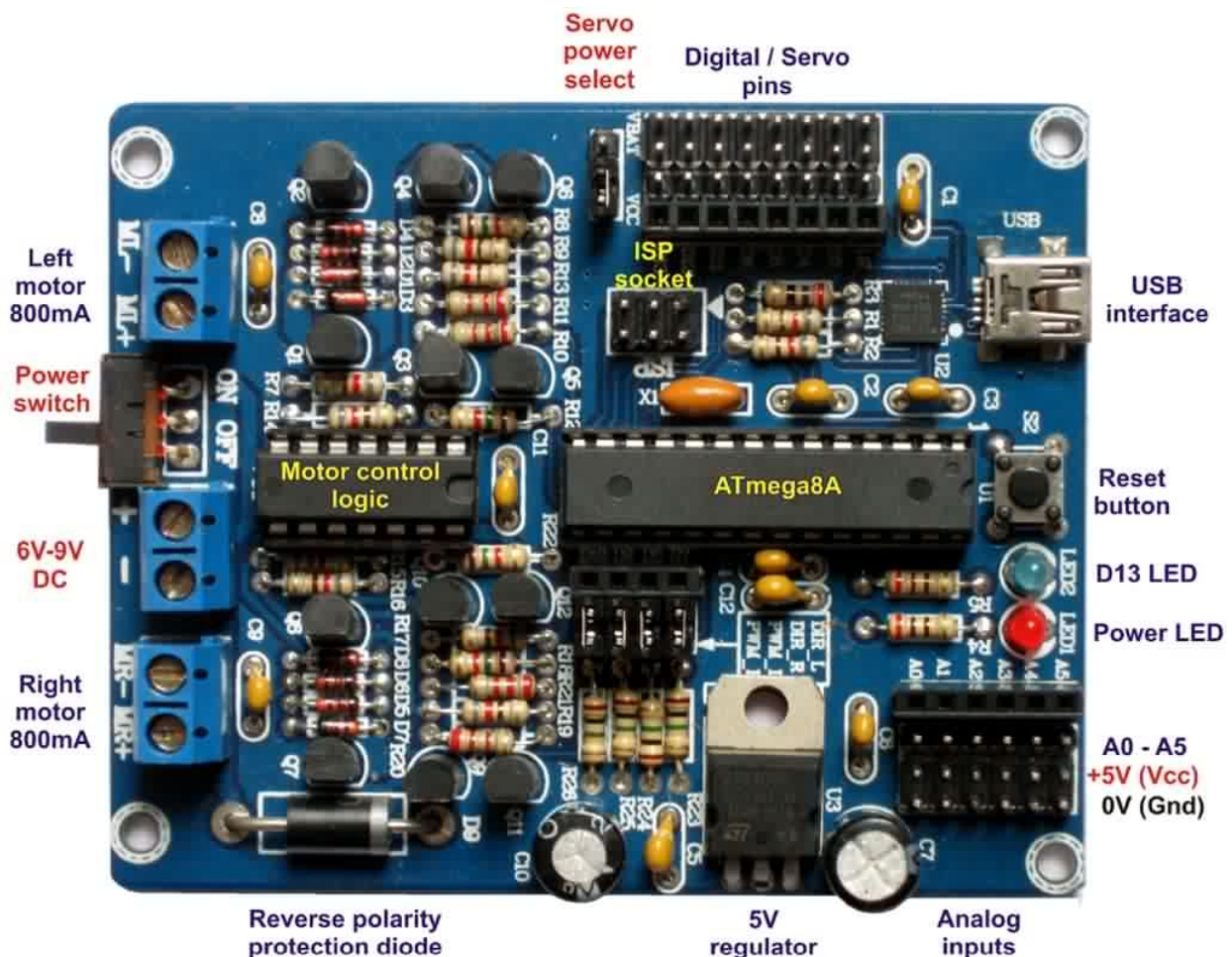# Magician
Robot Controller

The Magician robot controller is a low cost, Arduino compatible controller for beginners with everything you need to get started all on one board.

Features:

- USB interface and ISP socket for easy programming.
- ATmega8 controller preloaded with the Arduino boot loader (upgradeable).
- Dual motor controller rated at 800mA for each motor.
- Motor control circuit can be disconnected to provide additional digital pins.
- 8x 3 pin servo compatible outputs.
- 6x analog inputs with +5V and ground for powering sensors.
- Servo power selectable between battery voltage or 5V regulated.
- LDO +5V regulator rated at 1.5A when used with a heatsink.
- Reverse polarity protection diode rated at 3A to protect servos.
- Quality screw terminals for power and motor connections.
- Power switch, power LED, reset button and D13 LED.

Arduino Compatibility

The Magician controller uses the ATmega8 processor and comes preloaded with the Arduino boot loader. The ATmega8 is the chip used by the original Arduino and has enough program memory to suit beginners (8K). This chip can easily be replaced with an ATmega168 or ATmega328 to increase memory size while maintaining Arduino compatibility. This manual assumes you will use the Arduino IDE for programming the controller.

USB Interface

The USB interface allows the controller to be easily programmed with the Arduino IDE and a USB cable. When programming the controller can be powered directly from the USB cable although the USB power will not power the motor control circuit.

Motor Control Circuit

The Magician robot controller has two motor control circuits called "H" bridges. These "H" bridges will control the speed and direction of small DC brushed motors as used in most toys.

Each motor is controlled by two digital outputs. The left motor direction is controlled by D7 while it's speed is controlled by D9. The right motors direction is controlled by D8 while the speed is controlled by D10.

If your robot does not used DC brushed motors then you can remove the 4 jumpers next to pins D7-D10 giving you one male and one female header for each pin.

D9 and D10 can generate PWM signals when the servo command is not used.
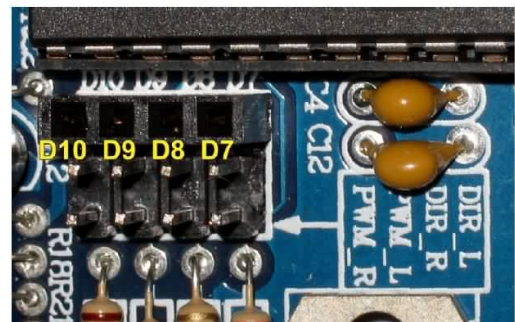
Digital / Servo pins

There are 8x digital pins configured especially for use with servos. These pins can still be used as standard digital I/O pins but they also have power pins for servos. +V can be selected between Vcc (+5V) from the regulator or Vbat from the battery allowing servos to be powered directly from the battery.

These pins do not have to be for servos. They can also be used with LEDs, simple switches or digital sensors in which case the voltage select jumper should be set to Vcc (+5V) to prevent damage.

Note each pin has a maximum current limit of 40mA making them unsuitable for driving relays or motors directly. When driving LEDs a current limiting resistor of about 270 ohms should be used in series with each LED. Digital pins D2 and D3 can also be used for external interrupts.

Analog Inputs

These pins are labeled A0 – A5 and are normally used to measure voltages between 0V and 5V. There are many sensors available that have analog outputs. If you use a 5V sensor then it can be powered by the Vcc and ground pins next to the analog input pins.

Note: Some analog sensors do not have the +5V pin in the center of the pluplug. You must swap the power wires on the sensor cable to prevent damage to the sensor.

Digital and Analog pins

When the controller is switched on for the first time or reset then all pins except D13 are converted to inputs. D13 is set to output so that the boot loader can operate it. You will notice that the LED on D13 flashes when a new program is uploaded. It is recommended that D13 be used for outputs only for this reason. If you want to use a pin for an output then you must configure it as an output.

Analog pins A0 – A5 can also be selected as digital pins D14 – D19 allowing them to be used as digital I/O pins.

All controller pins have an internal 20K pullup resistor available. To enable this pullup resistor, write a "1" or "HIGH" to that pin while it is configured as an input.

Power Supply

This controller is designed to work with battery voltages from 6V to 9V. Voltages over 9V will prevent the motor control circuit from functioning correctly. Voltages less than 5.5V can cause the 5V regulator to become unreliable. A reverse polarity protection diode will protect your controller if the power is accidentally reversed.

The 5V regulator uses a large copper track on the board for a heatsink and when running from a 6V battery can easily handle up to 1A of current. If necessary the regulator can be stood upright on the PCB with a heatsink attached. The maximum current rating of the 5V regulator is 1500mA.

Software and USB Drivers

The Arduino language is a simplified version of C++ which is easy to learn making it ideal for students and hobbyist. This software is free and available for Windows, Linux and Mac OSX. You can download it from:

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

The USB interface drivers are also available for Windows, Linux and Mac OSX. Download the latest drivers from:

http://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx

PWM_L
DIR_L
4011
U5A
R12 1k5
R11 2k2
R10 2k2
R7 82Ω
Q6 BC547
R8 1k5
U3B 4011
Q5 BC547
R9 82Ω
Q3 BC337
Q1 BC327
D3 1N4148
D1 1N4148
MOTO_L
C8 100n
VDD
D4 1N4148
D2 1N4148
Q4 BC337
Q2 BC327
R13 82Ω
R14 82Ω
R15 82Ω
R16 82Ω
Q9 BC337
Q7 BC327
D7 1N4148
D5 1N4148
MOTO_R
C9 100n
VDD
D8 1N4148
D6 1N4148
Q10 BC337
Q8 BC327
R17 82Ω
U5D 4011
Q11 BC547
R18 1k5
Q12 BC547
R22 1k5
R21 2k2
R20 2k2
R19 82Ω
U5C 4011
PWM_R
DIR_R

USB
4 HEADER
C1 100n
U2 CP2102
VDD GND D+ D- VBUS REGIN
NC NC NC NC NC NC
RST SUSPEND SUSPEND DCD DSR DTR RTS CTS
TXD RXD
RESET
R3 27
VCC
R2 82Ω
R1 82Ω
RXD TXD

ISP
J16
D14 D15 RST
D11
VCC

X1 16M
U1 ATMEGA8 DIP28
PD0 (RXD)
PD1 (TXD)
PD2 (INT0)
PD3 (INT1)
PD4 (XCK/T0)
PD5 (T1)
PD6 (AIN0)
PD7 (AIN1)
PB0 (ICP)
PB1 (OC1A)
PB2 (SS/OC1B)
PB3 (MOSI/OC2)
PB4 (MISO)
PB5 (SCK)
PB6 (XTAL1/TOSC1)
PB7 (XTAL2/TOSC2)
(RESET) PC6
(ADC5/SCL) PC5
(ADC4/SDA) PC4
(ADC3) PC3
(ADC2) PC2
(ADC1) PC1
(ADC0) PC0
VCC
GND
AVCC
AREF
GND
RXD TXD
DIR_R PWM_R
PWM_L DIR_L
D2 D3 D4 D5 D6 D11 D12 D13

VCC
R6 10k
C3 100n
C2 100n
S2 RESET
VDD
H15
J7 J8 J9 J10 J11 J12 J13 J14
D2 D3 D4 D5 D6 D11 D12 D13

LED1 RED R4 270 VCC
LED2 blue R5 270 D13

power
S1 SW SPDT
D9 1N4007
VDD
U3 LM7805CT
Vin GND +5V
C5 100n
C10 220u/16V
C7 220u/16V
C6 220n
VCC