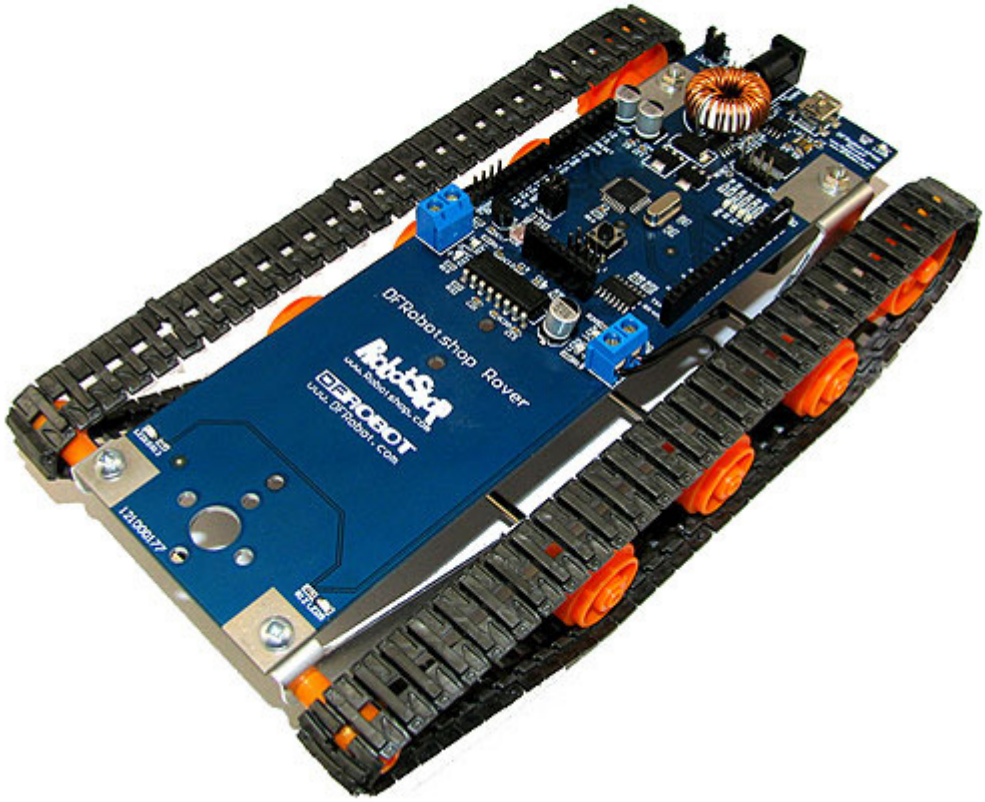
ROVER



USER GUIDE v1.5

This guide is only available in English

Ce manuel est seulement disponible en Anglais

RobotShop Inc. www.RobotShop.com

Contents

Key Features

- Bare-bones, highly versatile, programmable robot tank kit
- Arduino compatible based on ATMEga328 with 13 digital and 8 analog I/O, 3.3V and 5V output
- Dual H-bridge and onboard voltage regulator (only one battery needed)
- Compatible with a variety of shields
- Temperature and light sensor included
- No soldering required

Description

The DFRobotShop Rover – Arduino Compatible Tracked Robot (Basic Kit) is a versatile mobile robot tank based on the popular Arduino Duemilanove microcontroller. The Rover uses the popular Tamiya twin motor gearbox and the Tamiya track and wheel set. The DFRobotShop Rover PCB incorporates a standard Arduino Duemilanove (surface mount ATMega328), L293B motor driver (connected to pins 5 to 8), voltage regulator and prototyping area while contributing to the mechanical structural of the robot. The voltage regulator allows the entire board to be powered using as little as 3.7V to ~9V*.

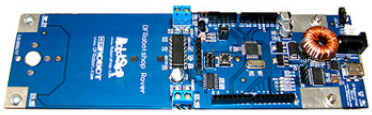
In order to make assembly as easy as possible, solderless quick connect terminals have been included to give customers the option of crimping the wires to the motors or using solder. The DFRobotShop Rover is compatible with a variety of shields (when used at the same time as the motor driver). Additional features include a built-in temperature sensor and light sensor (jumper selectable), I2C pinout, pinout for DFRobot Bluetooth and DFRobot APC220 RF modules as well as 6x cool blue LEDs (jumper selectable) placed around the board.

*Note that the motors included with the kit operate at 4.5V nominal. 6V motors are available separately.

Package Contents (Basic Kit)

The DFRobotShop Rover Basic Kit (RB-Rbo-33) includes everything you need to get started except a USB cable and AA batteries. Different versions of the kit may include additional parts.

Fully assembled DFRobotShop Rover PCB



Aluminum Frame (left and right)

Tamiya Twin Motor Gear Box

Tamiya Track and Wheel Set

4x AA Battery Pack

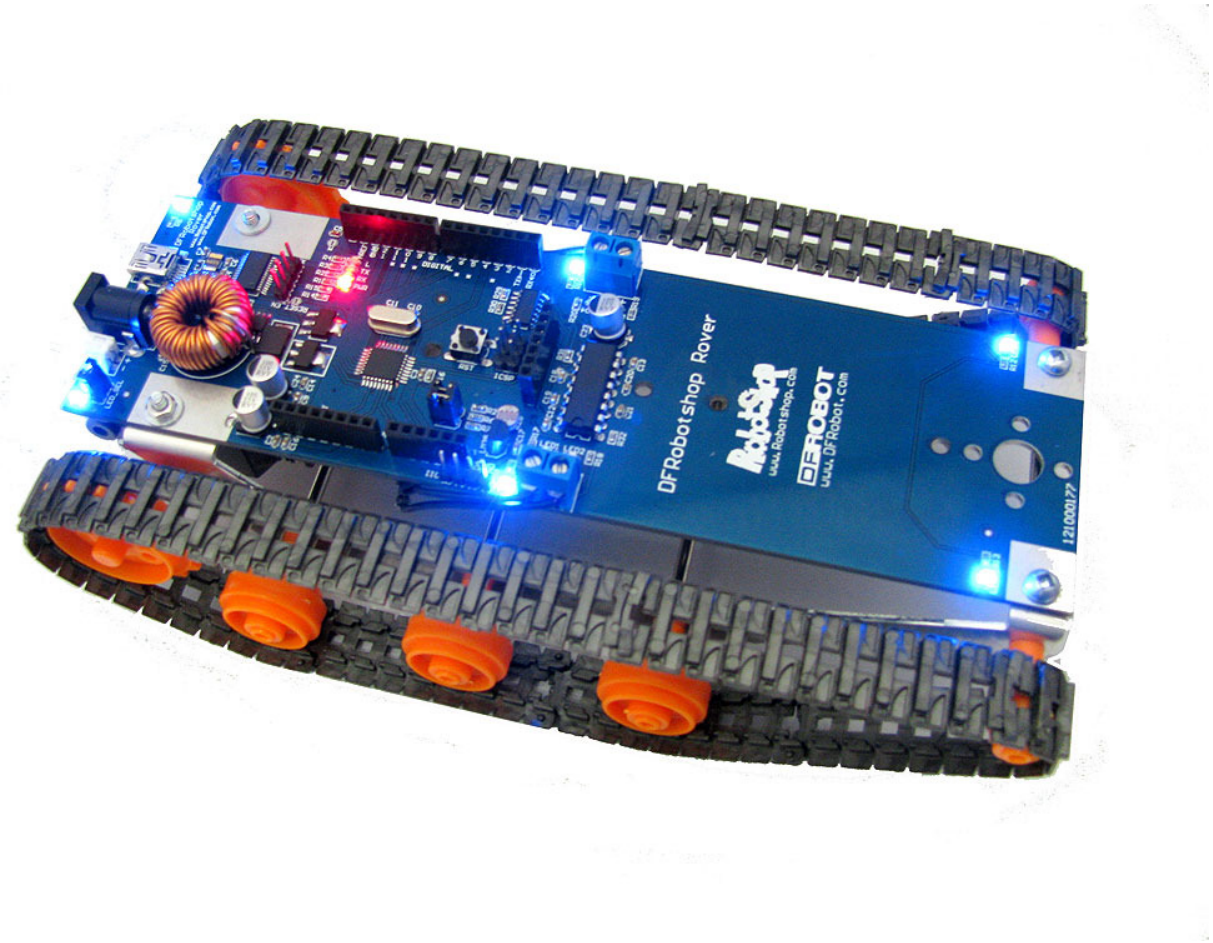
Hardware Bag

- 2x 3mm screws
- 2x 3mm nuts
- 2x mini rivets
- 2x washers
- 4x wire crimps

MiniB USB cable sold separately
AA batteries sold separately (rechargeable batteries suggested)

Features

- Arduino compatible and shield stackable
- Based on ATMEGA328 surface mount chip and L293B H Bridge
- Incorporates dual H-bridge for bi-directional motor control (digital pins 5, 6, 7 and 8)
- Voltage regulator included (connected to battery input and 3.5mm barrel connector)
- Light sensor and temperature sensor pre-soldered and selectable via jumpers
- Easy connection to DFRobot Bluetooth and APC220 wireless modules
- Large prototyping area for one 400 tie-point or 170 tie-point solderless breadboards or “cargo”
- I2C male connectors for easy connection
- “Universal connection point” at the front of the robot (see specifications for compatibility)
- 6x Blue LEDs around the board for effect (selectable via jumper LED_SEL)
- In-system programming via ICSP
- 4x LEDs to indicate motor direction
- On / Off switch



Assembly

The assembly guide can also be found on RobotShop's Youtube page (RobotShopTV) at:

http://www.youtube.com/user/RobotShopTV#p/a/u/0/yXW1yrmKiuI

Tools required: Standard screwdriver (motor assembly and frame) and small flat head screwdriver (for screw terminals). Soldering iron is optional but recommended.

Step 1: Assemble the Tamiya Twin Motor Gearbox in the Type C configuration. Note that Type A and Type B configurations will not fit. Ensure everything is properly adjusted and the "grub screws" are pressing against the flat of the shaft. We suggest adding the grease only after the entire system has been tested. Note that some parts will remain unused. Do NOT install motors yet.

Step 2a (no soldering): If you do not have the option to solder the included wires to the motors, the DFRobotShop rover includes four metal crimps to attach the wires to the motors. Take note that the motor leads are delicate and excessive force should not be used. If a lead on the motor should break, we suggest purchasing replacement motors (RB-Sbo-49 or RB-Sbo-50).

Step 2b (soldering): If you have a soldering iron and the skill to solder wires to motor leads, we suggest soldering the wires parallel to the shaft of the motor.

IMPORTANT NOTE: The bare motors leads closest to the board can potentially contact the pins on the underside of the PCB. We high suggest covering the pins closest to the motor leads with a bit of electrical tape, and also wrapping the bare leads of the motor with electrical tape (not included with the kit)

Step 3: Follow the instructions included with the Tamiya Track and Wheel Set to assemble two equal lengths of track using ALL of the rubber track links. Detach the orange plastic wheels and their inserts, but do not install yet.

Step 4: Install the motor frame/gears at the rear of the DFRobotShop Rover PCB so that the motors (when inserted later) will face the front of the board with the rear frame between the motor gearing and the PCB. Use the screws and nuts included with the Tamiya Twin Motor Gearbox. Either orientation for the screws is acceptable (nuts on bottom or top).

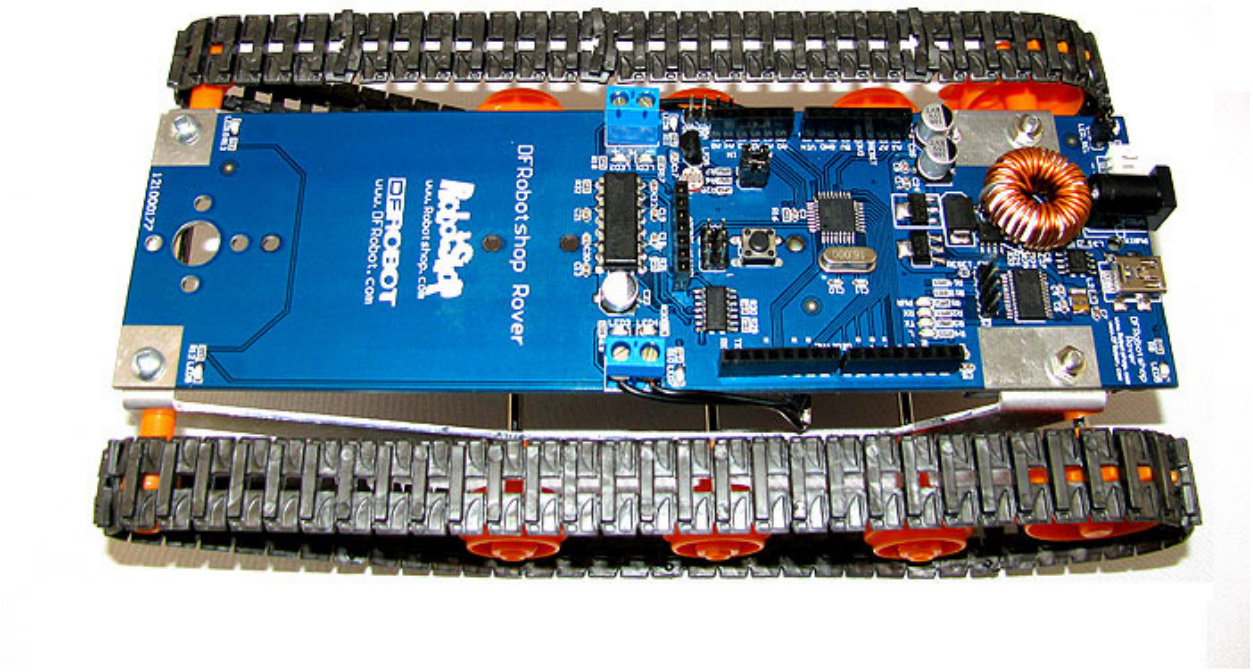
IMPORTANT NOTE: You will need to add a spacer (included) between the motor and the frame. A secondpair of hands is useful for this step. We suggest having the screws face upwards (so the nuts are on the top part of the PCB) for easy access.

Step 5: Insert the motors into the gearbox and connect the wires from the motors to the screw terminals on the PCB (try not to cross the wires. You can trim the wires so they do not interfere with the tracks. Connect the wires from each motor to the closest terminals. Please refer to the important note above once again.

Step 6: If you purchased a product to mount to the universal connection point at the front of the robot, now is a good time to install it (above or beneath the PCB).

Step 7: Connect the front of the aluminum frame to the PCB using the screws and nuts included in the hardware bag. Connect the 4xAA battery holder to the underside or top of the frame (see Q&A 1) using the two mini rivets supplied in the hardware bag.

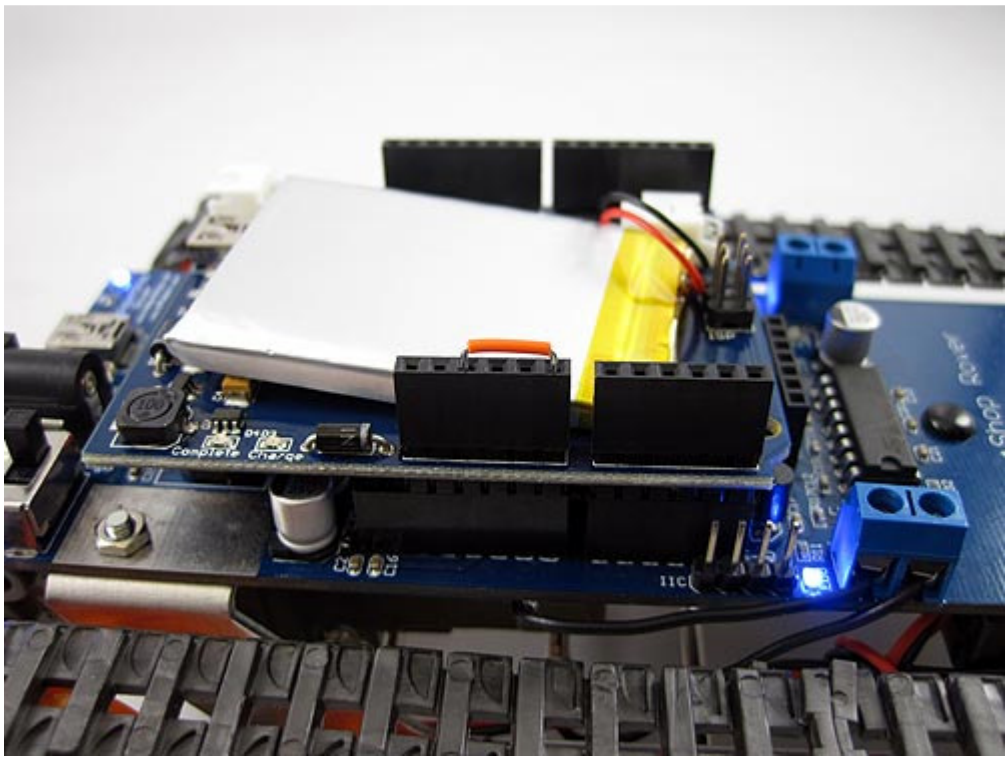
Step 8: Install the small idler wheels at the front of the frame, the three medium wheels at the bottom and the large drive wheels to the motor shafts. Install the track, ensuring the drive sprocket meshes with the track properly. The track should be fairly tight.



Power

The DFRobotShop Rover includes a 4xAA battery pack which can be connected directly to the white power input at the back of the board. Both alkaline and rechargeable batteries can be used, and the batteries power both the board and the motors.

The DFRobotShop Rover Bluetooth and XBee kits include a Seeedstudio charger and battery which replace the 4xAA battery pack. In order to use the LiPo battery with the shield, use a spare piece of wire and connect pins Vin and 5V on the shield. You can see a detailed view below (orange wire used). The battery itself should be connected to the JST plug closest to the 2x3 pin headers (not the one next to the USB plug). To charge the battery, simply plug your USB cable into the USB port of the shield.



Note: The Seeedstudio Solar Charger has been discontinued.

Specifications

Surface mount ATMega328 chip from ATMEL:
http://www.atmel.com/dyn/products/product_card.asp?PN=ATmega328P

ST L293B Four Channel H-Bridge Driver (DIP16):
http://www.st.com/stonline/products/literature/ds/1328.pdf

FTDI 0947-B USB UART IC:
http://www.ftdichip.com/Products/FT232R.htm

Light Sensor:
http://us.100y.com.tw/pdf_file/GL5528.pdf

Temperature Sensor:
http://www.national.com/mpf/LM/LM35.html

Voltage regulation:

Voltage: 3.5V (min) to 9V (max) via Vin pin, PWRin (3.5mm jack) or white connector. The Tamiya motors run at 3 to 4.5V nominal. 6V+ will work but reduce the motor's life 6V motors are available separately should you want to make your rover faster.

Maximum speed (at 4.8V using 4x AA NiMH batteries): 12.5cm/sec

PCB Dimensions: 57mm x 195mm

Overall dimensions: 200mm long x 108mm wide x 58mm high

Weight (assembled kit not including batteries): 250g

Compatibility

Universal Connection Point

The universal connection point incorporates the standard servo horn hole pattern used on Lynxmotion servo erector set brackets. These brackets are ideal for mounting a pan system to the rover, a pan and tilt or just a tilt. We suggest using micro sized servo brackets to reduce weight, though standard sized servo brackets can also be used. Giant scale servos are not suggested simply due to weight imbalance.

The Lynxmotion Aluminum multi-purpose sensor housing can be used to easily mount a Sharp infrared sensor or ultrasonic sensor to the front of the rover. The Robotics Connection Sharp IR Turret allows you to mount three such sensors.

To mount a gripper to the front of the robot, we suggest the following products:

- 1x RB-Lyn-83 Lynxmotion Aluminum L Connector Bracket Pair (or RB-Lyn-106)
- 1x RB-Lyn-76 Lynxmotion Little Grip (no servos)
- 1x RB-Lyn-118 Lynxmotion Little Grip Attachment Kit
- 1x RB-Hit-27 Hitec HS422 Servo Motor (standard)

Shields

The configuration of the DFRobotShop Rover is the same as the Arduino Duemilanove except for the fact that pins 5, 6, 7 and 8 are used to control the motor driver. If you are not using the motor driver, all shields should be compatible with the rover.

The following shields operate independently of the DFRobotShop Rover's dual motor controller:

- XBee shields (DFRobot, Arduino, Seeedstudio)
- Prototyping shields (DFRobot, Sparkfun, Adafruit) and I/O shield (DFRobot)
- WiFi shield (DFRobot)
- GPS Shield (Sparkfun, Adafruit)
- Electronic Brick (Seeedstudio)
- Solar Charger (Seeedstudio)

The following shields interfere with the the DFRobotShop Rover's dual motor controller pins:

- LCD shield (DFRobot)
- WiFi shield (Asynclabs)
- Input shield (DFRobot)
- Ethernet shield (DFRobot)
- Joystick Shield (Sparkfun)
- MicroSD shield (Sparkfun)

Untested:

- Ethernet shield (Arduino, Adafruit)
- Wave shield (Adafruit)
- MP3 Playback module (Rogue Robotics)
- Danger Shield (Seeedstudio)
- RGB LED Shield (Seeedstudio)
- Cellular Shield (Sparkfun)
- Color LCD Shield (Sparkfun)
- Flash Shield (Asynclabs)
- Voicebox Shield (Sparkfun)
- ELWire (Sparkfun)
- SD Card Shield (Seeedstudio)

The DFRobotShop Rover includes headers and connections for the DFRobot Bluetooth module and APC220 RF modules. Be sure to install the module facing the FRONT of the PCB. Note that unlike many other Bluetooth modules, one pin is used for Tx and another pin for Rx. Bluetooth allows you to communicate with and control the robot via computer or other Bluetooth enabled device. You can also use Bluetooth for remote (wireless) programming.

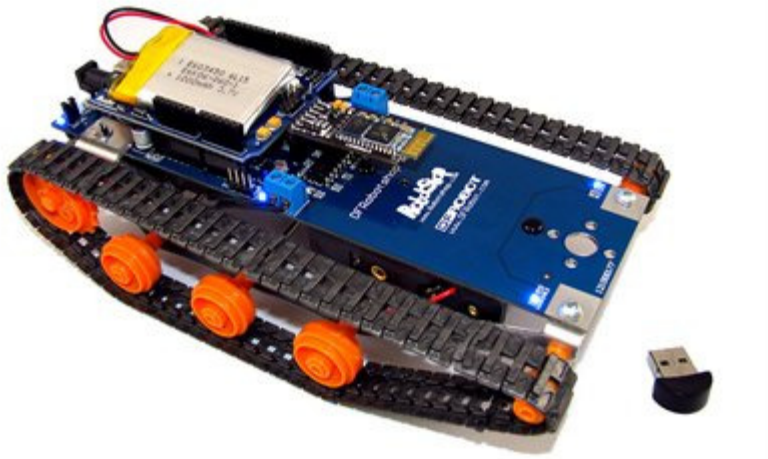
Configuration and Setup

Once you have fully assembled the DFRobotShop Rover according to the video on RobotShopTV, download the Arduino software from www.arduino.cc

1. Connect the DFRobotShop Rover PCB to the computer
2. Open the Arduino software
3. Ensure you selected the right COM port and board type (Duemilanove w/ ATMega328)
4. Copy/paste the code from the guide to the Arduino program
5. Remove any weird lines (page numbers / header / footer which may have been copied over from this guide). Be sure to check the entire program
6. Compile the code to ensure it works
7. Upload the code to the board
8. If you are using the AA battery pack, plug it into the Rover's white JST connector and use either 4xAA alkaline or 4xAA rechargeable batteries
9. If you are using the LiPo battery and shield, remove the AA battery pack (you will not need it). Plug the battery into the LiPo shield (to the white JST connector which is farthest from the USB plug) and plug the shield into a USB port to charge it. Charging takes about 3 hours and you can have the shield on the DFRobotShop Rover during charging (charges on or off the rover). Ensure you have the jumper in place (see Power section of this guide). Disconnect this USB cable from the shield once the battery is charged.
10. Turn the rover ON.
11. Open Hyperterminal and follow the "Hyperterminal Configuration" in this guide
12. Connect to the board (note that the USB cable is still plugged into the Rover - the other was removed)
13. In the serial window, you can type W, A, S, D (and any other key to stop) to move the rover.
14. If the rover is powered off or loses power, you may need to upload the code once again.

If you are using the Bluetooth module, please follow the procedure above to ensure everything works well. Next:

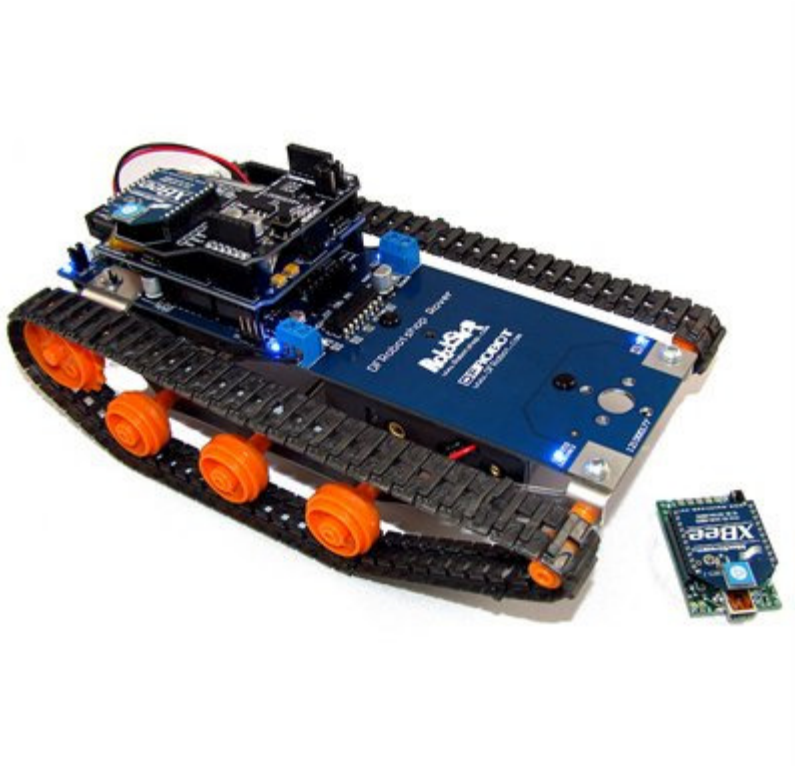
15. Disconnect the USB cable from the rover and close hyperterminal (the sample code should still be on the rover). If the rover is powered off or loses power, you may need to upload the code once again.
16. Install the DFrobot Bluetooth module facing forward as shown in the image below:



17. Install the USB Bluetooth dongle and setup a Bluetooth software (for example, blueusoleil). No software comes with the USB Bluetooth dongle.
18. Turn the rover ON if it is not already ON.
19. Ensure you know which COM port is associated with the USB Bluetooth dongle.
20. Open Hyperterminal and follow the “Hyperterminal Configuration” in this guide
21. In the serial window, you can type W, A, S, D (and any other key to stop) to move the rover.
22. If the rover is powered off or loses power, you may need to upload the code once again.

If you are using the XBee kit:

23. Disconnect the USB cable from the rover and close hyperterminal (the sample code should still be on the rover). If the rover is powered off or loses power, you may need to upload the code once again.
24. Install the DFrobot XBee shield onto the rover, as well as the XBee module, as shown in the image below:



25. Install the XBee onto the USB to XBee converter, and plug it into your computer's USB port. Ensure the drivers load properly. If not, go to the FTDI website and download the appropriate drivers.
26. Turn the rover ON if it is not already ON.
27. Ensure you know which COM port is associated with the USB to XBee module
28. Open Hyperterminal and follow the "Hyperterminal Configuration" in this guide
29. In the serial window, you can type W, A, S, D (and any other key to stop) to move the rover.
30. If the rover is powered off or loses power, you may need to upload the code once again.

Sample Code

This program allows serial commands to be sent to the DFRobotShop Rover by either a wired (USB) or wireless (Bluetooth, XBee) connection. The commands are "w", "a", "s" and "d" for driving forward, turning left, turning right and reversing. The rover will execute the command until it is told to stop by pressing any other character.

We suggest using the DFRobot Bluetooth module or XBee module with Windows Hyperterminal for fluid wireless control. Ensure you select the correct COM port and 9600 baud rate. Note that it is likely the two motors are not identical and you will need to adjust the speed so the robot goes perfectly straight.

Copy / paste the code on the following page into the Arduino Software. Font size is reduced to allow easy copy / pasting.

Title: DFRobotShop Rover Sample Sketch #1
Authors: DFRobot, RobotShop
Date: 12/03/2010
Licence: GPL v3
Description: Sketch for the DFRobotShop Rover.
URL: www.robotshop.com

The following code makes both motors turn at full speed:

```
/* Copy and paste the code below into the Arduino software */
int E1 = 6; //M1 Speed Control
int E2 = 5; //M2 Speed Control
int M1 = 8; //M1 Direction Control
int M2 = 7; //M2 Direction Control

void setup(void)
{
int i;
for(i=5;i<=8;i++)
pinMode(i, OUTPUT);
Serial.begin(9600);
}
void loop(void)
{
int leftspeed = 255; //255 is maximum speed
int rightspeed = 255;
analogWrite (E1,255);
digitalWrite(M1,LOW);
analogWrite (E2,255);
digitalWrite(M2,LOW);
delay(100);
}
```

To control the rover, use the code below:

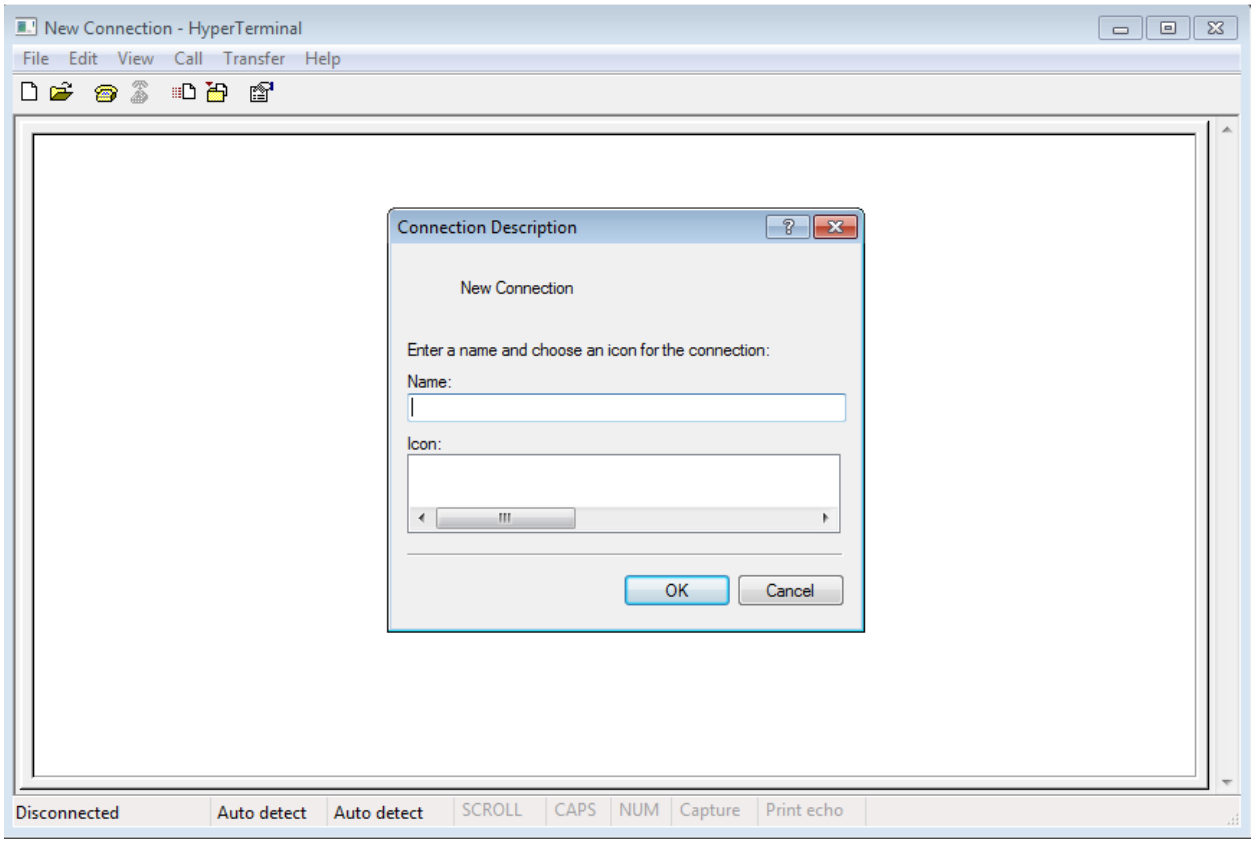
```
/* Copy and paste the code below into the Arduino software */

int E1 = 6; //M1 Speed Control
int E2 = 5; //M2 Speed Control
int M1 = 8; //M1 Direction Control
int M2 = 7; //M2 Direction Control

void setup(void)
{
  int i;
  for(i=5;i<=8;i++)
  pinMode(i, OUTPUT);
  Serial.begin(9600);
}

void loop(void)
{
  while (Serial.available() < 1) {} // Wait until a character is received
  char val = Serial.read();
  int leftspeed = 255;  //255 is maximum speed
  int rightspeed = 255;
  switch(val) // Perform an action depending on the command
  {
  case 'w'://Move Forward
    forward (leftspeed,rightspeed);
    break;
  case 's'://Move Backwards
    reverse (leftspeed,rightspeed);
    break;
  case 'a'://Turn Left
    left (leftspeed,rightspeed);
    break;
  case 'd'://Turn Right
    right (leftspeed,rightspeed);
    break;
  default:
    stop();
    break;
  }
}

void stop(void) //Stop
{
  digitalWrite(E1,LOW);
  digitalWrite(E2,LOW);
}

void forward(char a,char b)
{
  analogWrite (E1,a);
  digitalWrite(M1,LOW);
  analogWrite (E2,b);
  digitalWrite(M2,LOW);
}

void reverse (char a,char b)
{
  analogWrite (E1,a);
  digitalWrite(M1,HIGH);
  analogWrite (E2,b);
  digitalWrite(M2,HIGH);
}

void left (char a,char b)
{
  analogWrite (E1,a);
  digitalWrite(M1,HIGH);
  analogWrite (E2,b);
  digitalWrite(M2,LOW);
}
void right (char a,char b)
{
  analogWrite (E1,a);
  digitalWrite(M1,LOW);
  analogWrite (E2,b);
  digitalWrite(M2,HIGH);
}
```

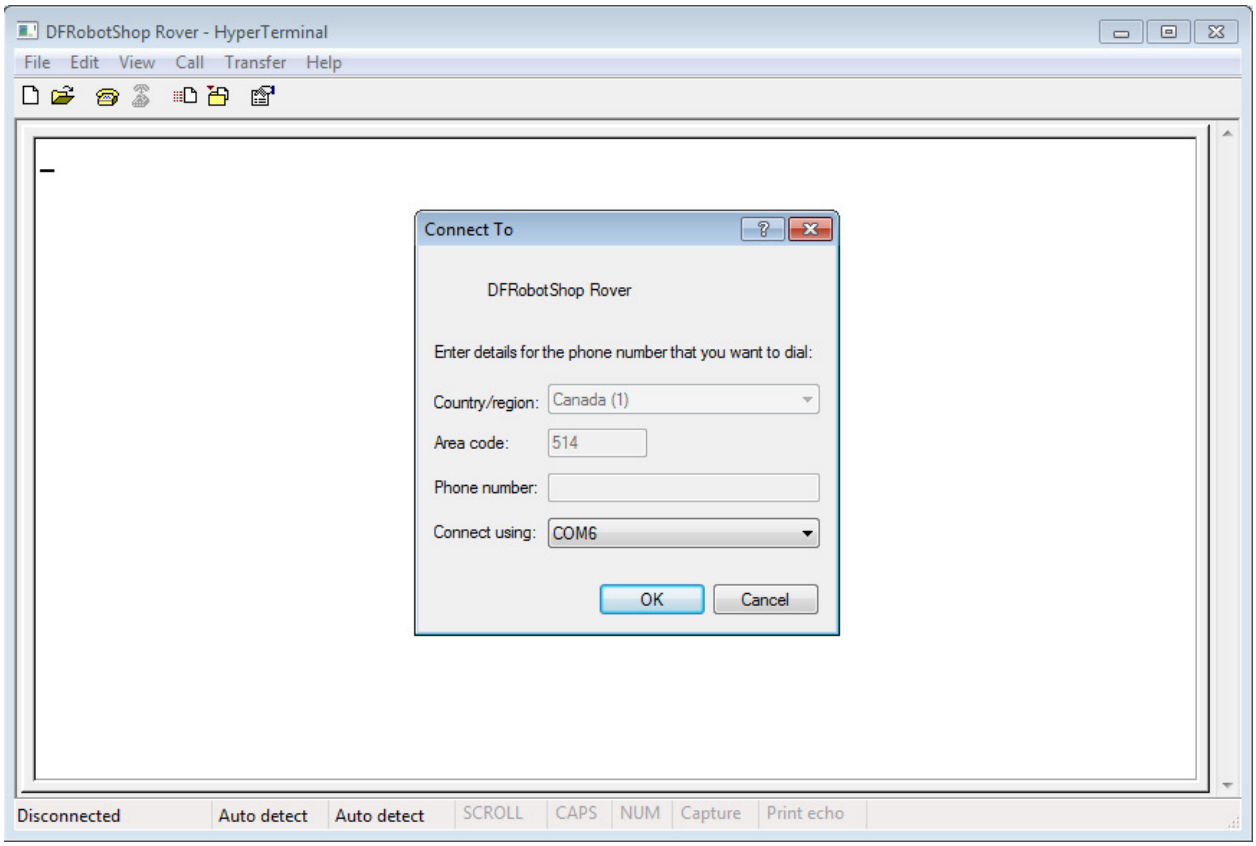
Hyperterminal configuration

To access Hyperterminal in Windows XP / 2000:

Start > All Programs > Accessories > Communications > HyperTerminal

Windows 7 does not come with Hyperterminal as a standard feature, so you must find an alternative. Note that hypertrm.exe is available online and emulates Hyperterminal.





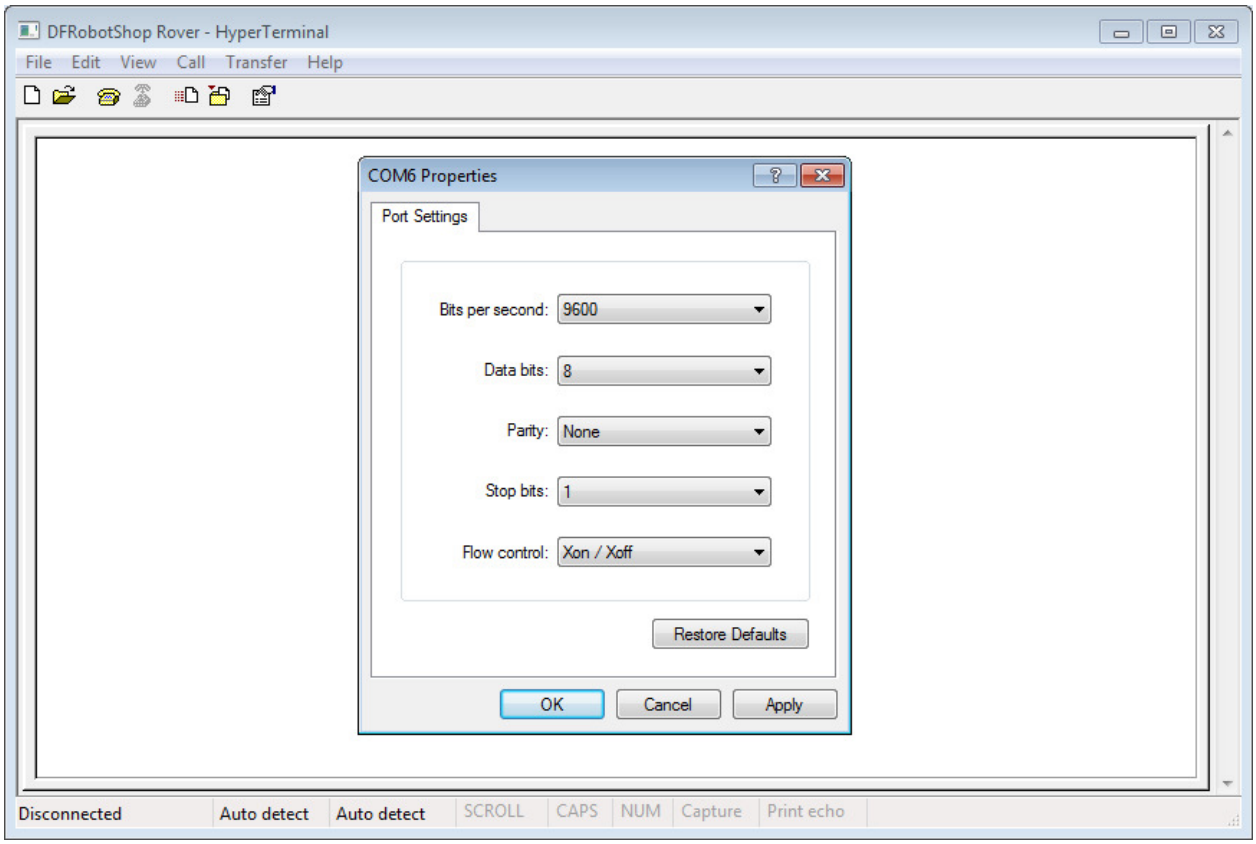
The name “DFRobotShop Rover is not necessary; you can name it whatever you want.

Specify the COM port (USB) that is connected to the DFRobotShop Rover. If you are using XBee, Bluetooth or RF, select the COM port connected to the Bluetooth dongle / XBee breakout / RF Transmitter (USB).

No configuration is needed for the DFRobot Bluetooth Module – simply connect to it in your Bluetooth application and the module installed on the DFRobotShop Rover will be picked up (assuming it is powered).

To use the XBee modules, install one on the USB to XBee breakout board in the same orientation as indicated on the board, and connect the board via USB to your computer. The board should be picked up as a standard COM port. Install the other XBee module on the XBee shield and install the shield on the board ensuring the Tx/Rx pins of the shield line up with Rx/Tx pins on the DFRobotShop PCB.

More information about the XBee shield can be found on www.arduino.cc.



The Bits per second should correspond to the Serial communication Baud rate in the Arduino code. In the sample code, we selected 9600. Flow control Xon/Xoff works best.

Of course, make sure the On/Off switch on the robot is set to ON (closer to the power input).

Use the W, A, S, D and X keys to move the robot. Note that if you purchased the basic kit, you will need to have the robot connected to the computer via USB for it to receive commands.

Q&A

Q1. The batteries fall out of the holder, what can I do?

If you do not plan to use the top of the PCB, you can mount the battery holder to the top rather than the bottom of the board. Another option is to use a low-cost LiPo pack and charger.

Q2. The robot moves in an arc when I give both motors the same speed value, how can I correct this?

The motors are likely not identical. To get the robot to move as straight as possible, progressively lower one of the speed values for the faster motor until it goes in a straight line. It is also important to check that the motor shafts and sprockets are equally spaced after assembly (you can use the frame as visual reference) and that the set screws are properly tightened.

Q3. The motors are noisy, how can I make them quieter?

Use the grease included with the Tamiya dual gearbox and add capacitors to the motors.
http://www.robotshop.com/PDF/motor-noise-reduction.pdf

Q4. Where can I find additional sample code for the board?

The board is directly compatible with Arduino Software available for download via www.Arduino.cc Take note that four of the pins are used for the H-bridge (pins 5, 6, 7, 8). Additional tutorials and sample code are available via www.arduino.cc

Q5. The drive wheels fall off the motor shaft, what can I do?

The track links are under tension and may fall off. Roughing up the shaft and adding a dab of glue before pressing on the drive sprocket should fix this.

Q6. Are there any other configurations for the tracks or motor?

We have not tested any other configurations though you are free to try.

Q7. Is the design open source?

The design is essentially an Arduino Duemilanove with several pins directly connected to the motor driver.

Additional questions can be submitted to the RobotShop Forum:

http://www.robotshop.com/forum/showthread.php?702-DFRobotShop-Rover

Q8. How can I do a quick motor test?

Copy/paste the following code into Arduino to run the motors continuously:

```
/* Copy and paste the code below into the Arduino software */

void setup(void)
{
int i;
for(i=5;i<=8;i++)
pinMode(i, OUTPUT);
Serial.begin(9600);
}
void loop(void)
{
int leftspeed = 255; //255 is maximum speed
int rightspeed = 255;
analogWrite (6,255);
digitalWrite(8,LOW);
analogWrite (5,255);
digitalWrite(7,LOW);
delay(100);
}
```

Q9. The battery holder provides intermittent power, what should I do?

The new battery holder should not have any issues, but if you have an old AA battery holder, you can rotate the batteries or push them in so they are tight. Check to see if there is a small gap between the AA closest to the wires and if so, put a small piece of conductive material (such as aluminum foil).

Useful Links

Manufacturer Websites: www.robotshop.com, www.dfrobot.com

Product Website:

Arduino Software: http://arduino.cc/en/Main/Software

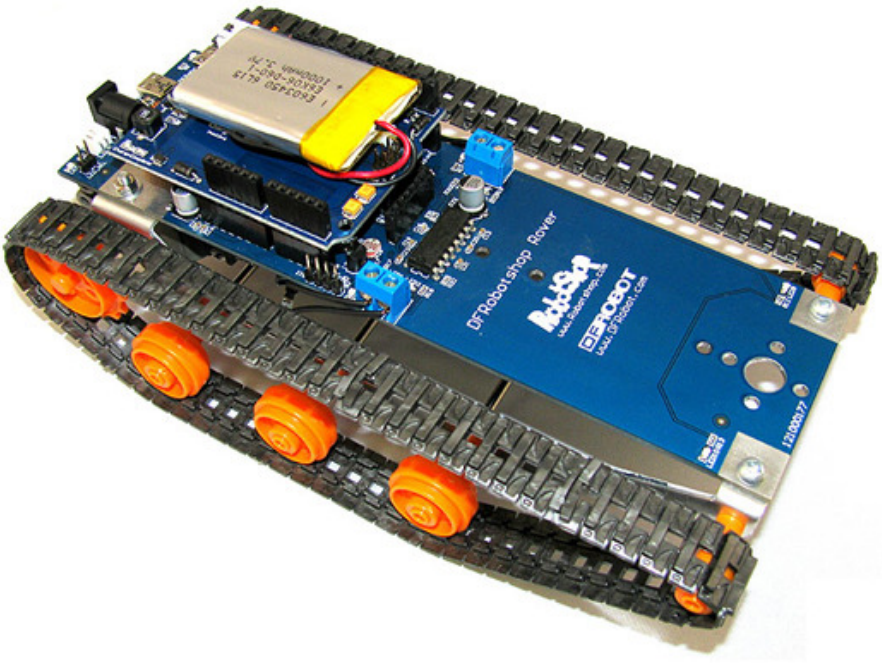
RobotShop Product Codes

DFRobotShop Rover PCB:	RB-Dfr-31
DFRobotShop Rover Frame & Hardware:	RB-Rbo-32
Tamiya Twin Motor Gear Box:	RB-Tam-01
Tamiya Track and Wheel Set:	RB-Tam-09

Project Ideas

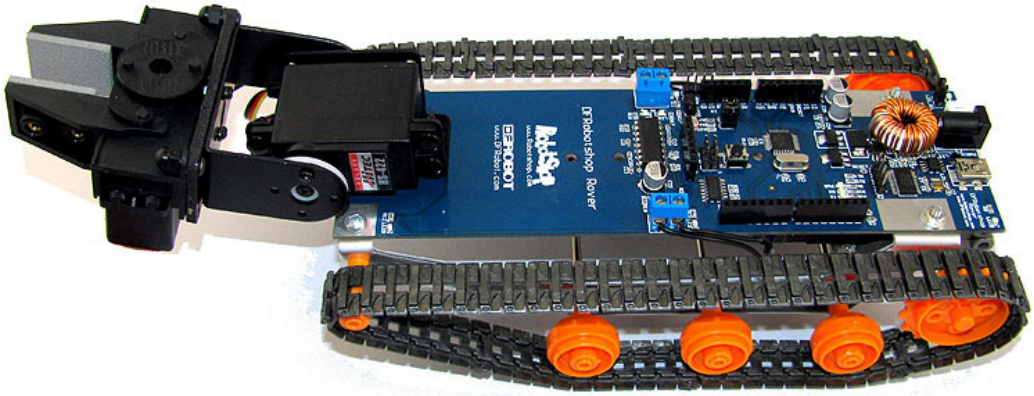
The first project you might try even before making the robot move is to get feedback from the included sensors. Ensure both jumpers (located next to the sensors and the analog pins) are in place. Sample code for analog sensors can be found on www.arduino.cc.

The battery connector on the PCB mates perfectly with Sparkfun's selection of low cost Lithium Ion battery packs. When used in conjunction with the Seeedstudio Solar charger, you can recharge the batteries right on the robot.

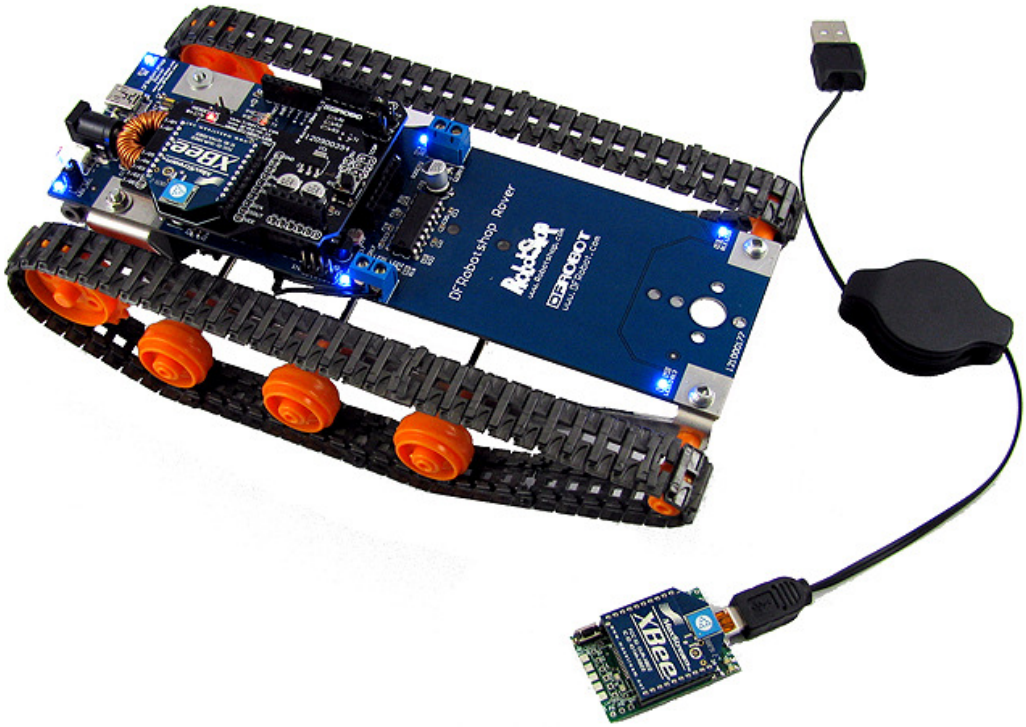


For example, the Lynxmotion mini grip can be added to the front of the rover (as shown below) but be careful of the center of mass! The Robot is incredibly lightweight and adding too much weight to the front will cause the robot to be unbalanced. To compensate, you can add weight to the rear of the robot, or move the AA pack to the rear. The configuration below is too heavy at the front and would

require additional weight to be placed at the rear of the robot.



DFRobotShop Rover with DFRobot XBee shield, two XBee modules and retractable USB cable:



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V 1.4 14/12/2010

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