User's Guide



USB to I²C Bus Host Adapter with *Circuit Sense*[™]





www.mcc-us.com

Introduction



The MCC **i2cStick 2**TM USB to I²C Bus host adapter with *Circuit Sense* allows any Windows, Linux, or Mac OS X host computer to become an I²C Master or Slave device, transmitting or receiving I²C messages between the host computer and one or more I²C devices across an I²C Bus.

This user's guide describes the installation and operation of the i2cStick 2 host adapter, including the Virtual Communication Port (VCP) driver, and the USB and I²C Bus interconnects. Also described are the iPort Utility Pack software for quick I²C Bus communication, MS.Net and LabVIEW libraries for custom software development, and other tools and applications.

A complete set of resources for the i2cStick 2 is available at:

www.mcc-us.com/i2cStick-2

This product conforms to the I²C Bus specifications defined by NXP/Philips Semiconductors.

To find out more about I^2C , we suggest you review our white paper " I^2C Bus Technical Overview" at:

www.mcc-us.com/I2CBusTechnicalOverview.pdf.

I²C is a trademark of NXP (Philips) Corporation. All trademarks acknowledged as the property of their owners.

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WARNING - Life Support Applications: MCC products are not designed for use in life support appliances, devices, or systems where the malfunction of the product can reasonably be expected to result in a personal injury.

WARNING - Radio Frequency Emissions: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules, and the CE General Emissions Standard EN55032 and General Immunity Standard EN55035. These limits are designed to provide reasonable protection against interference when the equipment is operated in a *commercial environment*. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause interference to radio communications. Operation of this equipment in a *residential area* is likely to cause interference, in which case the user will be required to correct the interference at his own expense.

WARNING - Electrostatic Discharge (ESD) Precautions: Any damage caused by Electrostatic Discharge (ESD) through inadequate earth grounding is NOT covered under the warranty of this product. See the "Electrostatic (ESD) Precautions" section of this guide for more information.



Electronic Waste Notice - This product must NOT be thrown into general waste, but should be collected separately and properly recycled under local regulations.

Created in the United States of America

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1 Overview

The i2cStick 2 USB to I²C Bus host adapter with *Circuit Sense* allows any Windows, Linux, or Mac OS X host computer to become an I²C Bus Master or Slave device, transmitting or receiving I²C messages between the PC and one or more I²C devices across an I²C Bus. Circuit Sense, our I²C Bus voltage sensing



technology, allows the i2cStick 2 to work with the latest I^2C Bus devices at voltages as low as 0.5 volts.



The i2cStick 2 uses a Virtual Communications Port (VCP) interface to communicate with a host computer via USB. A virtual serial port is created on the host computer when the driver is installed. Drivers are available for several operating systems, and can be installed stand-alone, or while installing the iPort Utility Pack.

i2cStick 2 Product Features

- OS Support: Windows, Linux, Mac OS X
- High Performance Processor Increases Throughput (2x to 200x).
- USB Bus Powered with USB 2.0 Type A Plug.
- Built-in ESD, Over-voltage, and Reverse-voltage Protection.
- Switch Controlled Properties:
 - I^2C Bus Power Source (3.3v or 5v @100ma).
 - I²C Bus Voltage Sense (0.5v to 5v, Enable or Disable).
 - I²C Bus Pull-Ups (1.8K ohm, Enable or Disable).
- Software Controlled Properties:
 - I²C Bus Master Clock Rates: 23KHz, 86KHz, 100KHz Std, 400KHz Fast
 - I²C Bus General Call Enable
 - I²C Bus Time-Out (0-32K ms)
 - Host Communication Flow Control (XON/XOFF or RTS/CTS)
 - User Interface Echo/Prompt Enable
 - User Data Format (HEX or ASCII/HEX)
- Supported I²C Bus Activities:
 - Master and Slave Functions
 - Transmit, Receive, and Tx/Rx Data Functions
 - Multi-Master Arbitration Loss Detection
 - Clock-stretch Detection
 - Bus Time-Out Detection
 - 7-bit Slave Address Generation and Detection
 - Up to 32K data bytes in a single message
 - SMBus Packet Error Detection
 - eXtended Commands for 2-Wire, "I²C-Like" Low-level SCL/SDA Signal Control
- Software Support:
 - Virtual ComPort Drivers (Windows, Linux, Mac OS X)
 - Free Application Software (Master, Slave, EEPROM Programming)
 - Software Development Tools (MS.NET, LabVIEW, and ASCII Commands)
- Compatible with existing iPort/AI, iPort/AFM, iPort/USB, iPort/LAN, i2cStick, iPort/USB 2, iPort/AFM 2, and iPort/LAN 2 applications.
- USB-IF (Full-Speed) and MS WHQL Certified.
- US-FCC and EUR-CE EMC Compliant.
- RoHS/Lead-Free Compliant.

i2cStick 2 Package Contents

The i2cStick 2 package includes the following items:

- i2cStick 2, USB to I²C Bus Host Adapter.
- i2cStick 2 Mini Clip-lead Cable.
- i2cStick 2 Quick Start Guide.
- i2cStick 2 Travel Case.
- Online Items*
 - i2cStick 2 Datasheet
 - i2cStick 2 User's Guide (this document)
 - i2cStick 2 Virtual ComPort Drivers
 - iPort Utility Pack Software
 - Application Software.
 - Software Development Tools

(* www.mcc-us.com/i2cStick-2)



The i2cStick 2 is also available in 5 and 10 packs excluding the Mini Clip-lead Cable and Travel Case.

OEM and customization is available. Contact <u>sales@mcc-us.com</u> with your requirements.

System Requirements

a. A host computer with one free USB port or self-powered USB hub.
b. Windows XP (x86), Vista (x86/x64), 7 (x86/x64), 8, 10.

- Windows XP+
- Linux 2.6+
- Mac OSX 10.5+

2. Interconnects

The i2cStick 2 includes two interconnections:



USB Connector

The USB Type A connector provides connection from the I^2C adapter to a USB port on the host computer or self-powered USB hub.

The i2cStick 2 operates as a high-power (>100 mA) bus-powered USB device, with up to 100 mA of (user optional) switch-selectable 3.3v or 5v for I²C Bus target system power.

Virtual Communications Port (VCP)

The i2cStick 2 uses a Virtual Communications Port (VCP) interface to communicate with a host computer via USB. A virtual serial port is created on the host computer when the driver is installed. Drivers are available for several operating systems, and can be installed separately, or while installing the iPort Utility Pack.

The drivers and installation instructions are available online at the following web address:

www.mcc-us.com/i2cStick-2

After the driver software is installed, plug the i2cStick 2 into a host computer USB port, or self-powered USB hub. Upon detecting the device, the operating system will automatically load the driver and create a new "virtual" serial port for communicating with the i2cStick 2. Once installed, application programs running on the host computer can communicate with the i2cStick 2 via the operating system serial port Application Program Interface (API).

The i2cStick 2 uses the following VCP serial port signals:

- TX Transmit Data from the Host Computer to the i2cStick 2.
- RX Receive Data from the i2cStick 2 to the Host Computer.
- RTS Request to Send from the Host Computer to i2cStick 2.
- CTS Clear to Send from the i2cStick 2 to the Host Computer.

Serial communications flow-control options include X-ON/X-OFF (default) or RTS/CTS. The flow-control method used by a host computer application should match the flow-control method selected for use by the i2cStick 2 host adapter.

I²C Mini Interface Connector

The i2cStick 2 includes a five wire (1x5) 2.54 mm (.100"), positive locking, shrouded header connector (see Appendix A) for interfacing to an external I²C Bus. Interface lines provided include:

- I²C Clock (SCL)
- I²C Data (SDA)
- Shield (optional)
- Ground
- +V (optional)

Minimum wiring for I^2C Bus communications include I^2C Bus Clock, Data, and Ground. Use of the +V and Shield wires in the I^2C Interface connector are user optional.

NOTE: See the Hardware Configuration section below for additional information

on configuring the I²C Bus interface.



I²C Bus Mini-Clip-Lead cables are available to connect the i2cStick 2 adapter to a target system. Each clip-lead is identified (White=C=SCL, Red=V=+V, Green=D=SDA, Black=G=Ground).

 I^2C Bus Mini-Interface cables with two Mini Interface plugs are also available to connect the I^2C adapter to an external I^2C Bus.

3. Hardware Configuration

Circuit Sense™

The i2cStick 2 includes MCC's *Circuit Sense* technology. Circuit Sense allows the I^2C interface +V wire to operate in two modes, Power Source Mode and Voltage Sense Mode. Mode selection is controlled by the MODE slide switch on the side of the unit enclosure.

• **Power Source Mode** - The +V wire can supply power (3.3v or 5v @ 100 mA) Vcc to an external I²C Bus system. Voltage selection is controlled by the SOURCE slide switch on the side of the unit enclosure. In Power Source Mode, the voltage of the i2cStick 2 SCL and SDA internal pull-ups, if enabled, and Voltage Sense circuit (0.3Vcc Low_{MAX}, 0.7Vcc High_{MIN}) is selected by the SOURCE switch. (*Use of the* +*V wire in Power Source Mode is user optional*).

Power Source Mode is similar to the standard mode of operation on earlier versions of MCC I²C Bus host adapters.

• Voltage Sense Mode - The +V wire must be connected to the external I²C Bus pull-up supply reference voltage (0.5v to 5v) Vcc. In this mode, the i2cStick 2 SCL and SDA voltage sense circuits automatically adjust to match (0.3Vcc Low_{MAX}, 0.7Vcc High_{MIN}) the external reference voltage. In Voltage Sense Mode, the voltage of the i2cStick 2 SCL and SDA internal pull-ups, if enabled, is supplied by the external voltage (Vcc) applied to the +V wire. (*Use of the* +V *wire in Voltage Sense Mode is required*).

I²C Bus Pull-up Resistors

I²C Bus systems are based on open-collector technology requiring pull-up devices on each signal wire (SCL and SDA). These pull-up devices usually take the form of pull-up resistors connected to bus power.

The i2cStick 2 adapter includes a PULL-UPS slide switch used to enable or disable internal 1.8K ohm pull-up resistors attached to the SCL and SDA lines. Every I^2C Bus system must have at least one pull-up on the signal lines. In some cases, the pull-ups may be present in the external I^2C Bus circuit. Use this switch to configure the pull-up resistors for your system.

See the Power Source Mode and Voltage Sense Mode sections for applied pull-up voltage.

Connecting to an SMBus Target System

If you are connecting the I²C adapter to a SMBus target system, you should follow these steps BEFORE applying power:

- Shut off the I²C adapter's internal pull-ups (See Pull-up Resistor section).
- Use external SMBus rated (appoximately15k ohms) pull-up resistors. These pull-ups may already be present in the target system.
- Visit our I²C versus SMBus FAQ page (www.mcc-us.com/I2CSMBusFAQ.htm).
- See the SMBus Specification for additional details.

Special Note for SMBus Users: MCC's I²C adapters are designed to be I²C Bus compatible, not SMBus compatible. Some features of the SMBus protocol not supported include time-outs, device reset, and Packet Error Check byte processing. The non-supported SMBus features may, or may not, permit the use of the I²C

adapter in your SMBus application. Consult the MCC FAQ web page and SMBus Specification for details.

4. ESD (Electrostatic Discharge) Precautions

Electrostatic discharge is defined as the transfer of charge between bodies at different electrical potentials. Electrostatic discharge can change the electrical characteristics of a semiconductor device, degrading or destroying it. Electrostatic discharge also may upset the normal operation of an electronic system, causing equipment malfunction or failure.

When connecting the I²C adapter to a host computer and a target system, extreme care must be taken to avoid electrostatic discharge. Failure to follow ESD protection procedures when using the I²C adapter could damage the host computer, I²C adapter, or the target system, and void product warranty coverage.

Host Computer Grounding

Case 1 - Desktop and Single-board Computers. The chassis on a desktop or single-board host computer must be connected to earth ground to comply with safety regulations. If the computer chassis is NOT connected to earth ground for some reason (i.e., use of a two-prong power mains plug), the host computer power supply ground will float to some unknown voltage potential.

Case 2 - Laptop Computers. Laptop computers present special ESD problems. Most laptop computers use an external double-insulated mains power supply which is NOT connected to the mains earth ground. This means that the laptop chassis is floating at some unknown voltage potential.

In either case, upon connection to the I²C adapter and the target system, the host computer will discharge energy through its serial port to the I²C adapter, and on to the target system. This discharge could damage the host computer, I²C adapter, and the target system.

Grounding Solutions

To avoid damage to the host computer, I²C adapter, or target system, follow these instructions:

• Wear an earth grounded wrist strap, or discharge any static charge build-up,

when handling the I²C adapter or any target system devices.

- Ensure that both the host computer and target system are connected to a common earth ground point.
- Make sure that all interconnections are made BEFORE applying power to the host computer, I²C adapter, and target system.
- If you are using a laptop computer or host computer that is NOT connected to mains earth ground, make a hard-wired connection from the host computer (i.e., port connector shell) and the target system ground connector to a common earth ground point.
- Avoid plugging and unplugging system components while the host computer or target system is powered.
- Ensure that any devices connected to the target system are properly grounded to the common earth ground point.
- If unsure how to properly ground system components, seek electrical expert help.

WARNING: Any damage caused by Electrostatic Discharge (ESD) through inadequate earth grounding is NOT covered under the warranty of this product.

5. Driver Software Set-Up

The i2cStick 2 uses a Virtual Communications Port (VCP) interface to communicate with a host computer via USB. A virtual serial port is created on the host computer when the driver is installed, and the i2cStick 2 is plugged in. Drivers are available for several operating systems, and can be installed separately, or while installing the iPort Utility Pack.

The stand-alone driver and iPort Utility Pack are available at the following link:

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www.mcc-us.com/i2cStick-2
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This section provides information on how to install, update, and uninstall the i2cStick 2 software driver on a Windows-based host computer.

Driver Install (Windows)

Download, extract, and install the stand-alone VCP driver or iPort Utility Pack using the i2cStick 2 resource link above. Pre-installation (before plug-in) places the VCP driver into the Windows Driver Store, ready for installation when the i2cStick 2 is first plugged into the host computer. After plug-in, you can find the ComPort number assigned to the i2cStick 2 by running the iPort Utility Pack Message Center or Message Manager software, and selecting the i2cStick 2 device, use Windows Device Manager (Start | Settings | Control Panel | System | Device Manager | Ports (COM & LPT)), or use the OS X or Linux ls /dev command to find the communications port address assigned to the i2cStick 2.

Driver Update (Windows)

i2cStick 2 VCP drivers are posted on the MCC website (www.mccus.com/i2cStick-2). Use Windows Device Manager (Start | Settings | Control Panel | System | Device Manager | Ports (COM & LPT)) to see the current version of the i2cStick 2 driver installed on your computer, and determine if newer driver is available. If a newer VCP driver is available, follow website instructions to download and install a driver update on your computer.

Driver Uninstall (Windows)

i2cStick 2 VCP drivers can be uninstalled using Windows Device Manager (Start | Settings | Control Panel | System | Device Manager | Ports (COM & LPT)), or the Driver Uninstall short-cut on the iPort Utility Pack Start menu.

6. Hardware Set-Up

This section provides information on connecting the i2cStick 2 to your host computer and I²C Bus target system.

USB Connection

After completing the Driver Installation instructions above, plug the i2cStick 2 adapter into a free USB port on your host computer or self-powered USB hub. If this is the first time the i2cStick 2 is connected to the host computer, the operating system will automatically install the VCP driver and assign the i2cStick 2 a communications port address (COMn, /dev).

After plug-in, you can find the ComPort number assigned to the i2cStick 2 by running the iPort Utility Pack Message Center or Message Manager software, and selecting the i2cStick 2 device, use Windows Device Manager (Start | Settings | Control Panel | System | Device Manager | Ports (COM & LPT)), or

use the OS X or Linux ls /dev command to find the communications port address assigned to the i2cStick 2.

I²C Bus Connection

Connect the I²C Bus cable to the I²C adapter and your I²C device. You can make this connection with the I²C Mini Clip-Lead cable or I²C Mini Interface Cable.

The I²C Bus interconnect includes 5 wires, Clock (SCL), Data (SDA), Ground (GND), Shield (SHD), and +V. The minimum connection for I²C Bus communication is Clock, Data, and Ground. You may not need to, or want to, connect the additional wires to your target system. Refer to the "Hardware Configuration" sections for details.

If you have any questions on I²C adapter setup and configuration, please visit our FAQ page (http://www.mcc-us.com/faq.htm), or contact our technical support team (<u>support@mcc-us.com</u>).

7. Software Support

MCC offers the following categories of I²C Bus software support:

I²C Bus Communication Utilities

iPort Utility Pack for Windows

The iPort Utility Pack for Windows provides a quick-start to I^2C Bus communications. The Utility Pack includes two Windows-based application that will help you get started sending and receiving I^2C Bus messages quickly and easily.

iPort Message Center

iPort Message Center is a bus master application with a spreadsheet-like user interface. Each row in the spreadsheet represents a single I²C Bus message. A message can transmit data to a specified slave device, or read data from a specified slave device. Received data is automatically displayed in the spreadsheet.

Message options include repeated-start, and a time delay after each message. One or more messages in the spreadsheet are transmitted in sequence, and can auto-repeat at the completion of the last message.

iPort Message Manager

iPort Message Manager is a bus master/slave application that can master transmit, master receive, slave transmit, and slave receive I²C Bus messages. Message options include master transmit and transmit/receive, and auto-repeat

iBurner I²C Bus EEPROM Programmer

iBurner is our I²C Bus EEPROM Programmer software package for Windows. With iBurner, you can quickly and easily blank-check, program, read, and verify a wide variety of I²C Bus EEPROMs. iBurner also supports scripting, allowing EEPROM programing serialization and automation.

I²C Bus Software Development Tools

MCC provides three methods for creating custom application software for ASCII Interface I²C Bus Adapters:

MS.NET Class Library

The MS.NET Class Library provides a comprehensive set of tools for the creation of robust I²C Bus applications. Included are Constructors, Methods, Properties, Events, Enumerations, and SampleCode for Visual Basic.NET, Visual C#, Visual C++, Visual J#, and LabVIEW.

LabVIEW VI Library

The LabVIEW VI Library provides a complete set of low-level, mid-level, and high-level Virtual Instruments (Vis) for the LabVIEW developer. Included are VIs for establishing a connection to the Adapter, performing I²C Bus Master and Slave operations, and Sample LabVIEW applications.

ASCII Command Interface

The ASCII Command Interface provides a direct low-level ASCII command

application program interface to the I²C Bus Adapter. ASCII commands can be accessed from a terminal emulation program running on the host computer, or from an application program using host computer operating system serial port functions.

i2cStick 2 software support and more is available at:

www.mcc-us.com/i2cStick-2

i2cStick 2 Revision Report

This section defines revisions and changes made to the i2cStick 2 interface:

Revision: 1.00

1. Initial Release

Additional Information

For additional information on the I²C Bus, please refer to the following:

"What is I²C?" www.mcc-us.com/I2CBusTechnicalOverview.pdf

"Frequently Asked Questions (FAQ)" www.mcc-us.com/faq.htm

"The I²C and How to Use It" www.mcc-us.com/i2chowto.htm

Appendix A - I²C Connector Information

I²C Bus Interface Connector and Plug Information

The i2cStic 2k uses the following 1x5 2.54 mm (.100") pitch, 0.64 mm (.025") square pin, header and plug assemblies for the I^2C Bus interface.

I²C Header

Molex C-Grid® SLTM 70553 Header

Molex Part # 70553-0004

I²C Plug Housing

Molex C-Grid[®] SL[™] 70066 Crimp Housing

Molex Part # 50-57-9405

Molex C-Grid® SLTM 70058 Crimp Terminal

Molex Part # 16-02-0102

The following I²C Cables are available from MCC

MCC Part #	I2CMIC	I ² C Mini Interface Cable 0.6 m (2')
MCC Part #	I2CMCL	I ² C Mini Clip Lead Cable 0.3 m (1')
MCC Part #	I2CMCAB	I ² C Mini CAB Cable 0.6 m (2')

Compliance Information

FCC Compliance Statement

Supplier's Declaration of Conformity

We, Micro Computer Control Corporation, of 83 Princeton Avenue #1D / PO Box 275, Hopewell, New Jersey 08525 USA, declare under our sole responsibility that the product:

i2cStick 2 (#MIIC-209)

to which this declaration relates:

Complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions; (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CE Declaration of Conformity

We, Micro Computer Control Corporation, of 83 Princeton Avenue #1D / PO Box 275, Hopewell, New Jersey 08525 USA, declare under our sole responsibility that the **i2cStick 2** (**#MIIC-209**), to which this declaration relates, is in conformity with General Emissions Standard EN55032 (CISPR 32:2015) Class A, and General Immunity Standard EN 55035:2017.

Test Laboratory Information:

CASS Industries Ltd.. Test Report Number: CI07805 Test Report Date: September 5, 2018 Technical file held by: Micro Computer Control Corporation, 83 Princeton Avenue #1D / PO Box 275, Hopewell, New Jersey 08525 USA, or its applicable authorized distributor or representative.

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