Components

The Orbit-EDU board has the following components:

**TI MSP430 F1612 Microcontroller** is an ultra low power 16 bit microprocessor. It can support clock rates up to 8MHz. It has 48 KB of flash ROM for code, and 10 KB of RAM for data. It also has two 16-bit timers, eight 12-bit ADC inputs, two DAC outputs, two UART
(serial) ports, and 48 General Purpose IO (GPIO) pins. Note that multiple functions may be assigned to one pin, so not all features are available at a single time. The function and direction of each pin must be set in all programs. Unused pins should be set as GPIO outputs. Documentation for the microcontroller is provided in the MSP430 directory. The latest versions may be downloaded from http://focus.ti.com/docs/prod/folders/print/msp430f1612.html

**KCWireFree KC21 Bluetooth Module** is a small, power efficient Bluetooth module with a built-in antenna. Nonetheless, to enable better power management through complete shut-off, it is powered through a separate regulator which is controlled by the MSP430 (P5.6). This way, it can be completely powered down, which is more power efficient than any of the built-in power saving modes of the Bluetooth module. Communication between the MSP430 and the Bluetooth module is by means of UART0 at 115kbps with no flow control. There are two status LEDs which are controlled by the Bluetooth module, BT_EN and BT_radio. These status indicators can also be read by the MSP430 through P3.2 and P3.3 respectively. BT_EN indicates the Bluetooth module is enabled and operational. BT_radio indicates there is radio activity and/or a connection is established. Documentation for the Bluetooth module is provided in the KC21 directory. The latest versions may be downloaded from www.kcwirefree.com

**Kionix KXM52-1050 3-axis analog accelerometer** supports acceleration up to 2G and typical sampling rates of up to 3.1 KHz in the X and Y directions and up to 1.3 KHz in the Z (vertical) direction. The X, Y, and Z outputs are connected to the A0, A1, and A2 ADC inputs respectively. The PS (enable) pin is connected to P6.3 and should be low when the accelerometer is not used to conserve battery power. Documentation for the accelerometer is provided in the KXM52 directory. The latest versions may be downloaded from www.kionix.com

**NI LM20 BIM7CT analog temperature sensor** is a low-power precision temperature sensor that can operate over a -55 to +130 degree Celsius range. Its precision is typically 1.5 degrees. Its output is connected to A4. To enable further power management, it is powered by P6.5 of the microcontroller. By setting P6.5 to high or low, the LM20 is turned on or off, respectively. Documentation is provided in the LM20 directory. The latest versions may be downloaded from www.national.com

**MAXIM MAX604 3.3v Linear Regulators** provide regulated 3.3v power to the board and the Bluetooth module. Pin 4 is ENABLE and must remain high for the regulator to operate. Note that the LCD is connected to the unregulated supply. Documentation, while not required for board operation, is provided in the LM20 directory. The latest versions may be downloaded from www.maxim-ic.com

**Potentiometer (POT):** Used to adjust the contrast of the LCD. If nothing shows on LCD, turn the POT to the far clockwise end.

**Buttons S1, S2, S3, S4:** When pushed, will ground the inputs P0.0, P0.1, P0.2, and P0.3 respectively
**X1:** 32.768 KHz (low frequency) crystal number 1. It is not fitted and does not require external capacitors.

**X2:** 8 MHz (high frequency) crystal number 2. This can be optionally soldered on. The required external capacitors are already mounted on the board.

**DIP Switches**

The Orbit-EDU board has one DIP-switch with four switches. All switches will be on when moved up, towards their corresponding number marks. They have the following functionalities:

- **DIP 1:** Board power
  - On: Battery power enabled
  - Off: external / programmer power

- **DIP 2:** Bluetooth module power
  - On: Same as board
  - Off: Separate regulator

- **DIP 3:** Board power / programming
  - On: Programmer powers board
  - Off: Battery / external power source

- **DIP 4:** Programming
  - On: Programming on battery / external power
  - Off: Not programming or programming with programmer power

**Examples:**

Normal board operation with an external power supply: DIP 1, 3 & 4 off

Normal board operation with the on-board battery: DIP 1 will be the power switch. DIP 3 & 4 off.

Programming the board powered by the programmer: DIP 1 & 4 off, DIP 3 on.

Programming the board powered by an external power supply: DIP 1 & 3 off, DIP 4 on.

Programming the board powered by the on-board battery: DIP 1 & 4 on, DIP 3 off.
**LED Status Indicators**

The Orbit-EDU board has the following LED indicators:

LED1: Board power

LED2: Bluetooth module power

LED3: BT_EN Bluetooth module enabled. Shows that the internal CPU of the Bluetooth module is running. This is the GPIO1 output of the Bluetooth module (page 31 of the *kcSerial User Guide*). Can be read by the CPU from P3.2.

LED4: BT_radio Bluetooth module baseband radio enabled. Shows the Bluetooth module has radio activity (scanning) or is connected. This is the GPIO4 output of the Bluetooth module (page 31 of the *kcSerial User Guide*). Can be read by the CPU from P3.3.

Note: Bluetooth connected is GPIO2. It may be possible to hack the board to replace LED3 with GPIO2 instead of GPIO1 by cutting the trace to pin 17 of the module (from right beside the module), and connecting the pins corresponding to pin17 and pin19 on the BT_CON connector together.

LED5: Indicator LED controlled by the MSP430. It is connected to P5.3 and is active high (lights up when the output is 1).

**Connectors**

The Orbit-EDU board has the following connectors:

JTAG: interface to the programmer (MSP-FET430UIF or similar).

LCD_CON: to interface with a 2x8 character LCD (Optrex DMC-50448N-AAE-AD). The LCD is powered by the UNREGULATED supply.

SENSE: Voltage across 1 ohm resistor which is serial to the entire board. The voltage across it is directly proportional to the current consumption of the entire board. The voltage drop is usually insignificant, and can be totally eliminated by placing a jumper across this connector.

POWER: DC voltage in, from an external power supply. Voltage should be 5-7v. Reverse polarity will not damage the board, as it is protected with a diode and will just not work.

JP1, JP2, JP3, JP4: Enables access to all 64 pins of the processor. Noise on some pins (especially the crystal and JTAG pins), for example from a user’s touch or sometimes even a probe, WILL cause irregular operation of the board.

BT_CON: Enables access to the pins of the BT Module. Noise on some pins, for example from a user’s touch, or sometimes even a probe may cause irregular operation of the board.
T1, T2, ..., T8: Touch sensors, are pulled up by 1 Mega-ohm resistors, and are connected to P1.0, P1.1, ... P1.7 on the MSP430 respectively.

Warning

Fire hazard: The battery is a 3.6v Lithium Ion rechargeable cell (LIR2032). Lithium Ion batteries can catch fire or explode if connected improperly, subject to a short circuit, or subject to extreme mechanical shock. Users must pay extreme attention to observe the correct polarity, and to not short circuit the battery, both on the board and elsewhere. Only use chargers that are specifically designed for charging the specific type of Li-Ion battery you are using. Never try to charge the battery using any other method. In any case, use caution when working with all electric / electronic devices, either connected to mains power or battery powered.
Board Schematic