ROCHESTER INSTITUTE OF TECHNOLOGY
MICROELECTRONIC ENGINEERING

Blue Tooth – Basics
Using BT-Arduino

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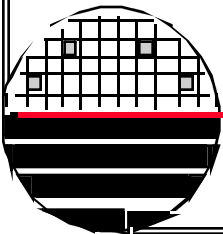
10-28-11 BluetoothBasics.ppt
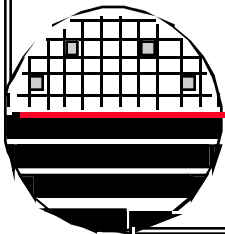
OUTLINE

Introduction
Definitions
Bluetooth Versions
Wireless Class
Code
Arduino-Bluetooth
BlueGiga Transceiver Used On Arduino
BlueGiga Hardware
Homework Questions

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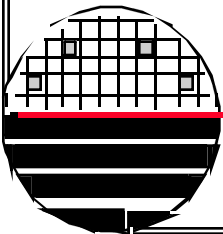
BLUETOOTH INTRODUCTION

Bluetooth is a proprietary open wireless technology standard for exchanging data over short distances (using short wavelength radio transmissions in the ISM band from 2400-2480 MHz) from fixed and mobile devices, creating personal area networks (PANs) with high levels of security. Created by telecoms vendor Ericsson in 1994, it was originally conceived as a wireless alternative to RS-232 data cables. It can connect several devices, overcoming problems of synchronization.

http://en.wikipedia.org/wiki/Bluetooth

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DEFINITIONS

Arduino – refers to a project that provides open source hardware
and software to learn by doing projects with micro controllers.

Arduino-BT – one of the several Arduino hardware platforms
available containing a micro controller, power regulator,
Blue Tooth Transceiver, interconnect pins, sockets, crystal,
LEDs and other components.

Shield – an add on hardware board that plugs into the Arduino micro
controller platform and provides additional capabilities such as
analog signal processing, WiFi, etc.

Processing – a "C" based software programming tool to create
graphical output and communicate with hardware platforms
such as the Arduino Uno.

Sketch – name for the "C" programs used by "Processing" and by
"Arduino" software to make the hardware do something and
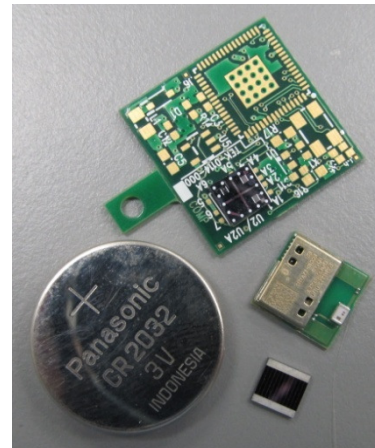to process the results.

WIRELESS MICROSYSTEMS

Capacitor Sensor

Bluetooth
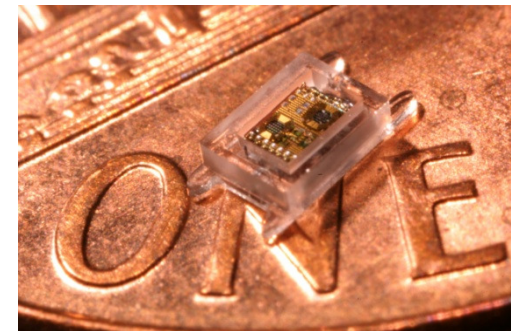Transceiver

Wireless Platform
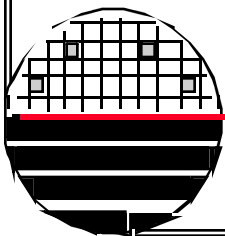Breadboard
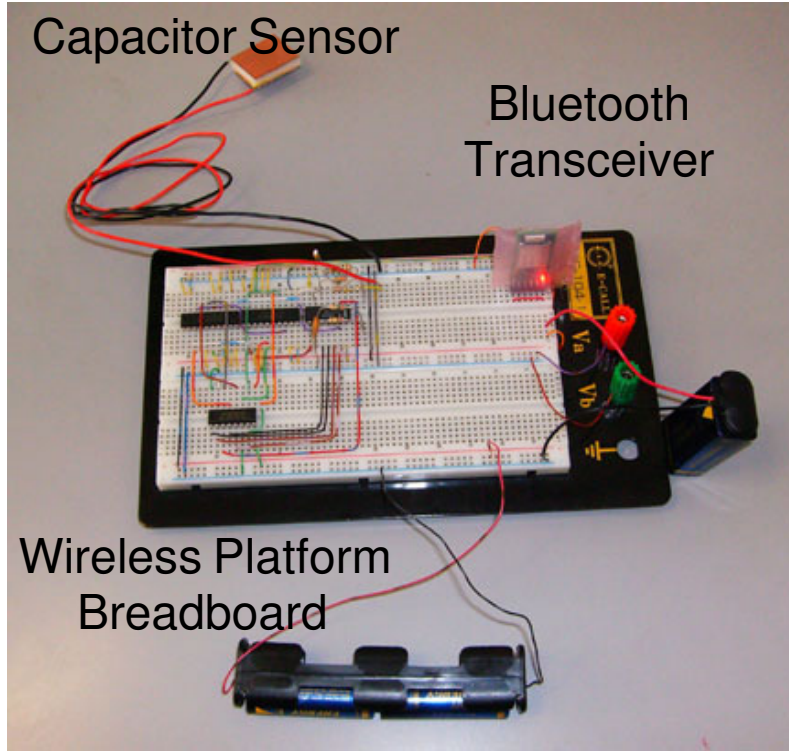
5" x 8" Breadboard
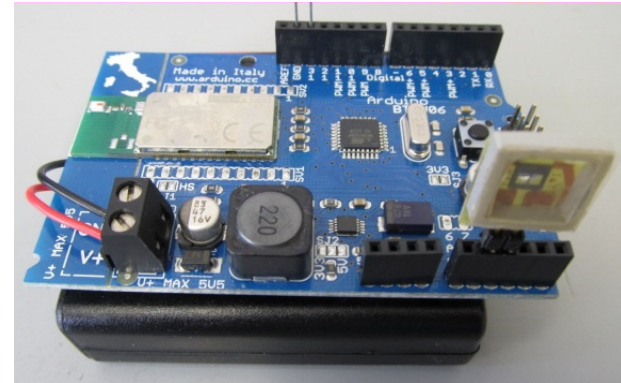
2.5" x 3" BT-Arduino

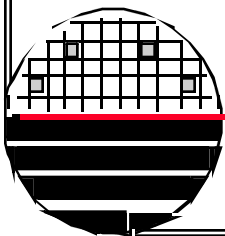1" x 1" PCB

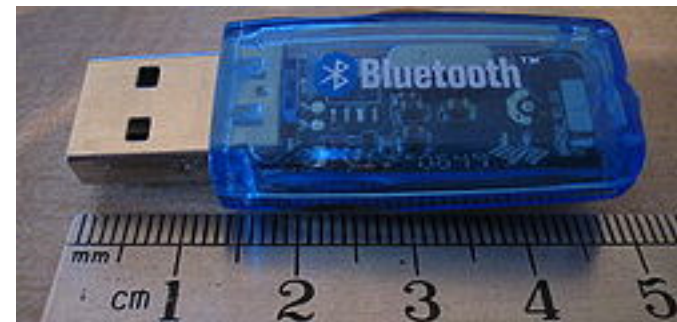2mm x 3mm
Custom CMOS & MEMS

BLUETOOTH

Bluetooth V2.0 and V2.1 Rate ~3Mbit/s

Bluetooth V3.0 Rate ~24Mbit/s

Bluetooth V4.0 Rate ~24Mbit/s + Low Energy

Hardware to transmit and receive radio signals

Transceivers, Dongles both with antennas

BLUETOOTH POWER CLASSES

The following table compares the available Bluetooth power classes:

|	Maximum Power	Operating Range
Class 1	100mW (20dBm)	100 meters
Class 2	2.5mW (4dBm)	10 meters
Class 3	1mW (0dBm)	1 meter

The actual range for each power class may vary depending upon environmental factors where the Bluetooth device is used.

- If you wish to communicate over the **100m** range, you will need a **class 1** Bluetooth device at **both** ends.

- If you wish to communicate over the **10m** range, you can have a **class 1 or class 2** device at both ends.

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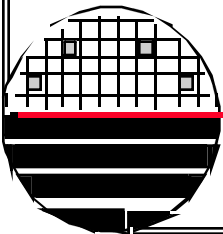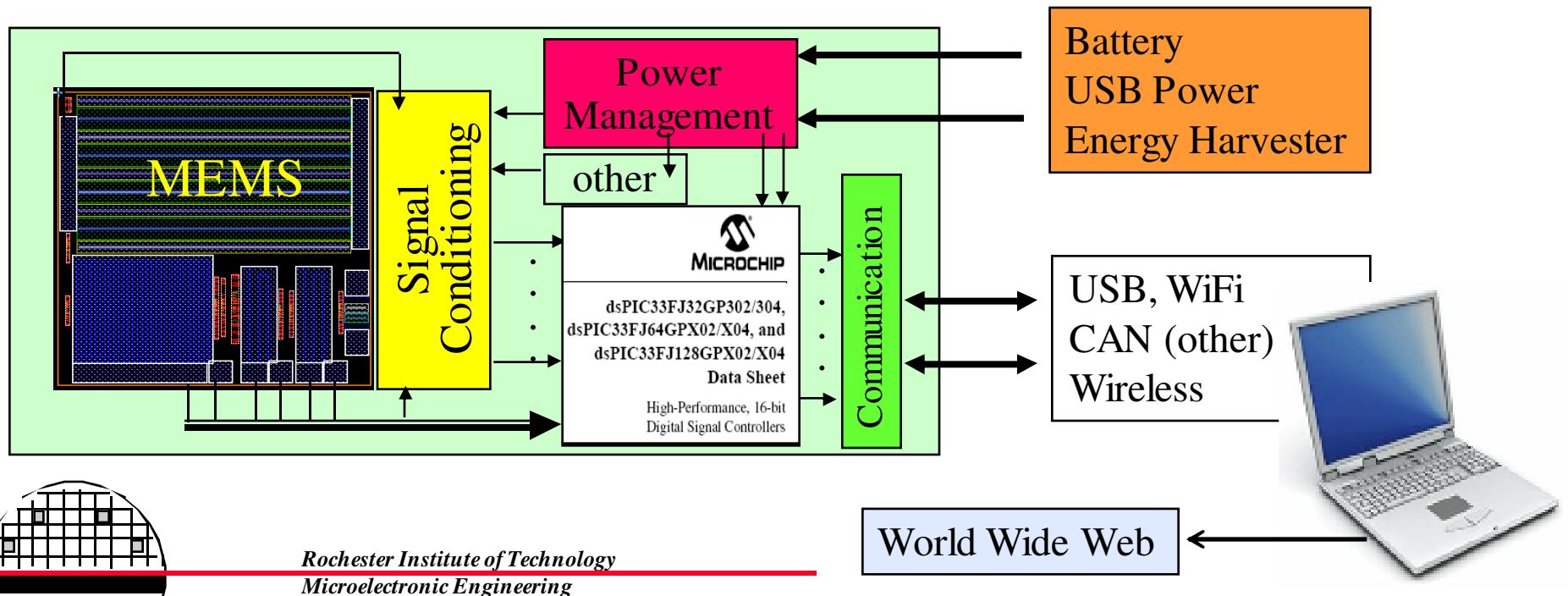
PERSONAL AREA NETWORKS (PAN)

At any given time, data can be transferred between the master and one other device (except for the little-used broadcast mode). The master chooses which slave device to address; typically, it switches rapidly from one device to another in a round-robin fashion. Since it is the master that chooses which slave to address, whereas a slave is (in theory) supposed to listen in each receive slot, being a master is a lighter burden than being a slave. Being a master of seven slaves is possible; being a slave of more than one master is difficult. The specification is vague as to required behavior in scatter nets.
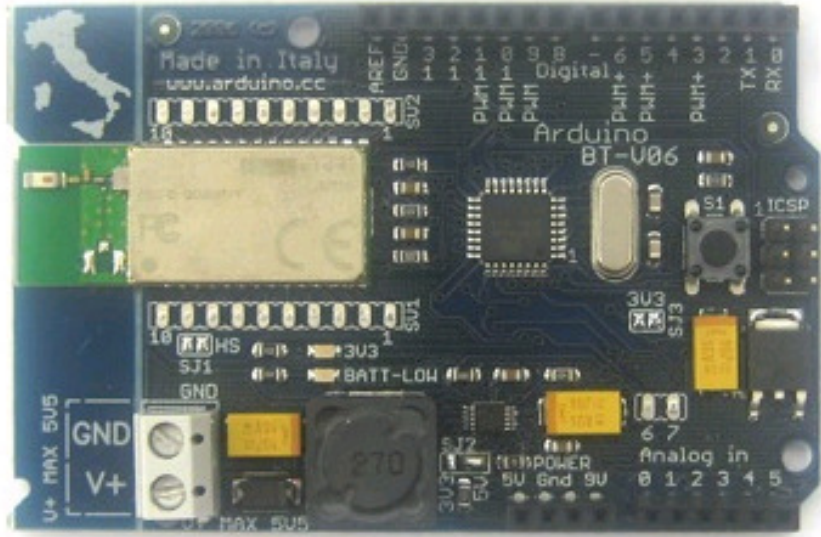
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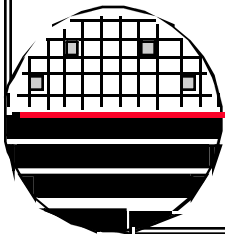
MICROSYSTEM

Our definition for Microsystems is the integration of MEMS sensors and actuators with CMOS electronics to provide solutions for a wide variety of applications including automotive, military, aerospace, consumer and biomedical.

MEMS

Signal Conditioning

Power Management

other

MICROCHIP

dsPIC33FJ32GP302/304, dsPIC33FJ64GPX02/X04, and dsPIC33FJ128GPX02/X04

Data Sheet

High-Performance, 16-bit Digital Signal Controllers

Communication

Battery
USB Power
Energy Harvester

USB, WiFi
CAN (other)
Wireless

World Wide Web

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ARDUINO BLUETOOTH

Microcontroller ATmega328
Operating Voltage 5V
Input Voltage (limits) 1.2-5.5V
Digital I/O Pins 14
   (of which 6 provide PWM output)
Analog Input Pins 6
DC Current per I/O Pin 40 mA
DC Current for 3.3V Pin 50 mA
Flash Memory 32 KB (ATmega328)
   of which 0.5 KB used by bootloader
SRAM 2 KB (ATmega328)
EEPROM 1 KB (ATmega328)
Clock Speed 16 MHz

BT-Arduino Development Board
2" x 2 ¾"
~$100

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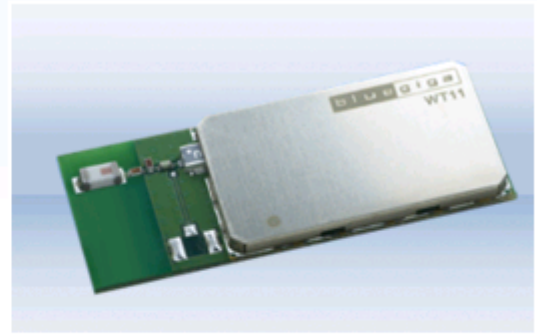## *BLUEGIGA WT11 MODULE USED WITH ARDUINO*

WT11 is a next-generation, class 1, *Bluetooth* 2.1 + EDR module. It's a highly integrated *Bluetooth* module, containing all the necessary elements from *Bluetooth* radio to antenna, and a fully implemented iWRAP protocol stack.

Key Features:

- *Bluetooth* class 1
- Integrated chip antenna or U.FL connector
- USB, UART, GPIO, AIO and PCM interfaces
- 802.11 co-existence interface
- 8MB flash memory
- Size: 35 x 14 x 2,3mm
- Simple iWRAP firmware for controlling *Bluetooth* wireless technology
- Industrial temperature range from -40C to +85C
- RoHS compliant
- Up to 14 supported *Bluetooth* profiles in iWRAP firmware
- Also available with HCI firmware
- Support for on-board applications
- Fully qualified end product with *Bluetooth* 2.1+ EDR, CE, IC and FCC

Used on ArduinoBT
　　　　Development Board

Arduino Bootloader (reconfigurable)
Baud Rate Set at 115200
Device Name Set to: ARDUINOBT
Access Code Set to: 12345

Description

Bluegiga WT11 provides an ideal solution for developers that want to integrate *Bluetooth* wireless technology into their design with limited knowledge of *Bluetooth* and RF technologies. By using WT11 combined with Bluegiga's complete development, testing and verification service offering and excellent developer support, OEMs and designers ensure that their products reach the market rapidly and cost-effectively in relation to time and resources. Bluegiga has in-house knowledge of both software and hardware - offering customers a single point of contact for all *Bluetooth* related issues.

OTHER BLUEGIGA HARDWARE

SETTING UP BLUETOOTH ARDUINO

Blink Program Test
Install BT adapter
        *DO NOT install the software with the adapter, it will keep on scanning the ports and slow down the reaction of Arduino. Let the Windows native driver work and ignore the other failed installation service, because only the serial communication is necessary.
Find Bluetooth device
        *Turn on the board, then right click on the Bluetooth icon appear on the bottom right corner>Add a device>choose **ARDUINOBT** and input the pass code **12345**>pair success
Check the automatic port setting
        *Right click on the Bluetooth icon appears on the bottom right corner>Open Settings>COM Ports Set the port number and restart PC
        *Right click on Computer icon>Manage>Device Manager>Ports(COM & LPT)>right click on the port(Standard Serial over BT link(COM#))>Properties>Port Settings>Bits per second=115200 and Advanced>COM Port Number
        *Choose a low port number that has not been used by other devices
Choose the correct board at Arduino IDE
        *Tools>Board>Arduino BT w/ATmega328
Choose the correct serial port. Only both outgoing and incoming ports show up in the menu, the board can work and respond correctly.
        *Tools>Serial Port>choose the outgoing port you set
Connect the LED between pin 13 and GND
Upload the blink program
        *Type in the code>Compile>Upload (press the reset button after binary sketch size showing up)
**Blink !!**

MONITORING MORE THAN ONE DEVICE

```
/* Arduino  BT Configuration File   Feb 05 2007
* Upload  and  run this file  <<once>> to configure  the  name  or other  variables  of your
BT module.
* Don't forget  to reset  your module  so that the new  commands  are executed.
* Massimo  Banzi
*/
int LED = 13;          // select  the pin for the LED
int RESET = 7;          // BT module  uses pin 7 for reset

void setup() {
 pinMode(LED,OUTPUT);          // declare  the LED and BT RESET pins as output
 pinMode(RESET,OUTPUT);
 Serial.begin(115200);// connect  to the serial  port

 digitalWrite(RESET,  HIGH);
 delay(10);
 digitalWrite(RESET,  LOW);
 delay(2000);
```
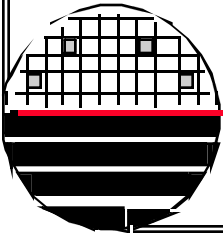
CHANGING DEVICE NAME AND AUTHORIZATION CODE

```
// the following "SET BT" commands are one-time commands
// that only need to be uploaded to your BT module and run
// when you want to change the BlueGiga's configuration.
// ok. First, the easy to change configuration commands:

 Serial.println("SET BT NAME ChenArduino");
// you can change the name of your module here.
// No spaces allowed in the name; names can be up to 256 charcters.
// Serial.println("SET BT NAME KarlMarx");        // example

 Serial.println("SET BT AUTH * 123123");
// 12345 == 0 to 16 digit Bluetooth passkey/PIN code
// Serial.println("SET BT AUTH * 987654321");     // example
}

void loop() {
 digitalWrite(LED, HIGH);
 delay(100);
 digitalWrite(LED, LOW);
 Serial.println("goodjob!");
 delay(1000);
}
```
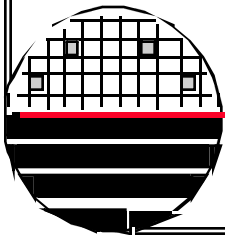
BATTERIES

Arduino-BT running blink and serial port write every second uses 20 mA at 3volts or 60 mW

AA Battery Stores ~2000 mAh of Charge Q
    Time = Q / I = 2000 / 20 = 100 hours

CR2032 Battery Stores ~200 mAh of Charge Q
    Time = 200/20 = 10 hours
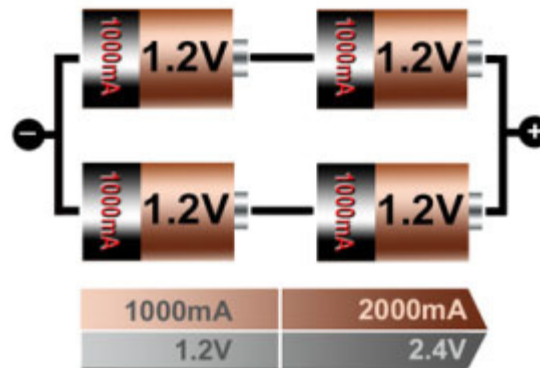
1 month is 720 hours
Current = Q / time
    I = 2.8 mA

Battery Type	Capacity (mAh)
D	12000
C	6000
AA	2000
AAA	1000
N	650
9 Volt	500
6 Volt Lantern	11000

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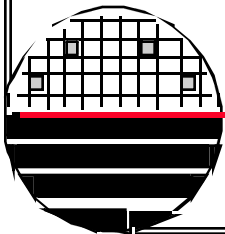*Microelectronic Engineering*
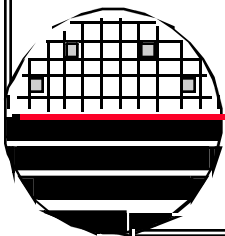
BATTERIES

Batteries in series doubles the voltage but maintains the same capacity
Batteries in parallel doubles the capacity but maintains the same voltage

1000mA	2000mA
1.2V	2.4V

Four AA connected batteries as shown give 4000mAh at 2.4V

2000 mAh, at 1.2V

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REFERENCES

1. Spark Fun Products, http://sparkfun.com
2. Arduino Home Page, www.arduino.cc
3. Processing Home Page, http://processing.org
4. www.bluetooth.com
5. Wikipedia   http://en.wikipedia.org/wiki/Bluetooth
6. Bluetooth BTD211 Micro USB 2.1 Adapter, BlueSoleil software supportfrom Azio Corporation, www.aziocorp.com
7. BlueGiga Company http://www.bluegiga.com

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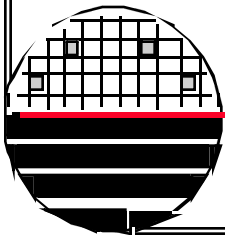
HOMEWORK – BLUETOOTH BASICS

1. None
2. None

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