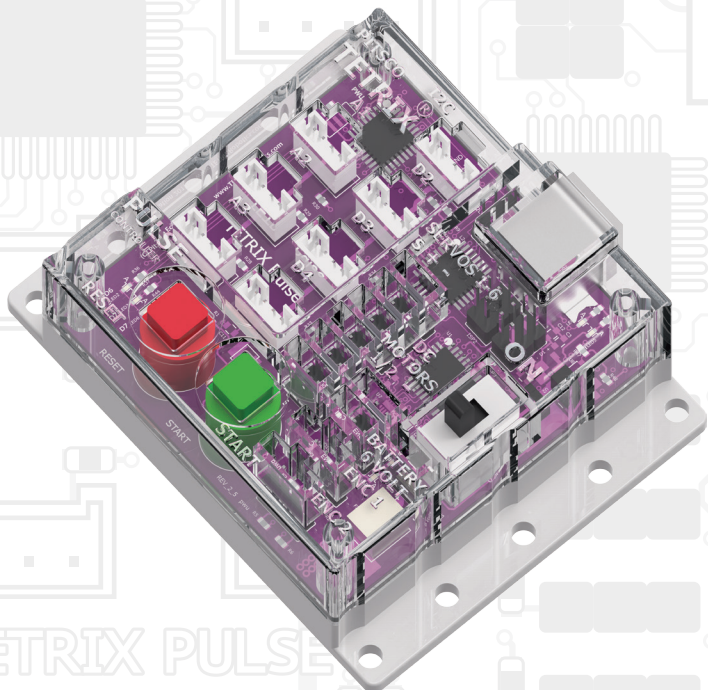


PITSCO

**TETRIX**  
PRIME



## **TETRIX® PULSE™ Robotics Controller Quick-Start Guide and Specifications**

**PITSCO**  
EDUCATION

44302

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A downloadable PDF of the most recent version of this guide can be found at [www.TETRIXrobotics.com/PULSEdownloads](http://www.TETRIXrobotics.com/PULSEdownloads).

## **WARNING**

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

**Notice:** The changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equivalent.

California Prop 65 - **WARNING:** This product contains one or more chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

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# TETRIX® PULSE™ Robotics Controller

## Quick-Start Guide and Specifications

### General Description:

TETRIX® PULSE™ is a programmable target designed to enable autonomous control of robotics and mechatronic systems constructed using TETRIX PRIME building elements. The design architecture of PULSE is Arduino compatible, using the same ATmega328P program memory chip and preprogrammed Optiboot bootloader as a genuine Arduino UNO. PULSE offers a fully integrated brain for your robot that is powerful yet easy to use and, when combined with the *Arduino Software (IDE)*, can provide an ideal learning tool for teaching engineering design and coding.

### Software:

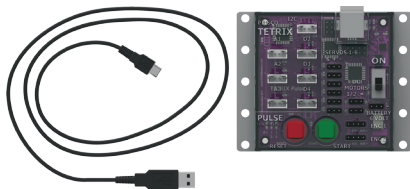
A drag-and-drop block-based graphic coding software is used to program the PULSE controller. The software has been developed using Google *Blockly* and is available for download at [www.TETRIXrobotics.com/PULSEdownloads](http://www.TETRIXrobotics.com/PULSEdownloads). In addition, the PULSE controller can also be programmed with a syntax-based coding method using the *Arduino Software (IDE)* and the PULSE Arduino Library.

The TETRIX PULSE Robotics Controller features the following:

- 2 DC motor control ports, and 6 standard control servo ports
- 3 digital sensor ports, which can be configured as digital input, digital output, or serial communication, and 3 analog sensor ports (A1-A3 can be configured as analog input or digital input or output)
- 1 I2C port, 1 USB programming port, and 2 quadrature encoder input ports
- 1 battery connection port
- 1 power on/off switch
- 1 program start push button
- 1 program stop/reset push button
- 3 LED indicators: red, green, and yellow

### What's Included:

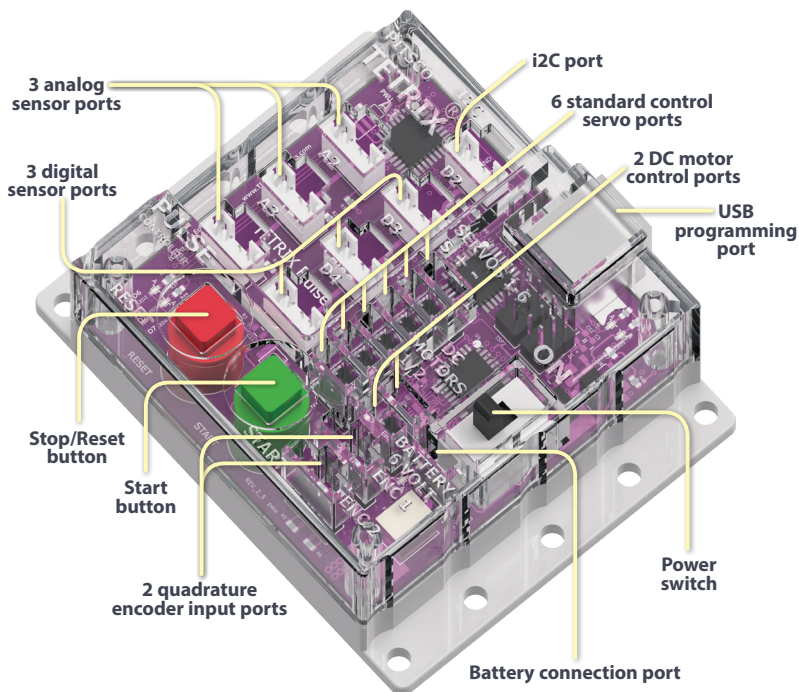
- 1 TETRIX PULSE Robotics Controller
- 1 USB cable Type A to B



## Technical Specifications:

Microcontroller:	ATmega328P with Arduino Optiboot bootloader installed
Memory:	32 KB flash programmable memory (ATmega328P)
Power:	6 volts DC using TETRIX® PRIME 6 V NiMH Battery Pack
DC motor ports:	2 three-position header pins; H-bridge PWM controlled; 3 A continuous current each channel, 5 A peak
Compatible DC motor:	TETRIX PRIME 6-Volt DC Motor (44298)
DC motor control modes:	Constant power (-100% to 100%) Support for PID constant speed (-100 to 100 degrees per second) Support for PID constant speed to encoder target position and hold Support for PID constant speed to encoder degree position and hold
Motor encoder ports:	2 quadrature, 5 volts DC, 50 mA max; Spec: 360 CPR, 1,440 PPR; ENC 1 and ENC 2
USB connector:	USB Type B
USB driver:	FTDI
Standard servo ports:	6 total: servo channels 1-6
Total servo power limit:	6 volts DC, 6 A max
Servo control modes:	Set servo speed (0% to 100%) Set servo position (0-180 degrees)
Battery voltage monitoring:	0-7.5 volts range
3 digital sensor ports (D2-D4):	Each can be configured as digital input, digital output, or serial communication.
3 analog sensor ports (A1-A3):	Each can be configured as analog input or digital input or output ports.
1 I2C port (I2C):	100 kHz speed. This connection shares the same I2C bus as the internal DC motor and servo motor control chips. I2C addresses 0x01-0x06 reserved by the PULSE controller.

Battery connection port:	3-position pin header. Use only TETRIX® PRIME 6 V NiMH Battery Pack.
1 green Start button (START):	Programmable push button
1 red Stop/Reset button (RESET):	Non-programmable push button
1 red LED:	Programmable LED used as an indicator
1 yellow LED:	Programmable LED used as an indicator
1 green LED:	Programmable LED used as an indicator
1 blue LED:	Indicates the power is on when illuminated
2 yellow LEDs:	Indicates serial data activity on the USB port
1 red and 1 green DC motor LED:	Indicates DC motor rotation and direction for each DC motor channel



## Installing the *Arduino Software (IDE)*:

In order to upload programs to the TETRIX® PULSE™ Robotics Controller, you need to install the *Arduino Software (IDE)*. Full and comprehensive instructions for installing the software on Windows and Macintosh computers can be found at the Arduino website at [www.arduino.cc](http://www.arduino.cc).

### To install:

From the homepage, click **Software** to access the software downloads section. After the *Arduino Software (IDE)* is installed, select **Arduino/Genuino Uno** from the **Tools > Board** menu to enable communication with PULSE. You will also need to select the COM port where PULSE has been installed by your computer system. A more detailed explanation of software installation is included in the full *TETRIX PULSE Robotics Controller Programming Guide* available for download at [www.TETRIXrobotics.com/PULSEdownloads](http://www.TETRIXrobotics.com/PULSEdownloads). Here, you will also find the latest updates on supported software platforms for the TETRIX PULSE Robotics Controller.

## Installing the PULSE Robotics Controller Arduino Library:

After you have successfully installed the *Arduino Software (IDE)*, you can add the PULSE Robotics Controller Arduino Library to your programming palette. The library is a specialized set of functions written specifically for the controller that greatly simplify the creation of programming applications to control your robot's motors and sensors. The PULSE Arduino Library is distributed as a zip file: TETRIX\_PULSE.zip.

### To install:

Download the PULSE Arduino Library from [www.TETRIXrobotics.com/PULSEdownloads](http://www.TETRIXrobotics.com/PULSEdownloads). After it is downloaded, save it to a location on your computer so you can install it into the *Arduino Software (IDE)*. If you are unfamiliar with how to install an Arduino library, reference the library installation section in the full *TETRIX PULSE Programming Guide* that is available for download. You can also visit the Arduino website at [www.arduino.cc](http://www.arduino.cc) for instructions on how to install libraries into the *Arduino Software (IDE)*.

## Arduino Code Examples:

The PULSE Arduino Library includes several code examples that will assist you in understanding how to program PULSE using the library functions. After the library has been installed, be sure to restart the *Arduino Software (IDE)*. After the software has restarted, the code examples will be located in the File > Examples drop-down menu.

## PULSE Robotics Controller Arduino Library:

Below is a reference of each function statement in the PULSE Robotics Controller Arduino Library. For a detailed description of each function statement, please download the full *TETRIX PULSE Programming Guide* found at [www.TETRIXrobotics.com/PULSEdownloads](http://www.TETRIXrobotics.com/PULSEdownloads).

```
PulseBegin();
PulseEnd();
setGreenLED(HIGH/LOW);
setRedLED(HIGH/LOW);
setYellowLED(HIGH/LOW);
setMotorPower(motor#, power);
setMotorPowers(power1, power2);
setMotorSpeed(motor#, speed);
setMotorSpeeds(speed1, speed2);
setMotorTarget(motor#, speed, target);
setMotorTargets(speed1, target1, speed2, target2);
setMotorDegree(motor#, speed, degrees);
setMotorDegrees(speed1, degrees1, speed2, degrees2);
setMotorSpeed(motor#, speed);
setMotorSpeeds(speed1, speed2);
setMotorInvert(motor#, invert);
readLineSensor(port#);
readSonicSensorCM(port#);
readSonicSensorIN(port#);
readBatteryVoltage();
readStartButton();
setServoSpeed(servo#, speed);
setServoSpeeds(speed1, speed2, speed3, speed4, speed5, speed6);
setServoPosition(servo#, position);
setServoPositions(position1, position2, position3, position4, position5, position6);
readServoPosition(servo#);
```

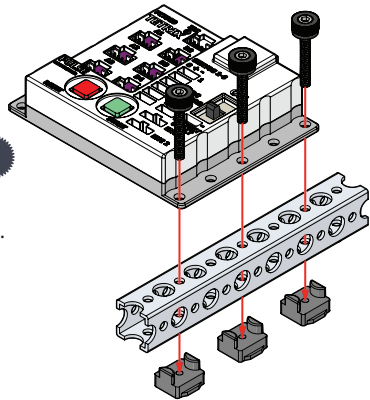
## Sensor Integration:

The TETRIX® PULSE™ Robotics Controller is designed with sensor ports that are compatible with the Grove system of modular sensors. Currently, the PULSE Arduino Library has integrated support for two of these sensors: the Line Finder and the Ultrasonic. These sensor packs are included in the TETRIX PRIME Programmable Robotics Set and the TETRIX PRIME Dual-Control Robotics Set and are available for purchase à la carte at

[www.TETRIXrobotics.com](http://www.TETRIXrobotics.com). Both the Line Finder Sensor Pack (43056) and Ultrasonic Sensor Pack (43055) include a mounting adapter that aligns with the TETRIX hole pattern, enabling easy robot attachment.

Additional Grove system sensors and Arduino example code for each can be found at [http://wiki.seeed.cc/Grove\\_System/](http://wiki.seeed.cc/Grove_System/). To view the sample Arduino code, simply click the sensor that is of interest.

TETRIX-compatible mounting adapters for the larger family of Grove sensors are sold separately and will be needed for securing sensors to the robot structure. Integrated support for additional Grove sensors will be added to the PULSE Arduino Library as further updates are released.



## Attaching the PULSE Controller:

The PULSE enclosure mounting holes are spaced to align with the TETRIX hole pattern. PULSE can be attached to TETRIX building elements using the screw and nut hardware included in the TETRIX robotics sets.

## Important Safety Information:

**Caution:** Use only a 6-volt TETRIX PRIME battery pack. Connect the TETRIX PRIME battery pack to the battery connection port. Never connect the battery pack to any port on the PULSE controller other than the battery port. Failure to do so could result in damage or injury.