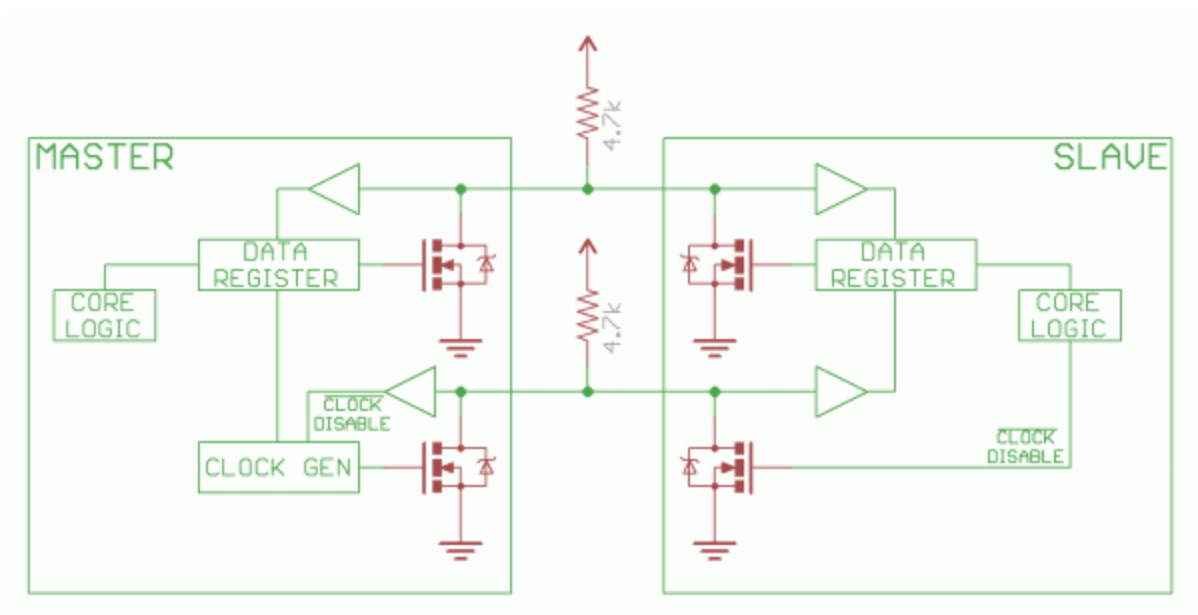


I2C AT THE HARDWARE LEVEL

Signals

Each I²C bus consists of two signals: SCL and SDA. SCL is the clock signal, and SDA is the data signal. The clock signal is always generated by the current bus master; some slave devices may force the clock low at times to delay the master sending more data (or to require more time to prepare data before the master attempts to clock it out). This is called “clock stretching” and is described on the protocol page.

Unlike UART or SPI connections, the I²C bus drivers are “open drain”, meaning that they can pull the corresponding signal line low, but cannot drive it high. Thus, there can be no bus contention where one device is trying to drive the line high while another tries to pull it low, eliminating the potential for damage to the drivers or excessive power dissipation in the system. Each signal line has a pull-up resistor on it, to restore the signal to high when no device is asserting it low.



Notice the two pull-up resistors on the two communication lines.

Resistor selection varies with devices on the bus, but a good rule of thumb is to start with 4.7k and adjust down if necessary. I²C is a fairly robust protocol, and can be used with short runs of wire (2-3m). For long runs, or systems with lots of devices, smaller resistors are better.

Signal Levels

Since the devices on the bus don't actually drive the signals high, I²C allows for some flexibility in connecting devices with different I/O voltages. In general, in a system where one device is at a higher voltage than another, it may be possible to connect the two devices via I²C without any level shifting circuitry in between them. The trick is to connect the pull-up resistors to the lower of the two voltages.

This only works in some cases, where the lower of the two system voltages exceeds the high-level input voltage of the higher voltage system—for example, a 5V Arduino and a 3.3V accelerometer.

If the voltage difference between the two systems is too great (say, 5V and 2.5V), SparkFun offers a simple I²C level shifter board. Since the board also includes an enable line, it can be used to disable communications to selected devices. This is useful in cases where more than one device with the same address is to be connected to a single master—Wii Nunchucks are a good example.

Source: <https://learn.sparkfun.com/tutorials/i2c>