# Orbit BoosterPack™ Reference Manual

Revised June 5, 2013
This manual applies to the Orbit BoosterPack rev. A

Overview

The Digilent Orbit BoosterPack™ is an add-on board for the Texas Instruments Stellaris® LaunchPad microcontroller evaluation kit. The Orbit greatly expands the input/output capabilities of the LaunchPad, as well as introducing Digilent Pmod™ expansion connectors.
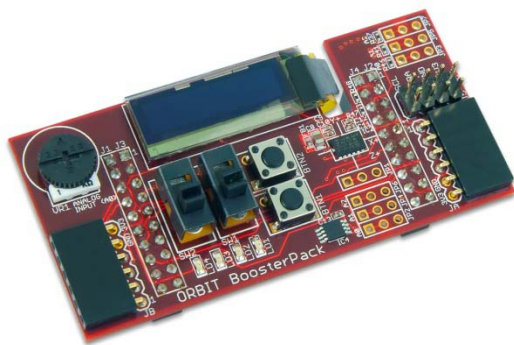
The Orbit BoosterPack.

Features include:

- Two 1x6 Digilent Pmod™ connectors
- 3-axis accelerometer
- 256 Kbit I^{2}C EEPROM
- I^{2}C temperature sensor
- 128x32 pixel OLED display
- Analog potentiometer

1   Orbit BoosterPack Hardware Description

The following gives a basic description of the input/output hardware contained in the Orbit BoosterPack and how to use it. Refer to Appendix A for a table showing pin definitions.

1.1   OLED Graphic Display

The Orbit board provides a 128x32 pixel, organic LED (OLED), graphic display panel. The graphic display panel used is the WiseChip/Univision UG-23832HSWEG04. This display uses the Soloman Systech SSD1306 display controller.

The UG2832 has a power on/power off sequence that should be followed. Failure to follow the power on/power off sequence can shorten the life of the display. The Orbit provides two FETs for software control of the two power supplies for the display. The VDD_OLED control is used to turn on/off the power to the logic of the display. The

VBAT_OLED control is used to turn on/off power to the OLED display itself. These two pins have pull-up resistors to turn off their respective power supplies when not being driven. The pins are made to be outputs and are driven low to turn on the power supplies.

Power on sequence:

Apply power to VDD

Send Display Off command

Initialize display to desired operating mode

Clear screen

Apply power to VBAT

Delay 100ms

Send Display On command

Power off sequence:

Send Display Off command

Power off VBAT

Delay 100ms

Power off VDD

The display has a D/C pin (display or command select) that is used to determine whether bytes sent to the display are interpreted as commands or as display data. The D/C pin is driven high for display buffer access and is driven low for command access. This pin is shared with VBUS detection on the LaunchPad. If VBUS is present, the pull-down resistor acts as a pull-up resistor in conjunction with resistor 6 (R6) on the LaunchPad. Please see the note in the Orbit BoosterPack Schematic available from www.digilentinc.com.

The D/C pin is also a non-maskable interrupt (NMI) pin on the LaunchPad, and is "locked" on the device's power-up. In order to unlock the D/C pin to be used as a general purpose output, 0x4C4F434B must be written to GPIOLOCK register. For more information, please see the LM4F120H5QR Datasheet at: www.ti.com.

The RES pin is used to reset the SG1306 display controller. The RES pin is driven low for reset and driven high for normal operation. The low-going reset pulse must be a minimum of 3μs (microseconds) for the display controller to reset correctly.

The UG2832 is a serial device that is accessed using SPI. It is however, a write-only device. It is not possible to read back either the display buffer contents or any kind of status from the panel. The maximum SPI clock frequency supported by the UG2832 is 10MHz.

Digilent has a library for use with the Orbit BoosterPack that provides functions for initializing the display and rendering simple text and graphics onto the display. This library can be used as is or as a starting point for a more sophisticated graphics library and is available at www.digilentinc.com.

1.2 Digilent Pmod Connectors

Two 1x6 pin female Digilent Pmod connectors are provided for functional expansion of the Orbit BoosterPack. They are labeled JA and JB respectively. Header JA has signals routed to the Synchronous Serial Interface (SSI)

peripheral on the LaunchPad. These signals can be used with Pmods that use standard 3 or 4 wire SPI communication protocol.

1.3   Discrete Digital I/O Devices

Pushbuttons: There are two pushbutton switches labeled BTN1 and BTN2. A read to the corresponding GPIODATA register bits will return a '0' when the button is released and a '1' when the button is pressed.

Slide Switches: There are two slide switches labeled SW1 and SW2. A read to the corresponding GPIODATA register bits will return a '0' when a switch is down (toward the LEDs) and a '1' when a switch is up (toward the OLED display).

LEDs: There are four LEDs, labeled LD1 – LD4. An LED will be illuminated when the corresponding GPIODATA register bit is set to a '1' (given the corresponding direction bit has been set in the GPIODIR registers) and off when set to a '0'.

1.4   I^{2}C Bus

The I^{2}C bus from the LaunchPad microcontroller board is brought onto the Orbit BoosterPack. There are three I^{2}C devices on the board: a 256 Kbit EEPROM, a temperature sensor, and an accelerometer. In addition, there is a connector for taking the I^{2}C bus off of the board to connect to additional external I^{2}C devices.

I^{2}C Connector: Connector J5 can be used to extend the I^{2}C bus off of the board to connect to additional external I^{2}C devices. J5 is a standard 2x4 pin header connector with 0.100" spaced pins. It provides access to the I^{2}C signals, SCL and SDA, plus VCC3V3 and GND. The VCC3V3 can be used to power external I^{2}C devices.

The I^{2}C bus uses open collector drivers to allow multiple devices to drive the bus signals. This means that pull-up resistors must be provided to supply the logic high state for the signals. The Orbit BoosterPack provides 2.2 K-ohm pull-up resistors. Generally, only one set of pull-up resistors are used on the bus.

Digilent has several small I/O modules available that can be connected using the I^{2}C connector. These include a 4-channel, 12-bit A/D converter, serial character LCD panel, 3-axis gyroscope, real-time clock/calendar, and I/O expander.

EEPROM: A 256Kbit (32Kbyte), I^{2}C EEPROM is provided using a Microchip 24LC256. This EEPROM, IC3, is located on the bottom side of the board.

The seven bit I^{2}C device address for the EEPROM is '1 0 1 0 A2 0 0', where A2 is an external pin. Pin A2 is pulled high through a 10 K-ohm resistor and a cuttable trace at JP7. Therefore, the 'as-is' seven bit I^{2}C device address for the EEPROM is '1010100', or 0x54. Cutting the trace between pins 1 and 2 of JP7 and loading a two-pin header with a shorting block on pins 2 and 3 of JP7 will make the 10 K-ohm resistor acts as pull-down. In this case, A2 must be set to '0' in software.

For complete technical documentation on the 24LC256, refer to the data sheet available from www.microchip.com.

Temperature Sensor: A digital temperature sensor is provided using a Microchip TCN75A 2-Wire Serial Temperature Sensor. The temperature sensor, IC4, is an I^{2}C device, and is located next to BTN1.

The TCN75A is rated for an accuracy of +/-1ºC and has selectable resolution from 0.5ºC down to 0.0625ºC. The seven bit device address is '1001111', or 0x4F. Note that the last three bits set to '1' because external pins A2, A1, and A0 are pulled high by 10 K-ohm resistors and cuttable traces at JP2, JP4, and JP6.

The TCN75A provides an alert output that can be programmed for various functions.

For complete technical documentation on the TCN75A, refer to the data sheet available at www.microchip.com.

Accelerometer: A 3-axis accelerometer is provided using an Analog Devices ADXL345. This accelerometer, IC2, is located to the right of BTN2. The silkscreen shows the axis configuration.

The 7 bit I^{2}C device address for the accelerometer is '0011101', or 0x1D.

The ADXL345 has two output pins for setting configurable interrupts, which include activity, inactivity, and DATA_READY.

For complete technical documentation on the ADXL345, refer to the data sheet available at www.analog.com.

1.5   Potentiometer

A potentiometer (pot) is provided on the board to be used as an analog signal source or analog control input. The pot is a 1 K-ohm trimmer pot connected between the VCC3V3 supply and ground. The wiper of the pot is connected to analog input AIN0.

Appendix A: Orbit BoosterPack Pinout Table

Connector #	Pin #	Port and Bit	Function	Description	Notes
J1	1	-	VCC3V3	Power supply	
J1	2	PB5	LD4	User LED	
J1	3	PB0	JB_03/RX	Pmod connector B pin 3/Rx	UART1
J1	4	PB1	JB_02/TX	Pmod connector B pin 2/Tx	UART1
J1	5	PE4	INT2_ACL	Accelerometer Interrupt Output	
J1	6	PF5	/RES_OLED	OLED reset	
J1	7	PB4	INT1_ACL	Accelerometer Interrupt Output	
J1	8	PA5	JA_02/MOSI	Pmod Connector A pin 2/Serial Out	SSI0
J1	9	PA6	SW2	Slide switch	
J1	10	PA7	SW1	Slide switch	
J2	1	-	GND	Ground	
J2	2	PB2	SCL	I^{2}C clock	I2C0
J2	3	PE0	BTN2	Push button	
J2	4	-	-	-	Not connected
J2	5	-	-	-	Not connected
J2	6	-	-	-	Not connected
J2	7	-	-	-	Not connected

J2	8	PA4	JA_03/MISO	Pmod Connector A pin 3/Serial In	SSI0
J2	9	PA3	JA_01/SS	Pmod Connector A pin 1/Slave Select	SSI0
J2	10	PA2	JA_04/SCK	Pmod Connector A pin 4/Serial Clock	SSI0
J3	1	-	-	-	Not connected
J3	2	-	GND	Ground	
J3	3	PD0	SCK_OLED	OLED serial clock	SSI3/SSI1
J3	4	PD1	/CS_OLED	OLED chip select	SSI3/SSI1
J3	5	PD2	BTN1	Push button	
J3	6	PD3	SDI_OLED	OLED serial data in	SSI3/SSI1
J3	7	PF1	VBAT_OLED	OLED VBAT enable	
J3	8	PE2	VDD_OLED	OLED VDD enable	
J3	9	PE3	AIN	Potentiometer	AIN0
J3	10	-	-	-	Not connected
J4	1	-	-	-	Not connected
J4	2	-	-	-	Not connected
J4	3	PB3	SDA	I^2C data	I2C0
J4	4	PF0	JB_04/RTS	Pmod connector B pin 4/Request to Send	UART1
J4	5	PF1	JB01/CTS	Pmod connector B pin 1/Clear to Send	UART1
J4	6	PC6	LD1	User LED	
J4	7	PC7	LD2	User LED	
J4	8	PD6	LD3	User LED	
J4	9	PD7	/DC_OLED	OLED data/command select	
J4	10		-		Not connected