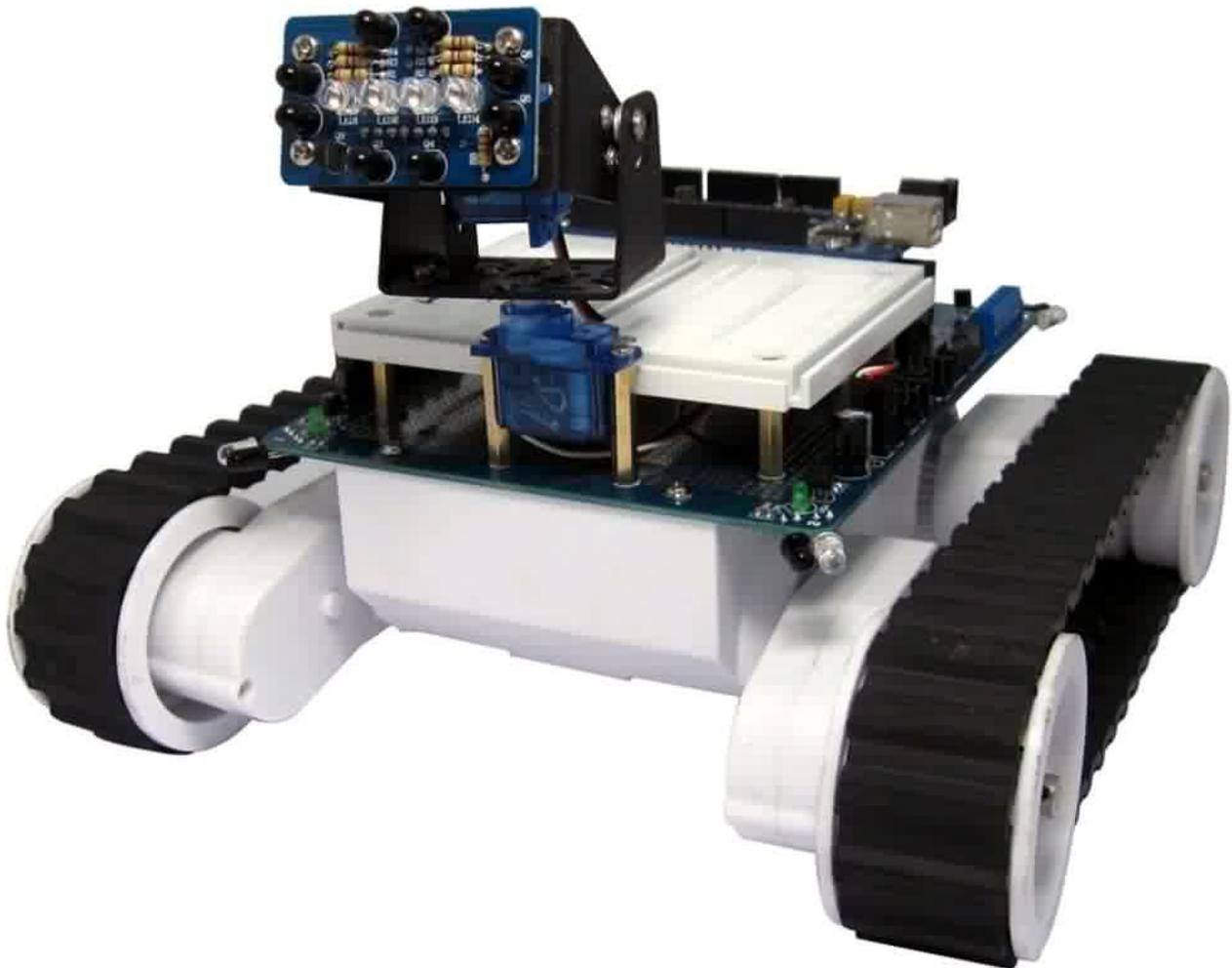


# Rover 5

## Explorer kit

The explorer kit provides the perfect interface between your Rover 5 chassis and your micro-controller with all the hardware you need so you can start programming right away.



### **PCB Features:**

- 2x FET “H” bridge motor drivers rated at 4A with current sensing.
- Servo power supply – 5.4V rated at 3A assuming the use of 7.2V battery.
- 5V LDO regulator rated up to 1.5A with suitable heatsinking.
- 3.3V LDO regulator rated at 500mA.
- Built in trickle charge circuit for NiMh or NiCd batteries.
- 4x IR analog/digital sensors mounted on the corners.
- 2x individual power rails (V1, V2) that can be connected to any voltage.
- Mounting holes for hardware including Arduino and Arduino Mega PCBs.

### **Additional Hardware:**

- 2x Small bread boards with mounting hardware.

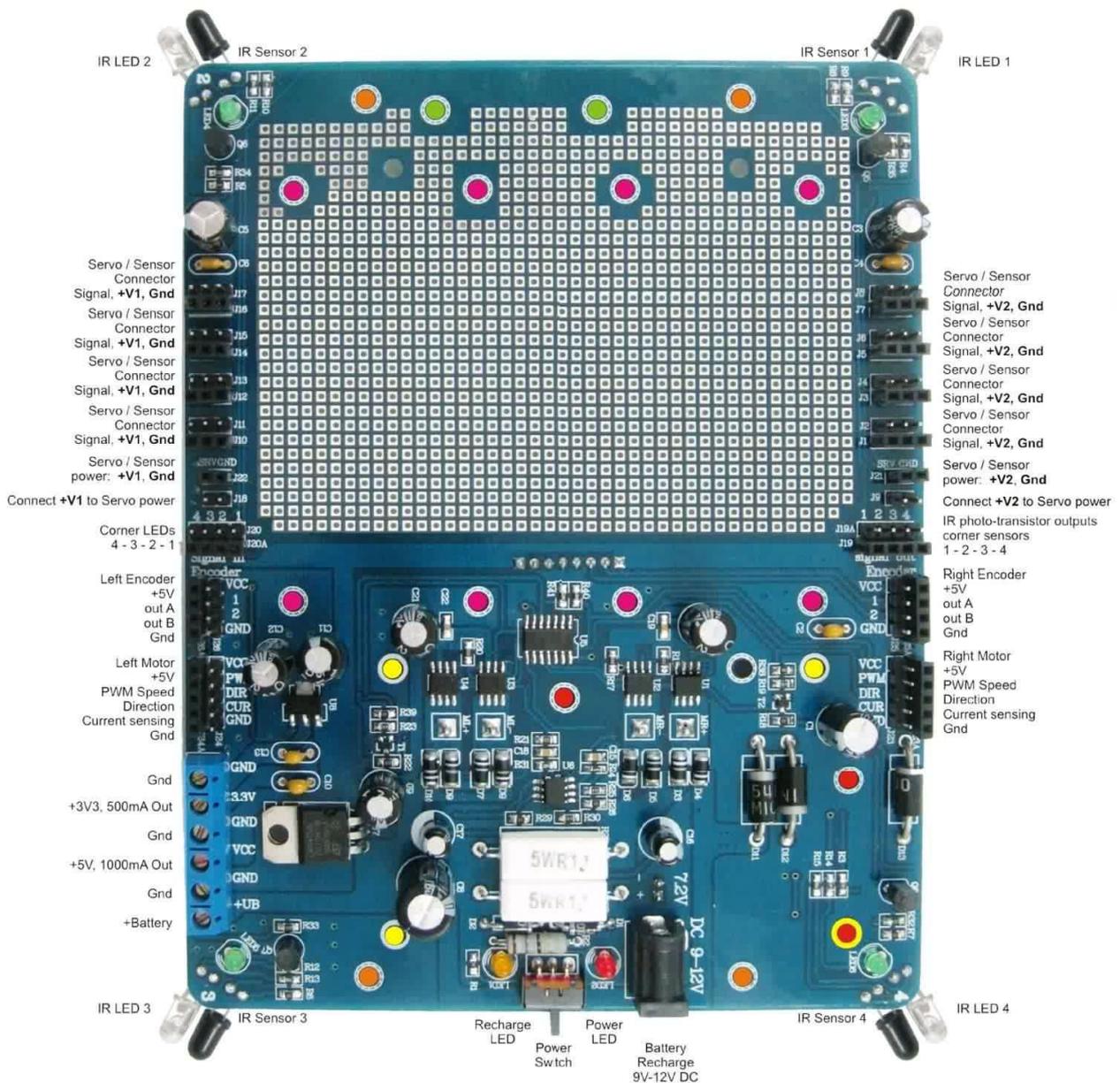
- 1x Pan / tilt kit with two miniature servos and mounting hardware.
- 1x IR compound eye.
- 1x Jumper wire pack.

### Mounting your hardware

Before you mount the explorer PCB onto the Rover 5 chassis, mount any hardware you wish to use.

The PCB is supplied with 2x small bread boards and 8x 16mm, hex brass spacers. This allows enough clearance for any custom circuitry you may wish to build on the prototype area under the breadboards. Use the mounting holes shown in pink.

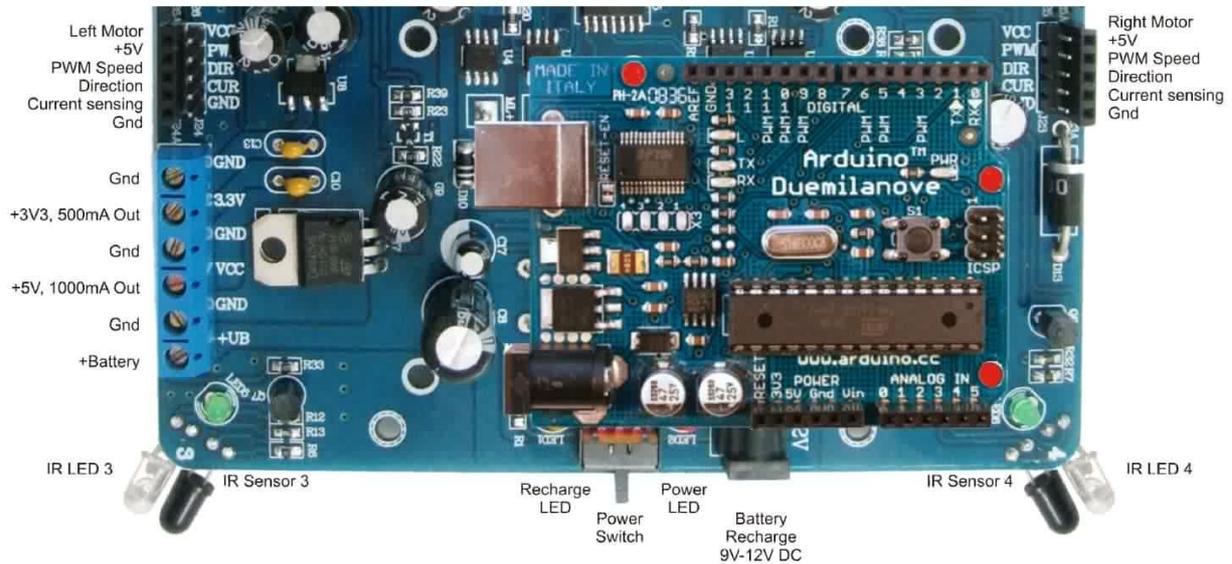
The pan / tilt assembly is mounted at the front using 25mm brass hex spacers. Use the mounting holes shown in green. Note that the holes are slightly off-centre so that when correctly mounted the output shaft of the pan servo will be centre on the PCB.



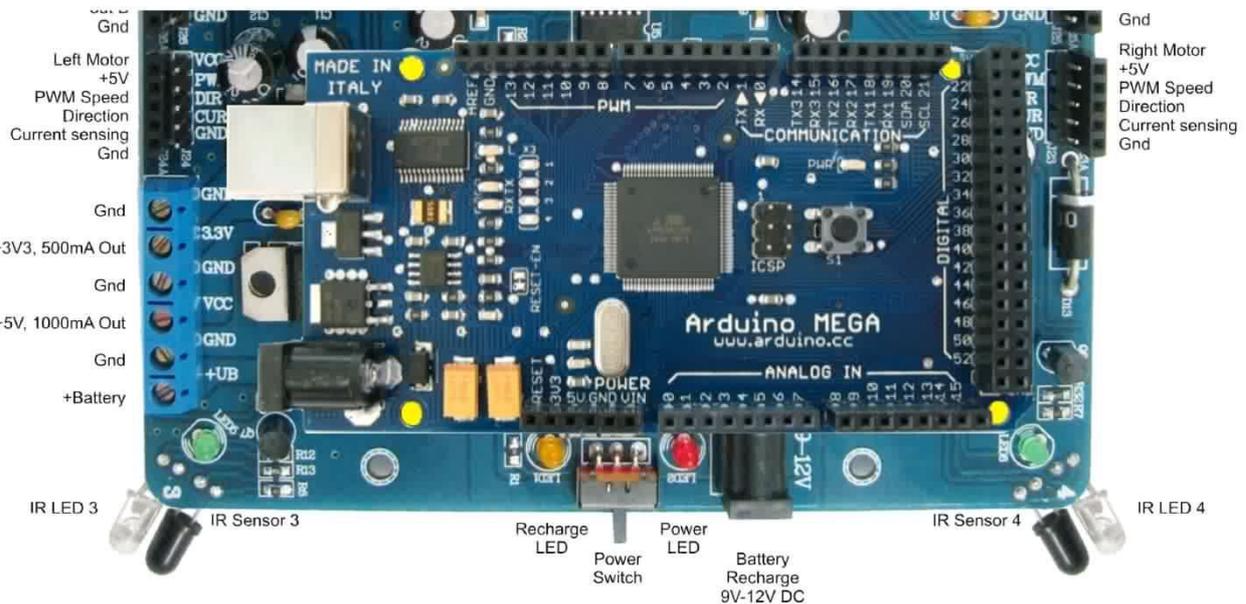
The holes used to mount the PCB to the Rover 5 chassis are marked in orange.

## Mounting Arduino Boards

The PCB has mounting holes to suit popular Arduino PCB's. Using the 25mm brass hex spacers provided Arduino Uno, Duemilanove, Diecimila and older can be mounted using the holes marked in red.



You can also mount an Arduino Mega 1280 / 2560 using the holes marked in yellow.



## Arduino Nano, Basic Stamp, Propeller and Picaxe to name a few!

Using the breadboards and supplied jumper wire kit a wide range of processors can be used with this PCB. The breadboards are a great way to interface experimental circuitry or even have multiple processors controlling your robot.

If the breadboards are not required then other hardware can be mounted using an expansion plate.

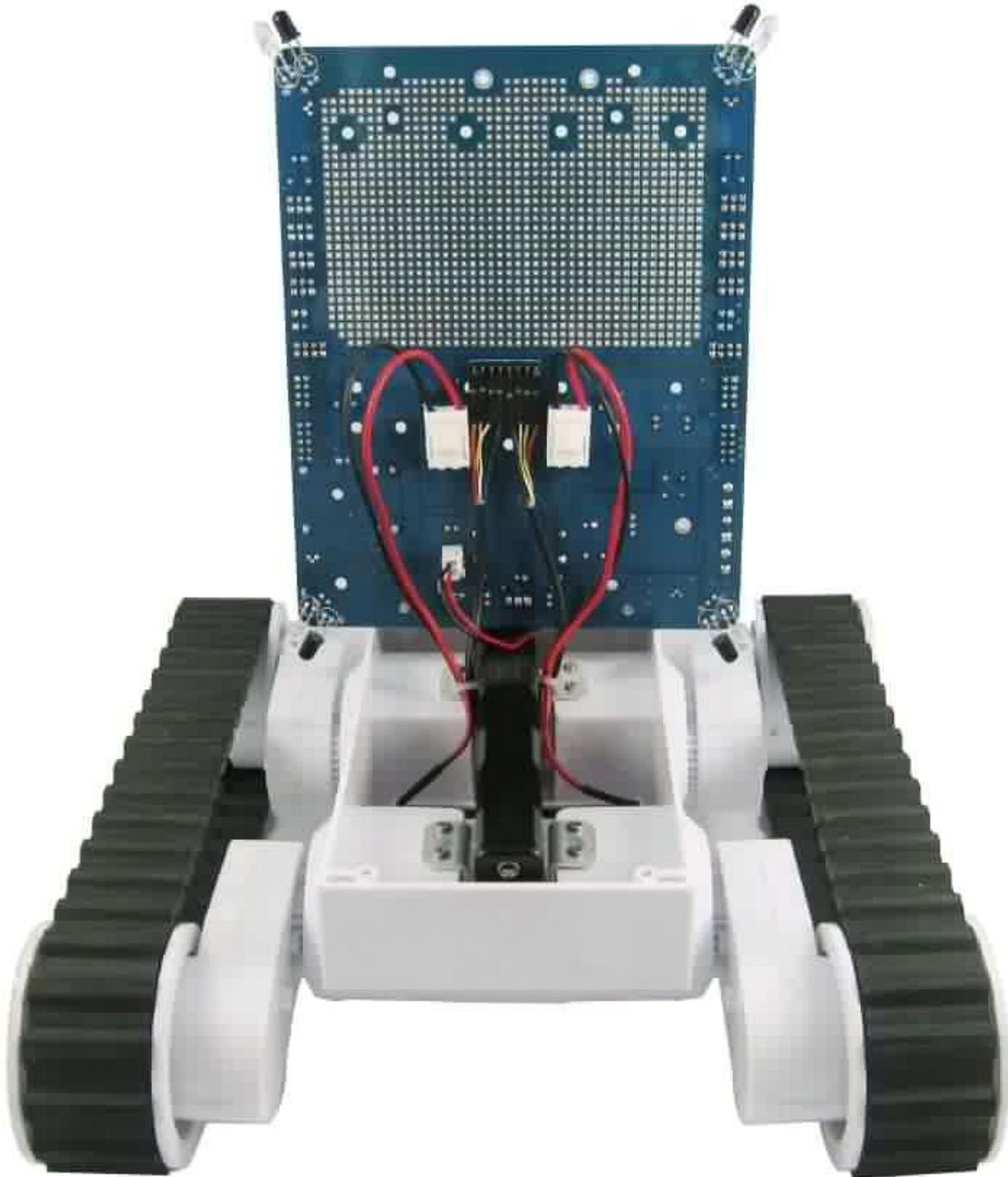
### Connection to Rover 5

Start by Installing rechargeable NiMh or NiCd batteries in the Rover 5 chassis. They can be recharged overnight by the built in trickle charge circuitry. This eliminates the need to remove the PCB to replace batteries.

Plug in your motors and if your chassis comes with encoders then plug them in as shown in the photo with the red wires (+5V) on the outer pins and the black wires (GND) on the innermost pins.

Each encoder has a white and a yellow signal wire. It is not too important which way these wires connect as this can be corrected in your program. Swapping the white and yellow wires of an encoder will reverse the encoders sense of direction.

Screw the PCB onto the Rover 5 chassis with the 4x self tapping screws provided.

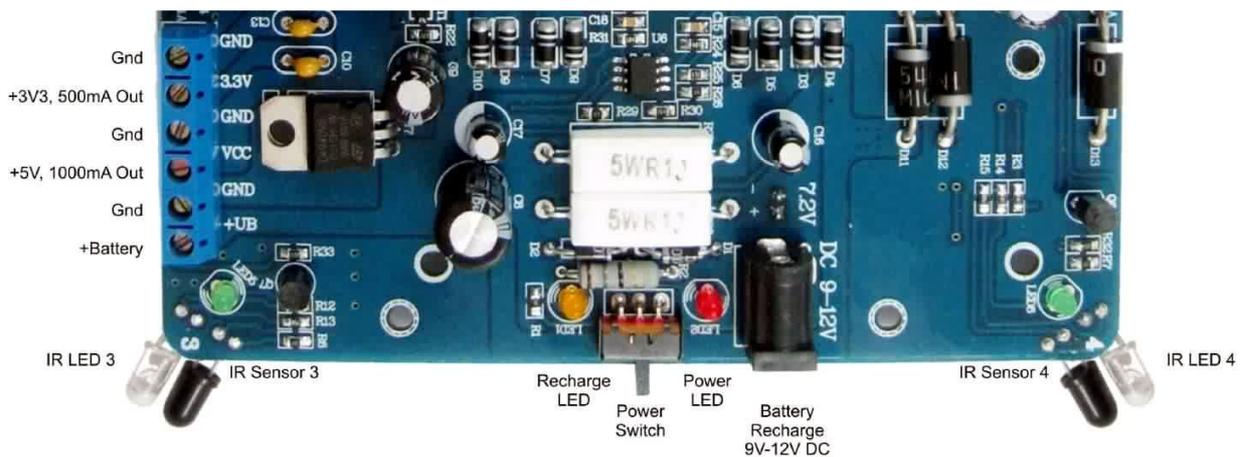


## Battery Charging

When the power switch is in the “Off” position the battery is internally connected to a simple trickle charge circuit. When power is connected to the battery charging socket the orange LED will light up.

The recharge circuit allows the batteries to be recharged overnight when a 12V power supply is connected to the recharge socket. If you want to recharge over a longer period of time such as the weekend then you should use a 9V power supply to prevent overcharging your batteries.

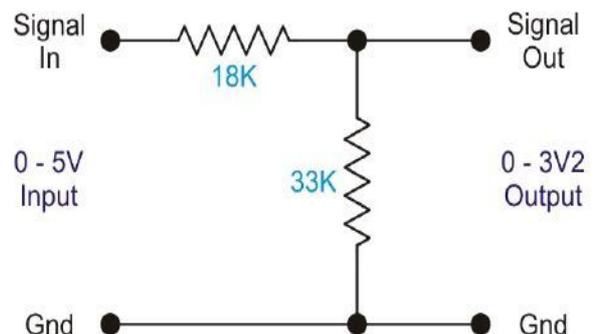
**WARNING:** This recharge circuit is designed for **NiCd and NiMh batteries only!** Do not use with Lithium (LiPo) batteries which require a specialized charging circuit.



## Power

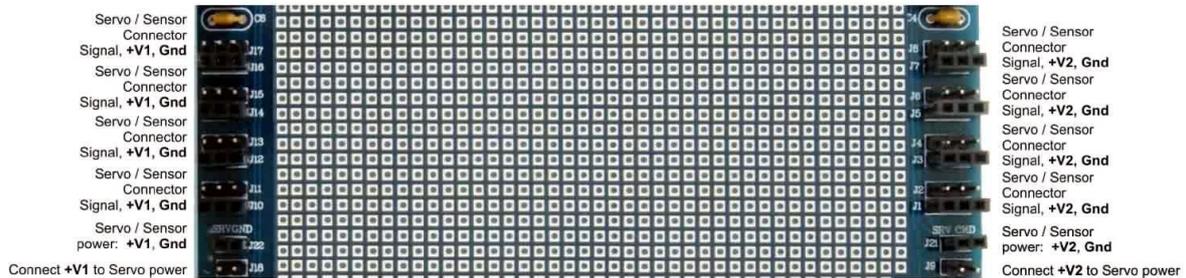
The Explorer PCB provides 4 different voltage levels for powering your robot.

1. **Battery voltage:** 7.2V when using NiMh or NiCd batteries is used to power the motors and can also be used to power other motors or circuits.
2. **Servo Power:** Servo's typically have a voltage rating of 4.5V – 6V. As the battery voltage is too high we use 3x diodes in series to drop the battery voltage to approximately 5.4V. The Diodes are rated at 3A and may get hot when servos are working under heavy loads.
3. **+5V (Vcc):** This voltage is supplied by a Low Drop Out (LDO) regulator which can provide up to 1A even when the battery voltage gets as low as 5.5V. As many development PCB's need at least 7.5V for their built in regulator you may need to power your processor directly from this regulator. By adding a larger heatsink you can increase the output of this regulator to 1.5A maximum.
4. **+3.3V:** Many newer processors and sensors require a 3.3V supply. We have included a low dropout regulator with a 500mA rating to support these devices. Because some devices such as the encoders require +5V all Vcc connections on the PCB are +5V. Motor control and IR LEDs can be driven by 3.3V signals. Signals from the encoders and corner sensors must go through a voltage divider. You can build this circuit either on the breadboards or the prototype area.



## V1 and V2

Power rails V1 and V2 are typically connected to the servo power (5.4V) allowing servos to plug directly into the PCB. These power rails can be disconnected from the 5.4V supply by removing the jumpers on J9 and J18. They can then be connected to the other voltages using J21 and J22.



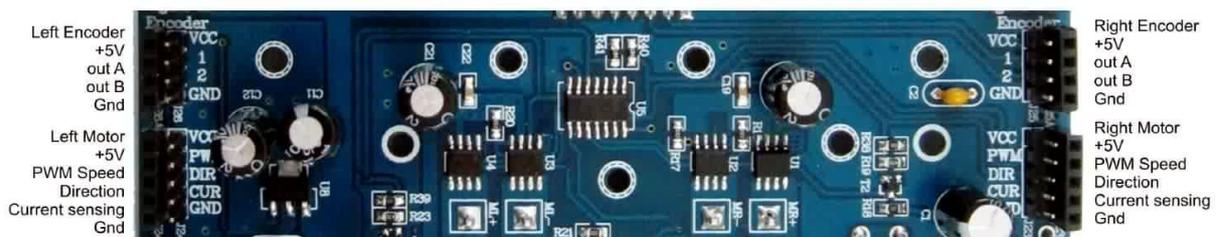
The V1 and V2 rails each provide power to 4x 3 pin servo compatible male connectors. Female connectors allow the servos or sensors to be easily connected to a breadboard or development board using the supplied jumper wires.

## Motor Control Circuitry

The built in motor control circuitry consist of 2x FET “H” bridges. Each motor control circuit can drive a motor forwards or backwards as well as controlling the speed of the motor using Pulse Width Modulation (PWM).

The motor control circuits each have a maximum continuous rating of 4.5A and a current sensing circuit that gives an output of approximately 1V per amp. This output can be monitored using a processors analog to digital (ADC) inputs to determine how much load the motor is under and if the motor has stalled.

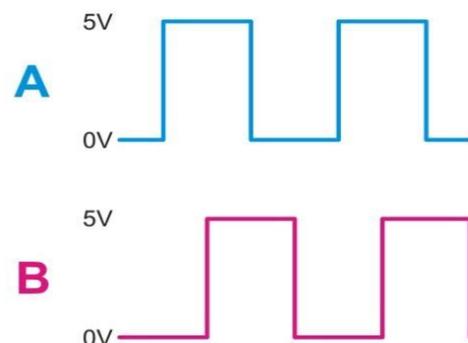
Each motor is controlled by two digital pins. The **Direction** pin changes the direction of the motor between forward and reverse. The **PWM Speed** pin controls the speed of the motor.



## Encoder Connectors

If your Rover 5 chassis includes encoders then the encoder can be read from the encoder socket. The encoders are powered from the PCB so you only need to read the outputs A and B. Swapping the connections to A and B will reverse the encoders sense of direction. The output of the encoders consist of 2 square waves that are 90 degrees out of phase. The pattern generated by these outputs can be used to measure speed, direction and distance traveled. A tutorial on how to use these encoders can be found here:

<http://letsmakerobots.com/node/24031>



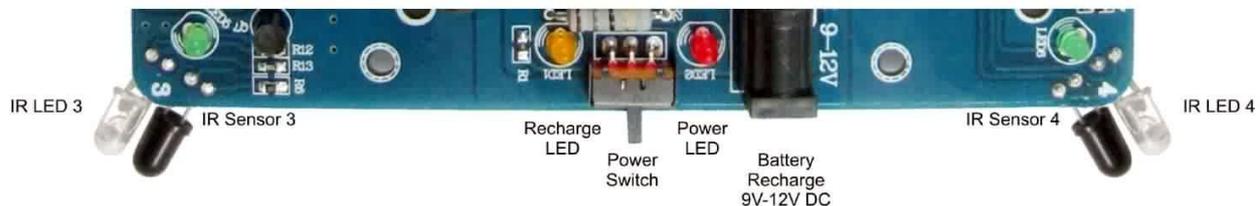
## Infrared Corner Sensors

The explored PCB includes 4 infrared (IR) sensors on the corners which can be used to detect objects or edges depending on the orientation of the sensors.



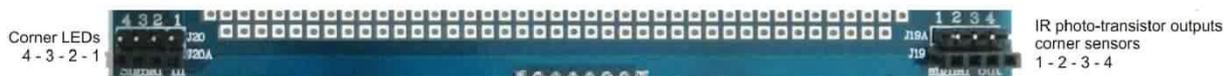
These sensors are numbered 1 to 4 for easy identification. Each sensor consists of an IR LED and an IR phototransistor. Because you cannot see IR with your eyes a small green LED is connected to each IR LED so you can see when it is on.

To get the maximum range from these sensors, the IR LED and IR phototransistor must be parallel to each other. If you aim the IR LED and phototransistor downward then they can be used to detect the edge of a table or the top of the stairs. Aim the sensors outward for object detection.



These sensors can be used with analog or digital inputs but best results are achieved with analog inputs.

To take a reading from a sensor first turn on the IR LED for that corner (1-4) by applying a high digital output to the appropriate pin on the left hand side of the board. In your code allow at least 50uS for the phototransistor to respond.

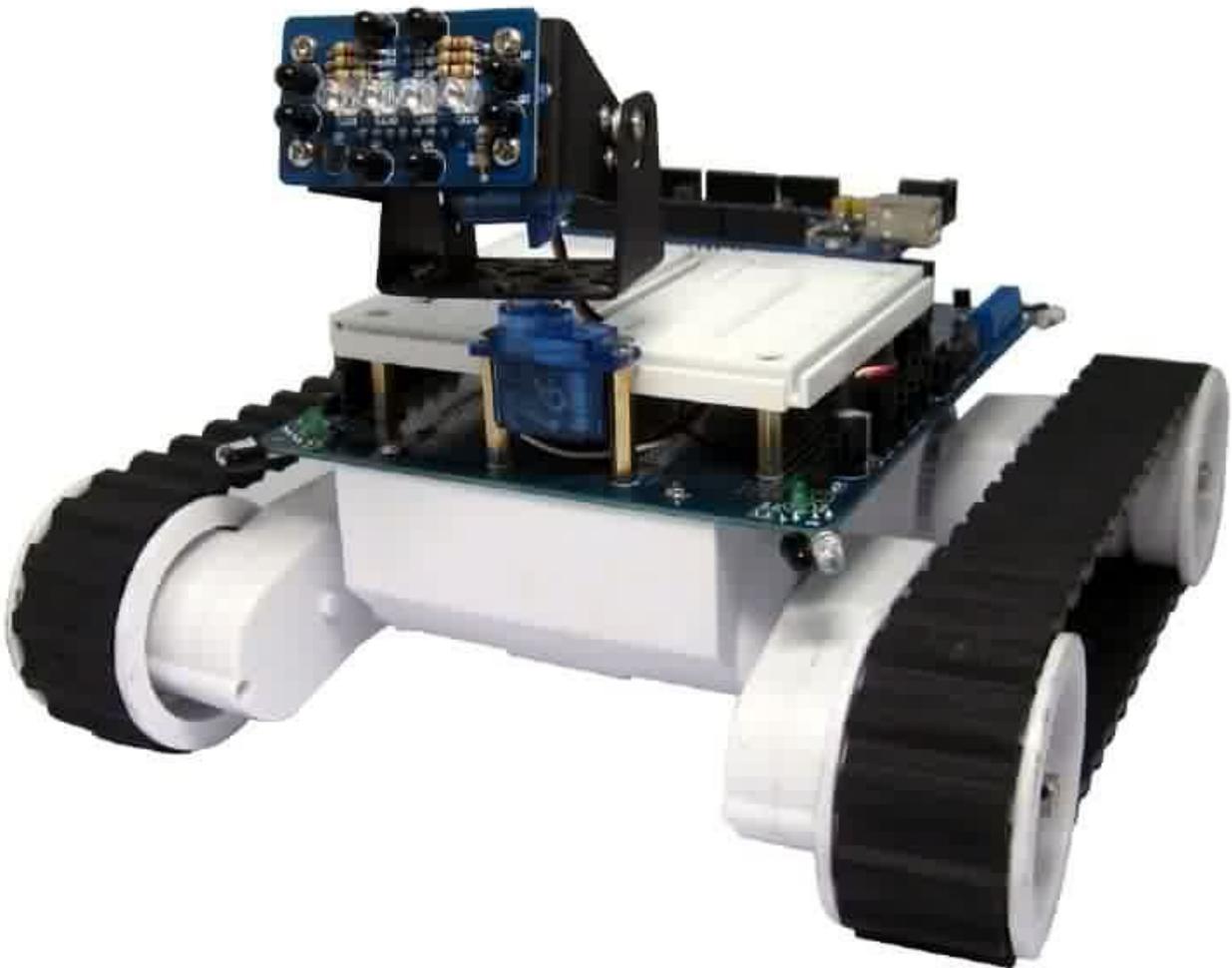


Now read the sensor using the appropriate pin (1-4) on the right hand side of the board using either an analog or digital input. When an object is detected then voltage on the sensor output will rise. The voltage level will depend on size, colour and distance of the object being detected. A digital input will only recognize when the voltage exceeds a certain voltage (usually between 50% and 70%) of the processors supply voltage. When using analog inputs, So that ambient light will not affect your readings it is recommended that you turn off the LED, wait 50uS again and then take a second reading. This second reading with the LED off is your ambient light reading. By subtracting this reading from the first reading you will get a result that represents only light from the LED reflected back by an object.

**NOTE:** These sensors will not work in bright sunlight and are intended for indoor / night use only.

### **Pan / tilt kit**

The pan / tilt kit is the perfect addition to your robot. With mounting holes to suit a wide range of IR and ultrasonic range finders or cameras this assembly gives your robot personality as well as increasing the usefulness of your sensor.



### **IR compound eye**

This sensor is a perfect, low cost companion to the pan / tilt assembly. Although only a short range sensor (15-20cm depending on ambient IR) it allows tracking of moving objects using simple code and low powered processors. Perfect for beginners!

### **Sample Code**

To help you get started quickly sample code can be downloaded from DAGU's product support site: <https://sites.google.com/site/daguproducts/>

Good luck and enjoy!