

How to Isolate the I²C Interface Signal

1 Introduction

Inter-integrated circuit (I²C) bus communication is a short distance communication two-line half-duplex communication solution, which has been widely used in various applications because of its simplicity. The I²C bus is used to communicate between two modules, and isolation may be needed if there is a high voltage in the system. Isolation can be used to protect circuits and operators, as well as to isolate noise that may interfere with signal communication.

Since digital isolators are one-way communication, implementing bi-directional communication over the I²C bus presents many challenges for designers. This article will discuss different approaches to use the isolated I²C bus.

2 Signal Isolation

Signal isolation of the I²C bus can be achieved in two ways. The first uses a digital isolator with an external circuit to separate the two-way data path into two one-way channels. The bi-directional data is separated into two uni-directional signals, and the digital isolator will modulate the input signals of each channel and pass the signals through the isolation gate before demodulation at output time. The design method of separating bi-directional I²C signals into uni-directional signals to interface with digital isolators is explained in detail.

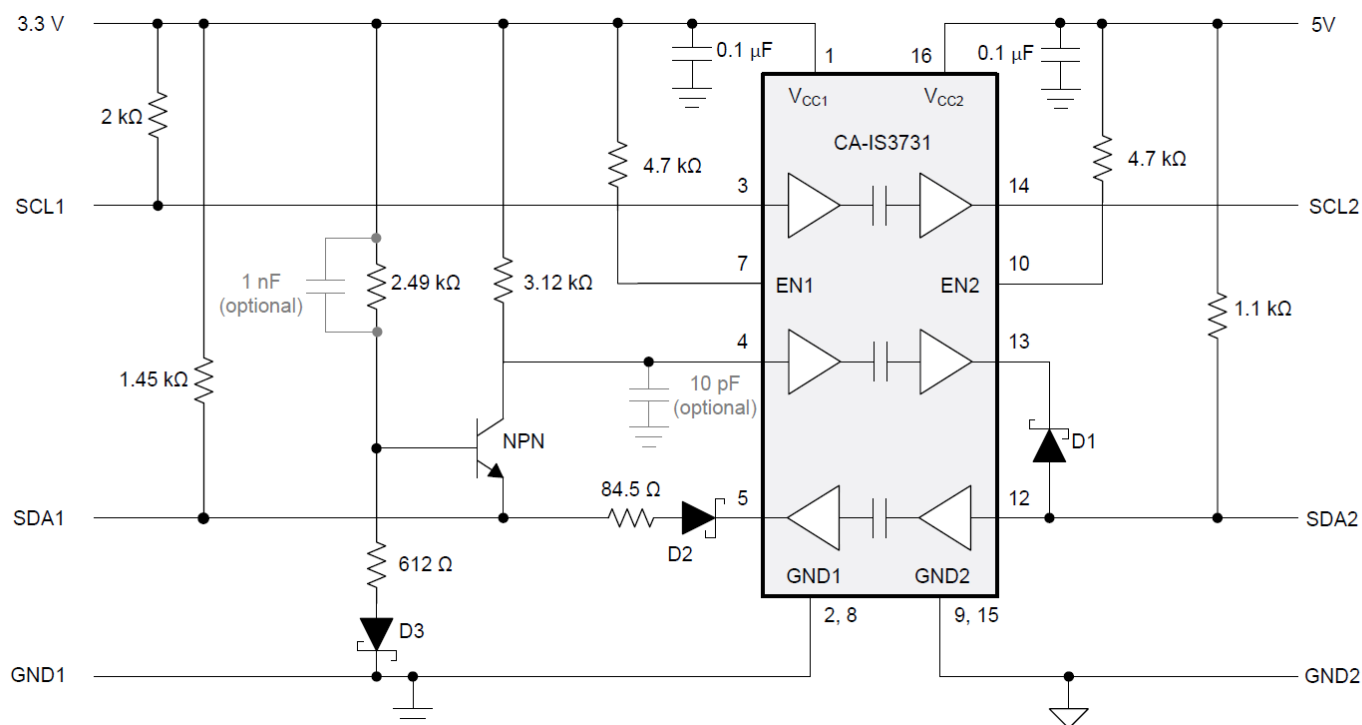


Fig. 1 CA-IS3731 Achieving I²C Communication

Fig. 1 shows an implementation of this approach in an application using bi-directional data and a uni-directional clock using a three-channel digital isolator, such as the CA-IS3731 device. Four-channel digital isolator (such as the CA-IS3742 device) can also be used for multi-host systems that require bi-directional data and clock signals.

The second is to use integrated solution such as the CA-IS302X series. This series of integrated circuit solutions use

internal circuit in combination with digital isolators to achieve equivalent device I²C buffering functions. The CA-IS3020 device is designed for systems with bi-directional data and clock signals, and the CA-IS3021 is designed for systems with bi-directional data and uni-directional clock.

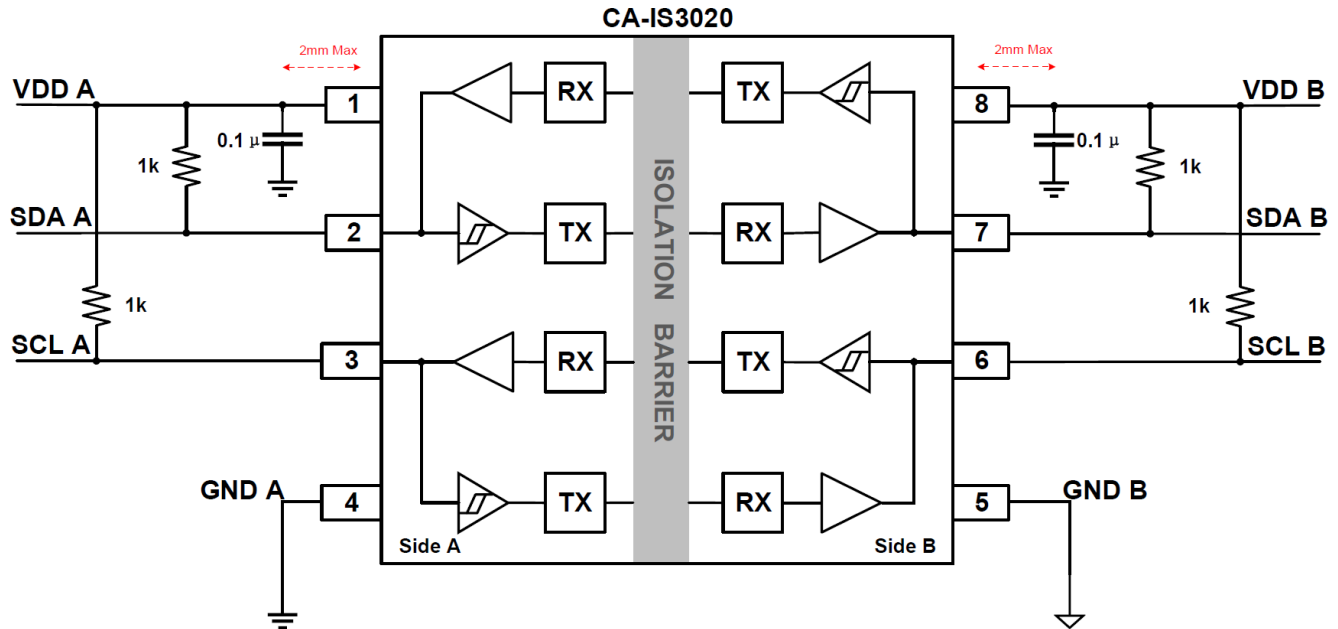


Fig. 2 CA-IS3020 Achieving I²C Communication

Fig. 2 shows how the bi-directional serial data (SDA) and serial clock (SCL) signals of the I²C bus of CA-IS3020 are internally separated into two uni-directional signals isolated by digital isolator channels. The CA-IS302x series I²C interface isolator internally divides the bi-directional SCL/SDA data into two uni-directional digital signal transmission channels. The output drives of each digital channel are I²C compatible open leakage outputs. The A side of the CA-IS302x chip is connected to the low-capacitance node on the I²C bus, supporting a maximum of 40pF load capacitance; side B connects to a high-capacitance node on the I²C bus, supporting a maximum of 400pF load capacitance. There is an I²C bus deadlock prevention circuit in the chip, which raises the low level of SCL/SDA output to about 700mV on side A of the chip. At the same time, the logic input on side A of the chip is judged by the internal hysterectomy comparator to determine whether the low level on side A is the input low level not more than 400mV that is directly pulled down by the SDA bus, or the output low level of 700mV that is driven by side A, so as to determine the signal transmission direction on the SCL/SDA line at this time.

Each solution for isolating signals in I²C system has pros and cons. Discrete solutions using digital isolators offer greater freedom in partial selection. Both CA-IS3731 and CA-IS3742 offer a variety of packages with different isolation grades to suit specific use conditions; however, the disadvantage of this solution is that it needs more board space and has more external circuits. The CA-IS302X integrated solution needs less board space, is designed more efficiently, and has a shorter product commissioning cycle.

3 Version Information

Version	Date	State Description
Ver1.0	July.2021	Initial version

4 Important Statement

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