

# User's Guide

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## iPORT/AFM 2™

ASCII Fast Mode  
RS-232 to I<sup>2</sup>C Host Adapter  
with *Circuit Sense*™



[www.mcc-us.com](http://www.mcc-us.com)

# Introduction



The MCC iPort/AFM 2™ (#MIIC-213), RS-232 to I<sup>2</sup>C Host Adapter with ASCII Fast Mode and *Circuit Sense*, allows any PC, Host Computer, or Data Terminal with a legacy or add-on RS-232 port to become an I<sup>2</sup>C Master or Slave device, transmitting or receiving I<sup>2</sup>C messages between the Host Computer and one or more I<sup>2</sup>C devices across an I<sup>2</sup>C Bus.

This user's guide describes the installation and operation of the iPort/AFM 2 host adapter and the iPort Utility Pack Software for Windows, and includes the Programmers Reference for creating custom applications.

Additional resources can be found at:

[www.mcc-us.com/iPortAFM-2](http://www.mcc-us.com/iPortAFM-2)

Are you new to I<sup>2</sup>C? Want to know more? We suggest you review our paper on the I<sup>2</sup>C Bus at:

[www.mcc-us.com/I2CBusTechnicalOverview.pdf](http://www.mcc-us.com/I2CBusTechnicalOverview.pdf)

This MCC product uses NXP (Philips) components and is licensed to use the I<sup>2</sup>C Bus.

“Purchase of Philips I<sup>2</sup>C components conveys a license under the Philips' I<sup>2</sup>C patent to use the components of the I<sup>2</sup>C system, provided the system conforms to the I<sup>2</sup>C specifications defined by Philips.”

I<sup>2</sup>C is a trademark of NXP (Philips) Corporation.

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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 can radiate levels of radio frequency energy that may cause interference to communications equipment. Operation of this equipment may cause interference with radio, television, or other communications equipment. The user is responsible for correcting such interference at the expense of the user.

**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.

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# Part 1

**iPORT/AFM 2<sup>TM</sup>**

RS-232

to

I<sup>2</sup>C Bus Host Adapter

with

*Circuit Sense<sup>TM</sup>*

# User's Guide

Model: MIIC-213

# 1 Overview

The MCC iPort/AFM 2 (#MIIC-213), RS-232 to I<sup>2</sup>C Bus Host Adapter with ASCII Fast Mode and *Circuit Sense*, allows any PC, Host Computer, or Data Terminal with a legacy or add-on RS-232 port to become an I<sup>2</sup>C Master or Slave device, transmitting or receiving I<sup>2</sup>C messages between the Host Computer and one or more I<sup>2</sup>C devices across an I<sup>2</sup>C Bus.



*Circuit Sense*, our new I<sup>2</sup>C Bus voltage sensing technology, allows the iPort/AFM 2 to work with the latest I<sup>2</sup>C Bus devices at voltages as low as 0.5 volts.



## 1.1 iPort/AFM 2 Product Features

- Host Support: Any Host Computer with legacy or add-on RS-232 Serial Port.
- High Performance Processor Increases Throughput (2x to 200x).
- External Power Jack or I<sup>2</sup>C Bus Powered (5VDC).
- Built-in ESD, Over-voltage, and Reverse-voltage Protection.
- Switch Controlled Properties:
  - I<sup>2</sup>C Bus Power Source/Voltage Sense (5v@100ma Source or 0.5v to 5v Voltage Sense).
  - I<sup>2</sup>C Bus Pull-Ups (1.8K ohm, Enable or Disable).
- Software Controlled Properties:
  - I<sup>2</sup>C Bus Master Clock Rates: 23KHz, 86KHz, 100KHz Std, 400KHz Fast
  - I<sup>2</sup>C Bus General Call Enable
  - I<sup>2</sup>C Bus Time-Out (0-32K ms)
  - I<sup>2</sup>C Bus Interrupt Signal Control (Assert, Release, Monitor)
  - Host Communication Flow Control (XON/XOFF or RTS/CTS)
  - User Interface Echo/Prompt Enable
  - User Data Format (HEX or ASCII/HEX)
- Supported I<sup>2</sup>C 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
  - Interrupt Signal Generation and 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, "I<sup>2</sup>C-Like" Low-level SCL/SDA Signal Control
- Software Support:
  - Free Application Software (Master, Slave, and EEPROM Programmer).
  - Free Software Development Tools (MS.NET and LabVIEW Libraries).
- Compatible with existing iPort/AI, iPort/AFM, iPort/USB, i2cStick, and iPort/LAN applications.
- US-FCC and EUR-CE EMC Compliant.
- RoHS/Lead-Free Compliant.

## 1.2 iPort/AFM 2 Package

The iPort/AFM 2 package includes the following items:

- iPort/AFM 2, RS-232 to I<sup>2</sup>C Bus Host Adapter.
- I<sup>2</sup>C Bus Mini Clip-lead Cable (5-wire, 1 ft.).
- DB-9F to DB-25M Serial Port Adapter Cable (1 ft.).
- Global 5VDC Power Supply.
- iPort/AFM 2 Quick Start Guide.
- iPort/AFM 2 Travel Case.
- Online Items\*
  - iPort/AFM 2 Datasheet
  - iPort/AFM 2 User's Guide (this document)
  - iPort Utility Pack Software
  - Application Software.
  - Software Development Tools

(\* [www.mcc-us.com/iPortAFM-2](http://www.mcc-us.com/iPortAFM-2))

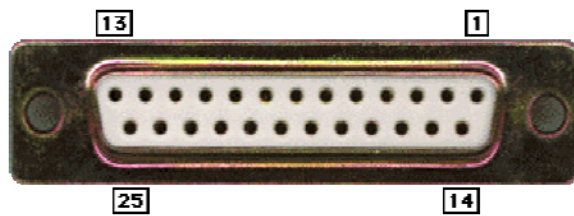


## 1.3 System Requirements

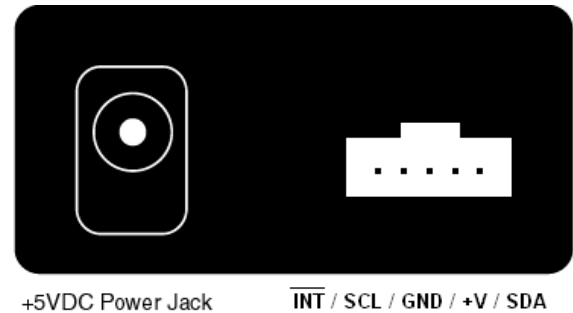
- a. A host computer with one free legacy or add-on RS-232 port.
- b. Windows XP OS or higher to run iPort Utility Pack applications.

## 2 Interconnects

The iPort/AFM 2 includes three (3) interconnections:



RS-232 Serial Port Connector



### 2.1 RS-232 Serial Port Connector

The RS-232 connector provides connection from the I<sup>2</sup>C adapter to the serial port on the host computer. For computers with DB-9 connectors, use the DB-9 to DB-25 (#C9F25M1) cable provided with the adapter, or equivalent.

The I<sup>2</sup>C adapter implements the RS-232 interface using the following pins:

#### 2.1.1 DB-25 Serial Port Pinout

- DB-25 Pin 2, Transmit Data from the Host Computer to the iPort
- DB-25 Pin 3, Receive Data from the iPort to the Host Computer.
- DB-25 Pin 4, Request to Send from the Host Computer to iPort.
- DB-25 Pin 5, Clear to Send from the iPort to the Host Computer.
- DB-25 Pin 7, Ground between Host Computer and iPort

#### 2.1.2 DB-9 Serial Port Pinout

- DB-9 Pin 3, Transmit Data from the Host Computer to the iPort
- DB-9 Pin 2, Receive Data from the iPort to the Host Computer.
- DB-9 Pin 7, Request to Send from the Host Computer to iPort.
- DB-9 Pin 8, Clear to Send from the iPort to the Host Computer.

## DB-9 Pin 5, Ground between Host Computer and iPort

### 2.2 +5VDC Power Jack (2.5mm, Center Positive)

The I<sup>2</sup>C adapter requires 50ma of REGULATED +5 volt power. This power can be supplied in one of two ways:

- Via the power jack.  
If the I<sup>2</sup>C adapter is powered via its +5VDC power jack, and the adapter is operating in power SOURCE mode, excess power is available via the +V wire in the I<sup>2</sup>C connector to power external devices.
- Via the I<sup>2</sup>C interface connector.  
If 50ma of regulated +5V power is available in the target system, and the adapter is operating in power SOURCE mode, the I<sup>2</sup>C adapter can be powered via the +V wire in I<sup>2</sup>C interface connector.

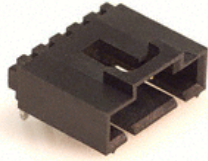
### 2.3 I<sup>2</sup>C Mini Interface Connector

The iPort/AFM 2 I<sup>2</sup>C Bus host adapter includes a five wire (1x5) 2.54 mm (.100"), positive locking, shrouded header receptacle connector (see Appendix A) for interfacing to an external I<sup>2</sup>C Bus. Interface lines provided include:

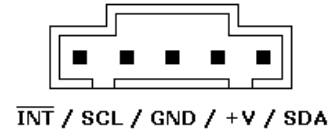
- I<sup>2</sup>C Clock (SCL)
- I<sup>2</sup>C Data (SDA)
- I<sup>2</sup>C /INTerrupt
- Ground
- +V

Minimum wiring for I<sup>2</sup>C Bus communications include I<sup>2</sup>C Bus Clock, Data, and Ground. Use of the /INTerrupt and +V wires in the I<sup>2</sup>C Interface connector are user optional.

NOTE: See the Hardware Configuration section below for additional information on configuring the I<sup>2</sup>C Bus interface.



I<sup>2</sup>C Bus Mini Interface Receptacle



Mini Interface Receptacle Pinout

I<sup>2</sup>C Bus Mini-Clip-Lead cables are available to connect the iPort/USB 2 adapter to a target system. Each clip-lead is identified (White=C=SCL, Red=V=+V, Green=D=SDA, Black=G=Ground, Gray=(no mark)=/INTerrupt).

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

## 2.4 Interrupt (/INT) Signal Connector

The Interrupt (/INT) signal is an extra pin found on some I<sup>2</sup>C devices. The /INT signal allows a slave-only device to attract the attention of a bus master device by lowering the /INT signal voltage level.

The iPort/AFM 2 provides an open-drain /INT signal which can be connected to a corresponding pin on a master or slave device. The /INT signal allows the iPort/AFM 2 to participate in interrupt signaling between master or slave devices.

The iPort/AFM 2 generates an I<sup>2</sup>C Bus interrupt assert (/INT=low) upon receiving an iNterrupt Assert command from the host computer. The interrupt signal is released (/INT = high) when the iPort/AFM 2 is addressed as an I<sup>2</sup>C Bus slave device, or an iNterrupt Release command is received from the host computer.

Interrupt monitoring is enabled upon receiving an Enable /INT Monitor command from the host computer. Interrupt monitoring causes the iPort/AFM 2 to monitor the /INT signal level, and send a notification to the host computer when the /INT signal changes state.

## 3 Hardware Configuration

### 3.1 *Circuit Sense™*

The iPort/AFM 2 includes MCC's *Circuit Sense* technology. Circuit Sense allows the I<sup>2</sup>C interface +V wire can 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 (5v @ 100 mA) Vcc to an external I<sup>2</sup>C Bus system. In Power Source Mode, the voltage of the iPort/AFM 2 SCL, SDA, and /INT internal pull-ups, if enabled, and Voltage Sense circuit ( $0.3V_{cc} \text{ Low}_{MAX}$ ,  $0.7V_{cc} \text{ High}_{MIN}$ ) is connected to the adapter's +5v power supply. (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 I<sup>2</sup>C Bus host adapters.

- **Voltage Sense Mode** - The +V wire is connected to the external I<sup>2</sup>C Bus system pull-up supply voltage (0.5v to 5v) Vcc, and automatically adjusts iPort/AFM 2 SCL, SDA, and /INT Voltage Sense circuit levels to match ( $0.3V_{cc} \text{ Low}_{MAX}$ ,  $0.7V_{cc} \text{ High}_{MIN}$ ). In Voltage Sense Mode, the voltage of the iPort/AFM 2 SCL, SDA, and /INT internal pull-ups, if enabled, is equal to the external voltage (Vcc) applied to the +V wire. (Use of the +V wire in Voltage Sense Mode is required).

### 3.2 Pull-up Resistors

I<sup>2</sup>C Bus systems are based on open-collector technology requiring pull-up devices on each signal wire (SCL, SDA, /INT). These pull-up devices usually take the form of pull-up resistors connected to bus power.

The I<sup>2</sup>C adapter includes a PULL-UPS slide switch used to enable or disable internal 1.8K ohm pull-up resistors attached to the SCL, SDA, and /INT lines. Every I<sup>2</sup>C 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<sup>2</sup>C Bus circuit. Use this switch to configure the pull-up resistors for your system.



### 3.3 Connecting to a Low-Voltage Target System

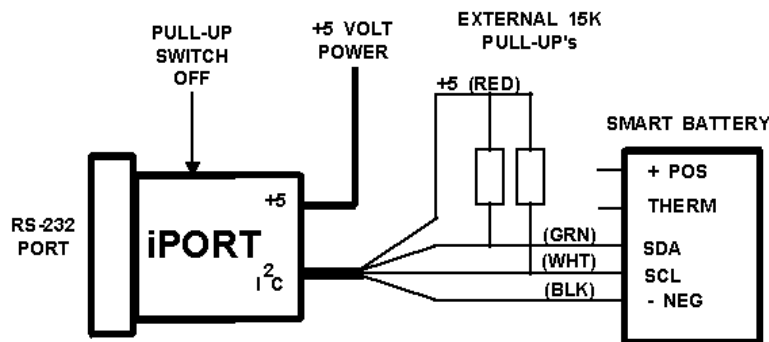
If you are connecting the I<sup>2</sup>C adapter to a low-voltage (<5v) target system, you should follow these steps BEFORE applying power:

- Using the adapter MODE slide switch, put the adapter in Sense Mode.
- If your target system does NOT supply I<sup>2</sup>C Bus pull-ups, use the adapter PULL-UPS slide switch to enable the adapter's internal 1.8K ohm pull-ups.
- Connect the I<sup>2</sup>C connector +V wire to the target system I<sup>2</sup>C Bus power. The I<sup>2</sup>C adapter will be powered from its own +5V power supply, and adapters pull-ups, if enabled, and Voltage Sense circuit will be powered by the target system's low-voltage power supply.

### 3.4 Connecting to an SMBus Target System

If you are connecting the I<sup>2</sup>C adapter to a SMBus target system, you should follow these steps BEFORE applying power:

- Shut off the I<sup>2</sup>C adapter's internal pull-ups (See Pull-up Resistor section).
- Use external SMBus rated (approx. 15k ohm) pull-up resistors. These pull-ups may already be present in the target system.



- Visit the I<sup>2</sup>C .vs. SMBus FAQ page ([www.mcc-us.com/I2CSMBusFAQ.htm](http://www.mcc-us.com/I2CSMBusFAQ.htm)).
- See the SMBus Specification for additional details.

**Special Note for SMBus Users:** MCC's I<sup>2</sup>C adapters are designed to be I<sup>2</sup>C 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 I<sup>2</sup>C 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 I<sup>2</sup>C 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 I<sup>2</sup>C adapter could damage the host computer, I<sup>2</sup>C adapter, or the target system, and void product warranty coverage.

### 4.1 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 I<sup>2</sup>C adapter and the target system, the host computer will discharge energy through its RS-232 port to the I<sup>2</sup>C adapter, and on to the target system. This discharge could damage the host computer, I<sup>2</sup>C adapter, and the target system.

### 4.2 Grounding Solutions

To avoid damage to the host computer, I<sup>2</sup>C adapter, or target system, follow these instructions:

- Wear an earth grounded wrist strap, or discharge any static charge build-up, when handling the I<sup>2</sup>C 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, I<sup>2</sup>C 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., RS-232 port D-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 Hardware Set-Up

This section provides information on connecting the I<sup>2</sup>C adapter to your host computer and I<sup>2</sup>C Bus target system.

1. Attach the I<sup>2</sup>C adapter to a free legacy or add-on RS-232 port on your host computer. If your RS-232 port has a DB9 connector, use DB-9F to DB-25M serial port cable included with the I<sup>2</sup>C adapter.
2. Connect the I<sup>2</sup>C Bus mini clip-lead cable to the I<sup>2</sup>C adapter and your I<sup>2</sup>C device. MCC also offers an I<sup>2</sup>C mini interface cables that are compatible with our adapters. You may not need to, or want to, connect the +V wire to your target system. Refer to the “+5VDC Power Jack” and “Hardware Configuration” sections for details on pull-up resistors and connecting the optional +V wire.
3. Connect I<sup>2</sup>C adapter power via the power jack or I<sup>2</sup>C Bus connector. See “+5VDC Power Jack” section for details.

If you have any questions on I<sup>2</sup>C adapter setup and configuration, please visit our FAQ Page (<http://www.mcc-us.com/faq.htm>) or contact our technical support team ([support@mcc-us.com](mailto:support@mcc-us.com)).

# Part 2

# iPort Utility Pack for Windows

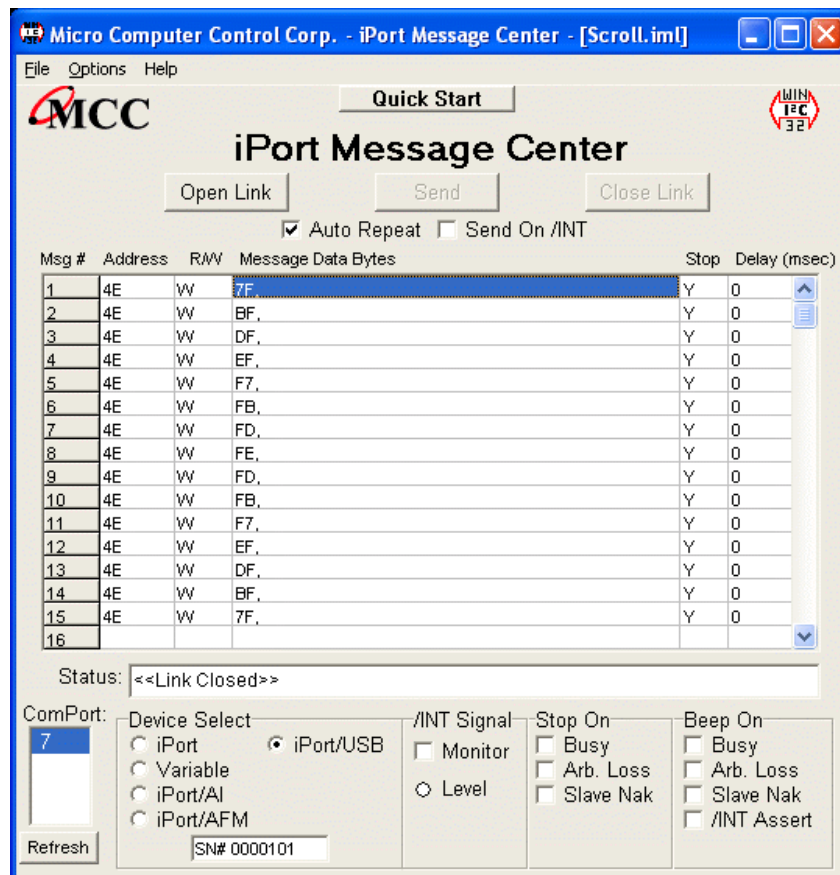
# 1 iPort Utility Pack for Windows

The iPort Utility Pack for Windows is your express lane to I<sup>2</sup>C Bus communications. The Utility Pack includes two (2) Windows-based applications (Message Center and Message Manager) that will help you get started sending and receiving I<sup>2</sup>C Bus messages quickly and easily.

## 1.1 iPort Message Center

The iPort Message Center, our most popular application, operates with all versions of our I<sup>2</sup>C Bus Host Adapters. With the Message Center, you can create, save, and automatically execute scripts of I<sup>2</sup>C Bus messages. I<sup>2</sup>C Bus message activity includes:

- Master Transmit
- Master Receive

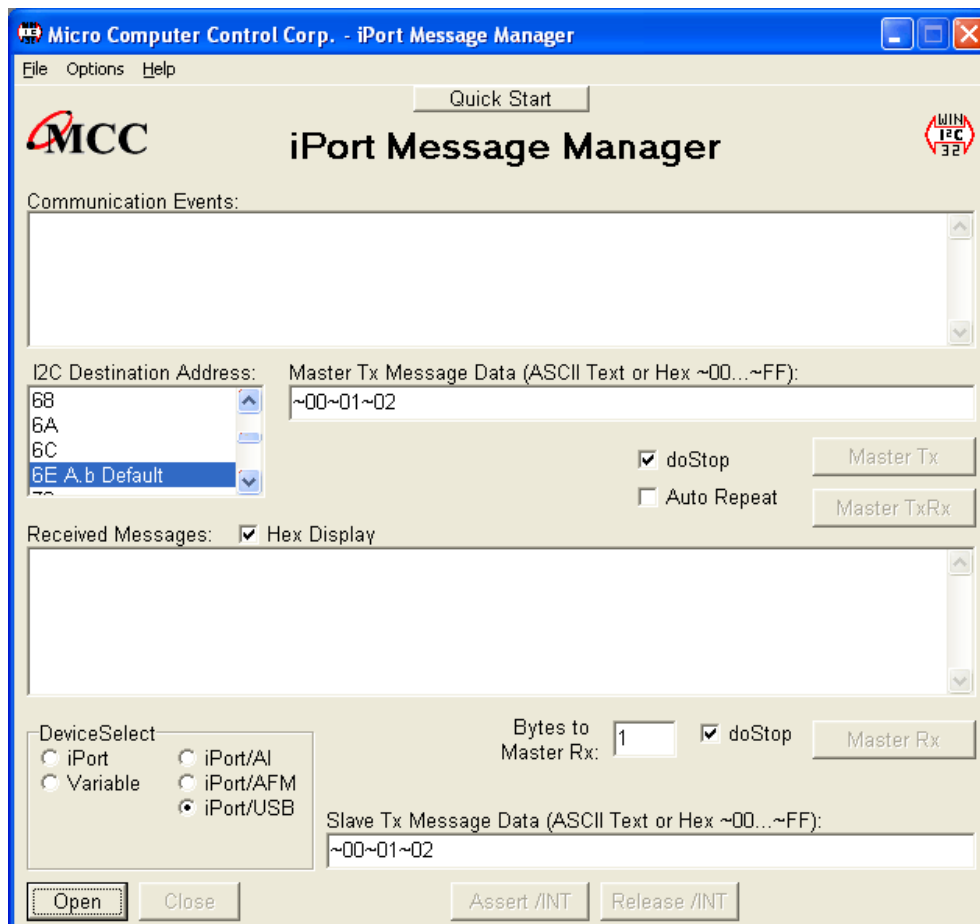


Main Screen (Typical)

## 1.2 iPort Message Manager

The iPort Message Manager operates with all versions of our I<sup>2</sup>C Bus Host Adapters. Using the Message Manager, you can perform all four (4) modes of I<sup>2</sup>C Bus message activity, including:

- Master Transmit
- Master Receive
- Slave Transmit
- Slave Receive



Main Screen (Typical)

## 2 System Requirements

- MCC I<sup>2</sup>C Bus Host Adapter.
- Windows XP OS or higher.
- 1 free legacy or add-on RS-232 Serial Port.

## 3 iPort Utility Pack Installation

The iPort Utility Pack is not mandatory, but can be very useful when communicating with I<sup>2</sup>C Bus devices.

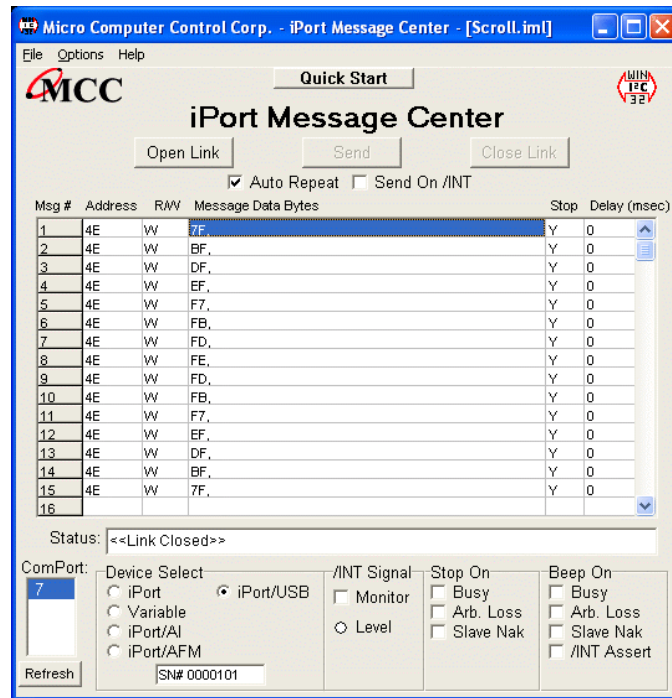
### 3.1 Installing from the Web

Visit MCC's web site ([www.mcc-us.com](http://www.mcc-us.com)), and click on the Upgrades/Updates link.

- 1 Click to download the .ZIP file.
- 2 Unzip the downloaded file, storing the files in a temporary folder.
- 3 Click on "Setup.exe."
- 4 Follow the instructions on screen.

## 4 iPort Message Center

The iPort Message Center supports I<sup>2</sup>C Master Transmit and Master Receive activities for all MCC I<sup>2</sup>C Bus host adapters. With this program you can create, save, and execute scripts of I<sup>2</sup>C Master messages.



Main Application

The iPort Message Center allows a PC to become an I<sup>2</sup>C Master transmitter or receiving device, sending I<sup>2</sup>C messages between the PC and one or more I<sup>2</sup>C devices across an I<sup>2</sup>C Bus.

The iPort Message Center is designed to be a simple application for experimenting with I<sup>2</sup>C messages. It provides methods to:

1. Enter/Edit a list of I<sup>2</sup>C Master Transmit or Receive Messages.
2. Save and/or Load a list of I<sup>2</sup>C Master messages to/from disk.
3. Transmit the current list of I<sup>2</sup>C Master messages, with the option to auto-repeat upon completion, send on INT signal assertion (with INT signal supported adapters only), and beep or stop on special I<sup>2</sup>C Bus events.
4. Use command line arguments to automatically load, send, and save I<sup>2</sup>C messages from a batch file or another program.

Each I<sup>2</sup>C message can transfer up to 32 bytes of 8-bit data, with Repeated Start and Time Delay options.



## 4.1 Message Center Operations

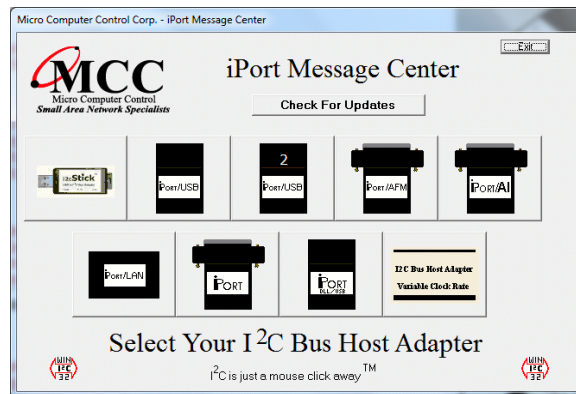
Communicating with another device on the I<sup>2</sup>C Bus is easy. Just install the software as described in Section 3, then following these simple steps:

### 4.1.1 Starting the Message Center

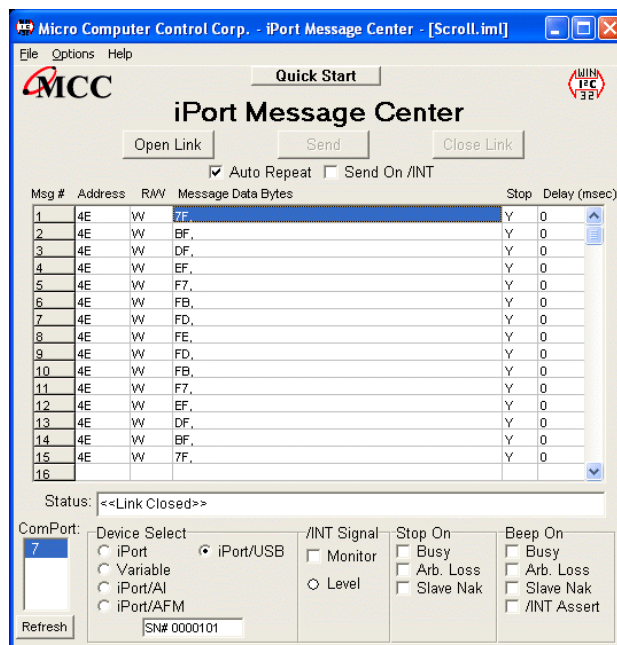
Click, Start | Programs | iPort Utility Pack | iPort Message Center

### 4.1.2 Selecting the Adapter

Select the I<sup>2</sup>C adapter you are using by clicking the corresponding adapter image (see Opening Screen), or the Device Select checkbox (see Main Application Screen).



Opening Screen



Main Application

### 4.1.3 Select the Communications Port

Use the “Using Com:” control to select the RS-232 communication port connected to the I<sup>2</sup>C adapter. Message Center supports USB and network connected local or remote RS-232 ports via the Windows Com driver.

### 4.1.4 Options Menu

Use the Options menu to override default Baud Rate and I<sup>2</sup>C Bus Clock rate settings. Default settings and options are adapter dependant.

### 4.1.5 Establish Adapter Communications Link

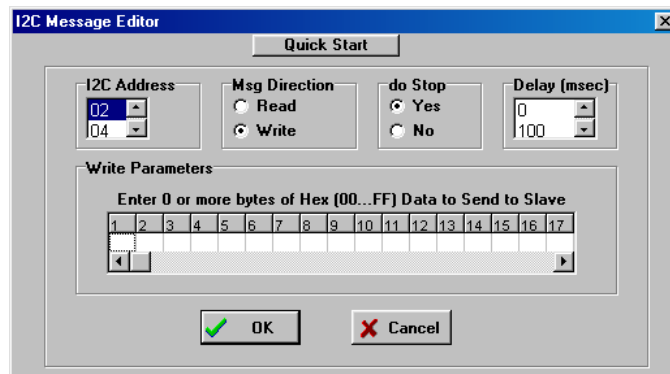
Establish the communications link to the I<sup>2</sup>C adapter by clicking the Open Link button.

The Message Center sets the adapter’s own I<sup>2</sup>C Slave address to 0xFE. Once the link has opened successfully, you are an active I<sup>2</sup>C node. I<sup>2</sup>C messages entered into the message spreadsheet can be transmitted upon request. If the link open is not successful, follow the on-screen directions. Make sure the communications port is working, is enabled in the Windows Device Manager, and is not being used by other software.

### 4.1.6 Entering or Editing I<sup>2</sup>C Messages

I<sup>2</sup>C messages can be entered with the Message Editor, or a previously recorded message list can be loaded from the File menu.

To enter or edit a message, open the “I<sup>2</sup>C Message Editor” screen by double clicking on a message row in the spreadsheet.



Use the I<sup>2</sup>C Message Editor to:

### 1. Set I<sup>2</sup>C Address.

The I<sup>2</sup>C Address is the I<sup>2</sup>C slave address of the slave device being addressed on the bus. All slave addresses are displayed as even numbers (00...FE), representing the 7 most significant bits of the 8-bit slave address transmitted on the bus (aaaa aaa0).

The I<sup>2</sup>C adapter automatically supplies the 8<sup>th</sup>, least significant, Read/Write bit when it sends the slave address across the bus. For master write operations, the Read/Write bit is always transmitted as a logical 0 (aaaa aaa0). For master read operations, the Read/Write bit is always transmitted as a logical 1 (aaaa aaa1).

Use the I<sup>2</sup>C Address control to set the slave address of the slave device you want to address on the bus.

### 2. Set Message Read/Write Direction.

As a bus master device, the I<sup>2</sup>C adapter can write data to, or read data from, any device on the bus. Use the Msg Direction control to specify if the current message is a master write, or master read, operation. Upon making your selection, additional Write or Read parameters appear.

### 3. Specify Repeated Start Messages.

I<sup>2</sup>C Bus communications support an operation called Repeated Start. In this operation, a message is sent across the bus beginning with a Start Condition, but without a Stop Condition at the end of the message. The next message sent across the bus begins with a Start Condition, in this case a Repeated Start.

An I<sup>2</sup>C Bus master, that successfully sends a message on the bus, owns the bus until that master sends a message with a terminating Stop Condition. The Repeated Start operation allows the bus master to retain control of the bus while sending one or more messages on the bus. This prevents other bus masters, in a multi-master system, from accessing the bus and interfering with message sequences.

The Message Center supports Repeated Starts with the doStop control. Sending an I<sup>2</sup>C message with doStop enabled will cause the message to be terminated with

a Stop Condition. Sending an I<sup>2</sup>C message with doStop disabled will cause the message to end without a Stop Condition, allowing the next message to be sent with a Repeated Start.

#### 4. Set Time Delay.

Message Center supports time delays after the completion of a message. Time delays can be used to synchronize or sequence bus messages with the activity of external devices.

#### 5. Specify Write Data or Read Byte Count.

Enter the hexadecimal data you want to write to a slave receiver device, or the number of data bytes to read from a slave transmitter. Message Center supports up to 32 bytes of 8-bit data per message.

NOTE: The data you send may have special meaning to the receiving slave device, but to the Message Center, and the I<sup>2</sup>C adapter, message data has no special meaning. Consult your slave device's data sheet for details.

Click OK to accept the message and enter it into the spreadsheet.

Master Write messages display the message data in the spreadsheet. Master Read messages display 0xFF placeholders in the spreadsheet. Upon execution, actual data received from a slave transmitter replaces the placeholders in the message spreadsheet.

Repeat above steps for additional messages. The Message Center supports up to 32,000 messages in a list.

#### 4.1.7 Inserting and Deleting Messages

You can insert a new message between existing messages by clicking once on a message below where you want to insert, then press the "Insert" key on your keyboard. The Message Editor also remembers the last message displayed, so double clicking on a blank spreadsheet row will allow you to copy a message. Delete a message by single clicking on the message row and pressing the "Delete" key on your keyboard.

#### 4.1.8 Saving or Loading Message Lists

Message Center I<sup>2</sup>C message lists can be saved to, or loaded from, a disk file. To save the current message list, click File|Save on the menu bar. To open an existing message list, click File|Open List on the menu bar.

Message lists are maintained in ASCII text files (\*.IML) that can be edited manually or created with a customer-developed program. See message list files for details.

#### 4.1.9 Send the Message List

An I<sup>2</sup>C message list can be sent manually, or automatically in response to an INT signal assertion (with INT signal supported adapters only). To send the list manually, click the Send button on the main application screen. To send the list in response to an INT signal assertion (low), enable the “/INT Signal Monitoring” checkbox, and check the “Send on /INT” checkbox. The list will be sent each time the INT signal is asserted.

The Message Center also supports the repeated sending of a message list. If the Auto Repeat checkbox is checked, a message list will automatically repeat upon completion.

#### 4.1.10 Special Event Handling

The Message Center supports the early termination of a message list, and beep on special events. See the “Stop On” and “Beep On” controls on the main application screen of available options.

#### 4.1.11 Slave Not Acknowledging

If you get a “Slave Not Acknowledging” message in the Status window, this could indicate you have the wrong address in the I<sup>2</sup>C Destination Address, or the device is not answering to its address. Some slave devices temporarily stop acknowledging their address. Consult the slave device’s data sheet for details.

## 4.2 Command Line Arguments

The Message Center can be controlled via command line arguments. This feature allows the Message Center to be accessed from a batch file or another program.

<b>Message Center Command Line Arguments</b>	
<b>Command</b>	<b>Description</b>
iPort, iPort/AI, iPort/AFM, Variable, iPour/USB, i2cStick, iPort/LAN	Specify I <sup>2</sup> C adapter type.*
COM1...COM20	Specify RS-232 communication port.
BAUD19200, BAUD57600, BAUD115200	Set RS-232 Baud Rate.*
CLOCK12.5K, CLOCK23K, CLOCK86K, CLOCK100K, CLOCK400K, VCLOCK	Set I <sup>2</sup> C Bus Clock Rate.*
Monitor/INT	Enable /INT Signal Monitor.*
StopOnBusy	Stop sending on I <sup>2</sup> C adapter busy.
StopOnArbLoss	Stop sending on I <sup>2</sup> C Bus Arbitration Loss.
StopOnNak	Stop on Slave Negative Acknowledgment.
BeepOnBusy	Beep on I <sup>2</sup> C adapter busy.
BeepOnArbLoss	Beep on I <sup>2</sup> C Bus arbitration loss.
BeepOnNak	Beep on Slave Negative Acknowledgment.
BeepOn/INT	Beep on /INT signal assert (low).*
AutoLoad	Load I <sup>2</sup> C message list file.
AutoSave	Save I <sup>2</sup> C message list file.
AutoOpen	Open link to I <sup>2</sup> C adapter.
AutoSend	Send I <sup>2</sup> C message list.
AutoExit	Exit after sending message list.

\* Adapter specific commands. See command details below.

Command Line Syntax: `imsgctr.exe AdapterType argument-list`

Example: `iMsgCtr.exe iPort/AFM adctest01.iml AutoOpen AutoSend AutoExit`

## 4.2.1 Set Adapter Type (Typical)

iPort iPort (#MIIC-201)  
Variable Variable Clock (#MIIC-201-V)  
iPort/AI iPort/AI (#MIIC-202)  
iPort/AFM iPort/AFM (#MIIC-203)  
iPort/USB iPort/USB (#MIIC-204)  
iPort/LAN iPort/LAN (#MIIC-205)  
i2cStick i2cStick (#MIIC-207)

The Adapter Type argument should be the first argument in the argument list as it controls the availability of other arguments. If the Adapter Type is not specified, the startup adapter selection screen will be presented.

## 4.2.2 Set RS-232 Communication Port

COM1 (Default)  
COM2...COM20

Set the RS-232 communications port attached to the I<sup>2</sup>C adapter.

## 4.2.3 Set RS-232 Baud Rate

BAUD19200 (Default)  
BAUD57600 (iPort/AFM, iPort/USB, iPort/LAN, i2cStick ONLY)  
BAUD115200 (iPort/AFM, iPort/USB, iPort/LAN, i2cStick ONLY)

Set the RS-232 Baud Rate.

## 4.2.4 Set I<sup>2</sup>C Bus Clock Rate

CLOCK12.5K (iPort ONLY)  
CLOCK23K (iPort/AFM, iPort/USB, iPort/LAN, i2cStick ONLY)  
CLOCK86K (iPort/AFM, iPort/USB, iPort/LAN, i2cStick ONLY)  
CLOCK100K (iPort/AFM, iPort/USB, iPort/LAN, i2cStick, Default)  
CLOCK400K (iPort/AFM, iPort/USB, iPort/LAN, i2cStick ONLY)  
VCLOCK=nnnHz (Variable ONLY. nnn=451...57787)

Set the I<sup>2</sup>C Bus Clock Rate to the specified value. The defaults rate for the Variable Clock the adapter is 451Hz. The Variable Clock adapter does not support all rates

within the specified range. The Message Center will adjust the specified rate to the nearest available supported rate.

#### 4.2.5 Enable /INT Signal Monitor

Monitor/INT (on INT supported adapters only. Default=OFF)

Enable /INT signal monitoring.

#### 4.2.6 Stop On Busy

StopOnBusy (Default=OFF)

Stop sending I<sup>2</sup>C messages if the adapter returns a "Busy" response to the host computer.

#### 4.2.7 Stop On Arbitration Loss

StopOnArbLoss (Default=OFF)

Stop sending I<sup>2</sup>C messages if the adapter returns a "Bus Arbitration Loss" response to the host computer. Bus Arbitration Loss occurs when another I<sup>2</sup>C Bus master wins arbitration while the adapter is attempting to become a bus master.

#### 4.2.8 Stop On Slave Negative Acknowledgment

StopOnNak (Default=OFF)

Stop sending I<sup>2</sup>C messages if the adapter returns a "Slave Not Acknowledging" response to the host computer. Slave Not Acknowledging occurs when the adapter is attempting to become a bus master and no slave device acknowledges the transmitted slave address.

#### 4.2.9 Beep On Busy

BeepOnBusy (Default=OFF)

Generate a host computer beep if the adapter returns a "Busy" response to the host computer.



#### 4.2.10 Beep On Arbitration Loss

BeepOnArbLoss (Default=OFF)

Generate a host computer beep if the adapter returns a "Bus Arbitration Loss" response to the host computer. Bus Arbitration Loss occurs when another I<sup>2</sup>C Bus master wins arbitration while the adapter is attempting to become a bus master.

#### 4.2.11 Beep On Slave Negative Acknowledgment

BeepOnNak (Default=OFF)

Generate a host computer beep if the adapter returns a "Slave Not Acknowledging" response to the host computer. Slave Not Acknowledging occurs when the adapter is attempting to become a bus master and no slave device acknowledges the transmitted slave address.

#### 4.2.12 Beep On /INT Assert

BeepOn/INT (on INT supported adapters only. Default=OFF)

Generate a host computer beep if the adapter returns a "/INT Signal Assert" response to the host computer. /INT Signal Assert occurs if /INT Signal Monitoring is enabled and a high to low transition is detected on the adapter /INT signal connector.

#### 4.2.13 Load I<sup>2</sup>C Message List File

AutoLoad=filename

AutoLoad="file name"

filename.iml

"file name.iml"

Automatically open file with extension .IML and load messages into Message Center spreadsheet.

#### 4.2.14 Saved I<sup>2</sup>C Message List File

AutoSave=filename  
AutoSave="file name"

Automatically save message list to the specified file upon executing AutoExit. Use to save message data read from a slave transmitter device.

#### 4.2.15 Auto Open

AutoOpen Auto Open Link to I<sup>2</sup>C Adapter

Open link to adapter.

#### 4.2.16 Auto Send

AutoSend Auto Send I<sup>2</sup>C Message List

Send I<sup>2</sup>C messages loaded with the AutoLoad command.

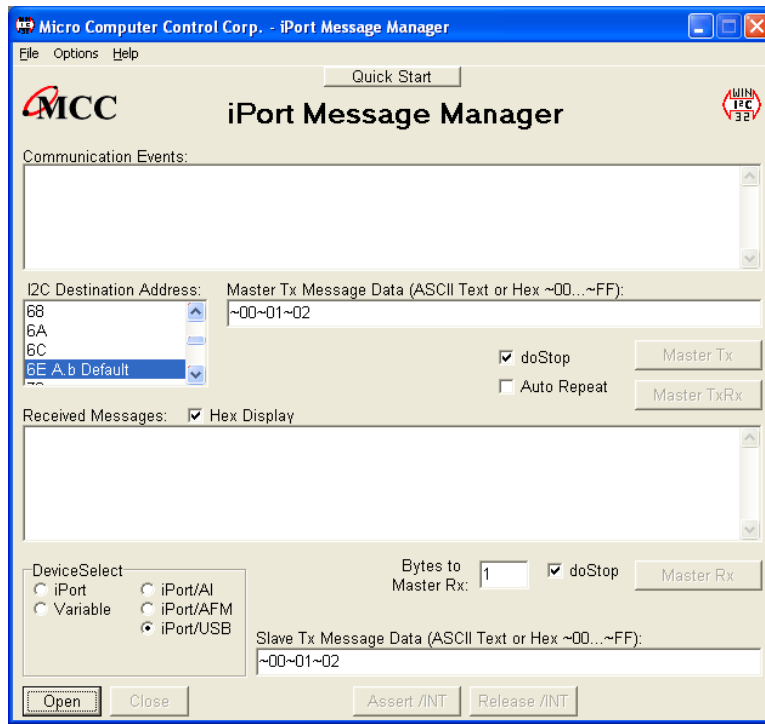
#### 4.2.17 Auto Exit

AutoExit Auto exit after sending the message list.

Message Center will auto exit after sending the last message in the I<sup>2</sup>C message list.

## 5 iPort Message Manager

The iPort Message Manager supports I<sup>2</sup>C Master and Slave, Transmit and Receive activities for all MCC I<sup>2</sup>C Bus host adapters, allowing a PC to become an I<sup>2</sup>C Master or Slave device, transmitting or receiving I<sup>2</sup>C messages between the PC and one or more I<sup>2</sup>C devices across an I<sup>2</sup>C Bus.



Main Application

The Message Manager is designed to be a simple application for experimenting with I<sup>2</sup>C messages. Message Manager provides methods to:

1. Set the I<sup>2</sup>C adapter's own I<sup>2</sup>C Slave address, General Call Enable, and other operating parameters.
2. Master Transmit ASCII text or Hex (00...FF) data to a specified I<sup>2</sup>C Slave Receiver device.
3. Master Receive data from a specified I<sup>2</sup>C Slave device.
4. Perform Master Read after Write operations.
5. Slave Transmit data to a requesting I<sup>2</sup>C Master device.
6. Display Master or Slave Receive data in hexadecimal or ASCII.
7. Display I<sup>2</sup>C Bus communication events.
8. Assert or release the INT signal (on supported adapters only).

## 5.1 Message Manager Operations

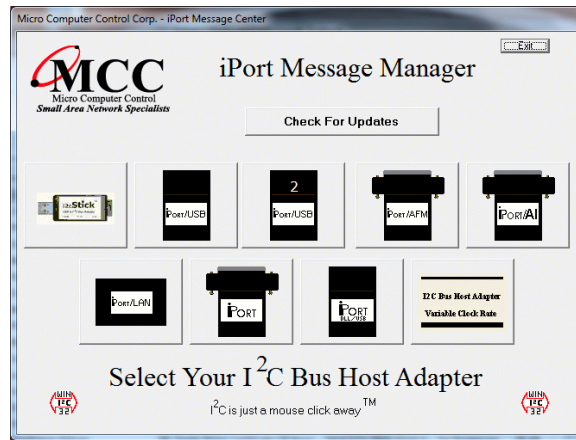
Communicating with another device on the I<sup>2</sup>C Bus is easy. Just install the software as described in Section 3, then following these simple steps:

### 5.1.1 Starting the Message Manager

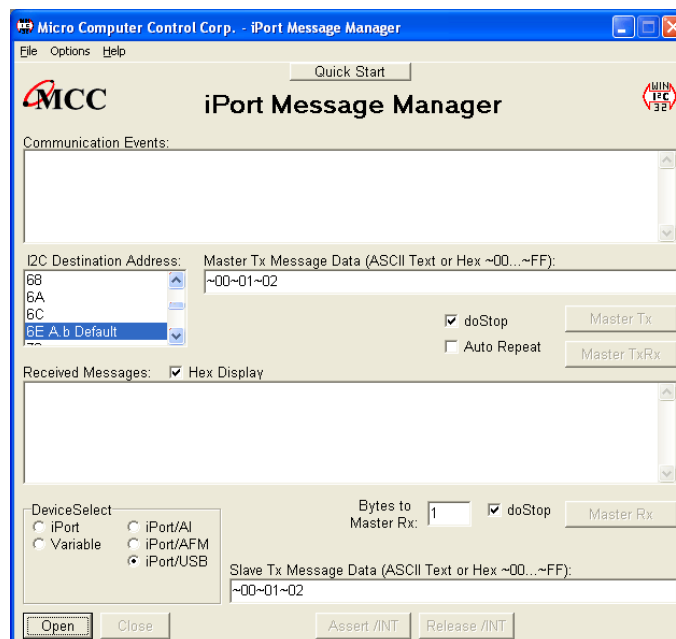
Click, Start | Programs | iPort Utility Pack | iPort Message Manager

### 5.1.2 Select the Adapter

Select the I<sup>2</sup>C adapter you are using by clicking the corresponding adapter image (see Opening Screen), or the Device Select checkbox (see Main Application Screen).



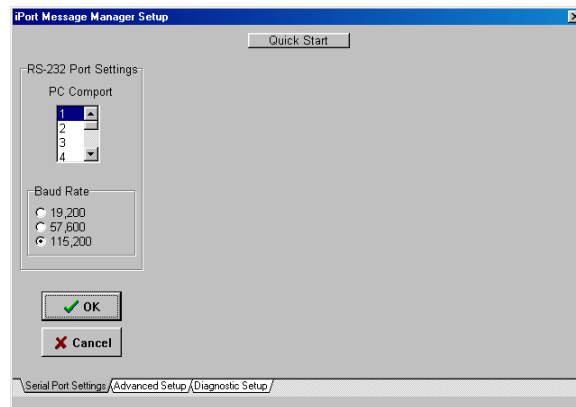
Opening Screen



Main Application

### 5.1.3 Establish Adapter Communications Link

On the main screen, click the Open button to view the Set Up Screen. Three levels of setup options are available, Basic, Advanced, and Diagnostic. Only Basic setup is required.



Basic Set Up Screen

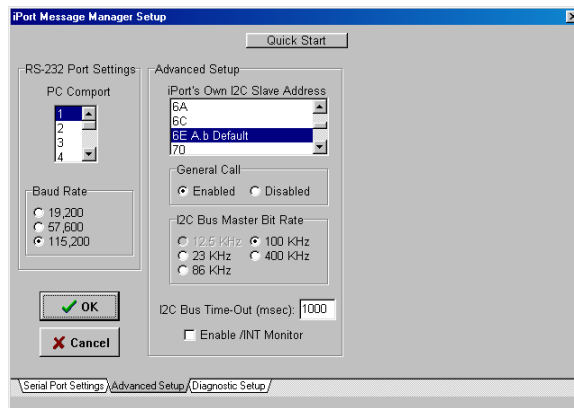
#### 5.1.3.1 Basic Setup

Use the “RS-232 Port Settings” control to select the RS-232 communication port connected to the I<sup>2</sup>C adapter. Message Manager supports USB and network connected local or remote RS-232 ports via the Windows Com driver.

Select from the list of available baud rates. Then click OK.

After a few moments, the Communication Events window on the Main Application screen should report “I<sup>2</sup>C Open Successful.”

If open is not successful, follow the on-screen instructions. Make sure the communications port is working, is enabled in the Windows Device Manager, and is not being used by other software. Additional communication port open information is available in the log file. See Diagnostic Setup options.



Advanced Set Up Screen

### 5.1.3.2 Advanced Setup

On the Advanced Setup screen you can set the following parameters:

#### Adapter's Own I<sup>2</sup>C Slave Address

Select the I<sup>2</sup>C adapter's own slave address. The adapter will acknowledge messages sent to this slave address. The default address is 0x6E.

#### General Call Enable

General Call Enable allows the I<sup>2</sup>C adapter to respond as a slave receiver to the I<sup>2</sup>C General Call Address (0x00). General Call is used by a master to broadcast an I<sup>2</sup>C message to multiple devices. The default value is enabled.

#### I<sup>2</sup>C Bus Master Bit Rate

Select I<sup>2</sup>C Bus speed during master operations. 100kHz is standard mode. 400kHz is fast mode. Available rates are I<sup>2</sup>C adapter dependant.

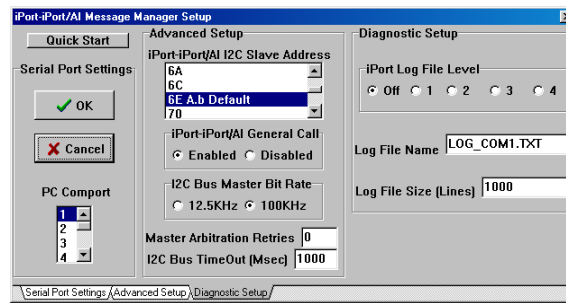
#### I<sup>2</sup>C Bus Time-Out

Specify how long the I<sup>2</sup>C adapter will wait before reporting an I<sup>2</sup>C Bus intra-byte time-out (0 = no time-out, 1 to 32767 milliseconds, iPort/AI fixed at 1 second).

#### Enable INT Signal Monitor (on supported adapters)

Enables monitoring of the INT signal state. INT state changes are reported in the

main screen Communications Events window.



Diagnostic Set Up Screen

### 5.1.3.3 Diagnostic Setup (on supported adapters)

On the Diagnostic Set-up screen you can set the following parameters:

#### Log File Level

A log file is available to troubleshoot RS-232 communication problems with the selected communication port. The log file is an ASCII text file viewable with any text editor. Select logging level. Level 1 provides minimum information. Level 4 provides maximum information.

#### Log File Name

Specify a log file name. Unless a path is specified, the log file will be created in the current working directory.

#### Log File Size

Specify log file length in lines. The log file overwrites earlier entries upon reaching the specified number on lines.

## 5.1.4 Sending I<sup>2</sup>C Messages

### 5.1.4.1 Master Operations

#### 5.1.4.1.1 Specifying the Destination Address

The Destination Address is the I<sup>2</sup>C slave address of the slave device being addressed on the bus. All slave addresses are displayed as even numbers (00...FE), representing the 7 most significant bits of the 8-bit slave address transmitted on the bus (aaaa aaa0).

The I<sup>2</sup>C adapter automatically supplies the 8<sup>th</sup>, least significant, Read/Write bit when it sends the slave address across the bus. For master write operations, the Read/Write bit is always transmitted as a logical 0 (aaaa aaa0). For master read operations, the Read/Write bit is always transmitted as a logical 1 (aaaa aaa1).

On the main screen, use the I<sup>2</sup>C Destination Address list control to set the slave address of the slave device you want to address on the bus.

#### 5.1.4.1.2 Repeated Start Messages

I<sup>2</sup>C Bus communications support an operation called Repeated Start. In this operation, a message is sent across the bus beginning with a Start Condition, but without a Stop Condition at the end of the message. The next message sent across the bus begins with a Start Condition, in this case a Repeated Start.

An I<sup>2</sup>C Bus master, that successfully sends a message on the bus, owns the bus until that master sends a message with a terminating Stop Condition. The Repeated Start operation allows the bus master to retain control of the bus while sending one or more messages on the bus. This prevents other bus masters, in a multi-master system, from accessing the bus and interfering with message sequences.

The Message Manager supports Repeated Starts with the doStop checkbox. Sending an I<sup>2</sup>C message with doStop checked will cause the message to be terminated with a Stop Condition. Sending an I<sup>2</sup>C message with doStop unchecked will cause the message to end without a Stop Condition, allowing the next message to be sent with a Repeated Start.



### 5.1.4.1.3 Auto Repeat

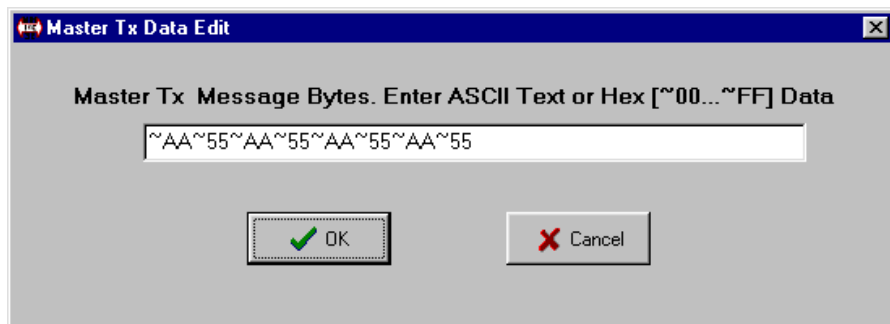
The situation often arises, where you would like to automatically repeat a master message operation.

The Message Manager supports auto-repeat with the Auto Repeat checkbox. You can automatically repeat a master operation by checking the Auto Repeat control before clicking the Master Tx, Master Rx, or Master TxRx buttons. The master operation repeats until the Auto Repeat control is unchecked.

### 5.1.4.1.4 Master Transmitting Data

#### Specifying Master Tx Message Bytes

Master Tx Message Bytes is the ASCII or Hexadecimal data you want to transmit to a slave receiver device. With the Message Manager, entering master transmit data is easy. On the main application screen, click on the Master Tx Message Bytes box to open the data editor.



In the data editor, enter one or more ASCII text characters or hexadecimal data bytes. Each hexadecimal byte is entered as two ASCII-Hex characters (00 to FF) preceded by a tilde (~) character. ASCII text and hex data can be intermixed, as long as each hex byte is preceded by a tilde.

For example, to enter hex data bytes 0x00, 0x01, and 0x02, enter the characters ~00~01~02 into the text box.

Each iPort Message Manager I<sup>2</sup>C message can include up to 80 bytes of 8-bit ASCII binary data.

**NOTE:** The data you send may have special meaning to the receiving slave device, but to the Message Manager, and the I<sup>2</sup>C adapter, message data has no special meaning. Consult your slave device's data sheet for details.

Click OK to accept the data.

## Sending Master Transmit Messages

Click the Master Tx button to write the specified Master Tx Data Bytes to the selected destination slave device. If Auto Repeat is checked, the message will automatically repeat upon completion.

The Communications Events window on the main screen should report “Master Tx Complete.” If this message does not appear, check the slave device address, connections, and power.

If you get a “Slave Not Acknowledging” message in the Communications Events window, this could mean you have the wrong address in the I<sup>2</sup>C Destination Address, or the device is not answering to its address. Consult your slave device’s data sheet for details.

### 5.1.4.1.5 Master Receive Data

#### Specifying Data to Read

On the lower part of the main screen, set the Bytes to MasterRx edit box to the number of bytes you want to read. For example: Set this to 1 to read a single byte. Click on the MasterRx button to read the data from the selected slave device.

Data received from the slave is displayed in the Received Messages text box on the main screen. The Communications Events window should report “Master Rx Transfer Complete.” If this message does not appear, check the slave device address, connections, and power.

If you get a “Slave Not Acknowledging” message in the Communications Events window, this could mean you have the wrong address in the I<sup>2</sup>C Destination Address, or the device is not answering to its address. Consult your slave device’s data sheet for details.

## Negative Acknowledge Last Byte

On supported adapters, the doNak checkbox gives you the option to acknowledge, or negatively acknowledge, the last byte read from a slave device. Some Slave Transmitter Devices require a negative acknowledgment on the final byte read from the slave device. I<sup>2</sup>C adapters not supporting this option automatically negatively acknowledge the last byte read.

### 5.1.4.1.6 Master Transmit and Receive

The Master TxRx button send a master write message with no Stop Condition, immediately followed by a Repeated Start master read message with Stop.

### 5.1.4.2 Slave Operations

In addition to performing I<sup>2</sup>C Bus master operations, the Message Manager can also perform I<sup>2</sup>C bus slave transmit and receive operations.

#### 5.1.4.2.1 Slave Transmit Data

Slave transmit data is entered in the Slave Tx Message Bytes text box control on the main screen. Data in this text box is automatically sent to a requesting master upon receiving a slave transmit request.

Like Master Transmit data, Slave Transmit data is entered with the data editor. To enter data to be transmitted, click on the Slave Tx Message Bytes text box to open the data editor. See “Specifying Master Tx Message Bytes” section for data entry details.

#### 5.1.4.2.2 Slave Receive Data

Data bytes received from a Master Transmitter are automatically displayed in the main application screen Received Message window. Received data is displayed in ASCII printable, or hexadecimal (~00 to ~FF) formats. Use the Hex-Display checkbox to force ASCII printable data to display in hexadecimal format .

## 6 Uninstalling iPort Utility Pack

To uninstall the iPort Utility Pack for Windows software, use the Windows Control Panel “Programs and Features” (formerly “Add or Remove Programs”) utility. Note that uninstalling the iPort Utility Pack for Windows software does not uninstall any device or driver software.

# Part 3

## Programmer's Reference

### ASCII Command Interface Definitions

# Programmer's Quick Start

Creating a custom iPort/AFM 2 program is easier if you know what to expect. Follow these steps to manually control the iPort/AFM 2 from your computer's keyboard and screen.

- 1 Install the iPort/AFM 2 as directed in the "Hardware Set-Up" section of this User's Guide.
- 2 Use a terminal emulator program, like Windows' Hyperterminal, to start communicating with the I<sup>2</sup>C adapter. Remember to select the correct Com Port (COM1, COM2,...) and set the communication parameters to 19200 Baud, 8 Data Bits, No Parity, and 1 Stop Bit.
- 3 Enter `//[CR]` to get an iPort/AFM 2 Status Report. Note: All iPort/AFM 2 commands are terminated with a Carriage Return (`[CR]`) character. On most terminal emulators, press the Enter key.
- 4 Enter `/F0[CR]` (XON/XOFF) or `/F1[CR]` (RTS/CTS) to set iPort/AFM 2's communications Flow Control to match your terminal.
- 5 Enter `/Ixx[CR]` (xx = 02...FE even) to set iPort/AFM 2's Own I<sup>2</sup>C Slave Address.
- 6 Enter `/O[CR]` to Open the iPort/AFM 2 Connection. The iPort/AFM 2 does not need to be connected to an I<sup>2</sup>C Bus to open a connection.
- 7 Enter `/Dxx[CR]` (xx = 00...FE even) to select a Destination I<sup>2</sup>C Slave Address
- 8 Enter `/Ttext[CR]` (text = ASCII or Hex-Equivalent ~00...~FF) to Master Transmit a message to the current Destination I<sup>2</sup>C Slave device
- 9 Enter `/Rn[CR]` (n = 0...32767) to Master Read a message from the current Destination I<sup>2</sup>C Slave device.

**Note: For more advanced programming support, see our MS.NET Class Library and LabVIEW VI Library available online at: [www.mcc-us.com](http://www.mcc-us.com)**

## iPort/AFM 2 ASCII Command Interface

Note: [CR] = Carriage Return Code or Enter Key.  
Syntax: [Select], (Optional), xx = [00..FE], n = [0..32767]

Command	Description
Ctrl/R, Ctrl/R, Ctrl/R	<b>iPort/AFM 2 Reset</b> This command resets the iPort/AFM 2 to its default state.
//[CR]	<b>Status Display</b> Display iPort/AFM 2 status information.
/B[0 1 2][CR]	<b>RS-232 Baud Rate Control</b> Set the RS-232 Baud rate (0 = 19.2, 1 = 57.6, 2 = 115.2 Baud)
/C[CR]	<b>Close I<sup>2</sup>C Connection</b> Disconnect from the I <sup>2</sup> C Bus.
/Dxx[CR]	<b>Set Destination I<sup>2</sup>C Slave Address</b> Set the destination I <sup>2</sup> C Slave Address for subsequent Master Transmit or Receive operations.
/E[0 1][CR]	<b>Echo/Prompt Control [0 = Off, 1 = On]</b> Enable/Disable data entry echo and prompts.
/F[0 1][CR]	<b>Flow Control [0 = XON/XOFF, 1 = RTS/CTS]</b> Select RS-232 communication handshaking protocol.
/G[0 1][CR]	<b>I<sup>2</sup>C General Call Control [0 = Disabled, 1 = Enabled]</b> Enables/Disables iPort/AFM 2 response to I <sup>2</sup> C Bus General Call (00) messages.
/H[0 1][CR]	<b>Hex Only Display Control [0 = Disabled, 1 = Enabled]</b> Controls display format of received message data.
/Ixx[CR]	<b>Set iPort/AFM 2's Own I<sup>2</sup>C Slave Address</b> Sets iPort/AFM 2's own I <sup>2</sup> C Slave Address. iPort/AFM 2 will respond to I <sup>2</sup> C Bus messages sent to this address.
/K[0 1 2 3][CR]	<b>I<sup>2</sup>C Bus Clock Rate Control</b> Set I2C Bus Clock Rate Control (0=23, 1=86, 2=100, 3=400 KHz)
/M[CR]	<b>Command Menu Display</b> Displays iPort/AFM 2's Command Menu
/N([0 1 A R])[CR]	<b>iNterrupt Signal Monitor/Control/Status</b> Sets Monitor/Control/Status of INT line. [0 = Disable, 1 = Enable, A = Assert, R = Release, CR=Status]
/O[CR]	<b>Open I<sup>2</sup>C Connection</b> Activates iPort/AFM 2 as an I <sup>2</sup> C device attached to the bus.
/(*)Rnnnn[CR]	<b>Master Read Message</b> Read the specified number of data bytes from the current Destination I <sup>2</sup> C Slave device. * = No Stop for Repeated Start.

/Stext[CR]	<b>Slave Transmit Message</b> Write the specified data bytes to a requesting I <sup>2</sup> C Master Receiver device.
/(*)Ttext[CR]	<b>Master Transmit Message</b> Master Transmit the specified data bytes to the current Destination I <sup>2</sup> C Slave device. * = No Stop for Repeated Start.
/Un[CR]	<b>I<sup>2</sup>C Bus Time-oUt</b> Set I <sup>2</sup> C Bus Time-oUt in msec (0=Disable)
/V[CR]	<b>Display Firmware Version</b> (Major XX.XX Minor) (Requires Firmware V2.0 or later)
/X[CR]	<b>eXtended Commands</b> (See Prompt or User's Guide) (Requires Firmware V2.0 or later)
/(*)Y[CR]	<b>Display Tx bYte Count</b> Display number of data bytes last sent to slave device (Requires iPort/AFM Firmware v2.0+, iPort/AI 2, iPort/AFM 2, iPort/USB, i2cStick, iPort/USB 2). *= Also display last received Ack bit received from slave device (Requires iPort/AI 2, iPort/AFM 2, i2cStick, iPort/USB 2).

## Synchronous Interface Events

Synchronous Events are those iPort/AFM 2 interface activities initiated by the Host computer.

### iPort/AFM 2 Reset

Reset iPort/AFM 2 to its default state.

The reset command consists of three (3) sequential Ctrl/R characters. Ctrl/R is the character code Decimal 18 and Hexadecimal 0x12. When using a terminal emulator program, you can generate a Ctrl/R by holding down the Ctrl key and pressing the R key.

Note: It is recommended that the Host computer turn off all serial port flow control before sending this command to override any flow control from the I<sup>2</sup>C adapter that could block the transmission. Flow control should be enabled once the response is received.

Command: Ctrl/R,Ctrl/R,Ctrl/R 'iPort Reset  
Response: \* 'Ready  
Default Setting: None



## Status Display

Display iPort/AFM 2 status.

Command: `//[CR]` 'Status Display

Response: (as follows)

iPort/AFM2 I<sup>2</sup>C Host Adapter w/ASCII Fast Mode Interface Vxx.xx  
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Visit our Web Site at: <http://www.mcc-us.com>

RS-232 Baud Rate (19.2kHz)  
Destination I<sup>2</sup>C Slave Address (xxH)  
Echo/Prompt (Disabled)  
Flow Control (XON/XOFF)  
Hex Only Display (Enabled)  
I<sup>2</sup>C Connection (Closed)  
General Call (Enabled)  
iPort's own Slave Address (xxH)  
I2C Bus Clock Rate (100kHz)  
iNterrupt Signal (Released)  
I2C Bus Time-oUt (10000 msec)

## RS-232 Baud Rate

This command sets the RS-232 Baud Rate. (0=19.2k, 1=57.6k, 2= 115.2k)

Command: `/B[0|1|2][CR]` 'Set RS-232 Baud Rate  
Response 1: `/BC0[CR]` 'Baud Change Complete  
Response 2: `/BC1[CR]` 'Baud Change Complete  
Response 3: `/BC2[CR]` 'Baud Change Complete  
Response 3: `/I89[CR]` 'Invalid Command Argument

Default Setting: `/B0[CR]`

## Close I<sup>2</sup>C Connection

Disconnect iPort/AFM 2 from the I<sup>2</sup>C Bus.

Command: `/C[CR]` 'Close I<sup>2</sup>C Connection  
Response: `/CCC[CR]` 'Close Connection Complete

Default Setting: 'Closed

## Set Destination I<sup>2</sup>C Slave Address

Set the destination I<sup>2</sup>C Slave Address (Hex 0,2...FE) for all subsequent Master Transmit or Receive operation.

Command: /Dxx[CR] 'Set Destination I<sup>2</sup>C Slave Address  
Response 1: \* 'iPort/AFM 2 Ready  
Response 2: /I89[CR] 'Invalid Command Argument  
Default Setting: 00

## Echo/Prompt Control

This command enables or disables data entry echo and prompts used as feedback to manual operations from a computer terminal.

Command: /E[0|1][CR] 'Echo/Prompt Control [0 = Off, 1 = On]  
Response: \* 'iPort/AFM 2 Ready  
Default Setting: Off

## RS-232 Flow Control

Select the serial communication handshaking protocol to be use in communicating with the Host computer.

iPort/AFM 2 implements either XON/XOFF (by default) or RTS/CTS flow control protocols. Flow control is used by the iPort/AFM 2 to limit character flow to and from the Host computer to avoid overflowing internal communication buffers and lost data.

The XON/XOFF protocol inserts characters directly into the ASCII data stream. XON (Hexadecimal 0x11) is used to enable the flow of data. XOFF (Hexadecimal 0x13) is used to stop the flow of data.

The RTS/CTS protocol uses two additional wires in the cable connecting communicating devices. The RTS wire is an output signal. It indicates that the device generating the signal has buffer space available, and can receive data. The CTS wire is an input signal. It indicates that the other device has buffer space available, and can receive.

In general, XON/XOFF requires a minimal three-wire connection, Ground, Transmit Data, and Receive Data. This protocol does insert control characters into the stream of data, and may not be appropriate for all Host systems. If supported, these control characters are normally automatically stripped out of the data stream by Host communication driver software, and are not visible at the application program level.

The RTS/CTS protocol requires a serial port, cabling, and Host communication driver software that supports the additional control signals.

Command:        /F[0|1][CR] 'Flow Control [0 = XON/XOFF, 1 = RTS/CTS]  
Response:       \*               'iPort/AFM 2 Ready  
Default Setting: XON/XOFF

### **I<sup>2</sup>C General Call Control**

Enables or disables iPort/AFM 2 response to I<sup>2</sup>C Bus General Call (Address x00) messages.

Command:        /G[0|1][CR] 'I<sup>2</sup>C General Call [0 = Disabled, 1 = Enabled]  
Response:       \*               'iPort/AFM 2 Ready  
Default Setting: Enabled

### **Hex Only Display Control**

Controls Hex Only (~00...~FF) output of Master or Slave received data.

When enabled, all received I<sup>2</sup>C message data bytes are displayed in Hex (~00...~FF) format. When disabled, received I<sup>2</sup>C message data bytes representing ASCII printable characters (x20...x7F) are displayed as their ASCII printable character. Non-ASCII printable data bytes are always displayed in Hex (~00...~FF) form.

Command:        /H[0|1][CR] 'Hex Only Display [0 = Disabled, 1 = Enabled]  
Response:       \*               'iPort/AFM 2 Ready  
Default Setting: Enabled

## Set iPort/AFM 2's Own I<sup>2</sup>C Slave Address

Sets iPort/AFM 2's own I<sup>2</sup>C Slave Address (Hex 2...FE). Subsequent I<sup>2</sup>C messages to this address will cause iPort/AFM 2 to become an active Slave device on the bus.

Command:        /ixx[CR]   'Set iPort/AFM 2's Own I<sup>2</sup>C Slave Address  
Response 1:     \*           'iPort/AFM 2 Ready  
Response 2:     /I89[CR]   'Invalid Command Argument  
Default Setting: 6E

## I<sup>2</sup>C Bus Clock Rate Control

Set the I<sup>2</sup>C Bus master clock rate. (0=23, 1=86, 2=100, 3=400 KHz)

Command:        /K[0|1|2|3][CR] 'Set iPort/AFM 2's Clock Rate  
Response 1:     \*           'iPort/AFM 2 Ready  
Default Setting: /K2[CR]

The iPort/AFM 2 I<sup>2</sup>C Bus master clock rate is controlled by the frequency of the oscillator used in the adapter. The oscillator frequency has been selected to give accurate RS-232 baud rates, as the RS-232 baud rate must exactly match the rate used by the host computer. Actual master I<sup>2</sup>C clock rates are close to, but not faster than, the stated rates. Slave I<sup>2</sup>C clock rates are driven by the external master device, with possible clock-stretching as required to store or retrieve message data.

## Command Menu Display

Display iPort/AFM 2's command menu.

Command:        /M[CR]   'Command Menu Display  
Response:       (as follows)

iPort/AFM 2 Command Menu Syntax: [Select], (Optional), xx=[00..FE],  
n=[1..32767]

//                Status Display  
/B[0|1|2]        RS-232 Baud Rate Control (0=19.2, 1=57.6, 2=115.2KHz)  
/C                Close I2C Connection  
/Dxx             Set Destination I2C Slave Address  
/E[0|1]          Echo/Prompt Control (0=Disable, 1=Enable)

/F[0 1]	Flow Control (0=XON/XOFF, 1=RTS/CTS)
/G[0 1]	General Call Control (0=Disable, 1=Enable)
/H[0 1]	Hex Only Display Control (0=Disable, 1=Enable)
/Ixx	Set iPort/AFM 2's Own I2C Slave Address
/K[0 1 2 3]	I2C Bus Clock Rate Control (0=23, 1=86, 2=100, 3=400 KHz)
/M	Menu Display
/N([0 1 A R])	iNterrupt Signal Monitor/Control/Status (0=Disable, 1=Enable / A=Assert, R=Release / <CR>=Status)
/O	Open I2C Connection
/(*)Rn	Master Rx Message *=No Stop
/S(text)	Slave Tx Message
/(*)T(text)	Master Tx Message *=No Stop
/Un	Set I2C Bus Time-out in msec 0=Disable)
/V	Display Firmware Version (Major XX.XX Minor)
/X[...]....	Extended Cmds (See Prompt or User's Guide)
/(*)Y	Display Tx bYte Count *with Last Rx Ack Bit

## Interrupt Signal Control/Status

The INT signal allows the iPort/AFM 2 to participate in INT master and/or slave communications.

	Control	
Command:	/N0[CR]	'Disable Monitor
	/N1[CR]	'Enable Monitor
	/NA[CR]	'Assert INT Signal
	/NR[CR]	'Release INT Signal

	Status	
Command:	/N[CR]	'Get Status
Response:	/NSA	'INT Asserted
	/NSR	'INT Released

Response: \* 'iPort/AFM 2 Ready  
 Default Setting: /N0, /NR

## Open I<sup>2</sup>C Connection

Activates iPort/AFM 2 as an active device on the I<sup>2</sup>C Bus.

Command: /O[CR] 'Open I<sup>2</sup>C Connection

Response: /OCC[CR] 'Open Connection Complete  
Default Setting: Closed

## Master Read Message

This command causes iPort/AFM 2 to read the specified number of data bytes from the currently selected Destination I<sup>2</sup>C Slave Address with or without generating an I<sup>2</sup>C Stop condition after the last byte is received.

Enter Byte Count (Decimal 0...32767) then Press Enter, or ESCape to Cancel. A Byte Count of Zero (0) represents a Variable Length message, where the first byte read from the I<sup>2</sup>C Slave device indicates the number of additional trailing bytes that are available to read. The iPort/AFM 2 automatically reads the first byte, then the additional bytes as specified by the first byte. All message bytes including the Length byte are returned to the Host computer.

The received text is a representation of the data bytes within the Master Receive message. The format of this data is controlled by the current setting of the Hex Only Display Control .

If the slave device acknowledges its I<sup>2</sup>C Slave Address, the specified number of bytes are read. The iPort/AFM 2 acknowledges all bytes read except the last. If not disabled, the message is then terminated with an I<sup>2</sup>C Stop condition.

Sending Master Receive messages with No Stop allows the Master to retain exclusive control of the I<sup>2</sup>C Bus until it finally sends a Stop. During this time, the Master can send additional (Repeated Start) Master Transmit or Master Receive messages to the same or other I<sup>2</sup>C Slave devices.

Command: /(\*)Rnnnn[CR] 'Master Read Message (\* = No Stop)

Response 1: /MRCtext[CR] 'Master Read Complete  
Response 2: /SNA[CR] 'Slave Not Acknowledging  
Response 3: /I81[CR] 'iPort/AFM 2 is Busy, Command Ignored  
Response 4: /I83[CR] 'I<sup>2</sup>C Arbitration Loss Detected  
Response 5: /I88[CR] 'iPort Connection Not Open  
Response 6: /I89[CR] 'Invalid Command Argument  
Default Setting: None

## Slave Transmit Message

This command should be issued to iPort/AFM 2 in response to a Slave Transmit Request (/STR). This command causes iPort/AFM 2 to write the specified data bytes to the requesting I<sup>2</sup>C Master Receiver device.

Enter Message Bytes (1 or more Printable ASCII or Hex-equivalent ~00..~FF), then Press Enter, or ESCape to Cancel.

Note 1: Upon receiving a Slave Transmit request from a Master Receiver device on the I<sup>2</sup>C Bus, the iPort/AFM 2 outputs a Slave Transmit Request to its Host device, and initiates an I<sup>2</sup>C Clock Stretch (SCL Low) until a Slave Transmit command is received from the Host computer. While clock stretching, no other messages can be transmitted on the I<sup>2</sup>C Bus.

Note 2: The tilde (~) character and the Carriage Return (CR) characters are used as special marker characters within all iPort/AFM 2 RS-232 transmitted text messages. These characters may not be used within the text of a message, but must be replaced by the following "Hex equivalent" characters:

Tilde replaced by "~7E"

Carriage Return replaced by "~0D"

iPort/AFM 2 automatically translates "Hex equivalent" characters to their single-byte value for transmission across the I<sup>2</sup>C Bus.

All entered data bytes are transmitted to the requesting Master Receiver device. Slave Transmit stops upon receiving the first negative acknowledgment (Nack) from the Master Receiver.

Command:	/Stext[CR]	'Slave Transmit Message
Response 1:	/STC[CR]	'Slave Transmit Complete
Response 2:	/I88[CR]	'iPort Connection Not Open
Response 3:	/I8A[CR]	'Slave Transmit Request Not Active, Cmd Ignored
Default Setting:	None	

Examples:

/Sabcd1234[CR] 'ASCII Printable characters "abcd1234"

/S~00~01~02[CR] 'Binary data bytes 00, 01,02

/Sab~7Ecd[CR] 'Tilde embedded in ASCII Printable characters

/S12~0D24[CR] 'Carriage Return embedded in ASCII Printable characters

## Master Transmit Message

Write the specified data bytes to the currently selected Destination I<sup>2</sup>C Slave Address with or without generating an I<sup>2</sup>C Stop condition after the last byte is transmitted.

Enter Message Bytes (0 or more Printable ASCII or Hex-equivalent ~00..~FF), then Press Enter, ESCape to Cancel.

Note: The tilde (~) character and the Carriage Return (CR) characters are used as special marker characters within all iPort/AFM 2 RS-232 transmitted text messages. These characters may not be used within the text of a message, but must be replaced by the following "Hex-equivalent" characters:

Tilde replaced by "~7E"

Carriage Return replaced by "~0D"

iPort/AFM 2 automatically translates "Hex equivalent" characters to their single-byte value for transmission across the I<sup>2</sup>C Bus.

All entered data bytes are transmitted to the Destination I<sup>2</sup>C Slave Receiver device. Master Transmit stops upon receiving the first negative acknowledgment (Nack) from the Slave Receiver. If not disabled, the message is then terminated with an I<sup>2</sup>C Stop condition.

Sending Master Transmit messages with No Stop allows the Master to retain exclusive control of the I<sup>2</sup>C Bus until it finally sends a Stop. During this time, the Master can send additional (Repeated Start) Master Transmit or Master Receive messages to the same or other I<sup>2</sup>C Slave devices.

Command:	/(*)Ttext[CR]	'Master Transmit Message (* = No Stop)
Response 1:	/MTC[CR]	'Master Transmit Complete
Response 2:	/SNA[CR]	'Slave Not Acknowledging
Response 3:	/I81[CR]	'iPort/AFM 2 is Busy, Command Ignored
Response 4:	/I83[CR]	' I <sup>2</sup> C Arbitration Loss Detected
Response 5:	/I88[CR]	'iPort Connection Not Open
Default Setting:	None	

Examples:



/Tabcd1234[CR] 'ASCII Printable characters "abcd1234"  
 /T~00~01~02[CR] 'Binary data bytes 00, 01,02  
 /\*T~00~01~02[CR] 'Binary data bytes 00, 01,02 with No Stop  
 /Tab~7Ecd[CR] 'Tilde embedded in ASCII Printable characters  
 /T12~0D24[CR] 'Carriage Return embedded in ASCII Printable characters

## Set I<sup>2</sup>C Bus Time-out in msec

Set bus time-out in milliseconds.

The iPort/AFM 2 reports a bus time-out if no intra-byte bus activity for the specified time occurs within an I<sup>2</sup>C Bus message.

Command: /Unnnn[CR] 'I<sup>2</sup>C Bus time-out (nnnn = 0 (disable)...32000 msec)  
 Response: \* 'iPort/AFM 2 Ready  
 Default Setting: 10000 'msec (10 seconds)

## Display Firmware Version (requires firmware V2.00+)

Display firmware version

Command: /V[CR] 'Get Firmware Version  
 Response: /VCCXX.XX[CR] '(Major XX.XX Minor)

## eXtended Commands (requires firmware V2.00+)

The eXtended commands are used to generate "out-of-spec" signaling. eXtended commands cannot use the adapter's I<sup>2</sup>C hardware to control the SCL and SDA lines, as the I<sup>2</sup>C hardware only generates I<sup>2</sup>C compatible signals. The eXtended commands use firmware to "bit-bang" the SCL and SDA lines. This firmware cannot operate as fast as the hardware, and it can be interrupted at any time by adapter internal interrupts. The eXtended commands run directly off the command characters as they are received on the RS-232 link. Speed of execution of eXtended commands is controlled by the RS-232 baud rate, the execution speed of the firmware, delays caused by execution interruptions that may occur while a command is executing, and I<sup>2</sup>C Bus clock-stretching by external slave devices.

The following commands manipulate the I<sup>2</sup>C Clock (SCL) and data (SDA) lines.

Command: /X[S|~xx|R|r|P|0|1|?|D|d|C|c|L|A| |"...], then Press Enter or ESCape  
Enter /X followed by zero or more sub-commands, the [CR]

Response: /XCC(see commands below)[CR]

High Level Sub-Commands:

S = Send Start  
~xx = Send Byte (xx = 00...FF)(response = A or N)  
R = Read Byte with Ack (response = ~xx)  
r = Read Byte with Nak (response = ~xx)  
P = Send Stop

Mid Level Sub-Commands:

0 = Send 0 Bit  
1 = Send 1 Bit  
? = Read Bit (response = 0 or 1)

Low Level Sub-Commands:

D = Set SDA High  
d = Set SDA Low  
C = Set SCL High  
c = Set SCL Low  
L = Read SCL (response = 0 or 1)  
A = Read SDA (response = 0 or 1)

Miscellaneous Sub-Commands:

space = no action  
"comment" = no action

Examples:

*Master transmit three bytes to slave address 0x4e using high level, mid level, and low level sub-commands.*

High Level Command: /X S ~4e ~01 ~02 ~03 P [CR]  
High Level Response: /XCCAAAA[CR]

Mid Level Command: /X S 01001110 ? 00000001 ? 00000010 ? 00000011 ? P [CR]  
Mid Level Response: /XCC0000[CR]

Low Level Command: /X dc dCcDCcdCcdCcDCcDCcDCcdCc DCAc  
dCcdCcdCcdCcdCcdCcdCcDCc DCAcdCcdCcdCcdCcdCcdCcDCcdCc DCAc  
dCcdCcdCcdCcdCcdCcdCcDCc DCAc dCD[CR]  
Low Level Response: /XCC0000[CR]

*Master read three bytes from slave address 0x4F. First two bytes are acknowledged by master.*

Command: /X S ~4f Rrr P [CR]  
Response: /XCCA~xx~xx~xx[CR] '(xx = 00...FF)

*Master transmit a Write WCR command to a Xicor X9241 at slave address 0x50. WCR data is 0x00.*

Command: /X S ~50 ~a0 ~00 P [CR]  
Response: /XCCAAA[CR]

*Master transmit a Write WCR command to a Xicor X9241 at slave address 0x50. WCR data is 0x3f.*

Command: /X S ~50 ~a0 ~3f P [CR]  
Response: /XCCAAA[CR]

*Issue a Read WCR command to a Xicor X9241 at slave address 0x50.*

Command: /X S ~50 ~90 ~R P [CR]  
Response: /XCCAA~xx[CR] '(xx = 00...FF)

*Issue an Increment Wiper command to a Xicor X9241 at slave address 0x50.*

Command: /X S ~50 ~20 1 P [CR]  
Response: /XCCAA[CR]

*Issue an Decrement Wiper command to a Xicor X9241 at slave address 0x50.*

Command: /X S ~50 ~20 0 P [CR]

Response: /XCCAA[CR]

## **Display Tx bYte Count** (requires firmware V2.00+)

Returns the number of bytes received by the slave device in the last master transmit message, with an option to receive the state of the last received Acknowledgment bit

Note: The byte count and last received acknowledgment bit state can be used for SMBus Packet Error Check (PEC) error detection. See SMBus v1.1+ specification for details.

Command:	/(*)Y[CR]	'Tx bYte Count (* = with last received Ack bit)
Response:	/TBCn[CR]	'n =00000...32767
Response:	/TBCn(A N)[CR]	'n =00000...32767, A = ACK, N = NACK)

## Asynchronous Interface Events

Asynchronous Events are those iPort/AFM 2 interface activities initiated by the iPort/AFM 2 I<sup>2</sup>C Host Adapter in response to activities on the I<sup>2</sup>C Bus.

### Slave Transmit Request

This event is caused by the reception of an I<sup>2</sup>C Bus Slave Transmit message directed at the current iPort/AFM 2's own Slave address.

Prompt: /STR[CR] 'Slave Transmit Request

Command: /Stext[CR] 'Slave Transmit Text

The normal Host computer response is to send a Slave Transmit (/Stext[CR]) command.

Note: Upon receiving a Slave Transmit request from a Master Receiver device on the I<sup>2</sup>C Bus, iPort/AFM 2 outputs a Slave Transmit Request to its Host device, and initiates an I<sup>2</sup>C Clock Stretch (SCL Low) until a Slave Transmit Text command is received from the Host computer. While clock stretching, no other messages can be transmitted on the I<sup>2</sup>C Bus.

### Slave Receive Complete

This event is caused by the reception of an I<sup>2</sup>C Bus Slave Receive message directed at the current iPort/AFM 2's own Slave address.

The received text is a representation of the data bytes within the Slave Receive message. The format of this data is controlled by the current setting of the Hex Only Display Control .

Prompt: /SRCtext[CR] 'Slave Receive Complete

Command: None Required

### General Call Receive Complete

This event is caused by the reception of an I<sup>2</sup>C Bus Slave Receive message directed at the I<sup>2</sup>C General Call Address (00), when iPort/AFM 2's General Call recognition is enabled.

The received text is a representation of the data bytes within the Slave Receive message. The format of this data is controlled by the current setting of the Hex Only Display Control .

Prompt: /GRCtext[CR] 'General Call Receive Complete  
Command: None Required

### **iPort/AFM 2 Ready**

Prompt: \* 'iPort/AFM 2 Ready

Cause: iPort/AFM 2 is ready for the next Host command.

### **Slave Not Acknowledging**

Prompt: /SNA[CR] 'Slave Not Acknowledging

Cause: There is no response (I<sup>2</sup>C Slave Address Acknowledgment) during a Master Transmit or Receive operation from an I<sup>2</sup>C Slave device at the current Destination I<sup>2</sup>C Address.

### **iPort/AFM 2 Busy**

Prompt: /I81[CR] 'iPort/AFM 2 Busy

Cause: The host computer attempted a Master operation while iPort/AFM 2 was busy. The host computer should wait for any previously issued command to complete, process any pending slave events, and retry the last command.

### **I<sup>2</sup>C Bus Arbitration Loss**

Prompt: /I83[CR] 'I<sup>2</sup>C Arbitration Loss Detected

Cause: iPort/AFM 2 lost I<sup>2</sup>C Bus Arbitration to another bus master device while Master Transmitting or Master Receiving an I<sup>2</sup>C message. Host should process any active slave events and repeat the last command.

### **I<sup>2</sup>C Bus Error Detected**

Prompt: /I84[CR] 'I<sup>2</sup>C Bus Error Detected

Cause: iPort/AFM 2 has detected an error condition on the I<sup>2</sup>C Bus. The host computer should retry the last command or issue an iPort/AFM 2 Reset command.

### **I<sup>2</sup>C Bus Time-out Detected**

Prompt: /I85[CR] 'I<sup>2</sup>C Bus Time-out Detected

Cause: iPort/AFM 2 issues this response when it detects a byte transfer delay greater than the specified I<sup>2</sup>C Bus Time-out period. No corrective action is taken by the iPort/AFM 2 regarding I<sup>2</sup>C Bus activity. No host computer response is required, but this event can be used to detect possible bus problems.

### **iPort/AFM 2 Connection Closed**

Prompt: /I88[CR] 'iPort/AFM 2 Connection is Closed.

Cause: The host computer is attempting to perform an I<sup>2</sup>C Bus message operation while the iPort/AFM 2 Connection is Closed. The host computer should issue an Open I<sup>2</sup>C Connection command before attempting to perform I<sup>2</sup>C Bus message operations.

### **Invalid Command Argument**

Prompt: /I89[CR] 'Invalid Command Argument Detected

Cause: This event normally indicates the value of a host command argument was out of range. The host should reissue command with correct arguments.

### **Slave Transmit Request Not Active**

Prompt: /I8A[CR] 'Slave Transmit Request Not Active

Cause: This event indicates the host attempted to issue a Slave Transmit Text command when no Slave Transmit Request was present.

### **Invalid iPort/AFM 2 Command**

Prompt: /I8F[CR] 'Invalid iPort/AFM 2 Command

Cause: This event normally indicates that an invalid command was issued by the

host. The host should reissue the correct command.

## **iPort/AFM 2 RS-232 Receive Buffer Overflow**

Prompt: /I90[CR] 'iPort/AFM 2 RS-232 Receive Buffer Overflow

**Cause:** This event normally indicates that data sent to the iPort/AFM 2 via the RS-232 serial port has been lost. Check the host computer's RS-232 Serial Port Flow Control (XON/XOFF, or Hardware) to make sure it matches current iPort/AFM 2 Flow Control. Also, check if the host computer's FIFO buffers in its 16550 UART are enabled. If so, reduce or disable Transmit Data Buffering. On Windows-based host computers, see the Device Manager, COM port, Advanced Settings. You may need to power down the host computer for any FIFO change to take effect.



## Example Code

The following examples are written in MS Visual Basic using the serial communications control (MSCOMM.VBX). It can be used as a guide in implementing iPort/AFM 2 interface programs in other programming languages and operating environments.

**Note: For more advanced programming support, see our MS.NET Class Library and LabVIEW VI Library available online at: [www.mcc-us.com](http://www.mcc-us.com)**

### **iPort/AFM 2 Reset**

```
Comm1.Output = Chr$(18) 'Ctrl/R
```

```
Comm1.Output = Chr$(18) 'Ctrl/R
```

```
Comm1.Output = Chr$(18) 'Ctrl/R
```

### **iPort/AFM 2 Initialization**

```
Comm1.Output = "/f0" 'Set iPort/AFM 2 XON/XOFF Flow Control
```

```
Comm1.Output = Chr$(13)
```

```
Comm1.Output = "/i70" 'Set iPort/AFM 2's Own Slave Address
```

```
Comm1.Output = Chr$(13)
```

```
Comm1.Output = "/d4e" 'Set Destination Slave Address
```

```
Comm1.Output = Chr$(13)
```

```
Comm1.Output = "/o" 'Open I2C Connection
```

```
Comm1.Output = Chr$(13)
```

### **Master Transmit Message**

```
Comm1.Output = "/T~00~01" 'Send Master Tx Command
```

```
Comm1.Output = Chr$(13) 'Terminate Command
```

### **Master Receive Message**

```
Comm1.Output = "/R10" 'Send Master Rx Command
```

```
Comm1.Output = Chr$(13) 'Terminate Command
```

## Communication Event Processing

Static Sub Comm1\_OnComm ()

Static LineBuf\$

While Comm1.InBufferCount

Msg\$ = Comm1.Input ' Get Comm input character

CharIn\$ = Msg\$

If Msg\$ = Chr\$(13) Then Msg\$ = "" ' Remove CR

If Msg\$ = Chr\$(10) Then Msg\$ = "" ' Remove LF

If Msg\$ = "\*" Then ' if iPort/AFM 2 Ready

Msg\$ = "\*\*\*\*" ' Substitute Token

CharIn\$ = Chr\$(13) ' Terminate Line

End If

LineBuf\$ = LineBuf\$ + Msg\$ 'Add new text to line buffer

If CharIn\$ = Chr\$(13) Then ' if Carriage Return detected

iPortResp\$ = Left\$(LineBuf\$, 4) 'Isolate Response Code

' Test for iPort/AFM 2 Synchronous Interface Events

If (StrComp(iPortResp\$, "/OCC") = 0) Then

' Open Connection Complete Processing

TextBox.Text = "/OCC Open Connection Complete"

ElseIf (StrComp(iPortResp\$, "/MTC") = 0) Then

' Master Transmit Complete Processing

TextBox.Text = "/MTC Master Tx Complete"

ElseIf (StrComp(iPortResp\$, "/MRC") = 0) Then

' Master Rx Complete Processing

TextBox.Text = LineBuf\$ 'Update Display

ElseIf (StrComp(iPortResp\$, "/STC") = 0) Then

' Slave Tx Complete Processing

TextBox.Text = "/STC Slave Tx Complete"

ElseIf (StrComp(iPortResp\$, "/CCC") = 0) Then

' Close Connection Complete Processing

TextBox.Text = "/CCC Close Connection Complete "

```

ElseIf (StrComp(iPortResp$, "/BC0") = 0) Then
' iPort/AFM 2 Baud Change 0 {19.2K}
  TextBox.Text = "iPort/AFM 2 Baud Change 0 {19.2K} "

ElseIf (StrComp(iPortResp$, "/BC1") = 0) Then
' iPort/AFM 2 Baud Change 1 {57.6K}
  TextBox.Text = "iPort/AFM 2 Baud Change 1 {57.6K} "

ElseIf (StrComp(iPortResp$, "/BC2") = 0) Then
' iPort/AFM 2 Baud Change 2 {115.2K}
  TextBox.Text = "iPort/AFM 2 Baud Change 0 {115.2K} "

' Test for iPort/AFM 2 Asynchronous Interface Events

ElseIf (StrComp(iPortResp$, "/SRC") = 0) Then
' Slave Rx Complete Processing
  TextBox.Text = LineBuf$  'Update Display

ElseIf (StrComp(iPortResp$, "/GRC") = 0) Then
' General Call Rx Complete Processing
  TextBox.Text = LineBuf$  'Update Display

ElseIf (StrComp(iPortResp$, "/STR") = 0) Then
' Slave Tx Request Processing
  Comm1.Output = "/S~00~01" 'Send Slave Tx Msg
  Comm1.Output = Chr$(13) 'Terminate Command
  TextBox.Text = LineBuf$  'Update Display

' Test for iPort/AFM 2 Response Messages

ElseIf (StrComp(iPortResp$, "*****") = 0) Then
  TextBox.Text = "* iPort/AFM 2 Ready" 'Update Display

ElseIf (StrComp(iPortResp$, "/SNA") = 0) Then
  TextBox.Text = "/SNA Slave Not Acknowledging"

ElseIf (StrComp(iPortResp$, "/I81") = 0) Then
  TextBox.Text = "/I81 iPort/AFM 2 Busy" 'Update Display

ElseIf (StrComp(iPortResp$, "/I83") = 0) Then

```

```

    TextBox.Text = "/I83 Arbitration Loss" 'Update Display

ElseIf (StrComp(iPortResp$, "/I84") = 0) Then
    TextBox.Text = "/I84 I2C Bus Error Detected"

ElseIf (StrComp(iPortResp$, "/I85") = 0) Then
    TextBox.Text = "/I85 I2C Bus Time-out Detected"

ElseIf (StrComp(iPortResp$, "/I88") = 0) Then
    TextBox.Text = "/I88 iPort/AFM 2 Connection Closed"

ElseIf (StrComp(iPortResp$, "/I89") = 0) Then
    TextBox.Text = "/I89 Invalid Command Argument"

ElseIf (StrComp(iPortResp$, "/I8A") = 0) Then
    TextBox.Text = "/I8A Slave Tx Request Not Active"

ElseIf (StrComp(iPortResp$, "/I8F") = 0) Then
    TextBox.Text = "/I8F Invalid iPort/AFM 2 Command"

ElseIf (StrComp(iPortResp$, "/I90") = 0) Then
    TextBox.Text = "/I90 iPort/AFM 2 Rx Buffer Overflow"

Else
    TextBox.Text = LineBuf$ 'Other Update Display
End If
LineBuf$ = ""
End If
Wend
End Sub

```

## **iPort/AFM 2 Revision Report**

This section defines revisions and changes made to the iPort/AFM 2 interface:

Revision: 2.00

1. Add Firmware Version command.
2. Add eXtended commands.
3. Add Tx bYte Count command.

Revision: 1.02

- 1 Initial Release

### **Additional Information**

For additional information on the I<sup>2</sup>C Bus, please refer to the following:

“What is I<sup>2</sup>C?”

[www.mcc-us.com/I2CBusTechnicalOverview.pdf](http://www.mcc-us.com/I2CBusTechnicalOverview.pdf)

“Frequently Asked Questions (FAQ)”

[www.mcc-us.com/faq.htm](http://www.mcc-us.com/faq.htm)

"The I<sup>2</sup>C and How to Use It"

[www.mcc-us.com/i2chowto.htm](http://www.mcc-us.com/i2chowto.htm)

"I<sup>2</sup>C-bus specification and user manual"

NXP Semiconductors N.V.

[www.nxp.com/documents/user\\_manual/UM10204.pdf](http://www.nxp.com/documents/user_manual/UM10204.pdf)

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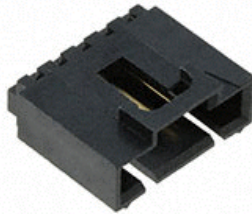
## Appendix A - I<sup>2</sup>C Connector Information

### I<sup>2</sup>C Bus Interface Connector and Plug Information

The iPort/AFM 2 uses the following 1x5 2.54 mm (.100") pitch, 0.64 mm (.025") square pin, header and plug assemblies for the I<sup>2</sup>C Bus interface.

#### I<sup>2</sup>C Header Receptacle

Molex C-Grid® SL™ 70553 Header



Molex Part # 70553-0004

#### I<sup>2</sup>C Plug Housing

Molex C-Grid® SL™ 70066 Crimp Housing



Molex Part # 50-57-9405

Molex C-Grid® SL™ 70058 Crimp Terminal



Molex Part # 16-02-0102

iPort/AFM 2 I<sup>2</sup>C cables are available online at [www.shop-mee-us.com](http://www.shop-mee-us.com)

## **Declaration of Conformity**

### **FCC Statement**

#### **DECLARATION OF CONFORMITY WITH FCC RULES FOR ELECTROMAGNETIC COMPATIBILITY**

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:

**iPort/AI 2 (#MIIC-212) and iPort/AFM 2 (#MIIC-213)**

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.

Test Laboratory Information:

MET Laboratories, Inc.

Test Report Number: EMC88332-FCC

Test Report Date: January 27, 2016

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.

### **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 **iPort/AI 2 (#MIIC-212)** and **iPort/AFM 2 (#MIIC-213)**, to which this declaration relates, is in conformity with EMC Emissions Standard for Information Technology Equipment EN55022:2010, and EMC Immunity Standard for Electrical Equipment for Measurement, Control and Laboratory Use EN 61326-1: 2013.

Test Laboratory Information:

CLASS Industries, Ltd.

Test Report Number: CI06074

Test Report Date: November 3, 2015

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