

# The CogBag RFID Reader (Plus)

## V1.2 – October 17, 2005

At the heart of the Cognitive Bag is an RFID reader positioned to monitor specially-tagged bag contents. Such contents include, but are not limited to: Wallet, keys, bus pass, and medication. So important is the RFID reader to the operation of the bag that all other peripherals should be considered secondary.

The RFID reader we're using is the SkyeTech model M1 with an EA1 antenna module. Experimentation shows that we can get 4" range with a 2x2" tag, and 6" range with a 4x3" tag. The pinout of the EA1 is as follows:

<u>Pin</u>	<u>Function</u>
1	+5V
2	GND
6	UART TTL RX – 9600N81
7	UART TTL TX – 9600N81

We attach the SkyeTech RFID reader to a mote by connecting the EA1's TX (pin 7) to the mote's USART1 RX (pin 19) and the EA1's RX (pin 6) to the mote's USART1 TX (pin 20) lines. Ensure the grounds are common between the devices and you're good to go.

To the mote, we've also attached a vibration sensor across pins 1 and 4. This allows us to detect when the bag is moving or otherwise being manipulated by the user.

Additionally, we've given the mote control of a sound module and amplifier system. The mote's pin 9 can be pulsed to activate a ring tone, and pin 10 is used to drive an amplifier. Together, these connections provide enough control so that the mote can make the bag ring much like a cellular phone when attention is required.

### The Radio Packet Interface

The RFID sensor has been designed to work hand-in-hand with modes 3 & 4 of the Mote Modem. This makes it easy for people to interact with the sensor without requiring specific knowledge of TinyOS messages.

Using a Mote Modem in mode 3 or 4, you can interact with the sensor using simple text queries and/or commands. Most responses are rather self explanatory.

<u>Query:</u>	<u>Response:</u>
PING	RFID_PONG
RFID_POWER	RFID_MV=nnnn (3400 typical)
RFID_HASMOVED	RFID_MOVEDYES or RFID_MOVEDNO
RFID_CONTENTS	ID=nnnnnnnnnnnnnnnn for every item in bag.
RFID_YELLOWON	RFID_YELLOWISON
RFID_YELLOWOFF	RFID_YELLOWISOFF

RFID_REDON	RFID_REDISON
RFID_REDOFF	RFID_REDISOFF
RFID_GREENON	RFID_GREENISON
RFID_GREENOFF	RFID_GREENISOFF

### **The Serial Interface on USART0**

By default, the sensor's USART0 has been programmed to operate at 9600 baud, N81. You can connect the device to a PC by using the Crossbow MIB510 interface board and a program such as HyperTerminal.

Alternatively, a TTL connection is available on J21 or J22. Attach to pin 28 as transmit data (data from the mote to an external device). This connection is meant for embedding the unit into a larger system, as you cannot connect directly to a PC using this method—a TTL to RS-232 adapter is required. If you really want to connect to a PC and not use the MIB510, adapters are readily available from HVW Technologies ([www.HVWtech.com](http://www.HVWtech.com)) for only \$10.

When the sensor first powers-up, the following sign-on message is displayed:

```
Extended TOS Platform.  
APP: MOTE RFID  
Aug 18 2005 at 13:56:02
```

The sign-on message is the best opportunity to verify that the serial connection has been made correctly, and that the sensor has been programmed with the correct version of software.

### **Operation**

The RFID sensor can take the same commands through USART0 as it normally would through the radio. This allows a PC or other computer to use the RFID device directly.

Another exciting feature of the RFID sensor is that it will forward text strings through its radio in a format compatible with Modes 3&4 of the mote modem. The RFID sensor will also listen for Modes 3&4 messages coming in over the radio, and forward them to USART0. In this way, the RFID sensor behaves as both sensor and Mote Modem.

### **Command and Control**

The RFID Sensor can be configured through USART0 using familiar AT-style command strings, similar in spirit to a Hayes smart modem. The device can be put into a "command" mode by sending it the string "ATCOMMAND" (without the quotes) on USART0, followed by a carriage return [cr] character.

It is envisioned that a systems integrator will configure the device using a terminal program such as HyperTerminal. When the integrator enters the command string

“ATCOMMAND” (without the quotes) followed by a carriage return, the following is displayed:

```
CMD MODE BEGIN
OK
```

The integrator could now get the menu of commands available. This is accomplished by typing “ATH” followed by a carriage return. The following is displayed:

```
COMMANDS :
ATBAUD4800 .. SETS 4800 BAUD
ATBAUD9600 .. SETS 9600 BAUD
ATBAUD19200 .. SETS 19200 BAUD
ATBAUD38400 .. SETS 38400 BAUD
ATBAUD57600 .. SETS 57600 BAUD
ATDEFAULT .. RESTORES SYSTEM DEFAULTS
ATINITR .. SETS INIT STATE OF RED 1=ON 0=OFF
ATINITG .. SETS INIT STATE OF GREEN 1=ON 0=OFF
ATINITY .. SETS INIT STATE OF YELLOW 1=ON 0=OFF
ATECHO .. ECHO CHARACTERS ON USART0 1=YES 0=NO
AT2TXn .. TRANSMIT PACKETS TWICE 1=YES 0=NO
ATSHOW .. SHOW CURRENT SETTINGS
ATSAVE .. EXIT COMMAND MODE & SAVE
ATEXIT .. EXIT COMMAND MODE WITHOUT SAVING
ATH OR AT? .. THIS SCREEN
OK
```

The baud rate commands are self explanatory.

Use ATINITR, ATINITG, and ATINITY to set the initial power-on state of the red, green, and yellow LEDs respectively. This is especially useful when external devices are controlled by the LED signals.

The AT2TX setting applies to transmitted packets. When enabled, all radio packets are actually sent twice. This increases the odds of a packet getting through in some situations, but comes at the expense of increased network congestion. Note that the RFID Mote is intelligent enough to reject redundant packets, so that if the same packet is received twice within a small time window, the extra packet is dropped.

Command ATECHO controls whether or not characters received on USART0 are sent back out USART0. Terminal programs may appreciate the echo where some other application code may not.

Use ATSHOW to display current settings. An example show is as follows:

```
SETTINGS :
BAUD=9600
AT2TX=0
ATECHO=0
OK
```

Command ATSAVE is used to save the settings into flash and exit command mode. The unit will automatically reset and the new settings will take effect.

Command ATEXTIT is used to exit command mode without saving the settings into flash. The unit will automatically reset and the old settings will be restored.