EVE3x-39A/G TFT Module

Hardware Manual

Revision 1.1

Revision History

Revision	Date	Description	Author
1.0	March 13, 2020	Initial Release	Henry
1.1	June 24, 2020	Updating Display Timings	Raquel

Contents

1. Introduction

Hardware manual for the EVE3x-39A & EVE3x-39G Displays for PCB 1.x

1.1. Key Features

- 3.9" Bar 1U 480x128 SPI TFT
- Resistive TFT, Capacitive, or Non Touch TFT
- 0mb or 32Mb or 128Mb QSPI NOR Flash
- BT815 or BT816 EVE3
- 1 MB graphics RAM
- 3.3V or 5-15V
- SPI/QSPI interface
- Optional USB interface with FTDI FT232H
- Optional Haptic feedback
- Optional Speaker
- Integrated backlight PWM LED Driver
- Designed, supported and Made in CANADA
- Long life cycle
- Customer silk screening available
- Semi-custom & Custom designs available

1.2. Block Diagram

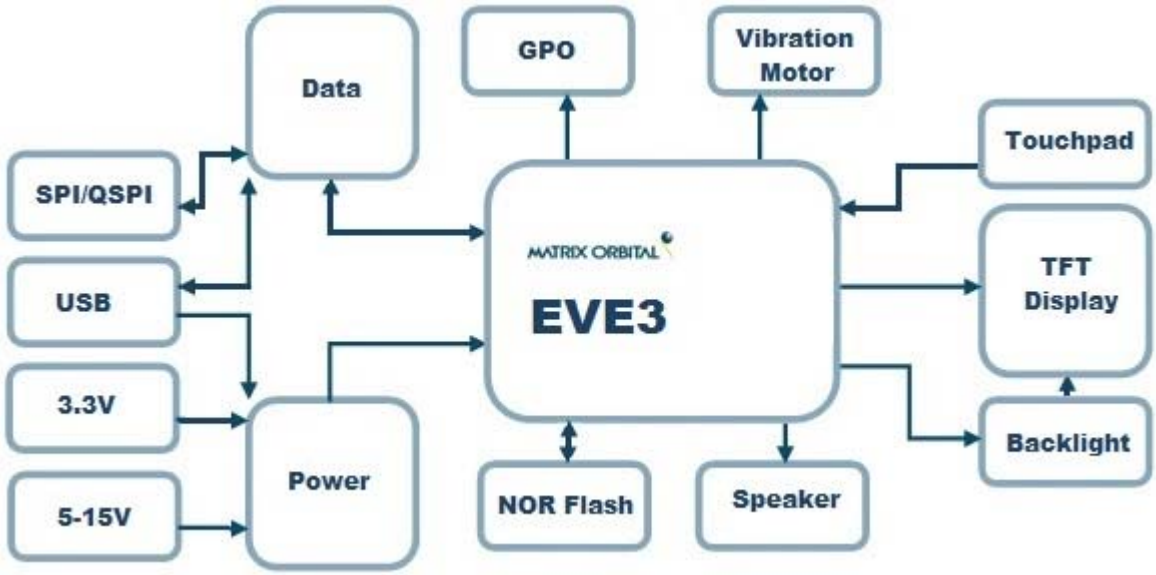


Figure 1: EVE3 Block Diagram

2. EVE3 Graphics Engine

The EVE3 series chips are graphics controllers with add-on features such as audio playback and touch capabilities, and contain a rich set of graphic objects (primitive and widgets) that can be used for displaying various menus and screens for a range of products including home appliances, toys, industrial machinery, home automation, elevators, and many more.

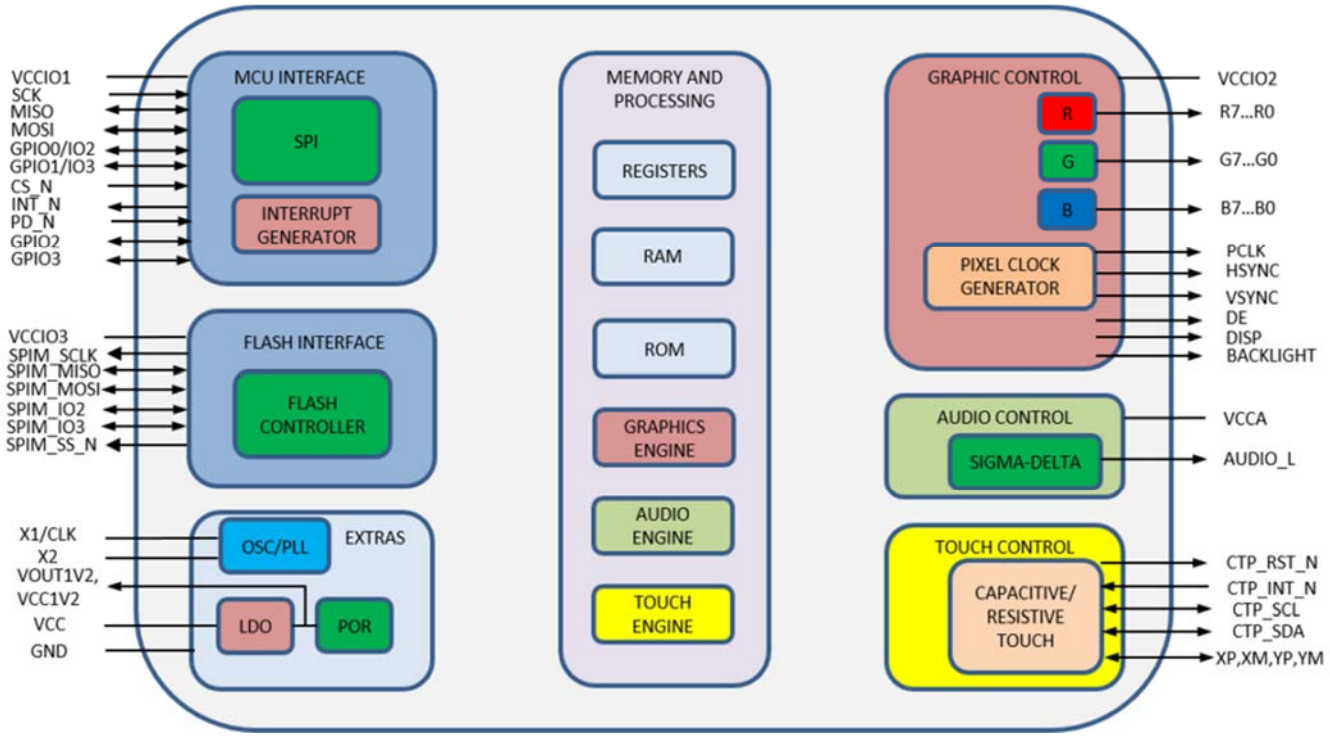


Figure 2: EVE3 Embedded Video Engine

Matrix Orbital uses both the BT815 and BT816 EVE3 chips.

Model	Touch	EVE3 IC Used
TPN	Non Touch	BT815 or BT816 based on stock level
TPR	Resistive Touch	BT816
TPC	Capacitive Touch	BT815

2.1 Programming manual, examples, software from Bridgetek

Programing Manual:
http://www.brtchip.com/bt81x

EVE Utilities
https://brtchip.com/eve-toolchains/

2.2 Matrix Orbital Example Code and Support

Free support forums

https://www.lcdforums.com/forums/viewforum.php?f=45

Example Code on Github

https://github.com/MatrixOrbital

3. Part Numbering

The EVE3x has multiple size and touch variants, to ensure that there is an option for every application. Resistive and capacitive touch panels are also available, allowing interactive touch functionality for all applications.

3.1. Part Numbering Scheme

Table 1: EVE3 Part Numbering Scheme

EVE3x	-39	A	-BLH	-TPN	-F32	-USB	-SPK	-VS	-HAP
1	2	3	4	5	6	7	8	9	10

3.2. Options

Table 2: EVE3 Display Options

#	Designator	Options
1	Product Type	EVE3x
2	Display Size	35: 3.5” 39: 3.9” 43: 4.3” 50: 5.0” 70: 7.0”
3	Screen Type	A: Standard TFT G: Extended Bezel capacitive touch panel
4	Backlight	-BLM: 300 Nit < Brightness < 600 Nit -BLH: 600 Nit < Brightness < 1000 Nit -BLD: Brightness > 1000 Nit
5	Touch	-TPC: Capacitive -TPR: Resistive -TPN: None
6	Memory	-F0: 0 Mb QSPI NOR Flash memory -F32: 32 Mb QSPI NOR Flash memory -F64: 64 Mb QSPI NOR Flash memory -F128: 128 Mb QSPI NOR Flash memory … -F2056: 2Gb QSPI NOR Flash memory
7	USB Interface	FTDI FT232H USB Interface and 5-15V option
8	Speaker	Mono Speaker
9	Voltage	5-15V Wide Voltage
10	Haptic	Haptic Motor

3.3. Development Accessories

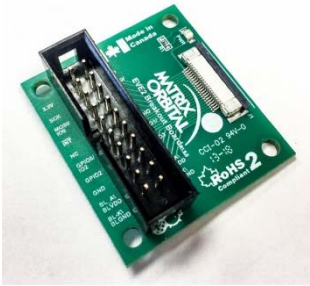
EVE2-USB2SPI-KIT-A

The USB to SPI Bridge is used for initial testing, decrease development time and the easiest way to upload data to the NOR Flash.

EVE2-SHIELD

The Scoodo is an interface module for Matrix Orbital EVE SPI TFT displays to Arduino Uno, STM32-Nucleo and Parallax Propeller Shield products.

EVE2-SPI2BBC



A simple breakout board that allows converts the EVE's 20 pin FFC cable to a 20 position 2.54mm 2x10 row straight pin header.

EVE-FFC20

FFC Cable, 20-pin, 0.5mm pitch, 6" long, Top one side – Bottom one side, backers both sides.

4. Headers & Pinout

Please note, the EVE3x-39A and EVE3x-39G share the same interface board, the only exception is that the mounting holes are not present on the EVE3x-39G

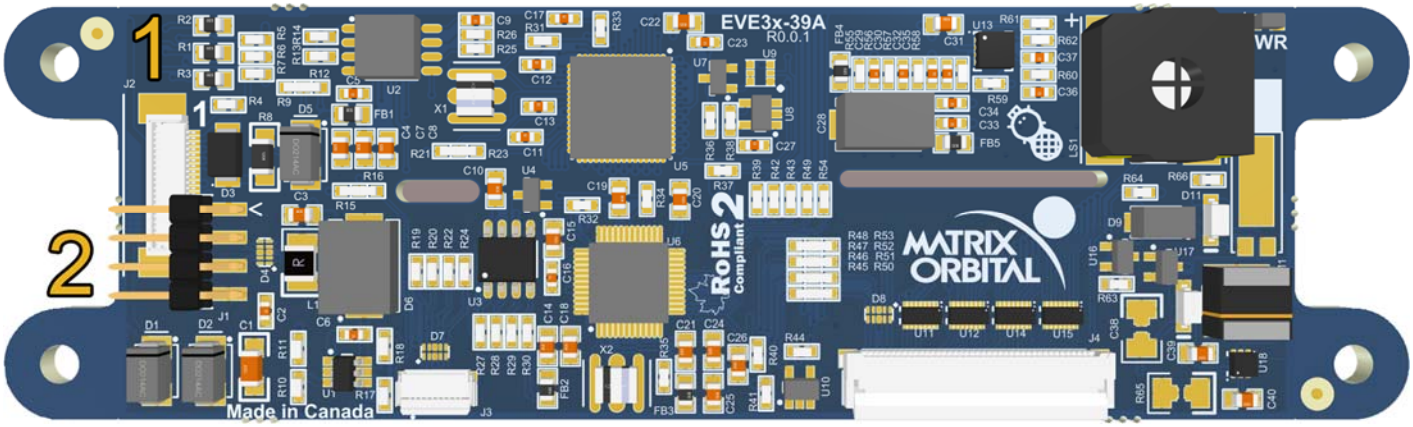


Figure 3: EVE3 TFT Module Header Locations

Table 3: List of available Headers

#	Header	Standard Mate
1	20 Pin FFC	20 pin, 0.5mm, bottom contact
2	4 Pin USB	4 pin male 2.54mm pitch

When the USB is selected, Header #1 is NOT populated!

Header Population

#	Header	Standard	USB
1	20 Pin FFC	X	
2	Alternate USB		X

X Standard, 0 Optional

4.1. #1 SPI Communication and Power Header Pinout

The 20 pin FFC header on the EVE3 is used to interface with an SPI controller.

Suggested mating FFC Headers and Cables

FFC Header	Part Number
Molex	5051102091
Amphenol ICC (FCI)	10051922-2010ELF

FFC Cable	Part Number
Matrix Orbital	FFC20-150-TB
Würth Elektronik	687620050002

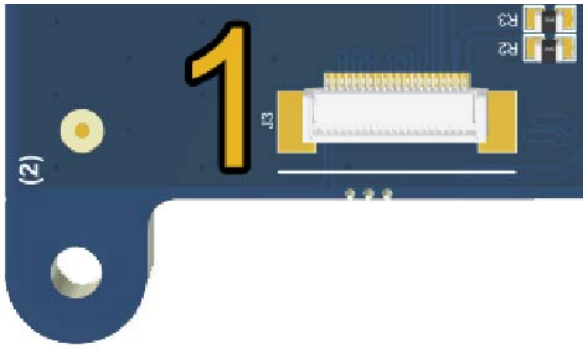


Figure 4: 20 pin FFC communication header

Table 4: 20 pin FFC communication header pinout

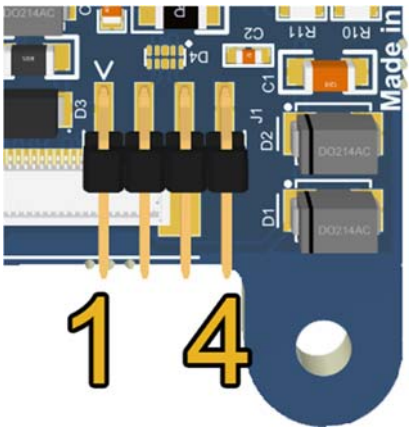
Pin	Symbol	Type	Function
1	VCC	Power	Logic Voltage (3.3V)
2	GND	Ground	Ground Connection
3	SCK	Input	SPI clock input
4	MISO	Input/output	SPI Single mode: SPI MISO output SPI Dual/Quad mode: SPI data line 1
5	MOSI	Input/output	SPI Single mode: SPI MISO input SPI Dual/Quad mode: SPI data line 0
6	CS	Input	SPI slave select input*
7	$\overline{\text{INT}}$	Open Drain Output	Interrupt to host**
8	RST		BT81x Reset pin
9	N/C	No connection	No connection
10	AUDIO	Output	Audio PWM out
11	IO2	Input/output	SPI Single/Dual mode: General purpose IO 0 SPI Quad mode: SPI data line 2
12	IO3	Input/output	SPI Single/Dual mode: General purpose IO 1 SPI Quad mode: SPI data line 3
13	GPIO2	Input/output	General purpose IO 2
14	GPIO3	Input/output	General purpose IO 3
15	GND	Ground	Ground connection
16	VCC	Power	Logic Voltage (3.3V)
17	BLVDD	VDD	No Connect (Optional Backlight Voltage)
18	BLVDD	VDD	No Connect (Optional Backlight Voltage)
19	BLGND	Ground	Ground
20	BLGND	Ground	Ground

***Note:** The CS pin signifies when a SPI transaction occurs by going active low. When the pin goes inactive high, the write operation is considered complete.

****Note:** Open drain output (default) or push-pull output, active low

4.2. #2 USB

4 pin 2.54mm header. When the USB is selected, Header #1 is NOT populated.



Pin	Symbol	Function
1	VCC	5V Power
2	D-	Communication
3	D+	Communication
4	GND	Ground

4.3. Power LED

When the EVE3x is powered correctly, the LED will turn on.

5. Mounting

5.1. Mounting of EVE3x-39G Series

Our G series extended capacitive touch EVE3 TFT Module units will come with a double sided adhesive already applied on the exposed back side of the over-sized cover glass. The tape can maintain its bond in environments of 100% relative humidity at 38°C, and can withstand temperatures up to 149°C.

Figure 5: EVE3-38G Installation

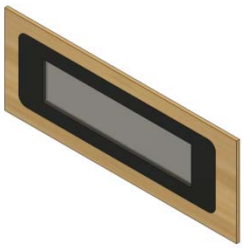


Figure 6: Completed Assembly

5.2. Mounting of EVE3x-39A Series

The A series uses 4 mounting points with a 3.05mm diameter. M3 and 4/40 screws can be used. Chassis grounding is optionally provided, please contact us for more information.

6. Dimensional Drawing

6.1. EVE3x-39A

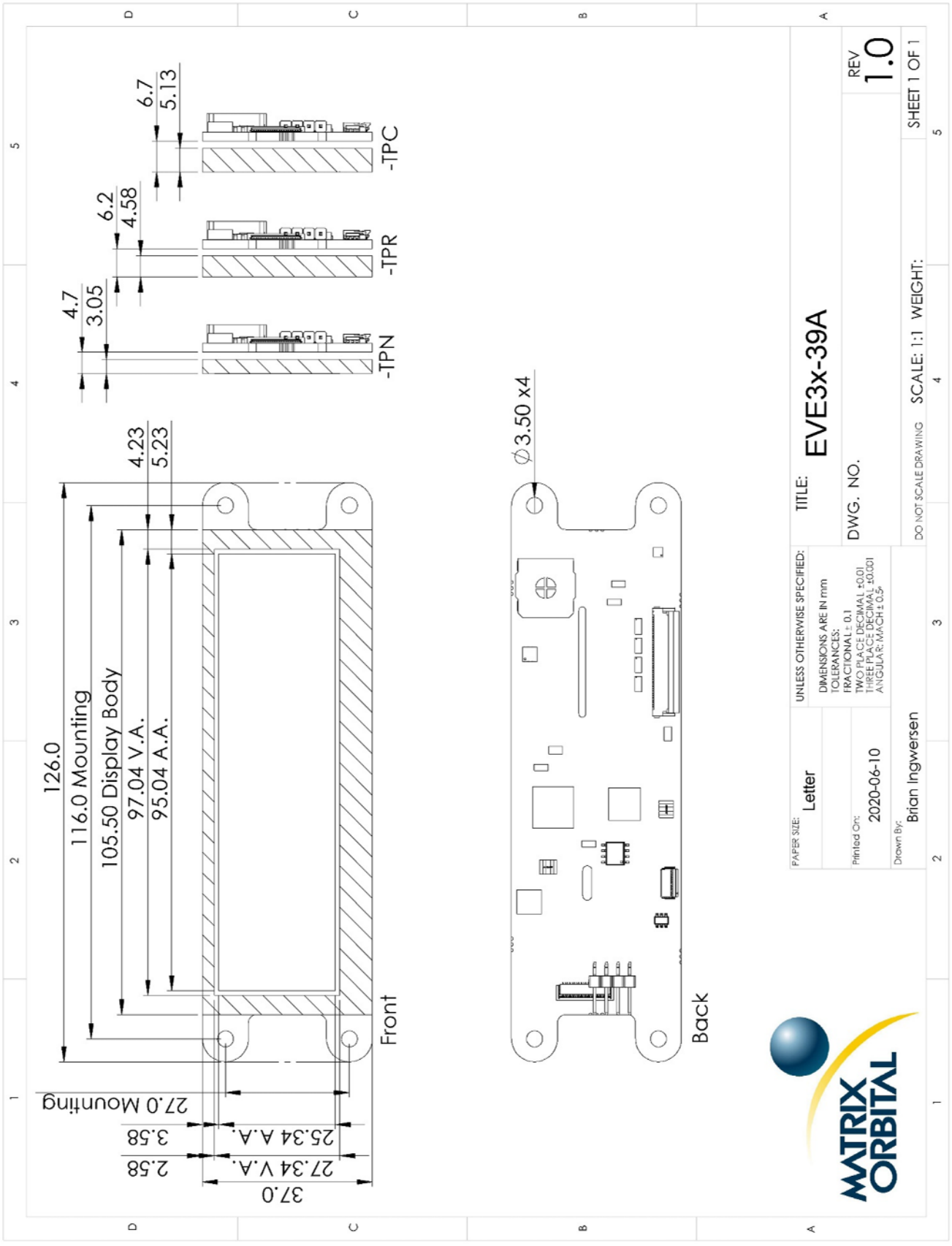


Figure 7: EVE3 Technical Drawing

6.2. EVE3x-39G

Coming soon

7. SPI Communication

The EVE3 communicates to hosts through SPI.

Channel Mode	Interface pins	Data	Max bus speed
MODE 0	MISO, MOSI, SCLK, CS, INT	MSB first	30 MHz

For reading from the BT81x, the protocol is:

RD-Command/Addr2, Addr1, Addr0, **Dummy-Byte,** DataX, DataY, DataZ

The below diagram depicts the behaviour of both the SPI master and slave in the master read case. In this example we are reading the Register ID which is 7C.

Please notice the extra 00 before receiving the 7C, the extra 00 is the Dummy-Byte.

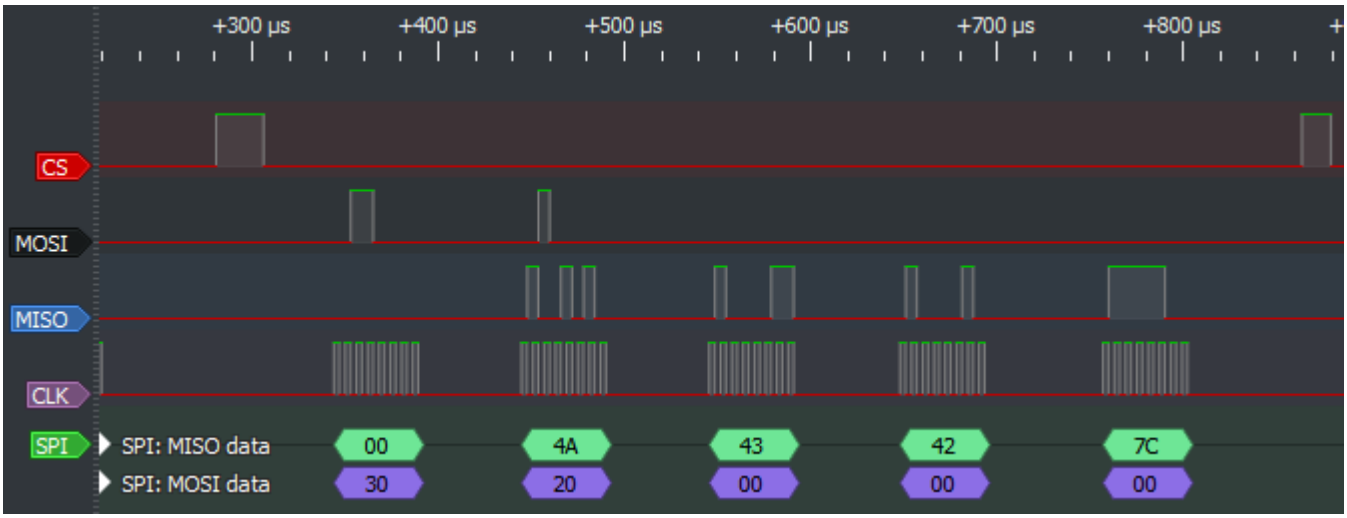


Figure 8: SPI Master and Slave bus behaviour

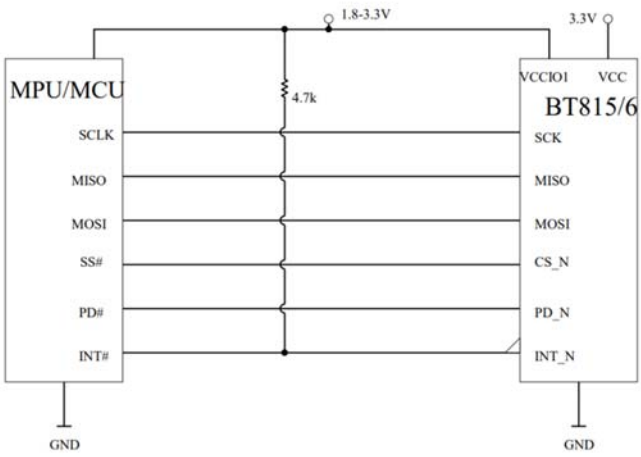


Figure 9: Single Channel SPI Interface connection

8. Peripherals

8.1. General Purpose Input Outputs

The EVE3x provides 4 GPIO pins that are user configurable. When the Speaker is present GPIO2 is used. When the Haptic is present it uses GPIO3, leaving GPIO1 and GPIO2 available to the user.

8.2. Speaker

The EVE3x features an optional Speaker. GPIO3 is used to power On and Off the amplifier circuit. By default, the pin is pulled low thus the circuit is Off. To activate Speaker circuit, set GPIO2 to High.

8.3. Haptic

The EVE3x features an optional Haptic feedback for enhanced user interaction. It is activated with GPIO3. By default, the pin is pulled High. To activate Haptic, set GPIO3 to Low.

8.4. QSPI NOR Flash

The on-board flash memory allows you to store audio files, images, animations and videos, reducing the amount of flash memory taken up on the host side. The NOR Flash is connected directly to the BT815/816 IC by QSPI. The EVE processor talks directly to the NOR Flash bypassing the host. This makes transfer of data from the NOR Flash to the display incredibly fast. Note: You can communicate with the EVE3 chip by SPI and the EVE3 chip will talk to the NOR Flash at QSPI with out any user interaction.

Memory
-F0: 0Mb
-F32: 32Mb
-F128: 128Mb

The above memory sized are offered as standard products, the maximum is 2Gb, for other sizes please contact us.

The easiest way to upload

8.5. Backlight Driver

The EVE3x TFT Module comes equipped with its own backlight driver and integrated backlight control circuit.

Backlight brightness is controlled by software PWM by the EVE3 chip.

Item	Data	Comment
PWM	0-128	0: OFF … 128: Maximum Brightness

The backlight driver PWM should be 2kHz.

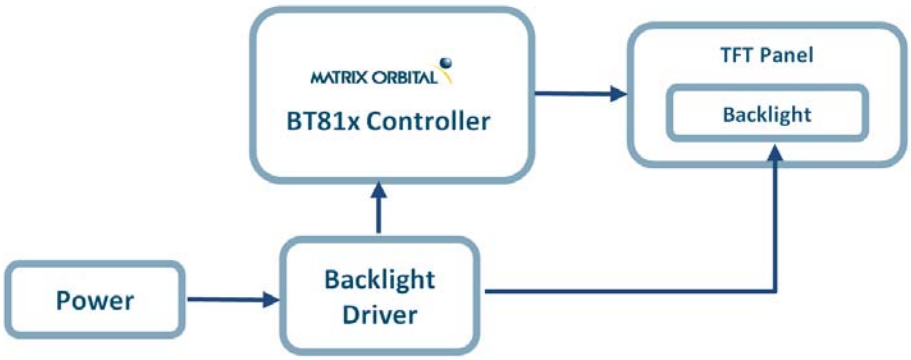


Figure 10: Backlight Driver Block Diagram

8.6. Touch Panel

The EVE3x TFT Module can be ordered with a resistive or capacitive touch panel. Both touch variants require minimal setup in order to operate.

The EVE3x-TPR resistive touch panel sensitivity can be increased by adjusting the resistive pressure threshold. The pressure threshold is specified through the REG_TOUCH_RZ register. A lower pressure value indicates a higher-pressure threshold. It is recommended to set the pressure threshold to 1200 for testing, and adjust the value accordingly to suit your application.

The EVE3x-TPC uses a GT911 I2C touch controller. The default address is 0x05D0. The EVE3 needs to be initialized by setting the REG_TOUCH_CONFIG register to 0x05D0.

Parameter	-TPR	-TPC
IC	NA	GT9xx
Touch Points	1	5
Hardness	3H	6H

9. TFT Display

9.1. EVE3x RGB Displays Used

For more detailed information for the TFT's Electro-Optical Characteristics, Reliability Test Conditions, Inspection Criteria, and Handling Precautions. Please consult the Parallel TFT Datasheet

EVE3 Display	Parallel TFT Datasheet
EVE3x-29A	MOP-TFT320102-29A
EVE3x-35A	MOP-TFT320240-35A
EVE3x-35G	MOP-TFT320240-35G
EVE3x-38A	MOP-TFT480116-38A
EVE3x-38G	MOP-TFT480116-38G
EVE3x-39A	**MOP-TFT480128-39A**
EVE3x-39G	**MOP-TFT480128-39G**
EVE3x-43A	MOP-TFT480272-43A
EVE3x-43G	MOP-TFT480272-43G
EVE3x-50A	MOP-TFT800480-50A
EVE3x-50G	MOP-TFT800480-50G
EVE3x-70A	MOP-TFT800480-70A
EVE3x-70G	MOP-TFT800480-70G

9.2. EVE3x TFT Display Timings

Table 5: EVE3 TFT Display Timings

Display Timings	Display				
	EVE3x-29	**EVE3x-39**	EVE3x-43	EVE3x-50	EVE3x-70
REG_HSIZE		**480**			
REG_VSIZE		**272**			
REG_HCYCLE		**524**			
REG_HOFFSET		**44**			
REG_HSYNC0		**44**			
REG_HSYNC1		**28**			
REG_VCYCLE		**288**			
REG_VOFFSET		**15**			
REG_VSYNC0		**8**			
REG_VSYNC1		**11**			
REG_ PCLK		**5**			
REG_SWIZZLE		**0**			
REG_PCLK_POL		**1**			
REG_CSPREAD		**1**			
REG_DITHER		**1**			

10. Characteristics & Specifications

10.1. Power

Item	Description	Min.	Typ.	Max.	Unit	Conditions
VCC	Supply voltage	3.0	3.3	3.6	V	Standard Unit
VCC	Supply current		330	3.3V: 580*	mA	Standard Unit
VCC	Supply voltage	5.0	12	15	V	-VS/-USB
VCC	Supply current		240	5V: 450**	mA	-VS/-USB

* current max is haptic, speaker, and display at max brightness
**current max is haptic, speaker, USB and display at max brightness

10.2. Optical

Item	All	TPN	TPR	TPC	Unit
Size	3.9”				
Pixels	480 x 128				
Pixels Pitch	0.2 x 0.2 mm				
Luminance		1000	800	900	nit
Contrast Ratio		500	500	500	
Viewing Direction	6 O’clock				
LED Life	50,000 Hrs*				

* The LED Life-time is defined as the estimated time to 50% degradation of initial brightness running at maximum at Ta=25°.

10.3. Environmental

Table 6: Power Characteristics

Item	Min	Max	Unit
Operation Temperature	-20	70	C
Storage Temperature	-30	80	C
Humidity		90%*	RH

*noncondensing

11. Contact

Sales

Phone: +1-403-229-2737

Email: sales@matrixorbital.ca

Support

Phone: +1-403-229-2737

Email: support@matrixorbital.ca

Online

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