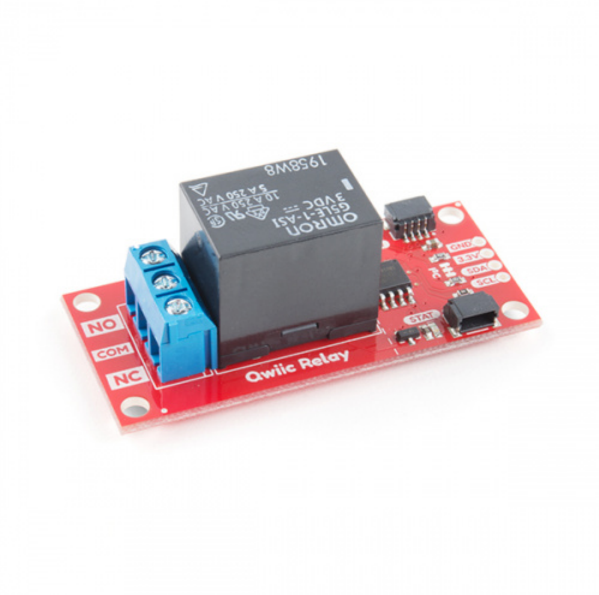
Qwiic Single Relay Hookup Guide

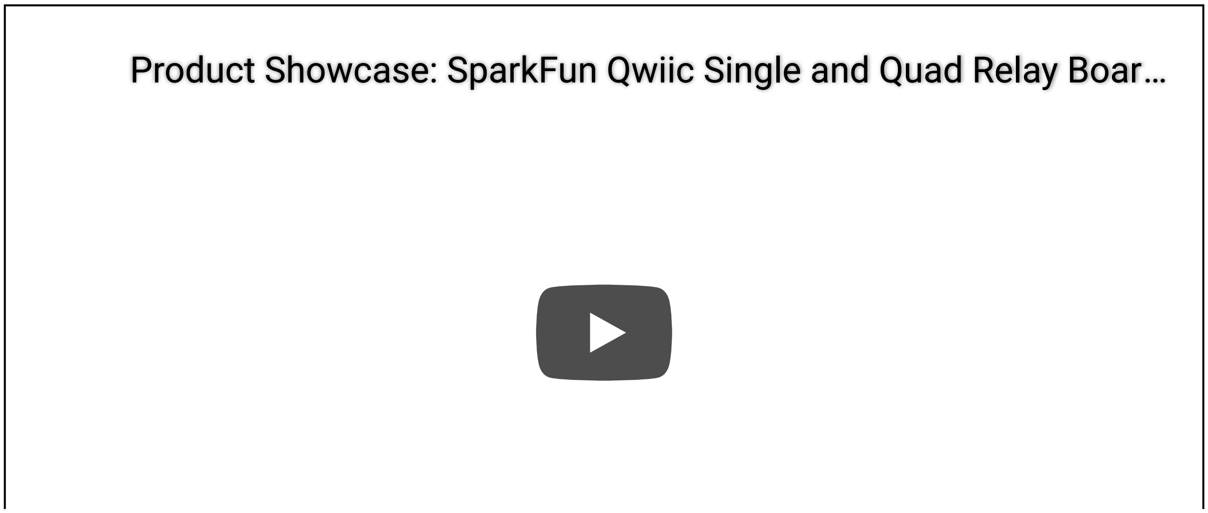
Introduction

The Qwiic Single Relay is SparkFun's easiest to use relay yet. The single relay can handle up to 5.5A at 240 VAC for long periods of time. The Qwiic connectors and screw terminals also mean that no soldering is necessary.



SparkFun Qwiic Single Relay

○ COM-15093

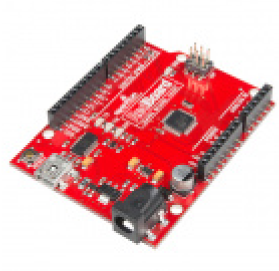


Product Showcase: SparkFun Qwiic Single and Quad Relay Boar...

⚡ **Warning!** The Qwiic single relay is great for switching loads like motors, batteries, solenoids, pumps, and more! Keep in mind controlling high voltage (110/220VAC) requires certain precautions. A beginner can do it but if you're unsure then please consider the pre-made IoT Power Relay. It's not I^{2}C but the IoT Power Relay contains shielding to prevent accidental shock.

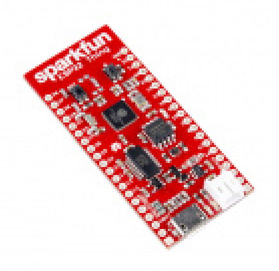
Required Materials

To get started, you’ll need a microcontroller to control everything. You may not need everything though depending on what you have. Add it to your cart, read through the guide, and adjust the cart as necessary.



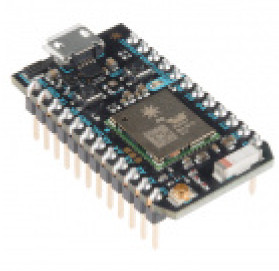
SparkFun RedBoard - Programmed with Arduino

◉ DEV-13975



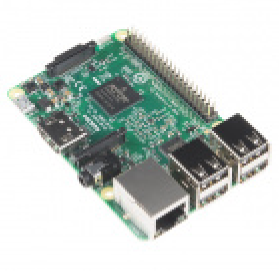
SparkFun ESP32 Thing

○ DEV-13907



Particle Photon (Headers)

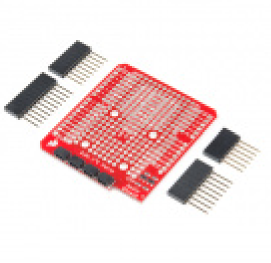
◉ WRL-13774



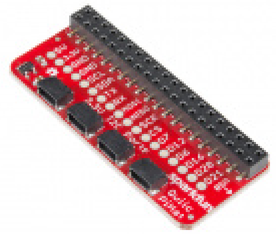
Raspberry Pi 3

○ DEV-13825

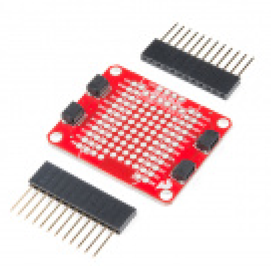
Now to get into the Qwiic ecosystem, the key will be one of the following Qwiic shields to match your preference of microcontroller:



SparkFun Qwiic Shield for Arduino
● DEV-14352



SparkFun Qwiic HAT for Raspberry Pi
● DEV-14459



SparkFun Qwiic Shield for Photon
⊖ DEV-14477

You will also need a Qwiic cable to connect the shield to your Qwiic Single Relay, choose a length that suits your needs.

Qwiic Cable - 100mm
● PRT-14427

Qwiic Cable - 500mm
● PRT-14429

Qwiic Cable - 200mm

Qwiic Cable - 50mm

◉ PRT-14428

○ PRT-14426

Tools

You will need a flush cutter and wire stripper to remove the sheath and insulation from a cable. A Phillips head screwdriver will be required to connect the load's to a screw terminal.

Self-Adjusting Wire Strippers

◉ TOL-14872

Flush Cutters - Xcelite

⊖ TOL-14782

SparkFun Mini Screwdriver

◉ TOL-09146

Suggested Reading

If you aren’t familiar with the Qwiic system, we recommend reading here for an overview.

Qwiic Connect System

We would also recommend taking a look at the following tutorials if you aren’t familiar with them.

Serial Communication

Asynchronous serial communication concepts: packets, signal levels, baud rates, UARTs and more!

I2C

An introduction to I2C, one of the main embedded communications protocols in use today.

Serial Terminal Basics

This tutorial will show you how to communicate with your serial devices using a variety of terminal emulator applications.

Qwiic Shield for Arduino & Photon Hookup Guide

Get started with our Qwiic ecosystem with the Qwiic shield for Arduino or Photon.

Hardware Overview

First let's check out some of the characteristics listed in the relay's datasheet that we're dealing with, so we know what to expect out of the board.

Characteristic	Range
Operating Voltage	**1.7V-3.6V**
Supply Current	100mA
Coil Resistance	23.5Ω
I^{2}C Address	**0x18 (Default)**, *(Jumper changes to 0x19)*
Max Current (Through Relay)	5.5A (240 VAC)

Pins

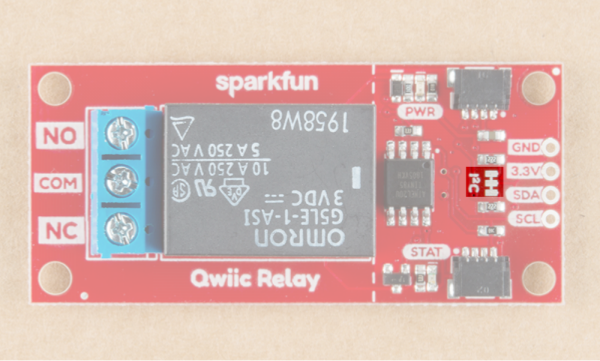
The following table lists all of the relay's pins and their functionality.

Pin	Description	Direction
GND	Ground	In

3.3V	Power	In
SDA	Data	Bi-directional
SCL	Clock	In
NC	Normally Closed	Switch
NO	Normally Open	Switch
COM	Switch Common	Switch

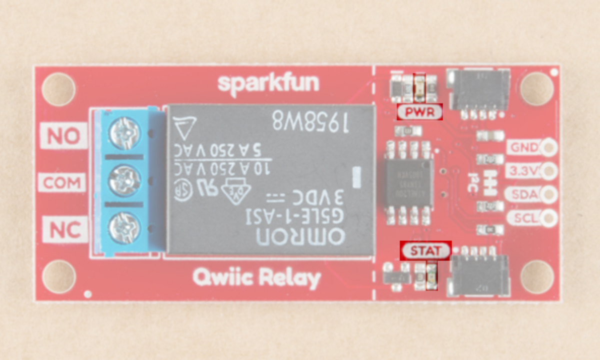
Optional Features

The Qwiic Relay has pull up resistors attached to the I^{2}C bus; if multiple sensors are connected to the bus with the pull-up resistors enabled, the parallel equivalent resistance will create too strong of a pull-up for the bus to operate correctly. As a general rule of thumb, disable all but one pair of pull-up resistors if multiple devices are connected to the bus. If you need to disconnect the pull up resistors they can be removed by cutting the traces on the corresponding jumpers highlighted below.



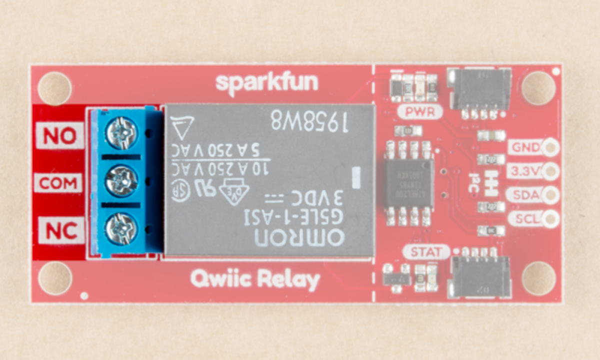
Pull-up Jumper

The Power LED will light up when the board is powered. The Status LED will light up when the relay has been triggered and the switch is closed, both are highlighted in the below image



Power LED

The onboard screw terminal should be used to connect your high-power load, it is highlighted below. The middle `COM` pin should be hooked up to the **Live** wire (Usually black) coming from the wall, while `NO` or `NC` should be connected to the **Live** wire on the device side of things.



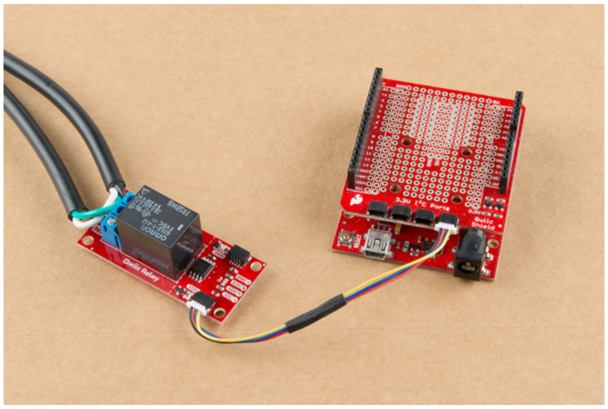
Screw Terminal

Hardware Assembly

If you haven't yet assembled your Qwiic Shield, now would be the time to head on over to that tutorial. Depending on the microcontroller and shield you've chosen, your assembly may be different, but here's a handy link to the Qwiic Shield for Arduino and Photon Hookup Guide to get you started!

QWIIC SHIELD FOR ARDUINO PHOTON HOOKUP GUIDE

With the shield assembled, SparkFun's new Qwiic environment means that connecting the relay could not be easier. Just plug one end of the Qwiic cable into the Qwiic Relay, the other into the Qwiic Shield and you'll be ready to upload a sketch and start turning things on and off. It seems like it's too easy too use, but that's why we made it that way!

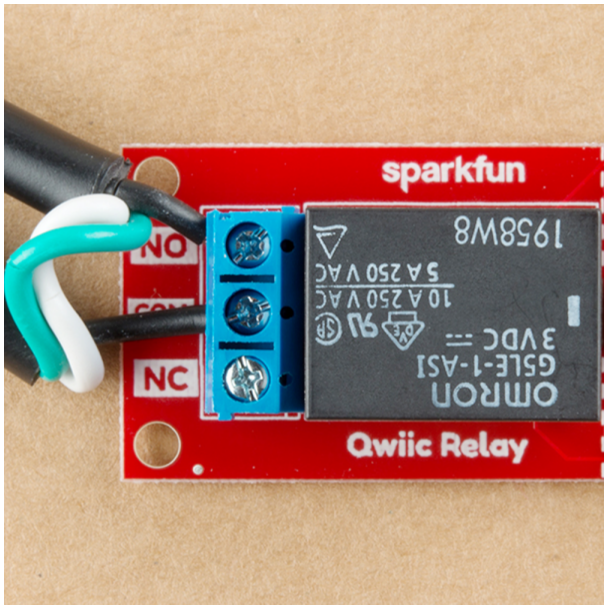


SparkFun RedBoard and Qwiic Shield with the Qwiic Relay attached

Note: Not sure about what color insulation wiring is used in you region? Check out the standard wire insulation colors listed online for reference. If you are unsure about the standard wiring color in your region, please consult a certified electrician to connect to the AC input voltage side.

⚡ **Warning!** Make sure the cable is **not** plugged into the wall as you cut into the wire in the following section.

You'll also need to place the relay in line with the AC powered item you're attempting to control. You'll have to cut your live AC line (usually black or red) and connect one end of the cut wire to `COM` and the other to `NC` or `NO`, depending on what you want the resting state of your device to be. If your AC device is going to be on for most of the time, and you occasionally want to turn it off, you should connect one end to `COM` and the other to `NC`. Connect to `NO` if the device will be off for most of the time. Check out the picture below for a visual aid.



Relay Example Connection

⚡ **Warning!** Make sure that your wires connecting to the wall outlet are secure and are rated to handle the current! Please be careful when handling the contacts when the cable is plugged into a wall outlet. **Touching the contacts while powered could result in injury.**

Looking for information about safety and insulation? Check out the notes about Safety and Insulation from our Beefcake Relay Control Kit.

⚡ **Each relay takes just over 100 mA to power** Daisy chaining these boards together on the same bus will result in pretty large power spikes, you may need a separate 3.3V source depending on what else is included in your project

Example Code

Note: This example assumes you are using the latest version of the Arduino IDE on your desktop. If this is your first time using Arduino, please review our tutorial on installing the Arduino IDE.

The Qwiic Relay is pretty simple, so all of the functions to control it are simply contained in the examples, which can be downloaded from the GitHub repo by clicking the button below.

QWIIC RELAY EXAMPLES (ZIP)

Example 1 - Basic Control

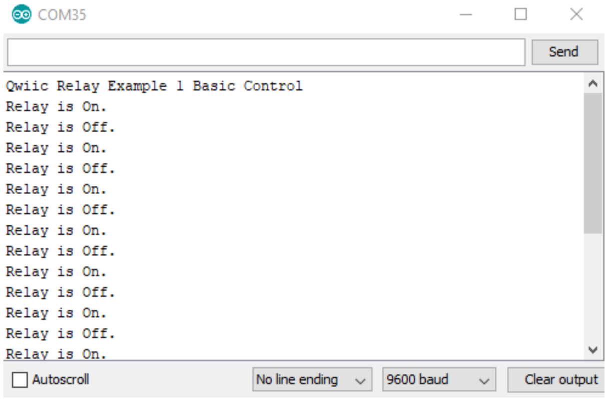
Go ahead and unzip the folder to a directory of your choosing and open up `Example1-Basic_control` . In this example, we’ll simply have the relay toggle on for 2 seconds, then off for two seconds. Let’s first look at the available functions in our sketch. The first two, `relayOn()` and `relayOff()` , are pretty self explanatory, they toggle the relay and return a message to the Serial monitor if no slave is found . The `testForConnectivity()` function simply tests to see if there is a slave at the proper address (0x18). These functions can be found below.

```
void relayOn() {
  Wire.beginTransmission(qwiicRelayAddress);
  Wire.write(COMMAND_RELAY_ON);
  if (Wire.endTransmission() != 0) {
    Serial.println("Check Connections. No slave attached.");
  }
}

void relayOff() {
  Wire.beginTransmission(qwiicRelayAddress);
  Wire.write(COMMAND_RELAY_OFF);
  if (Wire.endTransmission() != 0) {
    Serial.println("Check Connections. No slave attached.");
  }
}

void testForConnectivity() {
  Wire.beginTransmission(qwiicRelayAddress);
  //check here for an ACK from the slave, if no ack don't allow change?
  if (Wire.endTransmission() != 0) {
    Serial.println("Check Connections. No slave attached.");
    while (1);
  }
}
```

Now that we have these functions declared (Arduino handles prototype declarations for us), we can use them in our `void setup()` and `void loop()` . In our `setup()` function, we simply use the `testForConnectivity()` function to do just that. We then move on the `void loop()` where we turn the relay on, wait 2 seconds, turn the relay off, wait two seconds, and repeat. This code from Example 1 is shown below.

```
void setup() {
  Serial.begin(9600);
  Serial.println("Qwiic Relay Example 1 Basic Control");
  Wire.begin(); // join the I2C Bus

  testForConnectivity();

}

void loop() {
  relayOn();
  Serial.println("Relay is On.");
  delay(2000);
  relayOff();
  Serial.println("Relay is Off.");
  delay(2000);
}
```

Opening your serial monitor to a baud rate of **9600** should show something similar to the output below if everything is connected properly. You should also be able to hear the relay clicking on and off. If things aren't connected properly, you'll see the message `Check connections. No slave attached.` .



```
Qwiic Relay Example 1 Basic Control
Relay is On.
Relay is Off.
Relay is On.
Relay is Off.
Relay is On.
Relay is Off.
Relay is On.
Relay is Off.
Relay is On.
Relay is Off.
Relay is On.
Relay is Off.
Relay is On.
```

Example 1 Output

Example 2 - Change I^{2}C Address

To get started with the second example, open up `Example2-Change_I2C_Address` In this example, we simply change the address to `0x19` . First, let's take a look at the `changeAddress()` function, which checks to see if the address is valid (Between 0x07 and 0x78) and changes the relay's address to that. The function returns true if successful.

```
boolean changeAddress(byte address) {
  Wire.beginTransmission(qwiicRelayAddress);
  //check here for an ACK from the slave
  if (Wire.endTransmission()  != 0) {
    Serial.println("Check Connections. No slave found.");
    return (false);
  }

  //check if valid address.
  if (address < 0x07 || address > 0x78) {
    Serial.println("Invalid I2C address");
    return (false);
  }
  //valid address
  Wire.beginTransmission(qwiicRelayAddress);
  Wire.write(COMMAND_CHANGE_ADDRESS);
  qwiicRelayAddress = address;
  Wire.write(qwiicRelayAddress);
  Wire.endTransmission();
  return (true); //Success!
}
```

Now that we have these functions declared (Arduino handles prototype declarations for us), we can use them in our `void setup()` and `void loop()` . In our `setup()` function, we change the address to `0x19` , check to see that the address change was a success, and toggle the relay on and off on this new address. The sketch that handles this is shown below.

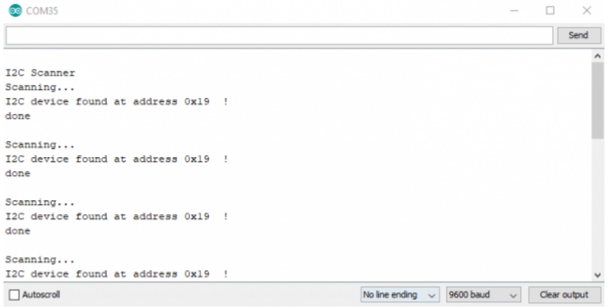
```
#include <Wire.h>
#define COMMAND_RELAY_OFF                 0x00
#define COMMAND_RELAY_ON                    0x01
#define COMMAND_CHANGE_ADDRESS          0x03

volatile byte qwiicRelayAddress = 0x18;     //Default Address

void setup() {
  Serial.begin(9600);
  Serial.println("Qwiic Relay Master Awake");
  Wire.begin(); // join the I2C Bus

  Wire.beginTransmission(qwiicRelayAddress); // transmit to device
  //check here for an ACK from the slave
  if (Wire.endTransmission() != 0 ) {
    Serial.println("Check Connections. Slave not found.");
  }
  else {
    Serial.println("Qwiic Relay found!");
  }

  boolean error = changeAddress(0x19); // Change the Relay's address to 0x19

  if (error != true) {
    Serial.println("!!!!! invalid address" );
  }
  else {
    Serial.println("success");
  }
}

void loop() { //Toggle the Relay on the new address
  relayOn();
  delay(2000);
  relayOff();
  delay(2000);
}

// changeAddress() takes a 7 bit I2C Address
// and writes it to the Relay. This function
// checks to see if the address is between
// 0x07 and 0x78. If valid, the new address is
// saved to the Relay's EEPROM. If not valid
// address is not changed and is ignored.
// This function returns true if successful and
// false if unsuccessful.
boolean changeAddress(byte address) {
  //check if valid address.
  if (address < 0x07 || address > 0x78) {
    Serial.println("Invalid I2C address");
    return (false);
  }
  //valid address
  Wire.beginTransmission(qwiicRelayAddress);
  Wire.write(COMMAND_CHANGE_ADDRESS);
  qwiicRelayAddress = address;
  Wire.write(qwiicRelayAddress);
  if (Wire.endTransmission() != 0)
  {
    return false;
  }
  return true;
}

// RelayOn() turns on the relay at the SLAVE_ADDRESS
// Checks to see if a slave is connected and prints a
// message to the Serial Monitor if no slave found.
void relayOn() {
  Wire.beginTransmission(qwiicRelayAddress);
  Wire.write(COMMAND_RELAY_ON);
  if (Wire.endTransmission() != 0) {
    Serial.println("Check Connections. No slave attached");
  }
}

// RelayOff() turns off the relay at the qwiicRelayAddress
// Checks to see if a slave is connected and prints a
// message to the Serial Monitor if no slave found.
void relayOff() {
  Wire.beginTransmission(qwiicRelayAddress);
  Wire.write(COMMAND_RELAY_OFF);
  if (Wire.endTransmission() != 0) {
    Serial.println("Check Connections. No slave attached");
  }
}
```

Example 3 - I^{2}C Scanner

To get started with the third example, open up `Example3-I2C_Scanner` In this example, we simply scan the I^{2}C bus for devices, useful if we’ve been changing around the address of our relay and have since forgotten what it was. The example comes from Arduino, and the code can be shown below. We basically check for an ACK at each address, and output that address when we get one back.

```
#include <Wire.h>

void setup()
{
  Wire.begin();

  Serial.begin(9600);
  while (!Serial);             // Leonardo: wait for serial monitor
  Serial.println("\nI2C Scanner");
}


void loop()
{
  byte error, address;
  int nDevices;

  Serial.println("Scanning...");

  nDevices = 0;
  for (address = 1; address < 127; address++ )
  {
    // The i2c_scanner uses the return value of
    // the Write.endTransmission to see if
    // a device did acknowledge to the address.
    Wire.beginTransmission(address);
    error = Wire.endTransmission();

    if (error == 0)
    {
      Serial.print("I2C device found at address 0x");
      if (address < 16)
        Serial.print("0");
      Serial.print(address, HEX);
      Serial.println("  !");


      nDevices++;
    }
    else if (error == 4)
    {
      Serial.print("Unknown error at address 0x");
      if (address < 16)
        Serial.print("0");
      Serial.println(address, HEX);
    }
  }
  if (nDevices == 0)
    Serial.println("No I2C devices found\n");
  else
    Serial.println("done\n");

  delay(5000);           // wait 5 seconds for next scan
}
```

Opening your serial monitor to a baud rate of **9600** will show what you have on your I^2C bus and should look something like the below image.



```
I2C Scanner
Scanning...
I2C device found at address 0x19  !
done

Scanning...
I2C device found at address 0x19  !
done

Scanning...
I2C device found at address 0x19  !
done

Scanning...
I2C device found at address 0x19  !
```

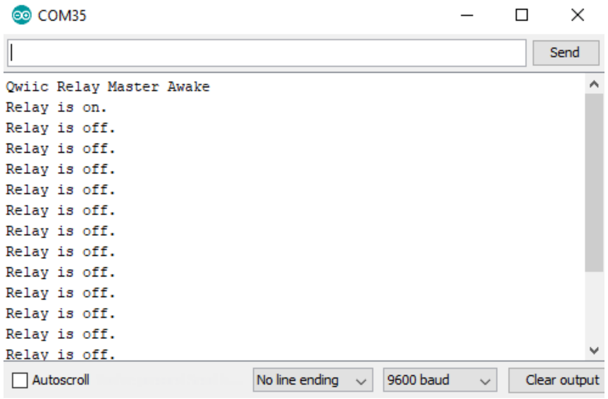
I^2C Scanner

Example 4 - Get Relay Status

The fourth example simply gets the current status of the relay. To get started with this example, open up `Example4-Get_Relay_Status`. We simply request a byte from the `COMMAND_STATUS` register on the ATTiny85, and output that byte, this function returns a `1` if the relay is on, `0` if it's off, and a `-1` if there's an error.

```
byte getStatus() {
  Wire.beginTransmission(qwiicRelayAddress);
  Wire.write(COMMAND_STATUS); // command for status
  Wire.endTransmission();    // stop transmitting //this looks like it was essential.

  Wire.requestFrom(qwiicRelayAddress, 1);    // request 1 bytes from slave device qwiicRelayAddress

  while (Wire.available()) { // slave may send less than requested
    char c = Wire.read(); // receive a byte as character.
    if (c == 0x01) return 1;
    else {
      return 0;
    }
  }
}
```

Opening your serial monitor to a baud rate of **9600** will show you the current status of the relay.



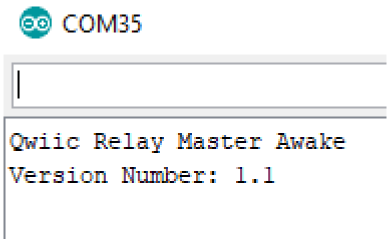
```
Qwiic Relay Master Awake
Relay is on.
Relay is off.
Relay is off.
Relay is off.
Relay is off.
Relay is off.
Relay is off.
Relay is off.
Relay is off.
Relay is off.
Relay is off.
Relay is off.
Relay is off.
```

Relay Status

Example 5 - Get Firmware Version

The Qwiic relay is controlled by an ATTiny85. SparkFun gives it some firmware to get it started, this final example shows you how to check which firmware version your ATTiny85 is using. Go ahead and open up `Example5-Get_Firmware_Version` to get started. Checking out the `getFirmwareVersion()` function, we see that it requests 2 bytes from the `COMMAND_FIRMWARE_VERSION` register (0x04) and returns them as a float. We simply call this function in our `setup()` function to get the firmware version.

Opening your serial monitor to a baud rate of **9600** will show you the current firmware version, and should look something like the below image.



```
Qwiic Relay Master Awake
Version Number: 1.1
```

Firmware Version

Resources and Going Further

Now that you've successfully got your Qwiic Single Relay up and running, it's time to incorporate it into your own project!

For more information, check out the resources below:

- Schematic (PDF)
- Eagle Files (ZIP)
- Datasheet (PDF)
- Default Firmware
- Example Code
- GitHub Repository
- SFE Product Showcase

Need some inspiration for your next project? Check out some of these related tutorials using relays. Be sure to check your current rating when handling the Qwiic Single Relay when browsing some of the other tutorials using relays.

Photon Remote Water Level Sensor

Learn how to build a remote water level sensor for a water storage tank and how to automate a pump based off the readings!

Blynk Board Project Guide

A series of Blynk projects you can set up on the Blynk Board without ever re-programming it.

ESP8266 Powered Propane Poofer

Learn how Nick Poole built a WiFi controlled fire-cannon using the ESP8266 Thing Dev Board!

Blynk Board Bridge Widget Demo

A Blynk project that demonstrates how to use the Bridge widget to get two (or more) Blynk Boards to communicate.

Beefcake Relay Control Hookup Guide

This is a guide for assembling and basic use of the Beefcake Relay Control board

How to Build a Remote Kill Switch

Learn how to build a wireless controller to kill power when things go... sentient.

IoT Power Relay

Using the ESP32 to make a web-configured timed relay.

New!

Qwiic Quad Relay Hookup Guide

SparkFun’s Qwiic Quad Relay is a product designed for switching not one but four high powered devices from your Arduino or other low powered microcontroller using I2C.