TENET TECHNETRONICS

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Bi-Directional Logic Level Convertor

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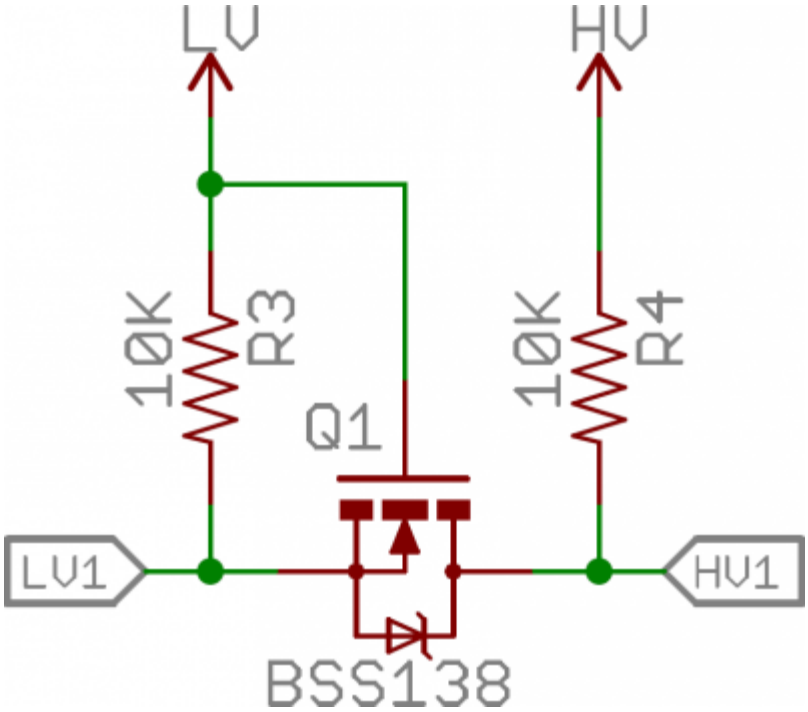
Introduction:

Do you have a 3.3V I2C or SPI sensor that might go up in smoke if connected to a 5V Arduino? Or a 5V device that needs a workaround to be compatible with your 3.3V Raspberry Pi, Arduino Due or MSP430?
Because the Arduino's are 5V devices, and most modern sensors, displays, flash cards and modes are 3.3V-only, many makers find that they need to perform level shifting/conversion to protect the 3.3V device from 5V.
This breakout has 6 BSS138 FETs with 10K pullups. It works down to 1.8V on the low side, and up to 10V on the high side. The 10K's do make the interface a little more sluggish than using a TXB0108 or 74LVC245 so we suggest checking those out if you need high-speed transfer.

While we designed it for use with I2C, this works great for SPI, TTL Serial, and any other digital interface both uni-directional and bidirectional. Comes with a fully assembled and tested PCB with 6 full bidirectional converter lines as well as 2 pieces of 8-pin header you can solder on to plug into a breadboard or perfboard.

Board Overview:
If you take a peak at the board's schematic, you'd find that the bi-directional logic level converter (let's shorten that to BD-LLC) is actually a very simple device. There is basically one level-shifting circuit on the board, which is repeated six times to create four level-shifting channels. The circuit uses a single N-channel MOSFET and a couple pull-up resistors to realize bi-directional level shifting.

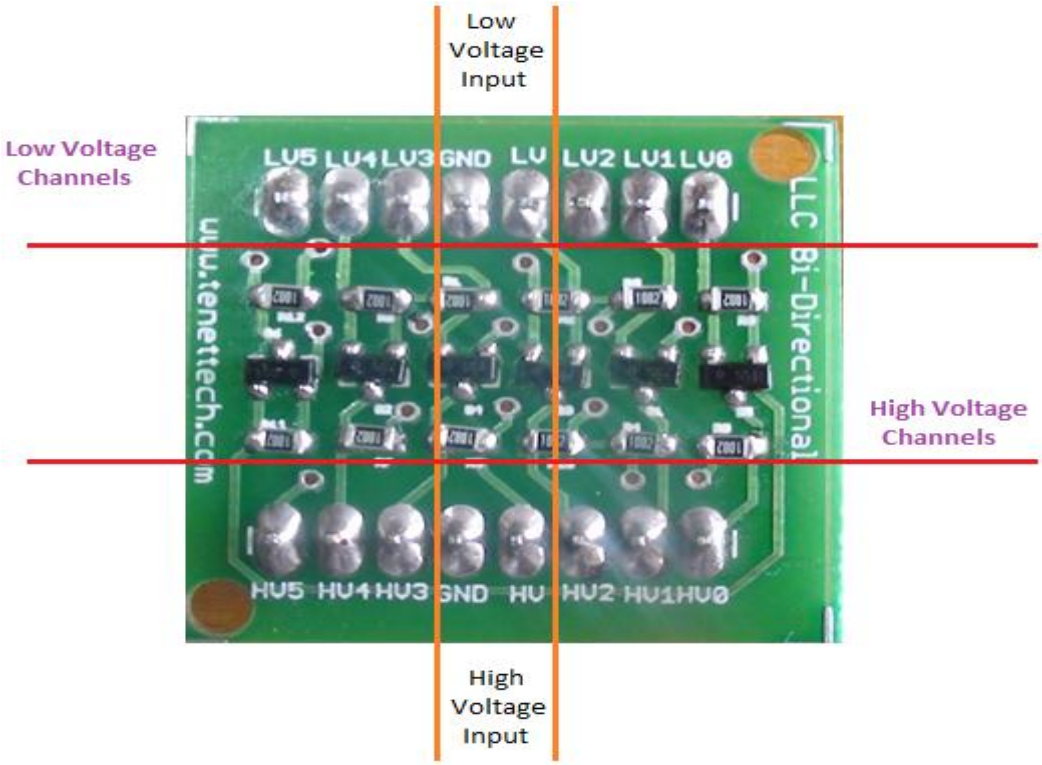


The bi-directional level-shifting circuit used on all six channels of the BD-LLC.

Through some semiconductor magic, this circuit can shift a low voltage signal to high and/or shift a high-voltage signal to a low voltage. A 0V signal on one end remains a 0V signal on the other. For a complete analysis of this circuit, check out this excellent Philips Application Note AN97055.

Pin out:

There are 16 total pins on the BD-LLC – two parallel rows of eight headers. One row contains all of the high voltage (e.g. 5V) inputs and outputs, the other row has all things low voltage (e.g. 3.3V).



The pins are labeled on both the bottom and top sides of the board, and organized into groups. Let's look closer at some of the pin groups:

Voltage Inputs

The pins labeled HV, LV, and two GND's provide high and low voltage references to the board. Supplying a steady, regulated voltage to both of these inputs is required.

The voltage supplied to the HV and GND inputs should be higher than that supplied to the LV side. For example, if you're interfacing from 5V to 3.3V, the voltage on the HV pin should be 5V, and the voltage on LV sould be 3.3V.

Data Channels

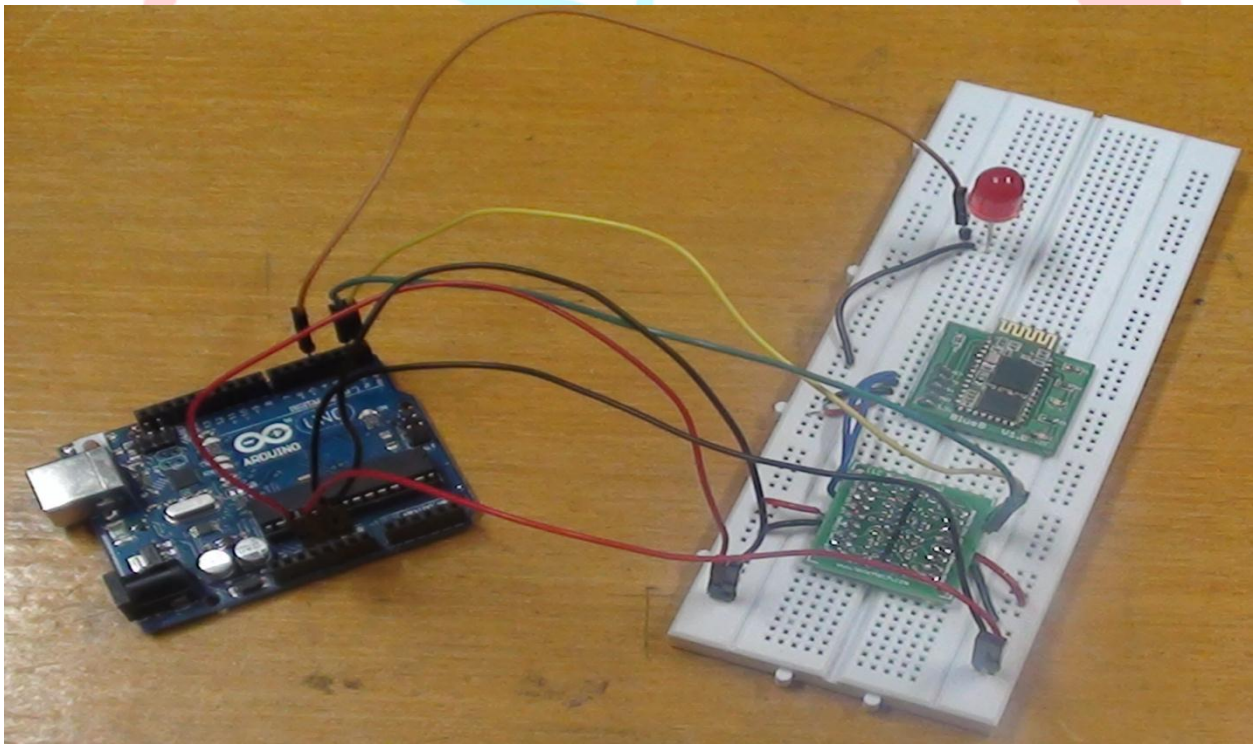
There are six separate data channels on the BD-LLC, each capable of shifting data to and from high and low voltages. These pins are labeled HV0, LV0, HV1, LV1, HV2, LV2, HV3, LV3, HV4, LV4, HV5 and LV5. The number at the end of each label designates the channel of the pin, and the HV or LV prefix determines whether it's on the high or low side of the channel.

A low-voltage signal sent in to LV1, for example, will be shifted up to the higher voltage and sent out HV1. Something sent in HV5 will be shifted down and sent out of LV5. Use as many of these channels as your project requires. You don't have to use every single one.

Keep in mind that these level shifters are purely digital. They can't map an analog voltage from one max voltage to another.

Using the BD-LLC for Serial:

Although you won't be taking advantage of the BD-LCC's bi-directional abilities, it's perfectly fine to use the board to shift serial communication. Serial usually requires two signal wires – RX (receive) and TX (transmit) – which both have a defined direction. These signals can be passed through any of the six channels on the BD-LLC.



Let's say, for example, you want to hookup Tenet Blue-B (which has a 3.3V maximum input voltage) to an Arduino Uno via their UARTs. Here's one possible hook up:

Using the BD-LLC for Servo Motor:

The BD-LLC's six channels are perfect match for servo motor. Servo motor usually requires 5V. Suppose if you are using MSP430 launch pad or ARM microcontroller, both device will give 3.3v from each i/o pins. For example, if you want to connect MSP430 to servo motor which has an operating range 5V, here's how the BD-LLC could be worked in: