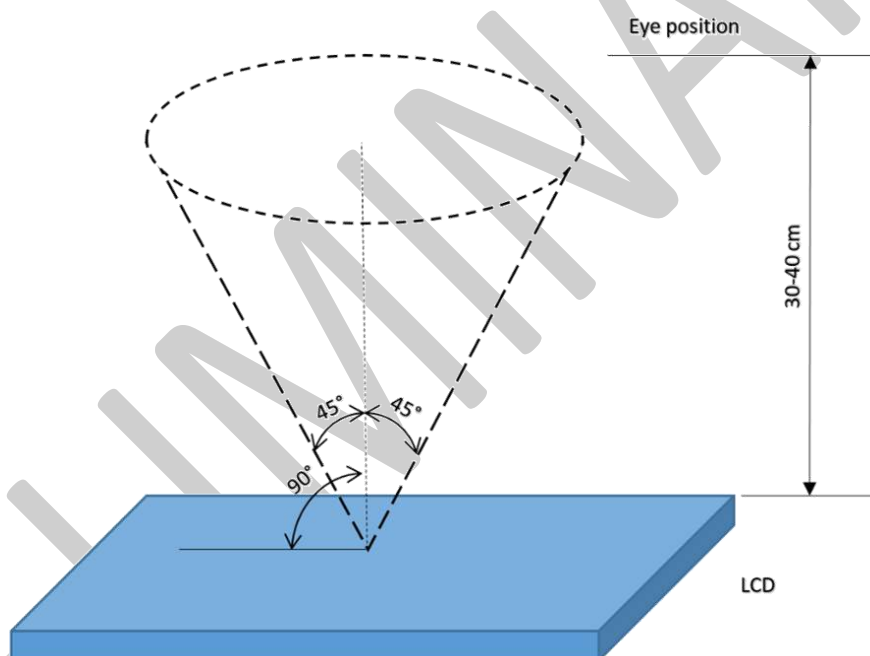
- Temperature: $25 \pm 2^{\circ}\text{C}$
- Humidity: $(60 \pm 10)\% \text{ RH}$
- Illumination: Single fluorescent lamp non-directive (300 to 700 lux)

Viewing distance:

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

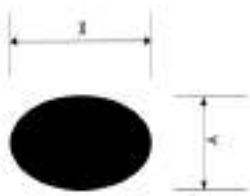
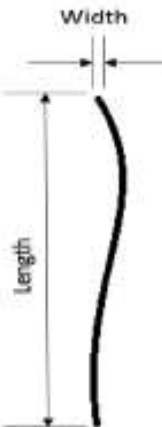
Viewing Angle:

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



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><th colspan="2">Size = 10.1"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></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>	Size = 10.1"		Average Diameter	Qualified Qty	D ≤ 0.2 mm	Ignored	0.2 mm < D ≤ 0.3 mm	N ≤ 4	0.5mm < D	N = 0					
Size = 10.1"																
Average Diameter	Qualified Qty															
D ≤ 0.2 mm	Ignored															
0.2 mm < D ≤ 0.3 mm	N ≤ 4															
0.5mm < D	N = 0															
LCD black spots, white spots, light leakage (line Type)	 *Spots density: 10 mm <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>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>	Size = 10.1"			Length	Width	Qualified Qty	-	W ≤ 0.05	Ignored	L ≤ 5.0	0.05 < W ≤ 0.1	N ≤ 3	5.0 < L	0.10 < W or 5.0 < L	N = 0
Size = 10.1"																
Length	Width	Qualified Qty														
-	W ≤ 0.05	Ignored														
L ≤ 5.0	0.05 < W ≤ 0.1	N ≤ 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															

Item	Criterion
Clear spots	Size $\geq 5''$
	Average Diameter
	D < 0.2 mm
	0.2 mm < D < 0.3 mm
	0.3 mm < D < 0.5 mm
	0.5 mm < D
*Spots density: 10 mm	
Touch panel spot	Size $\geq 5''$
	Average Diameter
	D < 0.25 mm
	0.25 mm < D < 0.5 mm
	0.5 mm < D
Touch panel white line Scratch	Size $\geq 5''$
	Length
	Width
	Qualified Qty
	-
	L < 5.0
	0.03 < W < 0.05
	0.05 < W

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 °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.

15 LEGAL INFORMATION

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RVT101HVBWN00

EVE4 IPS 10.1" LCD TFT Datasheet

Rev.0.1

2020-01-18

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 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	Without Touch Panel	/
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: LCM weight tolerance: ± 5%.

REVISION RECORD

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

CONTENTS

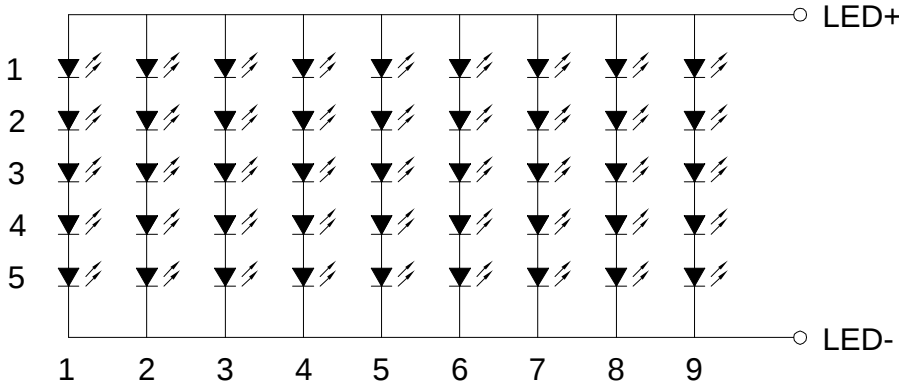
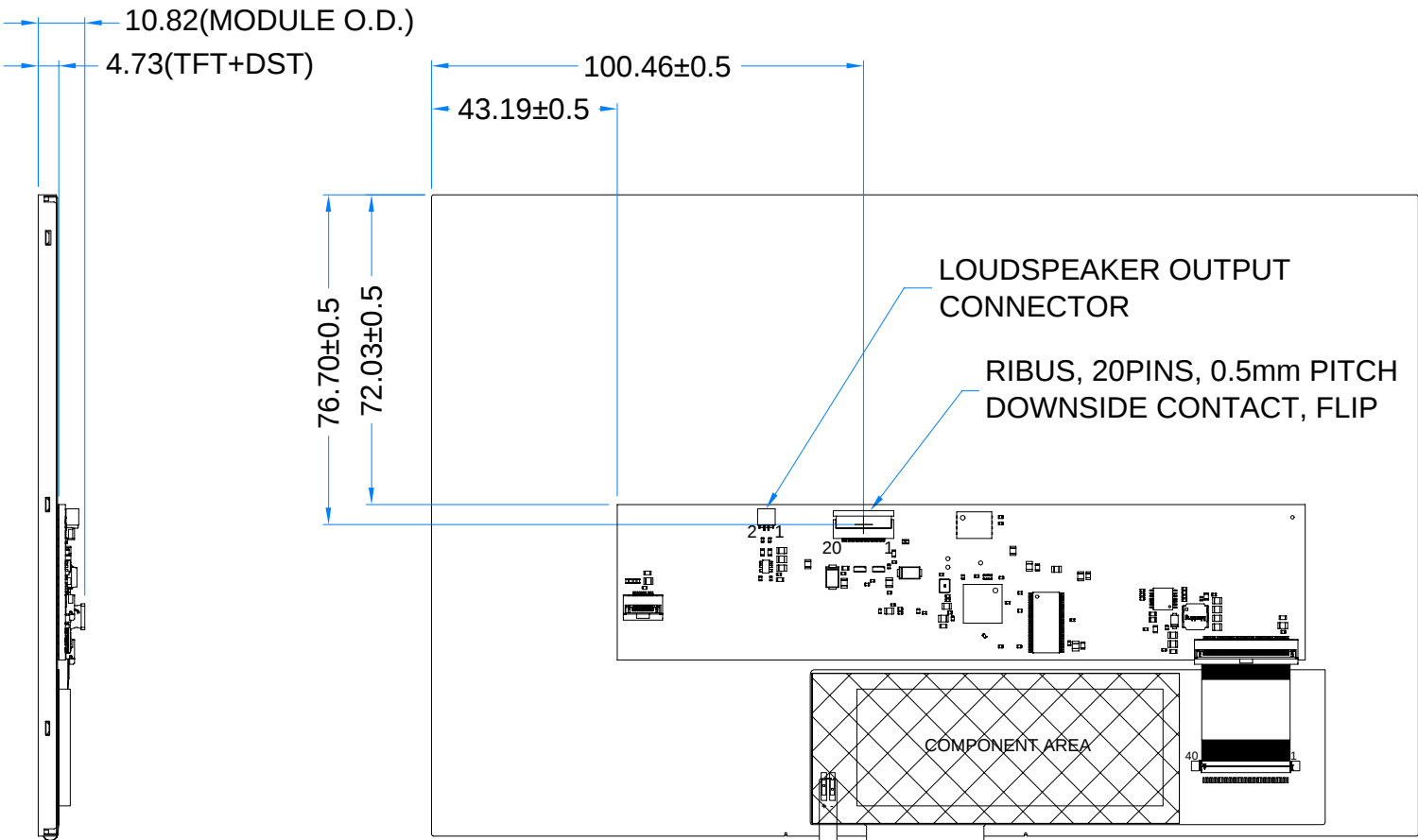
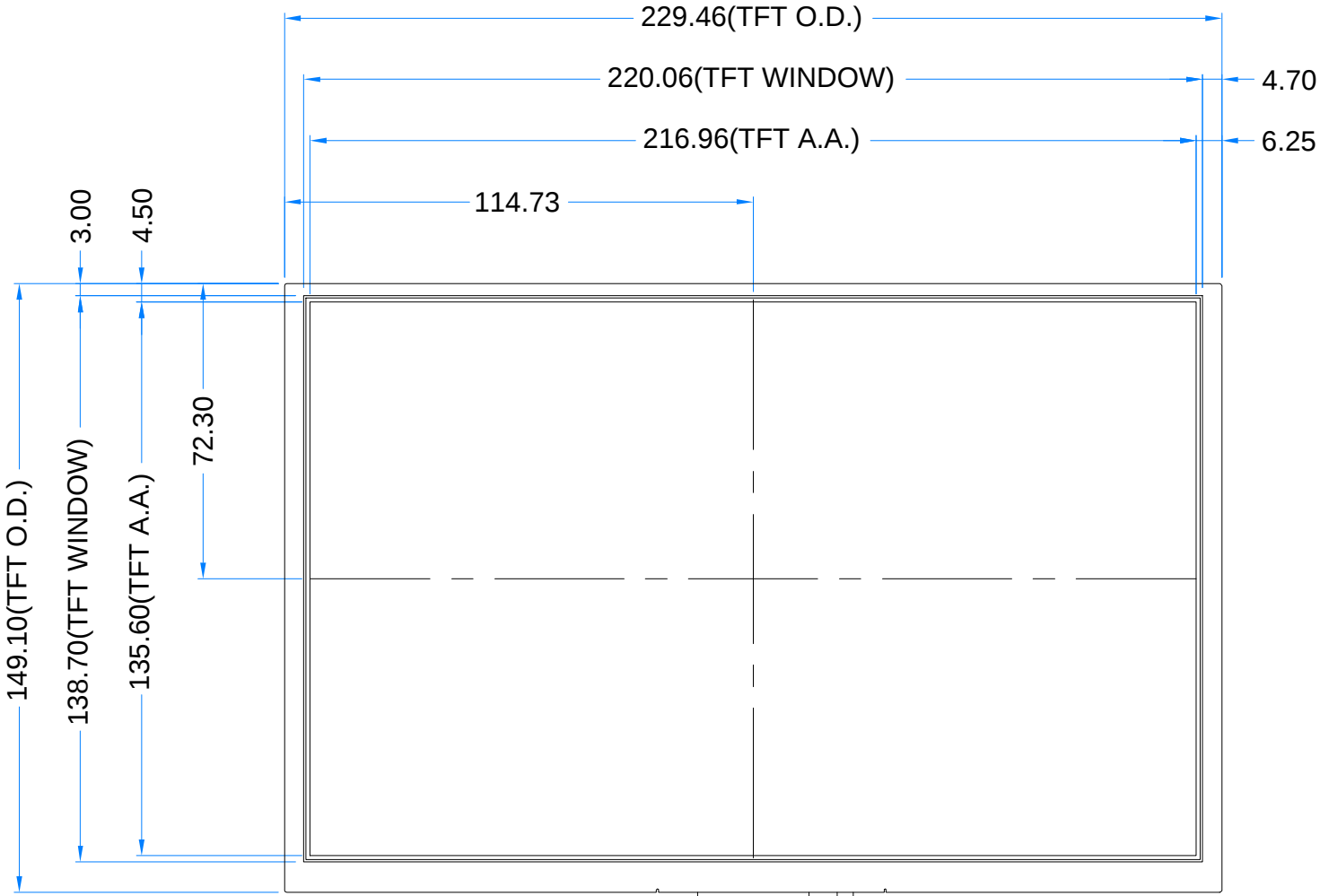
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1 MODULE CLASSIFICATION INFORMATION

RV	T	101	H	V	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	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	N – Without Touch Panel
10.	VERSION	00 – (00-99)

Revision:	Changes:	Date:
1.0	Initial Case	2020.12.09



LED Diagram Circuit

LCD NOTES: 1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS 2. RESOLUTION: 1280x800 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: 3.3 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: RVT101HVLNWN00			
		SN:			
		DRAWN: M.Natywa		2020.11.27	1:1.66
				2020.12.09	[mm]
			ISO A3	P. 1 of 1	

ES France - Département Composants & Modules - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 84 - Fax. 01 47 01 16 22 - e-mail: comp@es-france.com - Site Web: www.es-france.com

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 _{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).

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}	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 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 _{BLVDD=5.0V}	TBD	1367	TBD	mA	
Current drawn from BLVDD @7.0V	I _{BLVDD=7.0V}	TBD	858	TBD	mA	
Current drawn from BLVDD @9.0V	I _{BLVDD=9.0V}	TBD	667	TBD	mA	
Current drawn from BLVDD @12.0V	I _{BLVDD=12.0V}	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.

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	δ WHITE		-	75	-	%	FIG 3.	3
Surface Luminance	Lv		-	1000	-	cd/m ²	FIG 3.	2
Viewing Angle Range	θ	$\phi = 90^\circ$	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 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

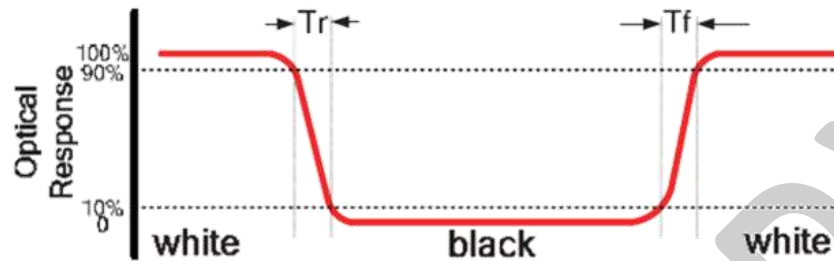
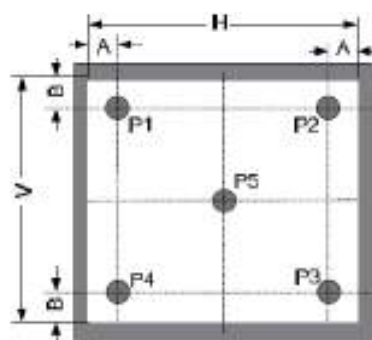


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

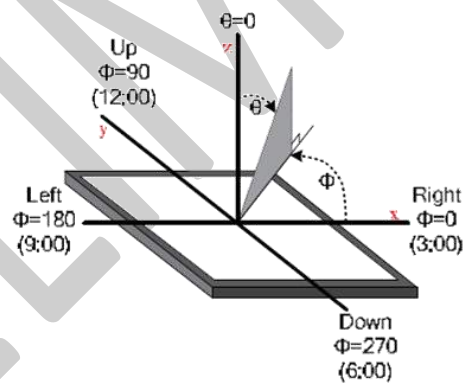
B: 5mm

H, V: Active Area

Light spot size $\varnothing=5\text{mm}$, 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



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

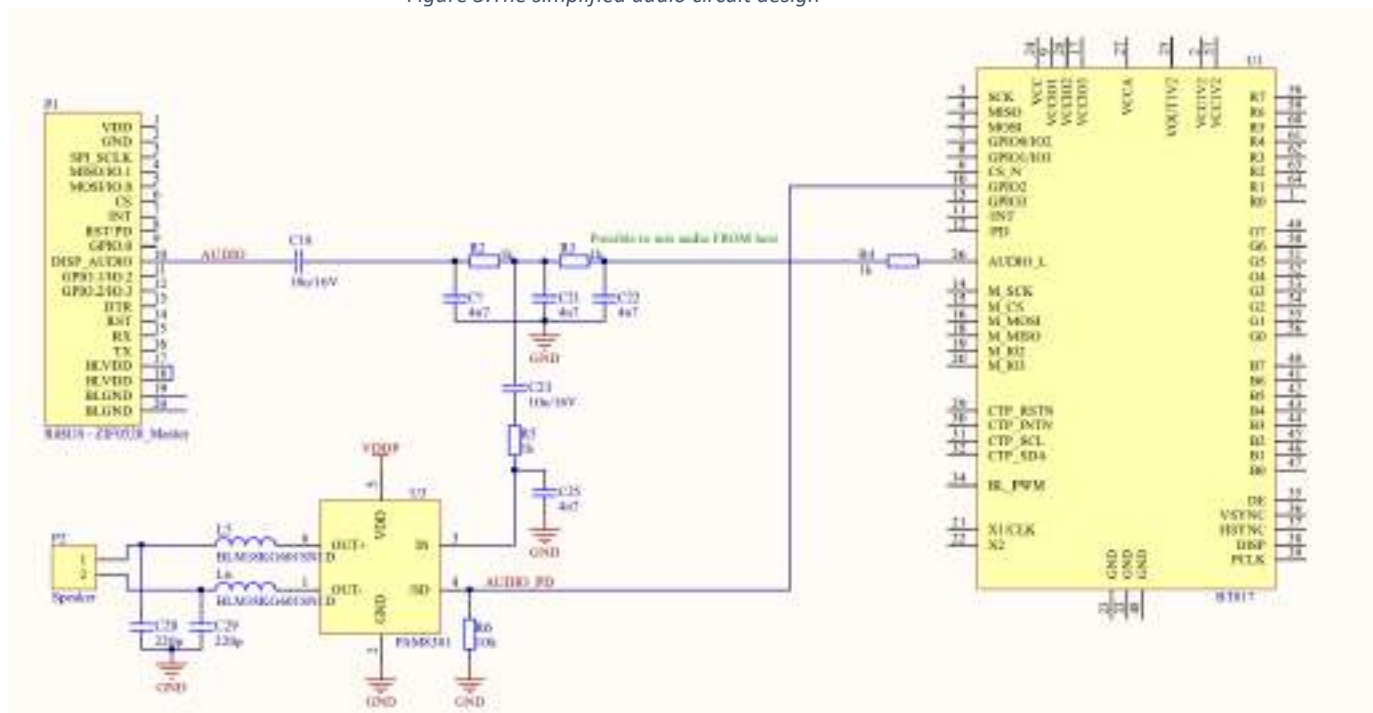
PIN NO.	SYMBOL	DESCRIPTION	NOTE
1	SPEAKER +	Speaker coil "+" terminal	Note 1
2	SPEAKER -	Speaker coil "-" terminal	

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.

Figure 5. The simplified audio circuit design



Note 2. Controller board in RVT101HVBWN00 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

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

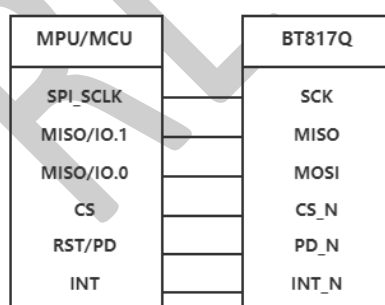
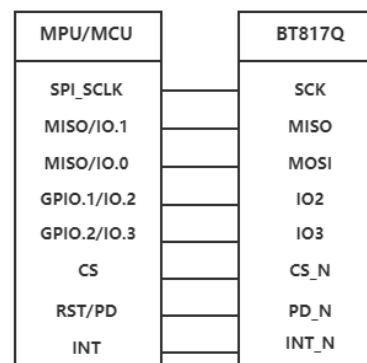


Figure 7. QSPI interface connection



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.

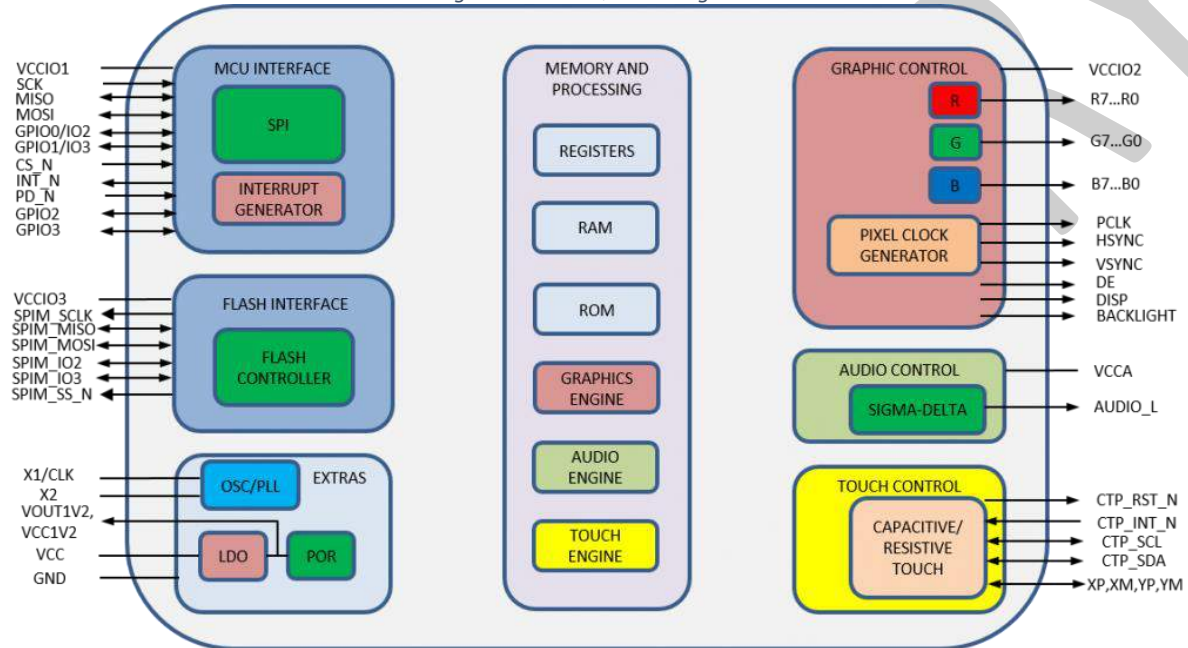
QSPI Interface – the QSPI slave interface operates up to 30MHz (It depends on EVE 4 system clock frequency and will be verified in Riverdi lab). Only SPI mode 0 is supported.

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.

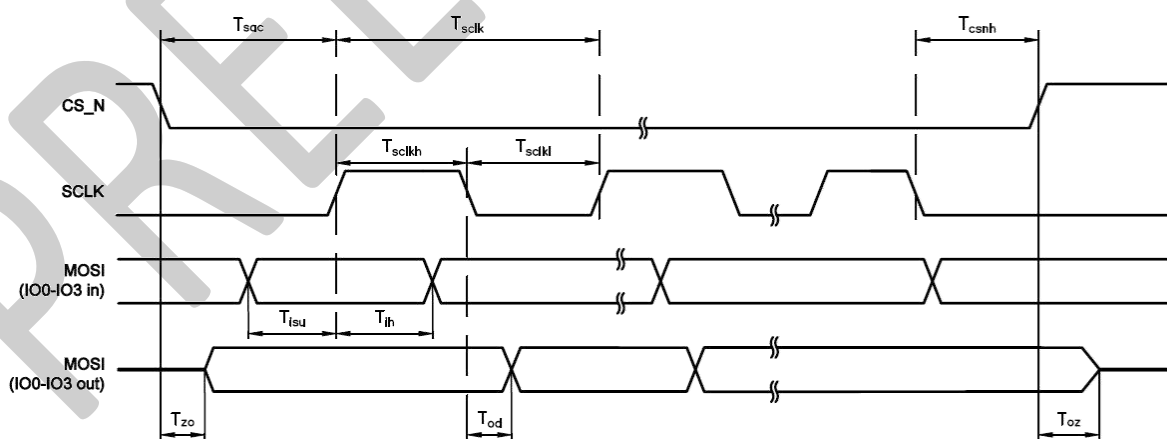
8.2 Block Diagram

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.

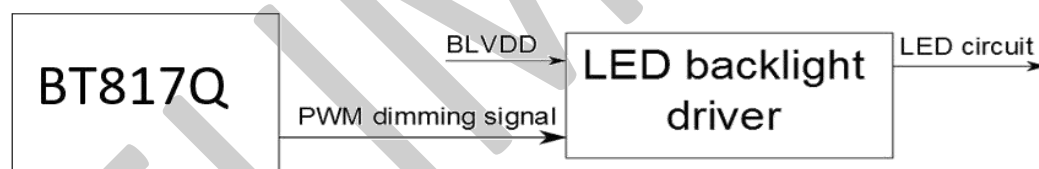
PARAMETER	DESCRIPTION	VCCIO=1.8V		VCCIO=2.5V		VCCIO=3.3V		UNIT
		Min	Max	Min	Max	Min	Max	
T _{sclk}	SPI clock period	33.3		33.3		33.3		ns
T _{sckl}	SPI clock low duration	13		13		13		ns
T _{sckh}	SPI clock high duration	13		13		13		ns
T _{sac}	SPI access time	4		3.5		3		ns
T _{isu}	Input Setup	4		3.5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

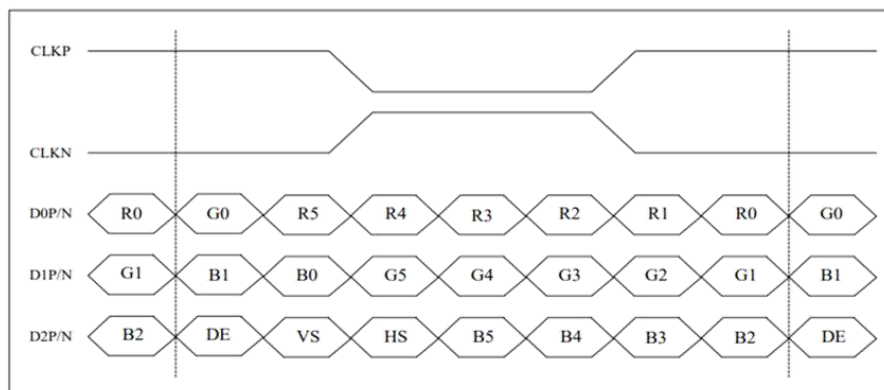


The LED backlight driver used in this module does not burst the LED current. Therefore, it does not generate audible noises on the output capacitor. It is equipped with soft start subsystem, which increases LED life time, as LED current peaks are reduced significantly.

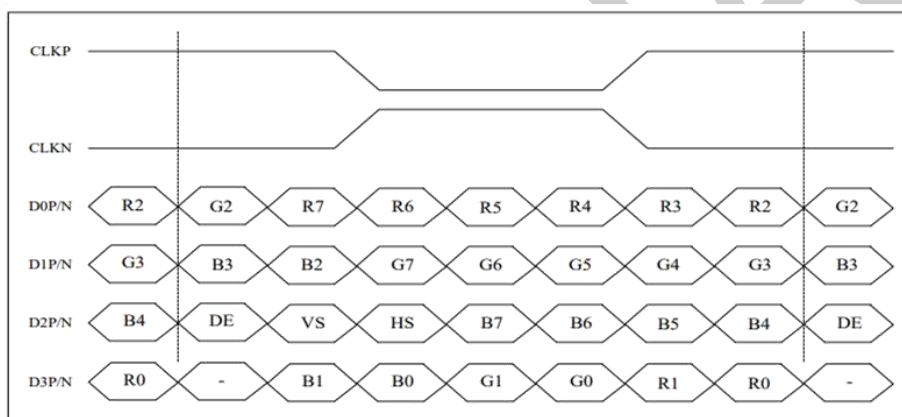
9 TIMING CHARACTERISTICS

9.1 LVDS interface characteristic

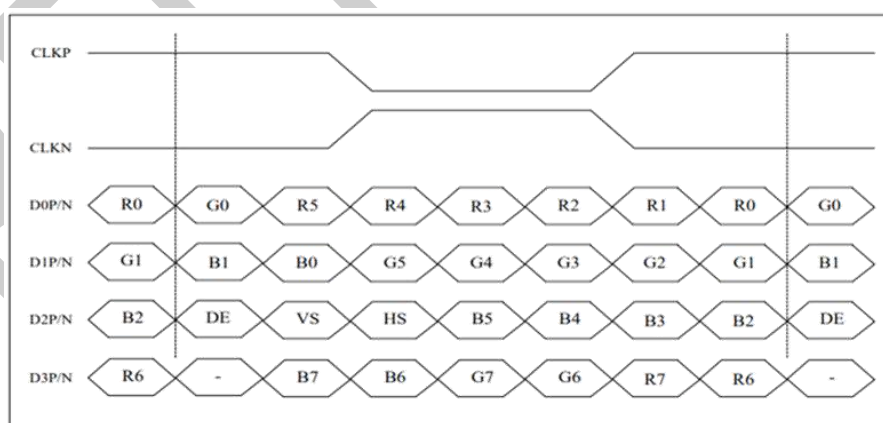
6-bit LVDS input (LVBIT=L, LVFMT=H OR L)



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



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



9.2 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
VSNC 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

10 INITIALIZATION CODE

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

11 INSPECTION

Standard acceptance/rejection criteria for TFT module.

11.1 Inspection condition

Ambient conditions:

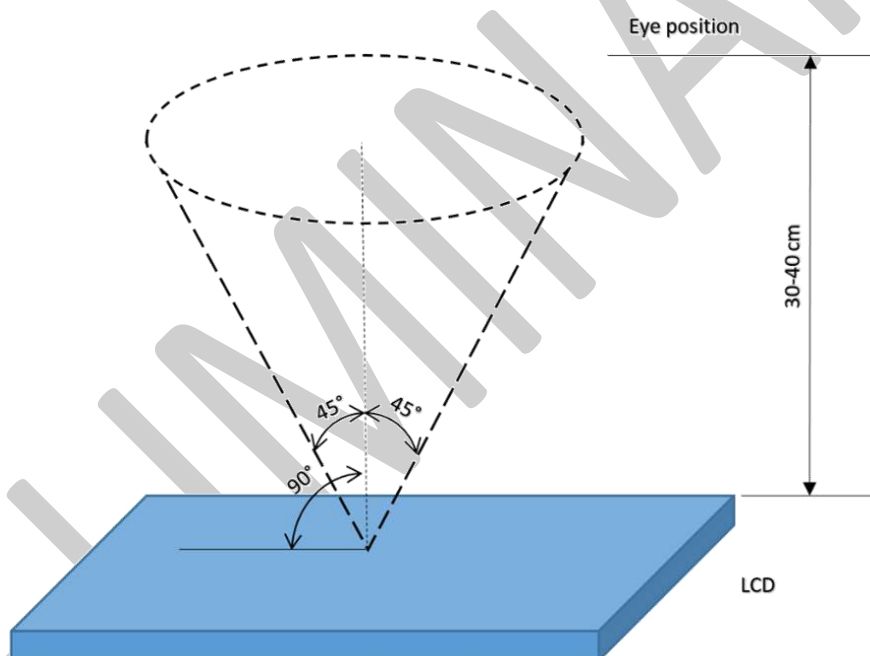
- Temperature: $25 \pm 2^{\circ}\text{C}$
- Humidity: $(60 \pm 10)\% \text{ RH}$
- Illumination: Single fluorescent lamp non-directive (300 to 700 lux)

Viewing distance:

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

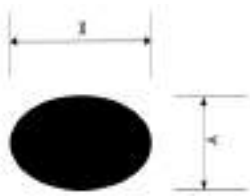
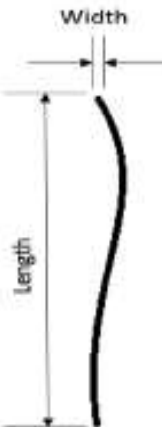
Viewing Angle:

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)	$D = \frac{(x + y)}{2}$ *Spots density: 10 mm <table><tr><th colspan="2">Size = 10.1"</th></tr><tr><th>Average Diameter</th><th>Qualified Qty</th></tr><tr><td>$D \leq 0.2 \text{ mm}$</td><td>Ignored</td></tr><tr><td>$0.2 \text{ mm} < D \leq 0.3 \text{ mm}$</td><td>$N \leq 4$</td></tr><tr><td>$0.5\text{mm} < D$</td><td>$N = 0$</td></tr></table>	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)	 *Spots density: 10 mm <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>$W \leq 0.05$</td><td>Ignored</td></tr><tr><td>$L \leq 5.0$</td><td>$0.05 < W \leq 0.1$</td><td>$N \leq 3$</td></tr><tr><td>$5.0 < L$</td><td>$0.10 < W$ or $5.0 < L$</td><td>$N = 0$</td></tr></table>	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															

Item	Criterion
Clear spots	Size $\geq 5''$
	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

12 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 °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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