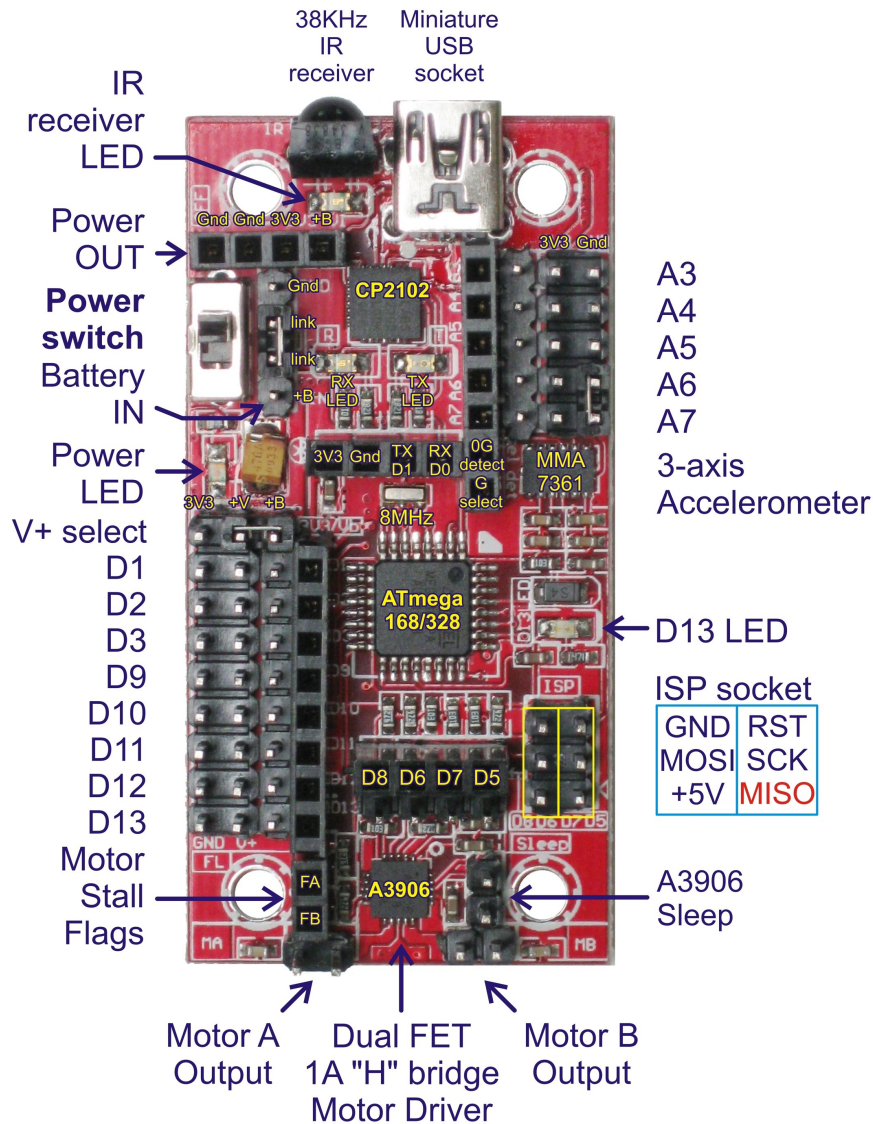


# Micro Magician robot controller



The Micro Magician robot controller is the perfect choice for small / low voltage robot projects. This low cost Arduino compatible controller is packed full of features:

- Small size of just 60mm x 30mm
- Supply voltage from 4.5V to 9V with 3.3V regulator and reverse polarity protection
- ATmega168 or ATmega328 MCU at 8MHz
- Dual 1A FET "H" bridge with electronic braking, current limiting and overload detect
- 3 axis accelerometer with 0G detection and either 1.5G or 6G full range sensitivity
- 38KHz IR receiver with signal detection LED
- Up to 8 servos can plug directly into the controller when V+ is set to Battery
- 3.3V and GND outputs available for powering sensors
- All I/O pins (except D4) have both male and female header pins
- Status LEDs for Power, RX, TX, IR signal and D13.

## **Power**

The Micro Magician is designed to work on voltages as low as 4.5V allowing it to be powered by 4xNiMH cells. Do not exceed 9V otherwise damage to the A3906 motor driver may occur.

Two link inputs allow two battery holders to be linked in series otherwise they can be ignored. These pins only connect to each other. A female header provides power output for external devices controlled via the onboard power switch.

The controller can be powered via the USB port or ISP socket for programming but battery power is needed for the motor controller and servos. Polarity protection prevents damage if the battery is accidentally connected the wrong way.

## **A3906 Dual FET “H” bridge**

The A3906 motor driver can drive two DC brushed motors or 1 stepper motor. The FET “H” bridges have a very low voltage drop so each output has been internally limited to 900mA to prevent damage from accidental short circuits. Electronic braking is possible by driving both inputs high.

The “motor stall flags” are normally held high by pullup resistors and will go low when a motor draws more than the 900mA current limit. Connect these to spare digital inputs so your program will know if your robot gets stuck.

When not in use the A3906 can be put into sleep mode and it’s control pins (D5 – D8) used for other purposes.

## **MMA7361L 3-axis accelerometer**

The MMA7361L detects acceleration due to both gravity and motion on all three axis’s. This feature gives robots a sense of balance and can be used to detect if the robot is about to fall over. If the robot has fallen over then this sensor can aid self-righting maneuvers. The ability to detect acceleration can also be used to determine if the robot is moving or has been involved in a collision eliminating the need for bumper switches. This sensor uses Analog inputs A0, A1 and A2.

The sensitivity defaults to +/- 1.5g but +/- 6g can be selected by pulling the “G select” pin high. If your robot falls then the “0G detect” pin will go high. Use this pin in conjunction with an external interrupt pin to disable servos (pull their control pin low) and shutdown motors to reduce the chance of stripped gears.

## **Connecting Servos**

The digital outputs D1, D2, D3, D9, D10, D11, D12, D13 can be used to drive servos. Use the V+ selection jumper to connect the V+ rail to +Bat. This will power your servos directly from the battery. Be careful not to connect any 3.3V device to V+ when powering servos.

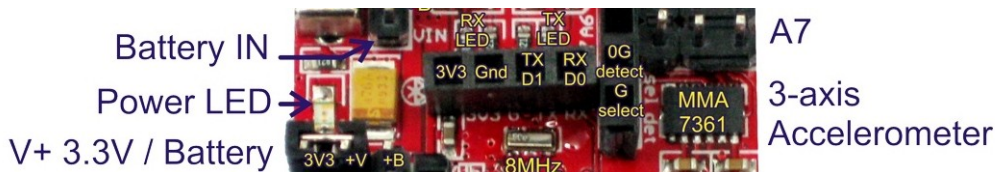
Because D1 is also the TX pin, any servo connected to this pin will move unpredictably during serial communications. This can be avoided by turning the power switch off during an upload. The processor will remain powered via the USB cable but the motors and servos will be disabled.

## 38KHz IR receiver

The built in IR receiver allows the controller to receive commands from a universal TV remote. This allows you to send the robot instructions while it is on the move and can be very useful for diagnostics. This sensor is hardwired to D4 and has a status LED to indicate when a signal is being received. The operation of the status LED is independent of the software making it an ideal tool for testing and debugging.

## Communications Header

The Micro Magician has a header for an external communications device such as a Bluetooth or Xbee module. This header is for 3.3V devices only. Because this header shares the same serial port used by the USB device it may be necessary to unplug any devices from this port when using the USB interface for programming and debugging.



Do not use D1 for servos or other devices when using an external communications device as this pin is the TX pin.

## External interrupt pins

D2 and D3 can be used for external interrupts. These pins connect to the MCU's internal hardware and allow your program to respond quickly to external events without constantly monitoring the pins in the program. These inputs are ideal for encoders.

## ISP socket

The ISP socket is normally used for writing the bootloader into the Micro Magician. The +5V pin feeds to the 3.3V regulator via a reverse polarity protection diode allowing the board to be powered by the ISP socket when the bootloader is being written. Series resistors protect the 3.3V system from damage when using a 5V device to write the bootloader. This allows another Arduino board to act as an ISP programmer.



## ISP socket

GND	RST
MOSI	SCK
+5V	MISO

Although a reset button is not included on the PCB you can connect one to pins 5&6 of the ISP socket (GND & RST). **Note:** Pin 1 (MISO) has a small white arrow printed on the PCB next to it.

## USB driver

The Micro Magician uses the CP2102 USB interface IC from Silicon Labs. Depending on your operating system you may need to install drivers so that your computer can communicate with the Micro Magician. The latest drivers for Window, Mac and Linux can be downloaded from here:

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

## Software

The Micro Magician can be programmed using a USB cable and the Arduino IDE, which is free from the internet. The controller comes preinstalled with the Arduino Pro (3.3V @8MHz) ATmega168 or ATmega328 bootloader.

To make the Micro Magician easier to use, an Arduino library “**microM**” has been written. This library includes functions for the on-board hardware and generates several global variables that can be accessed in your programs for reading information or changing default settings.

## Arduino library

The microM library can be downloaded from the DAGU product support site here:

<https://sites.google.com/site/daguproducts/home/arduino-libraries>

Unzip the “microM” folder and copy it into the Arduino libraries folder. Next time you run the Arduino IDE, go to File → Examples → microM to see some example code.

**microM.Setup()** This function initialises Timer 2 for use with the microM library. It is only required when using the global byte **microM.ircommand** and **microM.Impact()** function. Timer 2 is also used by some other libraries and commands such as “Tone()”. Use **microM.Setup()** to re-initialise timer 2 afterward.

## Detecting impacts with the 3 axis accelerometer

**microM.Impact()** This function uses timer 2 and monitors the 3 axis accelerometer at regular intervals looking for sudden changes that would indicate an impact. The global integer, **microM.sensitivity** determines the minimum magnitude to register as an impact. The default value is 50.

Because any object will vibrate when sustaining an impact, only the initial sensor readings will be valid. After initial impact has occurred, a timeout period determined by a global integer variable, **microM.devibrate** prevents false readings. This value defaults to 100 (approximately 500mS) but can be increased for large robots.

- **microM.deltx** – integer represents the impact magnitude along the X-axis.
- **microM.dely** – integer represents the impact magnitude along the Y-axis.
- **microM.deltz** – integer represents the impact magnitude along the Z-axis.
- **microM.magnitude** – integer represents the total impact magnitude vector.

Use the magnitude integer to determine if there is an impact and then use the delta X,Y and Z integers to determine the direction of impact. This allows the accelerometer to replace bumper switches on a robot.

As reading the analog inputs takes a relatively long time (260uS) the raw data is also available via these global integers to save your program reading them a second time.

- **microM.xaxis**
- **microM.yaxis**
- **microM.zaxis**

## Reading the IR receiver

The **microM** ISR (interrupt service routine) initialized by the **microM.Setup()** function includes a Sony SIRC decoder. When using a universal remote programmed to use a Sony IR Code the receiver can be read using the global variable **microM.ircommand**.

If you wish to use an external IR receiver connected to a different IO pin then use **microM.irpin** to change the input pin. This value defaults to 4.

## Driving DC and stepper motors

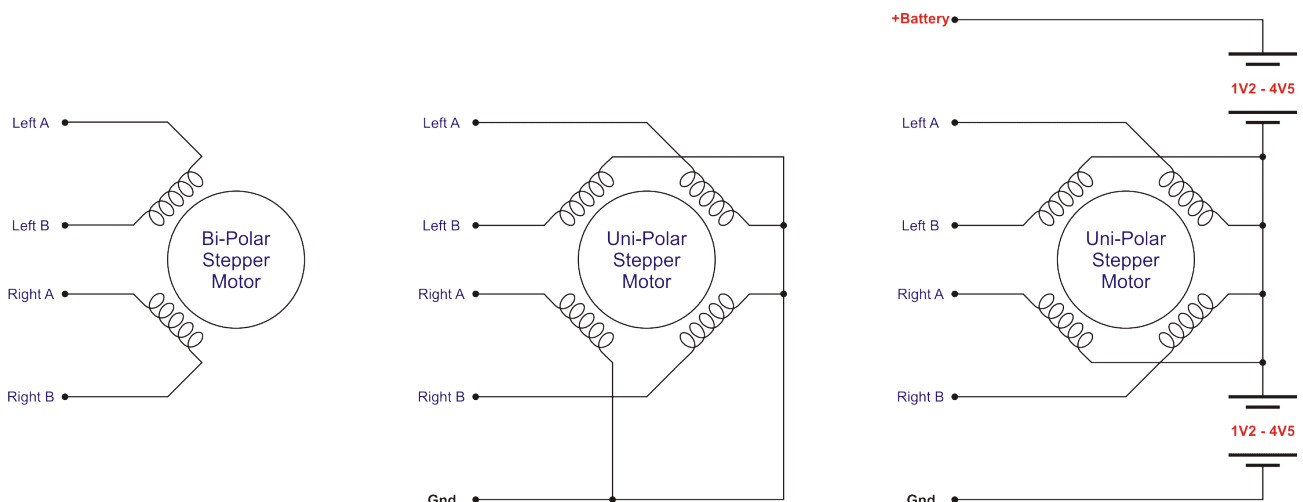
**microM.Motors(leftspeed, rightspeed, leftbrake, rightbrake)** function provides a simple means of controlling speed, direction and braking of two DC motors.

- **leftspeed** is an integer specifying speed and direction from  $-255$  to  $+255$ .
- **rightspeed** is an integer specifying speed and direction from  $-255$  to  $+255$ .
- **leftbrake** non zero values engage electronic braking on the left motor.
- **rightbrake** non zero values engage electronic braking on the right motor.

**microM.Stepper(direction, mode)** function provides an easy way to drive a stepper motor. Bi-polar and Uni-polar motors can be driven.

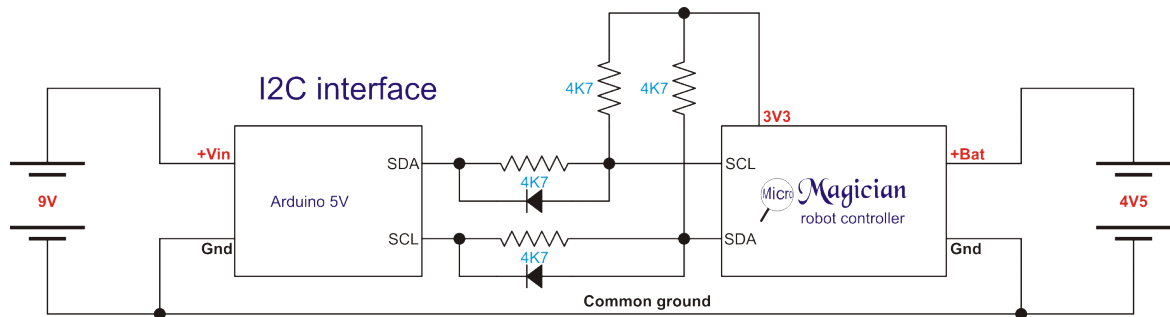
- **direction** integers greater than 0 step forward, less than 0 step reverse. A value of 0 will turn off power to the windings.
- **mode** full steps are the default. A non zero value indicates half steps.

Below is a diagram showing typical methods of connecting either a bi-polar (4 wire) or uni-polar (5 wire) stepper motor.



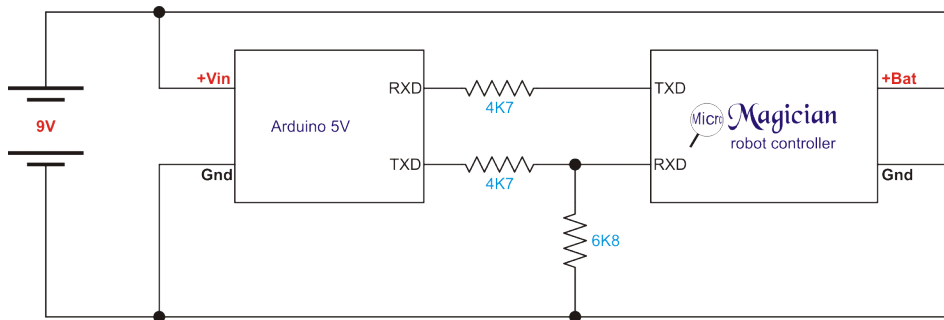
## Interfacing to 5V systems and devices

The micro Magician is a 3.3V system but you can still interface with 5V systems and devices by following a few simple precautions. When 5V devices or systems are powered from a separate battery or power supply then the ground of the 5V system should be connected to the ground of the Magician controller.

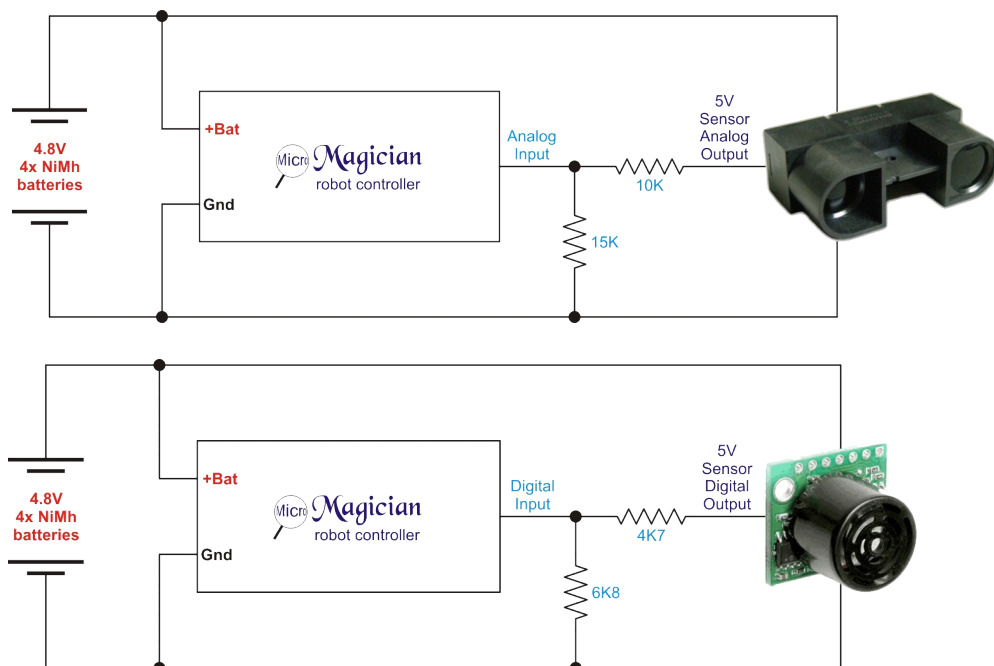


The digital I/O pins of the micro Magician should have at least 4K7 resistance in series when connecting to a 5V device. This will limit the current through the MCU's clamping diodes to a safe level.

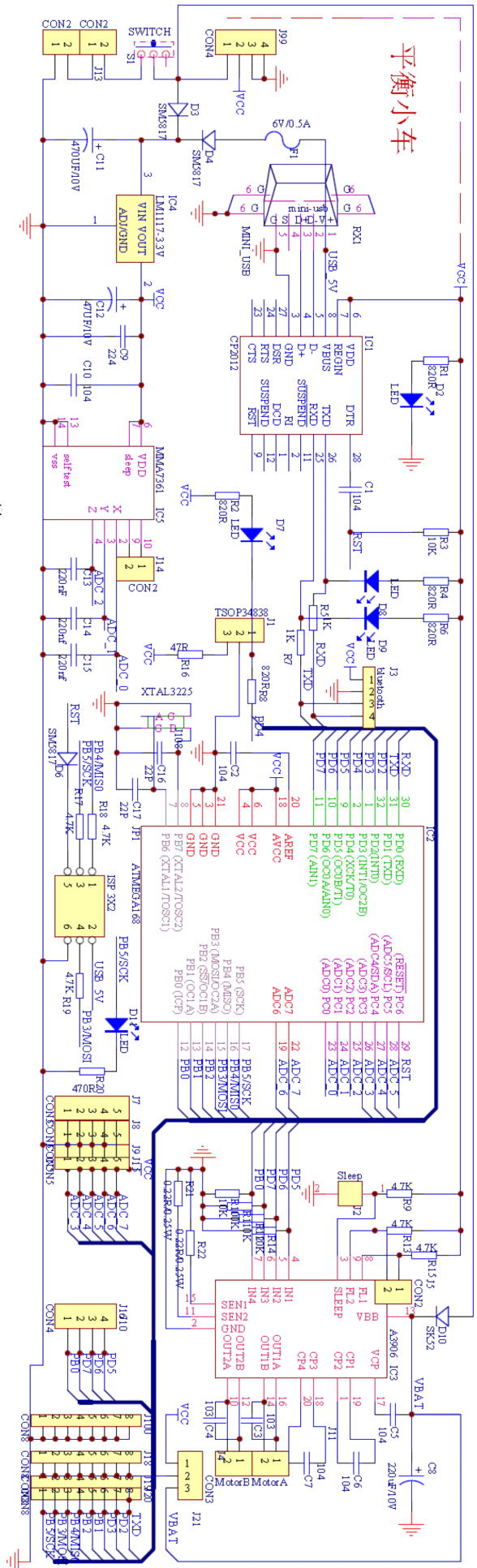
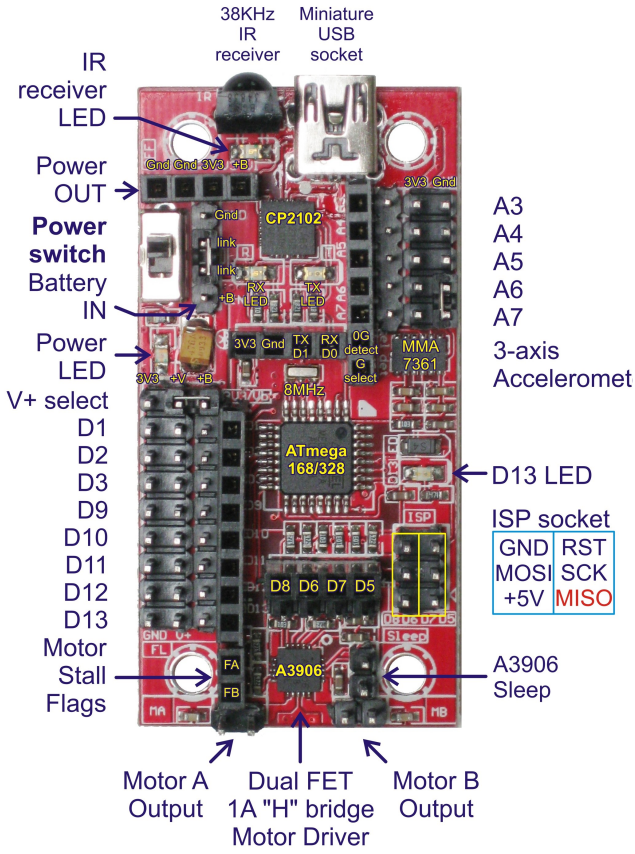
### Serial interface



When connecting 5V analog sensors to the analog inputs of the micro Magician a voltage divider should be used to limit the maximum input voltage to 3V. The diagrams below demonstrates the best way to connect 5V digital or analog sensors.



# Micro Magician robot controller

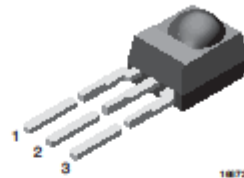


## IR Receiver Modules for Remote Control Systems

### Description

The TSOP348.. - series are miniaturized receivers for infrared remote control systems. PIN diode and preamplifier are assembled on lead frame, the epoxy package is designed as IR filter.

The demodulated output signal can directly be decoded by a microprocessor. TSOP348.. is the standard IR remote control receiver series for 3 V supply voltage, supporting all major transmission codes.



### Features

- Photo detector and preamplifier in one package
- Internal filter for PCM frequency
- Improved shielding against electrical field disturbance
- TTL and CMOS compatibility
- Output active low
- Supply voltage: 2.7 V to 5.5 V
- Improved immunity against ambient light



### Mechanical Data

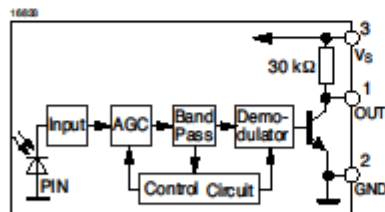
#### Pinning:

1 = OUT, 2 = GND, 3 =  $V_S$

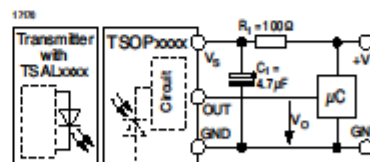
### Parts Table

Part	Carrier Frequency
TSOP34830	30 kHz
TSOP34833	33 kHz
TSOP34836	36 kHz
TSOP34837	36.7 kHz
TSOP34838	38 kHz
TSOP34840	40 kHz
TSOP34856	56 kHz

### Block Diagram



### Application Circuit



$R_1 + C_1$  recommended to suppress power supply disturbances.

The output voltage should not be held continuously at a voltage below  $V_O = 2.0$  V by the external circuit.





## ±1.5g, ±6g Three Axis Low-g Micromachined Accelerometer

The MMA7361L is a low power, low profile capacitive micromachined accelerometer featuring signal conditioning, a 1-pole low pass filter, temperature compensation, self test, 0g-Detect which detects linear freefall, and g-Select which allows for the selection between 2 sensitivities. Zero-g offset and sensitivity are factory set and require no external devices. The MMA7361L includes a Sleep Mode that makes it ideal for handheld battery powered electronics.

### Features

- 3mm x 5mm x 1.0mm LGA-14 Package
- Low Current Consumption: 400  $\mu$ A
- Sleep Mode: 3  $\mu$ A
- Low Voltage Operation: 2.2 V – 3.6 V
- High Sensitivity (800 mV/g @ 1.5g)
- Selectable Sensitivity ( $\pm$ 1.5g,  $\pm$ 6g)
- Fast Turn On Time (0.5 ms Enable Response Time)
- Self Test for Freefall Detect Diagnosis
- 0g-Detect for Freefall Protection
- Signal Conditioning with Low Pass Filter
- Robust Design, High Shocks Survivability
- RoHS Compliant
- Environmentally Preferred Product
- Low Cost

### Typical Applications

- 3D Gaming: Tilt and Motion Sensing, Event Recorder
- HDD MP3 Player: Freefall Detection
- Laptop PC: Freefall Detection, Anti-Theft
- Cell Phone: Image Stability, Text Scroll, Motion Dialing, E-Compass
- Pedometer: Motion Sensing
- PDA: Text Scroll
- Navigation and Dead Reckoning: E-Compass Tilt Compensation
- Robotics: Motion Sensing

MMA7361L

MMA7361L: XYZ AXIS  
 ACCELEROMETER  
 $\pm$ 1.5g,  $\pm$ 6g

Bottom View



14 LEAD  
 LGA  
 CASE 1977-01

Top View

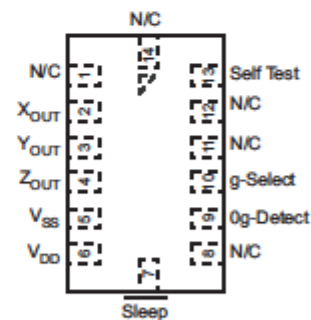


Figure 1. Pin Connections

### ORDERING INFORMATION

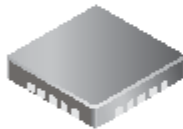
Part Number	Temperature Range	Package Drawing	Package	Shipping
MMA7361LT	-40 to +85°C	1977-01	LGA-14	Tray
MMA7361LR1	-40 to +85°C	1977-01	LGA-14	7" Tape & Reel
MMA7361LR2	-40 to +85°C	1977-01	LGA-14	13" Tape & Reel

## Low Voltage Stepper and Single/Dual DC Motor Driver

### Features and Benefits

- 2.5 to 9 V operation
- Internal PWM current limit control
- Synchronous rectification for reduced power dissipation
- Peak current output flag
- Undervoltage lockout
- Low  $R_{DS(on)}$  outputs
- Small package
- Brake mode for DC motors
- Sleep function
- Crossover-current protection
- Thermal shutdown

### Package: 20-contact QFN (suffix ES)



Approximate size

### Description

Designed for pulse width modulated (PWM) control of low voltage stepper motors, and single and dual DC motors, the A3906 is capable of output currents up to 1 A per channel and operating voltages from 2.5 to 9 V.

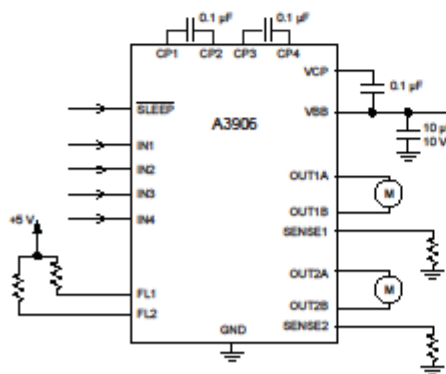
The A3906 has an internal fixed off-time PWM timer that sets a peak current based on the selection of a current sense resistor. An overcurrent output flag is provided that notifies the user when the current in the motor winding reaches the peak current determined by the sense resistor. The fault output does not affect driver operation.

The A3906 is provided in a 20-contact, 4 mm × 4 mm, 0.75 mm nominal overall height QFN, with exposed pad for enhanced thermal dissipation. It is lead (Pb) free, with 100% matte tin leadframe plating.

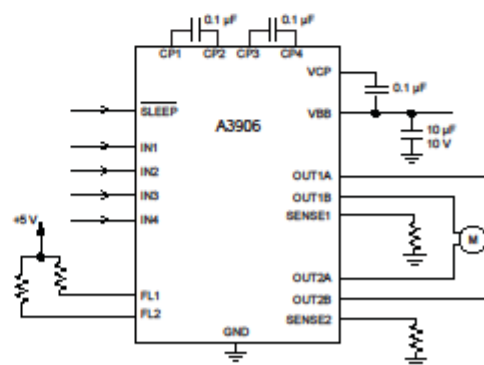
Applications include the following:

- Digital still cameras (DSC)
- Cell phone cameras
- USB powered devices
- Battery powered devices

### Typical Applications



Dual DC motor application



Stepper motor application