



### Hardware Features

- 16.0mm x 15.0mm x 2.3mm
- CSR1010  $\mu$ Energy Chipset
- Range Up To 200m
- +7.5dBm Transmitter
- -92.5dBm Receiver Sensitivity
- 12 Digital Programmable I/O Pins
- 3 Analog Programmable I/O Pins
- UART Interface
- 50 $\Omega$  External Antenna Port
- PWM Drivers

### Applications

- Wireless Mesh Networking
- iBeacon
- Tracking Sensors
- Medical Monitoring
- Key Finder
- Keyboards
- Remote Controls

### Firmware Features

- Bluetooth v4.0 Low Energy (Single Mode)
- Wireless Data Communications System
- Wireless Firmware Updating
- Easy To Use AT Command Interface Using UART
- Up To 80Kbps data transfer
- Custom Firmware Available

### Description

The KC-4014 low energy modules are pre-engineered, pre-qualified, and highly tuned surface mount PCB modules that provide fully embedded, ready to use Bluetooth low energy wireless technology. Multi-surface pads provide both bottom pads for high volume reflow soldering and edge pads for low volume hand soldering.

Our kcEnergy embedded firmware provides an easy to use AT style command interface over UART. kcEnergy is capable of storing OEM default settings, and is wirelessly upgradable. kcEnergy also provides remote control capability, where our AT commands can be issued remotely from any other Bluetooth Low Energy or dual mode EDR device using GATT. Custom firmware is available upon request.



## Standard Bluetooth Low Energy Profiles

The KC-4014 Low Energy modules comes standard with KcEnergy firmware which includes support for GAP, GATT, FMP, PXP, LLS, Device Information, Battery profiles, and other profiles and services. Here is a description of some of the main ones.

### **GAP – Generic Access Profile**

The Generic Access Profile is a BLE mandatory profile responsible for the device name, appearance and Bluetooth connecting, advertising, and scan responses. It determines device interactions and defines the peripheral or central roles between two devices. It is also where pairing, bonding, and security measures take place.

### **GATT – Generic Attribute Profile**

The Generic Attribute Profile is the profile in which determines how two BLE devices transfer data via the client/server relationship. The server is the device with the service and the client is the device that communicates with the server to complete the service. The GATT governs profiles, services, and characteristics transactions. Its job starts once two devices are connected. Other BLE profiles, besides GAP, are GATT based.

### **FMP – Find Me Profile**

The Find Me Profile is a profile designed for locating another low energy device. An alert signal is activated on one device, while a trigger is set on the other device.

### **PXP – Proximity Profile**

The Proximity Profile is used as an alert system that activates when two connected devices become out of range or beyond a desired distance. This triggers a response for the device, such as locking down, shutting off or perhaps rescanning for devices. It can also be used to detect when devices are closer, such as to trigger a different response like reconnection. It works in a proximity monitor and proximity reporter relationship where the GATT server is the proximity reporter.

### **LLS – Link Loss Service**

The Link Loss Service is responsible for defining the behavior of a device after a link is lost between two devices. This service does not require other GATT –based services or devices.

### **BAS – Battery Service**

The battery service is an internal device service that monitors and exposes the state of the battery within a device.

### **OTA– Over The Air Update mode**

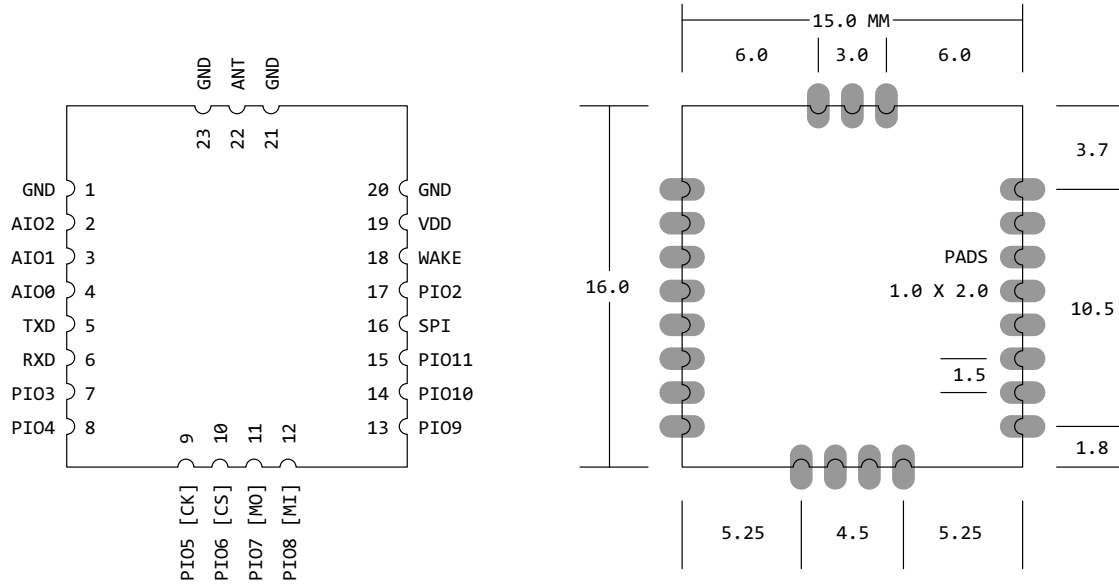
The over the air update mode enables users to update the application software using a wireless server/client connection. This is a different operating mode from the devices normal operating mode. The host device will actually disconnect from the server and then reconnect under the update mode. When the update is complete, the host disconnects and then resets, starting the new device application. Upon updating, the GATT database may change depending on the actions of the update.

### **Other Bluetooth Low Energy Profiles**

KC-4014 is capable of supporting additional Low Energy profiles. Please contact KC Wirefree for customization options.

## Physical Dimensions

KC-4014 Top View



### Pin Assignment

Pin	Function	Type	Description
1	GND	--	Ground
2	AIO2	I/O	Analog programmable I/O
3	AIO1	I/O	Analog programmable I/O
4	AIO0	I/O	Analog programmable I/O
5	TX [PIO0]	Output	UART data out [PIO 0]
6	RX [PIO1]	Input	UART data on [PIO 1]
7	PIO3	I/O	Digital programmable I/O
8	PIO4	I/O	Digital programmable I/O
9	PIO5 [CK]	I/O	Digital programmable I/O [SPI CLK]
10	PIO6 [CS]	I/O	Digital programmable I/O [SPI CS]
11	PIO7 [MO]	I/O	Digital programmable I/O [SPI MOSI]
12	PIO8 [MI]	I/O	Digital programmable I/O [SPI MISO]
13	PIO9	I/O	Digital programmable I/O
14	PIO10	I/O	Digital programmable I/O
15	PIO11	I/O	Digital programmable I/O
16	SPI	Input	HIGH enables SPI signals on PIO 5,6,7,8
17	PIO2	I/O	Digital programmable I/O [used during startup for EEPROM reading]
18	WAKE	Input	Sleep mode wakeup
19	VDD	Input	Power Supply 1.8V – 3.6V
20	GND	--	Ground
21	GND	--	Ground
22	ANT	RF	50Ω External antenna port
23	GND	--	Ground

Optional feature assignments shown in [brackets]

## Interface Pins

### AIO Interface Pins [2,3,4]

AIO 0, AIO 1, and AIO 2 are enabled for analog input by default, providing 10 bit samples. Analog pins are 1.8V logic for input mode. Voltage reading accuracy is guaranteed to 10 bits resolution. AIOs can also be used as digital PIOs if need be.

### UART Pins [5,6]

The UART is industry standard, and operates at a logic level of VDD. A buffered signal IC is recommended for voltage translations to different UART voltages. UART pins can be re-assigned as PIO pins in firmware if desired. Available settings: 1200 – 2Mbps Baud rates, RTS/CTS flow control is available as a software implementation, None/Odd/Even parity, Stop Bits 1/2, Data Bits 8. Factory default is 115200-8-N-1.

### PIO Interface Pins [7,8,9,10,11,12,13,14,15,17]

PIO pins are read and write enabled via kcSerial commands. Inputs can be configured for weak pull-up, weak pull-down, strong pull-up, strong pull-down. Voltage input tolerance and output level is equal to the VDD level. Note Pin 17 (Pio 2) is used to control the EEPROM during startup. Afterwards, it is available for general use.

### SPI Pins [9,10,11,12,16]

The SPI pins are only available for firmware loading and test tools. Pin 16 [SPI] (HIGH) enables the SPI bus on pins 9 [CK], 10 [CS], 11 [MO], 12 [MI]. Otherwise, these pins operate as PIO pins.

*We highly recommend providing a header or test points for each of these pins for emergency diagnostics access.*

### Wake Pin [18]

The wake pin will exit all sleep modes. It is the only pin that will wake the device from the deepest sleep mode (Dormant).

### VDD Pin [19]

Voltage supply pin accepts voltages between 1.8V - 3.6V. If a voltage regulator is used, it should have a fast response time < 20 $\mu$ s. It is essential that the power rail recover quickly. We recommend Texas Instruments TLV71333PDBVR. If a lithium coin battery is used, a large bypass capacitor (47 $\mu$ F – 100 $\mu$ F) is highly recommended due to increasing battery resistance when depleting. Note, the USB, UART, and PIO pins high outputs will be driven relative to this VDD input voltage level.

### GND Pin [20,21,23]

System ground.

### Antenna Pin [22]

A 50 $\Omega$  antenna port is provided. A simple printed antenna, chip antenna, or antenna connector can be attached without additional matching circuitry required.

## Current Consumption

Operation Mode	Consumption	Wake Time	Description
<b>Wireless TX/RX</b>	< 16mA		Wireless operations.
<b>Idle</b>	<1 mA	Wake time < 1 $\mu$ s	All systems are active, without wireless activity.
<b>Deep Sleep</b>	< 5 $\mu$ A	Wake time < 1ms	Wireless radio is still available and UART is only available if baud rate is <2400 bps. Analog outputs are off. Device can wake up with radio, Uart, PIO, or WAKE pin activity.
<b>Hibernate</b>	<1.5 $\mu$ A	Wake time < 1ms	Wireless radio and most other systems are off, but RAM is still active and firmware still runs. Device can wake up with an internal timed event or WAKE pin.
<b>Dormant</b>	<600 nA		Only an internal clock is running. Device can wake up with WAKE pin only. The device essentially reboots and loads firmware upon wake up.

### Electrical Characteristics

(Conditions VDD= 3.3V and 25 °C)

Absolute Maximum Ratings	Min	Max	Unit
VDD	1.8	4.2	V
I/O	-0.4	3.6	V
Temperature	-40	85	°C

Recommended Operating Conditions	Min	Max	Unit
VDD	1.8	3.6	V
Current		50	mA
Temperature	-30	85	°C

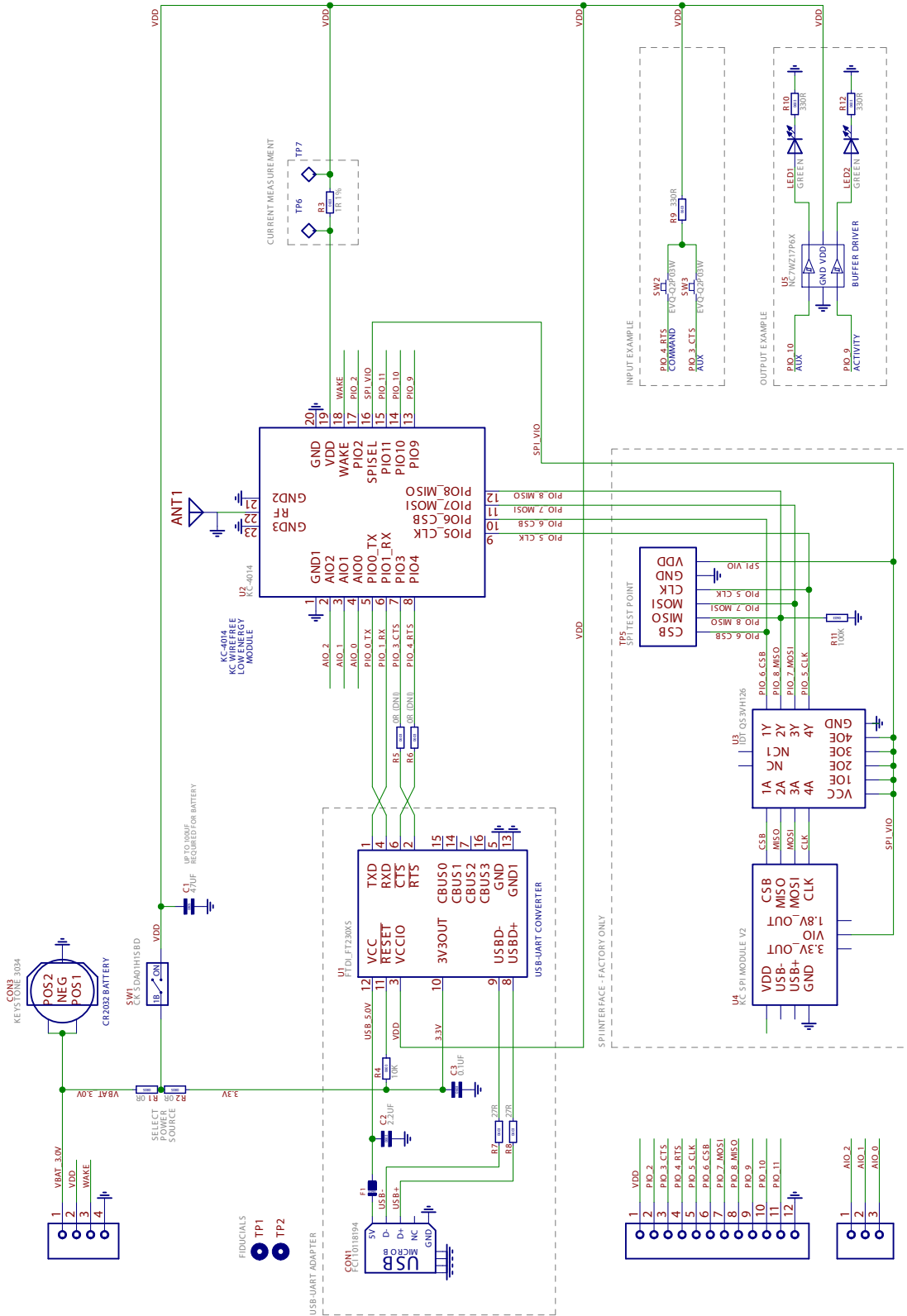
Digital PIO & UART Pins	Min	Max	Unit
Logic Low Input	-0.4	0.3 x VDD	V
Logic High Input	0.7 x VDD	VDD + 0.4	V
Logic Low Output	0	0.4	V
Logic High Output	0.7 x VDD	VDD	V
Current Input (weak pull down / strong pull down)		5 / 150	μA
Current Output		4	mA

Analog I/O Pins	Min	Max	Unit
Input	0	1.35	V
Output	0	1.35	V
Current Output		30	mA
Resolution		10	Bits
Accuracy		+/-1	Bit
Sample Rate		700	Samples/s

RF Characteristics	Typical	Unit
Load	50	Ω
PA Transmit	+7.5	dBm
LNA Receive Sensitivity	-92.5	dBm

### Example Hardware Interface Connections

This example schematic is our DEMO-4014 v3 Evaluation Board.





## Firmware Interface

Our kcEnergy firmware offers an easy to use AT Command set to issue configuration and operational commands via UART, using simple text strings. Firmware can be updated wirelessly.

kcEnergy firmware will be updated continuously for at least the next 12 months.

Firmware updates are performed wirelessly from a PC using a firmware update application (provided by KC Wirefree) and Bluetooth low energy (a Bluetooth low energy USB micro dongle is available from KC Wirefree).

## Qualifications

### Bluetooth

Qualification Design ID: B017702.

The KC-4014 is registered with and licensed by Bluetooth SIG as a qualified design. KC Wirefree provides a Qualified Design that should be sufficient for product licensing without additional Bluetooth testing requirements. Usage of Bluetooth registered trademarks must be licensed directly from Bluetooth SIG. Please contact Bluetooth SIG regarding product licensing fees.

### FCC

Pending

### CE

Pending

### Industry Canada

Pending

### SAR

Pending

## Datasheet Versions

Revisions	Changes
Jan 30, 2015	Initial Release
Apr 13, 2015	Schematic update

## Ordering Information

Order Part Number	Description
KC-4014.0	BlueEnergy Module
Product Series	KC-4014
Product Version	0
Country of Manufacture	USA

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