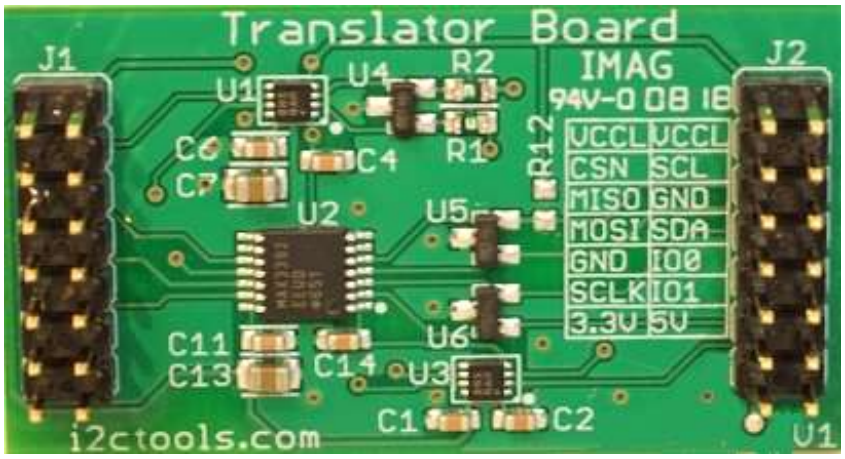
Level Shifter for USB-to-I2C

Hardware User's Manual



https://www.i2ctools.com/

Information provided in this document is solely for use with the I2C and SPI Level Shifter from SB Solutions, Inc. SB Solutions, Inc. reserves the right to make changes or improvements to this document at any time without notice. SB Solutions, Inc. assumes no liability whatsoever in the sale or use of this product, including infringement of any patent or copyright.
Reasonable efforts have been made to ensure the accuracy of the information presented. However, SB Solutions, Inc. assumes no responsibility for the accuracy of the information.
No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without the express written permission of
SB Solutions, Inc.
P.O. Box 4506
Cary, NC 27519-4506

Copyright © 2019 SB Solutions, Inc. All rights reserved. Revision 1.1

Table of Contents

INTRODUCTION **1**

Features **1**

I2C, SPI, GPIO level shifter CONTENTS **1**

DISCLAIMER AND WARRANTY **2**

GETTING STARTED **3**

MINIMUM REQUIREMENTS **3**

LEVEL SHIFTER SUPPLY REQUIREMENTS **3**

INSTALLATION **3**

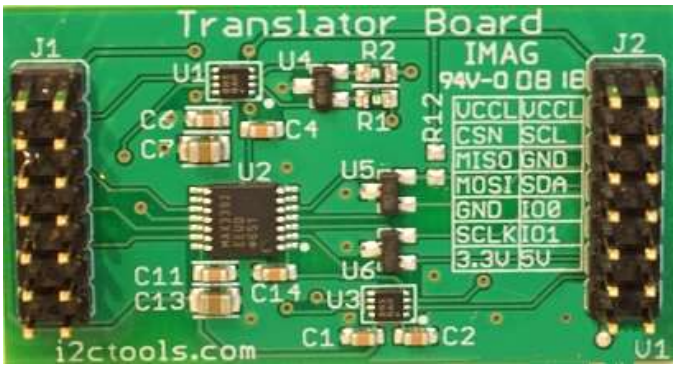
HARDWARE DESCRIPTION **4**

- **I2C Interface** **4**
- **SPI Interface** **6**
- **GPIO Interface** **6**

TECHNICAL SUPPORT **7**

INTRODUCTION

The Translator Board incorporates level shifting of I2C, SPI, and GPIO signals. The USB-to-I2C hardware operates at 3.3V, however, using this hardware, allows the user to connect I2C, SPI, and GPIO voltages ranging from 0.9 V to 3.3V.



FEATURES

- Direct connection to USB-to-I2C hardware through 14-pin ribbon cable
- Bidirectional level translators for I2C signals
- Rise and fall-time accelerators for I2C signals
- I2C voltage range from 0.9V to 3.3V
- Standard, Fast, and Fast-Mode Plus I2C speeds
- SPI level translators from 1.2V to 3.3V
- Supports SPI clock speeds up to 12 MHz
- Two GPIO signals with a 0.9V to 3.3V voltage range

I2C, SPI, GPIO LEVEL SHIFTER CONTENTS

- Voltage Level Translator hardware

DISCLAIMER AND WARRANTY

Proper use of the Voltage Level Translator is the sole responsibility of the user. SB Solutions, Inc. is not responsible for any damage resulting from misuse or improper installation.

SB Solutions, Inc. will, at our option, repair or replace the hardware within thirty (30) days of the purchase date. Return shipping is the responsibility of the user.

GETTING STARTED

Assumptions

We are assuming the user of this product has experience with the I^2C Bus protocol. The I^2C Bus specification is a good source of detailed information about the I^2C Bus. The complete specification can be downloaded from the NXP Semiconductors website.

Handling Precautions

The Level Shifter hardware is protected against ESD damage, but it is important to handle the product with care to ensure damage does not occur.
The hardware can be damaged by mishandling, so it is important to be familiar with the connection of the hardware to your target hardware.

MINIMUM REQUIREMENTS

- ✓ USB-to-I2C Ultra or USB-to-I2C Professional hardware

LEVEL SHIFTER SUPPLY REQUIREMENTS

The I2C/SPI/GPIO Level Shifter derives its power on the Master side from the USB-to-I2C hardware (the side connected to the USB-to-I2C hardware). This is a 3.3V supply.
The target side supply voltage must be supplied by the user application and cannot exceed 3.6V.

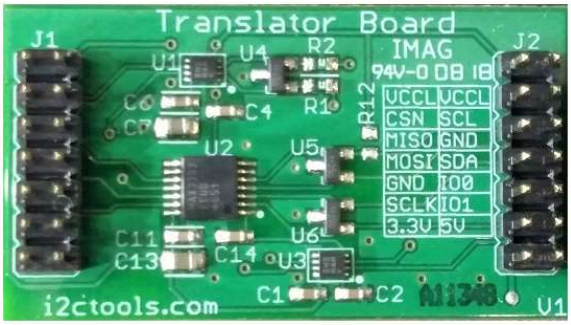
INSTALLATION

- The I2C/SPI/GPIO Level Shifter hardware connects directly to the 14-pin ribbon cable from the USB-to-I2C Ultra (or Professional) hardware.
- The target side of the hardware requires that you connect a supply voltage equal to the voltage of the I2C/SPI/GPIO hardware you are communicating with

HARDWARE DESCRIPTION

Connection to USB-to-I2C Hardware

VCC (3.3V)	VPU (3.3V)
SSN (SPI Slave Select)	SCL (I2C)
MISO (SPI Master IN)	GND
MOSI (SPI Master OUT)	SDA (I2C)
GND	IN (GPIO)
SCLK (SPI CLK OUT)	OUT (GPIO)
3.3V	5V



Connection to User Hardware

VCCL (0.9V - 3.3V)	VCCL (0.9V - 3.3V)
SSN (SPI Slave Select)	SCL (I2C)
MISO (SPI Master IN)	GND
MOSI (SPI Master OUT)	SDA (I2C)
GND	IN (GPIO)
SCLK (SPI CLK OUT)	OUT (GPIO)
3.3V (OUTPUT)	5V (OUTPUT)

Figure 1. Hardware Pin-Out

The figure above shows the connections to the USB-to-I2C (Ultra or Pro) hardware, and the user hardware.
On the USB-to-I2C hardware (left) side, connect the 14-pin ribbon cable directly between the USB-to-I2C hardware and the level shifter hardware. The pull-ups on the USB-to-I2C hardware may be removed or they may be left in.
On the User (right) side, it is important to connect a supply voltage to at least one of the VCCL pins. This voltage may be in the 0.9V to 3.3V range.
The 3.3V and 5V pins (bottom two pins) are directly connected to the USB-to-I2C hardware and are not affected by the Translator Board hardware.

I2C Interface

The I2C signals pass through an open-drain logic-level translator, with rise-time/fall-time accelerators. The master side (left side of board) of the I2C bus should be connected directly to the USB-to-I2C hardware through a 14-pin cable (included). No additional configuration is required on the I2C master side.
The right side connects to the user hardware. The signals pass through a bidirectional level translator with rise and fall-time accelerators. This device has 12kΩ (max) internal pull-ups, which cannot be disabled.
Standard, fast, and fast-mode plus speeds are supported.

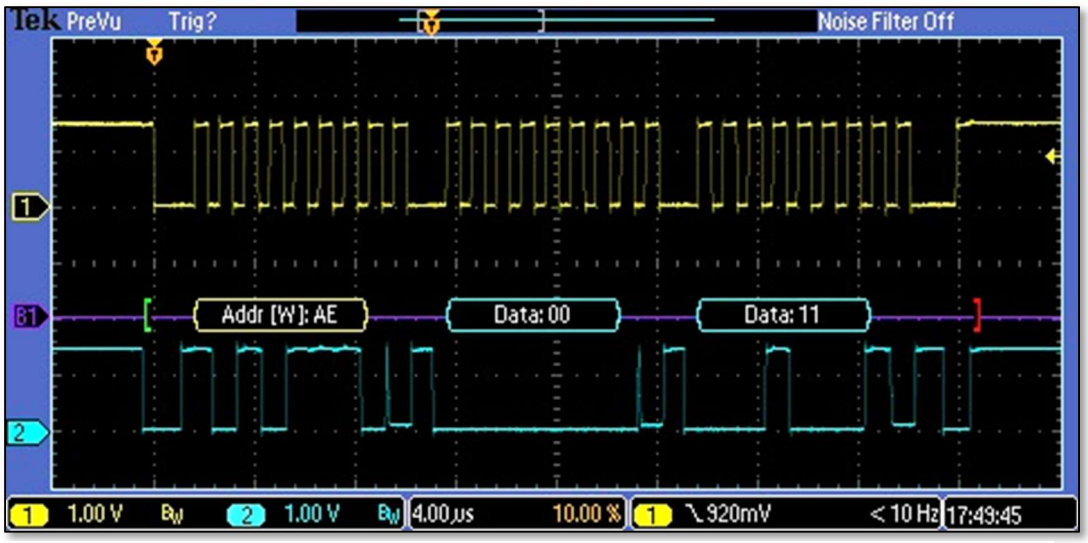


Figure 2 I2C waveform at 1.5V/1 MHz

The connection to an I2C device requires the following:

1. A supply voltage to the VCCL pin(s). This voltage may be from 0.9V to 3.3V. If you have pull-ups on the SDA and SCL signal lines, the pull-up voltage must match the VCCL voltage.
2. Signal ground (GND)
3. The I2C SDA (data) and SCL (clock) signals to the slave device.

The other signals may be left open if only using the I2C interface

I2C Port Electrical Characteristics

VCCL	User input voltage range	0.9V to 3.3V
Vil	Low level input voltage	0.15V (max)
Vih	High level output voltage	VCCL – 0.2V
Clock	Maximum I2C clock speed	1 MHz (Fast-Mode Plus)

SPI Interface

The SPI signals pass through a logic-level translator, with rise-time accelerators. The master side (left side of board) of the SPI bus should be connected directly to the USB-to-I2C hardware through a 14-pin cable (included). No additional configuration is required on the SPI master side.

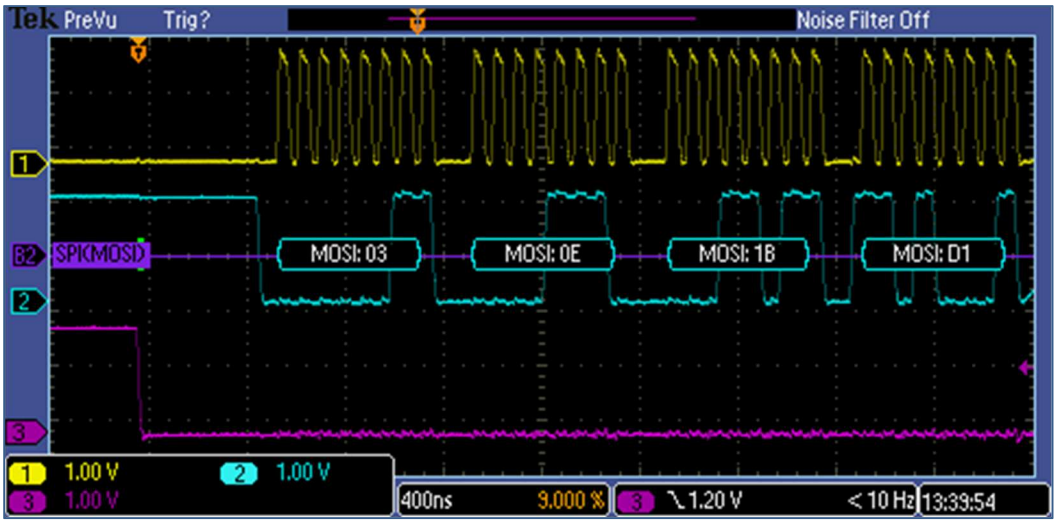


Figure 3. 1.8V SPI Signals at 12 MHz

The connection to an SPI device requires the following:

1. Supply voltage to the VCCL pin(s). This voltage may be from 1.2V to 3.3V.
2. Signal ground (GND)
3. MOSI (Master Out – Slave In) to the Slave Input
4. MISO (Master In – Slave Out) to the Slave Output
5. SCLK to the slave clock input
6. SSN to the Slave Select (or chip select) input

Other signals may be left open if only using the SPI interface

SPI Port Electrical Characteristics

VCCL	User input voltage range	1.2V to 3.3V
Vil	Low level input voltage	0.15V (max)
Vih	High level output voltage	VCCL – 0.2V
Clock	Maximum I2C clock speed	12 MHz

GPIO Interface

The I2C signals pass through a logic-level translator, with rise-time accelerators. The master side (left side of board) of the GPIO bus should be connected directly to the USB-to-I2C hardware through a 14-pin cable (included with the Ultra hardware package). No additional configuration is required on the GPIO master side.

The connection the GPIO interface requires the following:

1. Supply voltage to the VCCL pin(s). This voltage may be from 0.9V to 3.3V.
2. Signal ground (GND)
3. An input to the user hardware can be connected to the OUT GPIO
4. An output from the user hardware can be connected to the IN GPIO

Other signals may be left open if only using the GPIO interface

GPIO Port Electrical Characteristics

VCCL	User input voltage range	0.9V to 3.3V
Vil	Low level input voltage	0.15V (max)
Vih	High level input voltage	VCCL – 0.2V

TECHNICAL SUPPORT

Technical support for the I2C/SPI/GPIO level shifter is available via an email to support@i2ctools.com.