User's Guide

iPORT/AI™

RS-232 to I²C Host Adapter
ASCII Interface

with iPort Utility Pack Software

MCC
Micro Computer Control
Small Area Network Specialists

www.mcc-us.com

Introduction

The MCC iPort/AI™ RS-232 to I^2C Host Adapter (#MIIC-202) allows any PC, Host Computer, or Data Terminal with an RS-232 port to become an I^2C Master or Slave device, transmitting or receiving I^2C messages between the PC and one or more I^2C devices across an I^2C Bus.

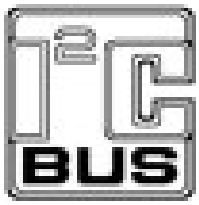
This user's guide describes the installation and operation of the iPort/AI host adapter and the iPort Utility Pack Software for Windows, and includes the Programmers Reference for creating custom applications.

Are you new to I^2C? Want to know more? We suggest you review "What is I^2C?" at www.mcc-us.com/I2CBusTechnicalOverview.pdf.

MCC products use Philips components and are licensed to use the I^2C Bus.

"Purchase of Philips I^2C components conveys a license under the Philips' I^2C patent to use the components of the I^2C system, provided the system conforms to the I^2C specifications defined by Philips."

I^2C is a trademark of 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/AI™

RS-232
to
I²C Bus Host Adapter
with
ASCII Interface

User's Guide

Model: MIIC-202

1 Overview

The MCC iPort/AI RS-232 to I^2C Bus Host Adapter with ASCII Interface (#MIIC-202) allows any PC, Host Computer, or Data Terminal to become an I^2C Master or Slave device, transmitting or receiving I^2C messages between the PC and one or more I^2C devices across an I^2C Bus.

Product Features:

- Turn ANY Computer's RS-232 Serial Port into an I^2C Port.
- Supports Bus Master and Slave, Transmit and Receive Operations.
- Compatible with 3.3V to 5V I^2C at bit rates up to of 100 KHz.
- Get on the I^2C Bus in Seconds. Includes our free I^2C Message Center and Message Manager Windows Applications.
- Simple ASCII Text Commands makes building your own custom I^2C applications quick and easy. Programmer's Reference and Sample Programs included.

The I^2C adapter system consists of the following components:

1.1 iPort/AI RS-232 to I^2C Bus Host Adapter

This adapter plugs into an RS-232 Port on any host computer and generates I^2C Bus signals.

1.2 iPort Utility Pack Software

This free software package includes the iPort Message Center and Message Manager applications to help you easily send and receive I^2C Bus messages.

1.3 iPort/AI Programmer's Reference

This section of the iPort/AI User's Guide provides a programmer's guide to creating custom I^2C Bus applications. Find additional sample programs and complete projects on our web site's Sample Program page.

1.4 Packing Slip

This package includes the following items:

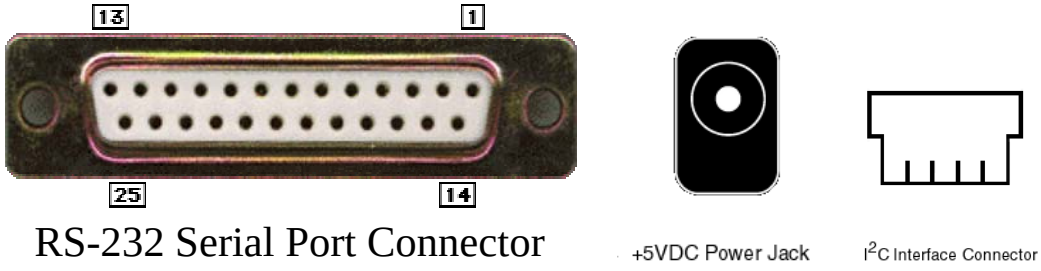
- iPort/AI RS-232 to I^2C Bus Host Adapter (#MIIC-202).
- I^2C Interface Cable.
- RS-232 Serial Port Cable, 9F/25M.
- iPort/AI User's Guide.
- iPort Utility Pack for Windows software.
- Power Supply.

1.5 System Requirements

a. A host computer with one free RS-232 port.
b. Windows 95 OS or higher to run iPort Utility Pack applications.

2 Interconnects

The I^2C Bus Host Adapter includes three interconnections:



RS-232 Serial Port Connector

2.1 RS-232 Serial Port Connector

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

The I²C 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

The I²C adapter requires 50ma of REGULATED +5 volt power. This power can be supplied in one of two ways:

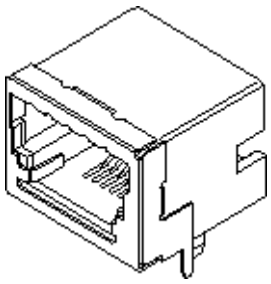
- Via the power jack.
  If the I²C adapter is powered via its +5VDC power jack, excess power is available via the +5V wire in the I²C connector to power external devices.

- Via the I²C interface connector.
  If 50ma of regulated +5V power is available in the target system, the I²C adapter can be powered via the +5V wire in I²C interface connector.

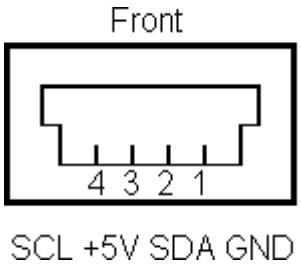
2.3 I²C Interface Connector

The I²C adapter includes a four wire, positive locking, modular receptacle connector (see Appendix A) for interfacing to an external I²C Bus. Lines provided include I²C Clock (SCL), I²C Data (SDA), Ground, and +5VDC.

Use of the +5V wire is optional. Connect this wire to the target system to power the I²C adapter and the target system from a common regulated 5V power supply.



Receptacle Connector



An I²C Interface Cable (White=SCL, Red=+5VDC, Green=SDA, Black=Ground) is provided to connect to an external I²C Bus. Since there is no standard I²C Bus connector, you may want to cut off one end of the cable and add a connector compatible with your target system.

Additional I²C Interface Cables (4 ft., 8ft., or 16 ft.), and modular connectors are available from MCC. Clip Lead cables are also available. (see Appendix A)

3 Hardware Configuration

3.1 Pull-up Resistors

The I²C adapter includes a slide switch used to enable or disable internal +5VDC I²C Bus 1.8K ohm pull-up resistors. Every I²C Bus system must have at least one pull-up on the SCL and SDA lines. Use this switch to configure the pull-up resistors for your system.

3.2 Connecting to a 3.3v System

If you are connecting the I²C adapter to a 3.3 volt 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 pull-ups to the target system's 3.3V power. These pull-ups may already

be present in the target system.
- Disconnect the I²C connector +5V wire from the target system. The I²C adapter will be powered from its own +5V power supply, and the target system will be powered by its own 3.3V power supply.

The I²C adapter is a 5-volt device. Any signal above 3.3V on the SCL and SDA lines is high enough for the adapter to see a Logical 1.

3.3 Connecting to an SMBus 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 (approx. 15k ohm) pull-up resistors. These pull-ups may already be present in the target system.
- Visit the I²C .vs. 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.

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^2C adapter and the target system, the host computer will discharge energy through its RS-232 port to the I^2C adapter, and on to the target system. This discharge could damage the host computer, I^2C adapter, and the target system.

4.2 Grounding Solutions

To avoid damage to the host computer, I^2C adapter, or target system, follow these instructions:

- Wear an earth grounded wrist strap, or discharge any static charge build-up, when handling the I^2C 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^2C 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^2C adapter to your host computer and I^2C Bus target system.

1. Attach the I^2C adapter to a free 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^2C adapter.

2. Connect the I^2C Bus cable to the I^2C adapter and your I^2C device. If your device does not have the matching I^2C connector, you can cut the end of the cable and attach the individual wires via any appropriate connector (See the "I^2C Interface Connector" section for details). MCC also offers an I^2C clip-lead cable (#CABCL) that is compatible with our adapters. You may not need to, or want to, connect the +5V 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 +5V wire.

3. Connect I^2C adapter power via the power jack or I^2C Bus connector. See "+5VDC Power Jack" section for details.

If you have any questions on I^2C adapter setup and configuration, please contact our technical support department via our web site.

Part 2

iPort Utility Pack for Windows

V5.2

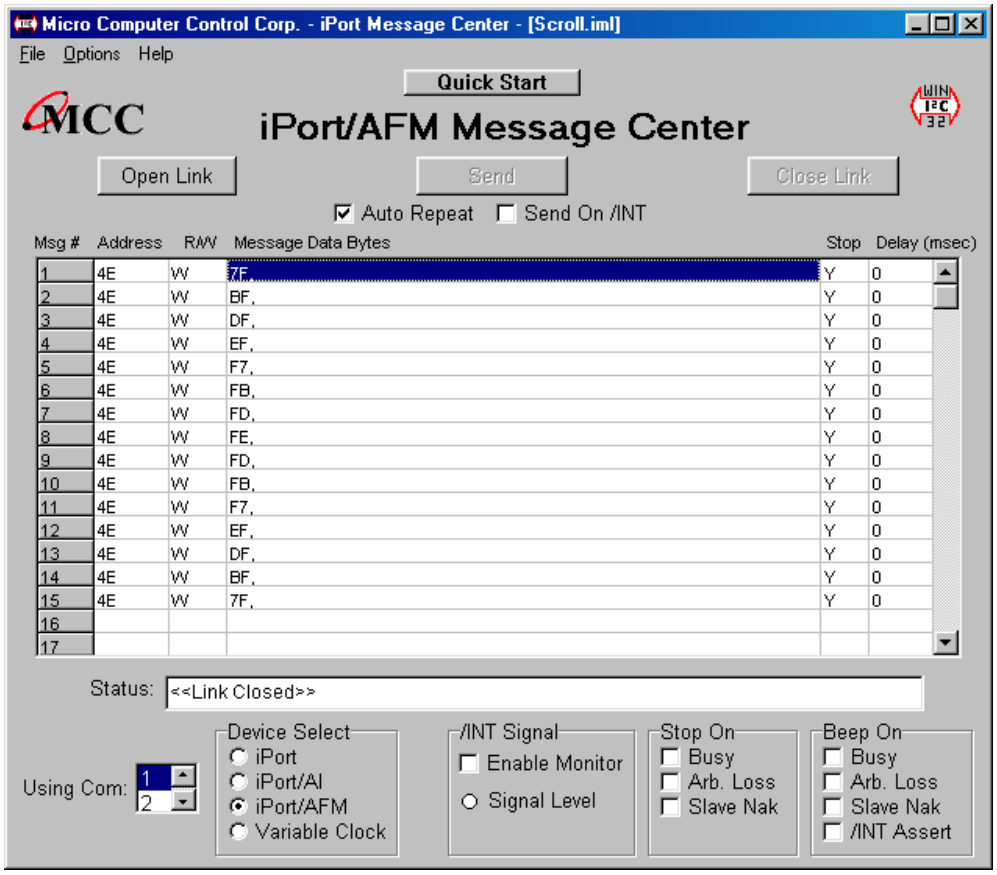
1 iPort Utility Pack for Windows

The iPort Utility Pack for Windows is your express lane to I²C 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 I²C Bus messages quickly and easily.

1.1 iPort Message Center

The iPort Message Center, our most popular application, operates with all versions of our I²C Bus Host Adapters. With the Message Center, you can create, save, and automatically execute scripts of I²C Bus messages. I²C Bus message activity includes:

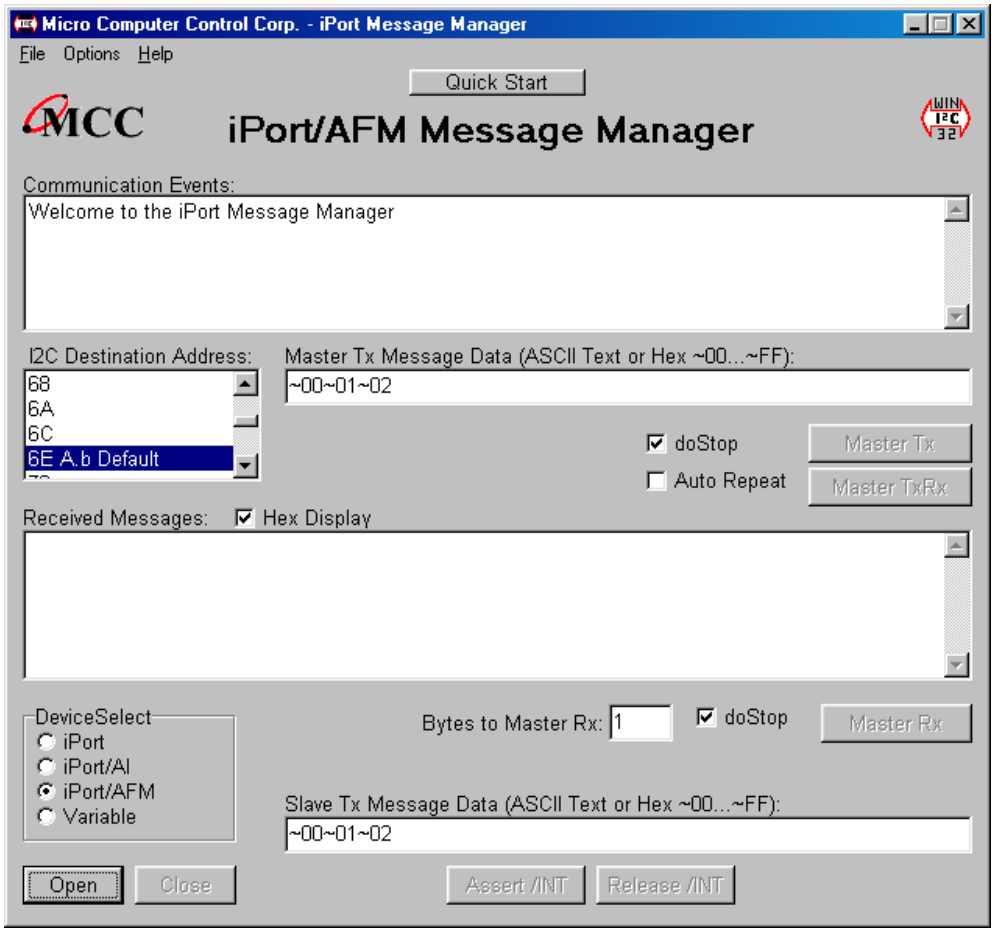
- Master Transmit
- Master Receive



1.2 iPort Message Manager

The iPort Message Manager operates with all versions of our I²C Bus Host Adapters. Using the Message Manager, you can perform all four (4) modes of I²C Bus message activity, including:

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



2 System Requirements

One of the following MCC I^2C Bus adapters:

1. iPort (#MIIC-201) Windows to I^2C Bus Host Adapter.
2. I^2C Bus Host Adapter Variable Clock Rate (#MIIC-201-V).
3. iPort/AI (#MIIC-202) RS-232 to I^2C Bus Host Adapter with ASCII Interface
4. iPort/AFM (#MIIC-203) RS-232 to I^2C Bus Host Adapter with ASCII Fast Mode Interface.

Windows 95 OS or higher.
1 free RS-232 Serial Port.

3 iPort Utility Pack Installation

3.1 Installing from CD

1. Insert a software distribution CD into your CD drive.
2. If the install program does not start automatically, select Start*Run and type “D:SETUP.EXE.” Click OK.
3. Follow instructions on screen.

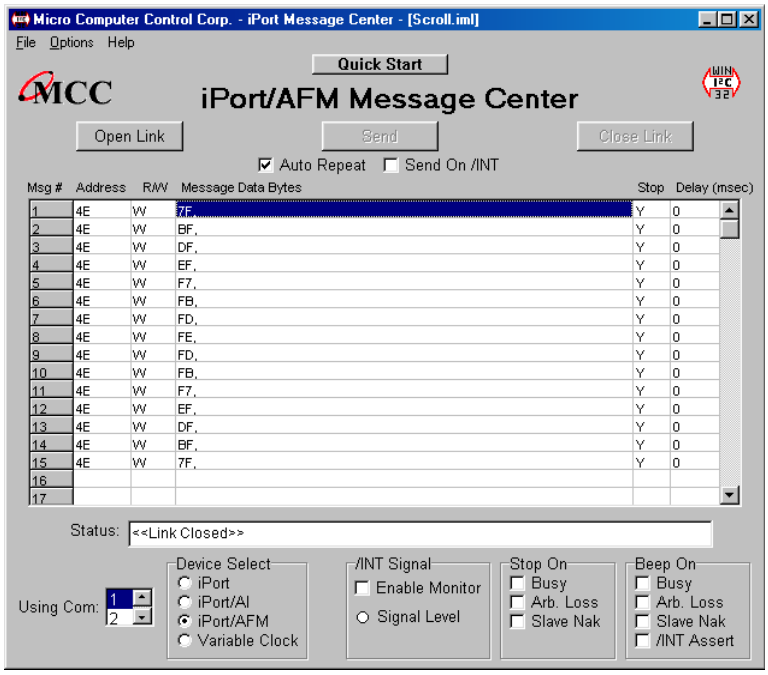
3.2 Installing from the Web

Visit MCC’s web site (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 I²C Master Transmit and Master Receive activities for all MCC I²C Bus host adapters. With this program you can create, save, and execute scripts of I²C Master messages.



Main Application

The iPort Message Center allows a PC to become an I²C Master transmitter or receiving device, sending I²C messages between the PC and one or more I²C devices across an I²C Bus.

The iPort Message Center is designed to be a simple application for experimenting with I²C messages. It provides methods to:

1. Enter/Edit a list of I²C Master Transmit or Receive Messages.
2. Save and/or Load a list of I²C Master messages to/from disk.
3. Transmit the current list of I²C 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 I²C Bus events.
4. Use command line arguments to automatically load, send, and save I²C messages from a batch file or another program.

Each I²C message can transfer up to 32 bytes of 8-bit data, with Repeated Start and Time Delay options.

4.1 Message Center Operations

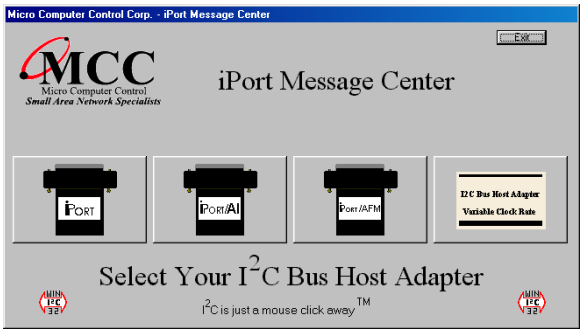
Communicating with another device on the I²C Bus is easy. Just install the software as described in Section 3, then following these simple steps:

4.1.1 Starting the Message Center

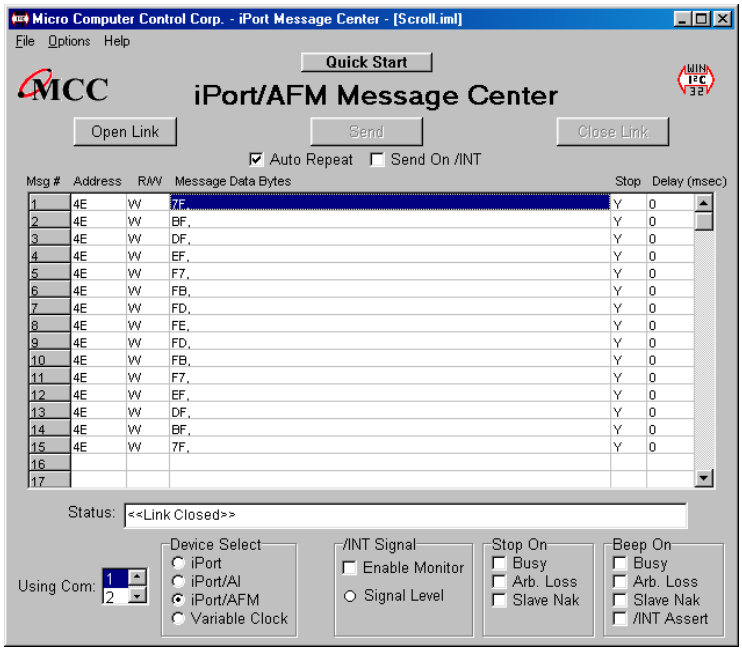
Click, Start *Programs *iPort Utility Pack*iPort Message Center

4.1.2 Selecting the Adapter

Select the I²C 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 I²C 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 I²C Bus Clock rate settings. Default settings and options are adapter dependant.

4.1.5 Establish Adapter Communications Link

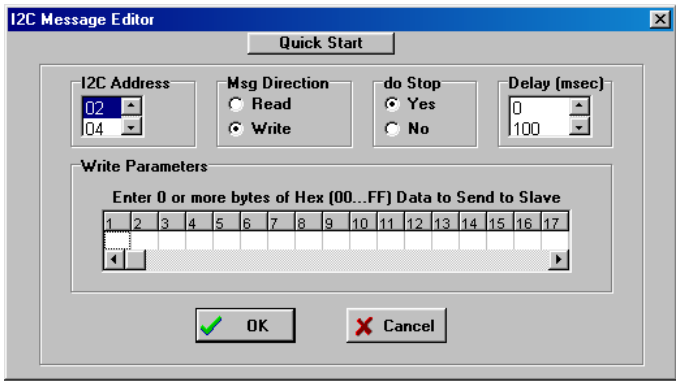
Establish the communications link to the I²C adapter by clicking the Open Link button.

The Message Center sets the adapter’s own I²C Slave address to 0xFE. Once the link has opened successfully, you are an active I²C node. I²C 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 I²C Messages

I²C 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 “I²C Message Editor” screen by double clicking on a message row in the spreadsheet.



Use the I^2C Message Editor to:

1. Set I^2C Address.

   The I^2C Address is the I^2C 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^2C adapter automatically supplies the 8^{th}, 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^2C 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^2C 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^2C 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^2C 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^2C message with doStop enabled will cause the message to be terminated with a Stop Condition. Sending an I^2C 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^2C 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^2C 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^2C 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^2C 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.

Message Center Command Line Arguments	
Command	**Description**
iPort, iPort/AI, iPort/AFM, Variable	Specify I^2C 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^2C Bus Clock Rate.*
Monitor/INT	Enable /INT Signal Monitor.*
StopOnBusy	Stop sending on I^2C adapter busy.
StopOnArbLoss	Stop sending on I^2C Bus Arbitration Loss.
StopOnNak	Stop on Slave Negative Acknowledgment.
BeepOnBusy	Beep on I^2C adapter busy.
BeepOnArbLoss	Beep on I^2C Bus arbitration loss.
BeepOnNak	Beep on Slave Negative Acknowledgment.
BeepOn/INT	Beep on /INT signal assert (low).*
AutoLoad	Load I^2C message list file.
AutoSave	Save I^2C message list file.
AutoOpen	Open link to I^2C adapter.
AutoSend	Send I^2C 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

iPort	iPort (#MIIC-201)
iPort/AI	iPort/AI (#MIIC-202)
iPort/AFM	iPort/AFM (#MIIC-203)
Variable	Variable Clock (#MIIC-201-V)

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^2C adapter.

4.2.3 Set RS-232 Baud Rate

BAUD19200	(Default)
BAUD57600	(iPort/AFM ONLY)
BAUD115200	(iPort/AFM ONLY)

Set the RS-232 Baud Rate.

4.2.4 Set I^2C Bus Clock Rate

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

Set the I^2C Bus Clock Rate to the specified value. The default 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^2C 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^2C messages if the adapter returns a "Bus Abritration Loss" response to the host computer. Bus Arbitration Loss occurs when another I^2C 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^2C 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^2C 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^2C 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^2C 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^2C Adapter

Open link to the adapter.

4.2.16 Auto Send

AutoSend Auto Send I^2C Message List

Send I^2C messages loaded with the AutoLoad command.

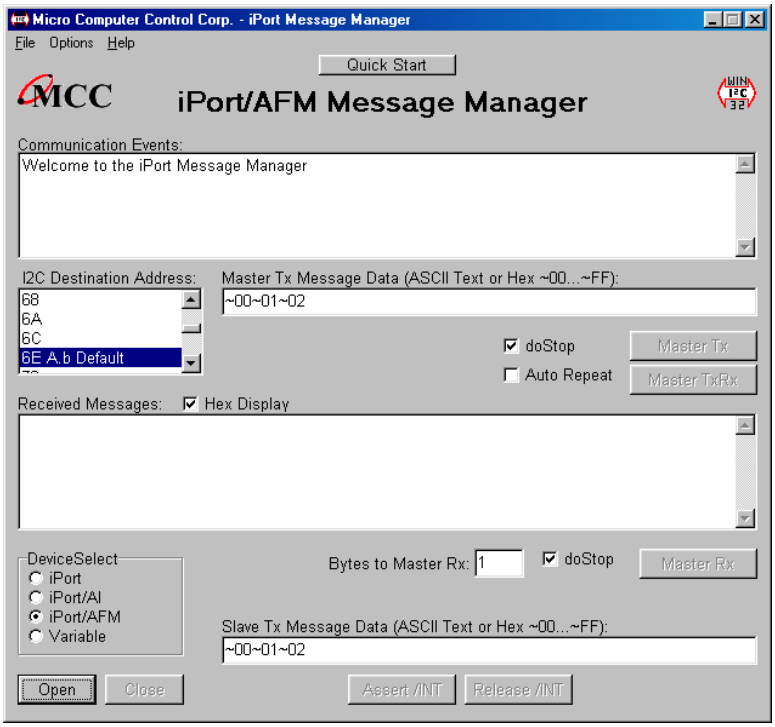
4.2.17 Auto Exit

AutoExit Auto exit after sending the message list.

Message Center will auto exit after sending the last message in the I^2C message list

5 iPort Message Manager

The iPort Message Manager supports I²C Master and Slave, Transmit and Receive activities for all MCC I²C Bus host adapters, allowing a PC to become an I²C Master or Slave device, transmitting or receiving I²C messages between the PC and one or more I²C devices across an I²C Bus.



Main Application

The Message Manager is designed to be a simple application for experimenting with I²C messages. Message Manager provides methods to:

1. Set the I²C adapter's own I²C Slave address, General Call Enable, and other operating parameters.
2. Master Transmit ASCII text or Hex (00...FF) data to a specified I²C Slave Receiver device.
3. Master Receive data from a specified I²C Slave device.
4. Perform Master Read after Write operations.
5. Slave Transmit data to a requesting I²C Master device.
6. Display Master or Slave Receive data in hexadecimal or ASCII.
7. Display I²C Bus communication events.
8. Assert or release the INT signal (on supported adapters only).

5.1 Message Manager Operations

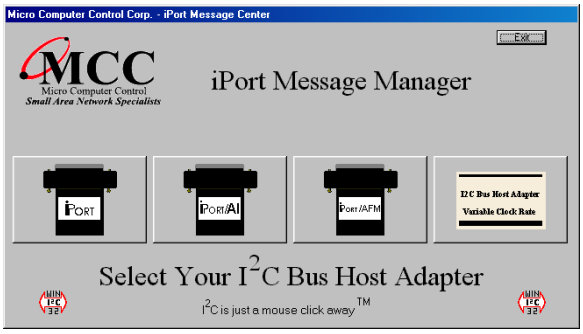
Communicating with another device on the I²C Bus is easy. Just install the software as described in Section 3, then following these simple steps:

5.1.1 Starting the Message Manager

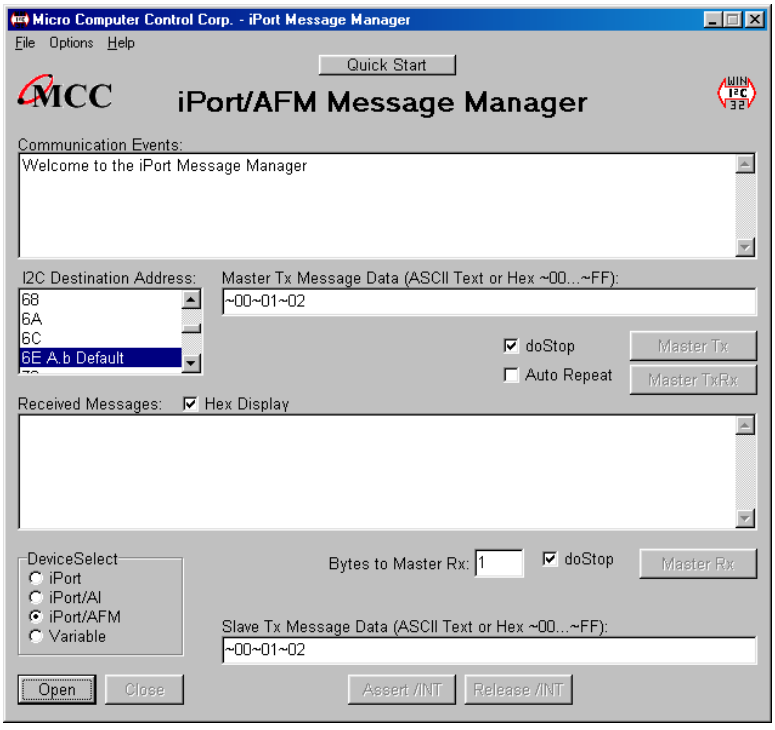
Click, Start *Programs *iPort Utility Pack*iPort Message Manager

5.1.2 Select the Adapter

Select the I²C 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

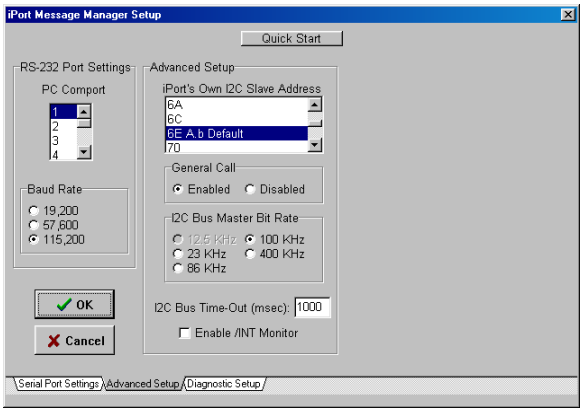
5.1.3.1 Basic Setup

Use the “RS-232 Port Settings” control to select the RS-232 communication port connected to the I^2C 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^2C 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^2C Slave Address

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

I^2C Bus Master Bit Rate

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

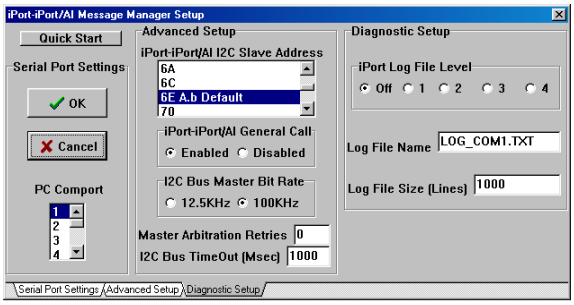
I^2C Bus Time-Out

Specify how long the I^2C adapter will wait before reporting an I^2C 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^2C Messages

5.1.4.1 Master Operations

5.1.4.1.1 Specifying the Destination Address

The Destination Address is the I^2C 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^2C adapter automatically supplies the 8^{th}, 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^2C 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^2C 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^2C 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^2C message with doStop checked will cause the message to be terminated with a Stop Condition. Sending an I^2C 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

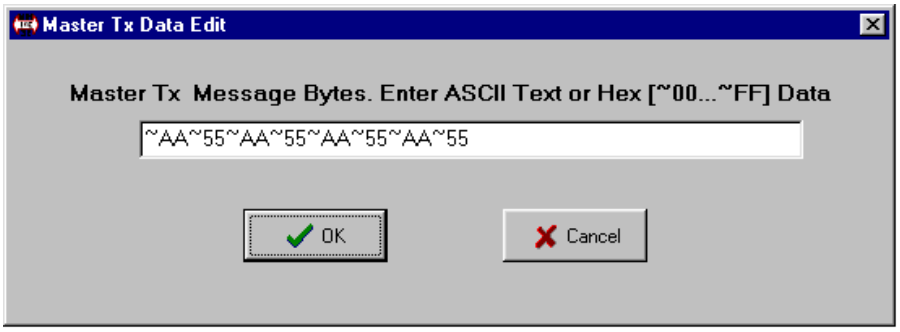
The situation often arises, where you would like to automatically repeat a master message operation.

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^2C 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^2C 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^2C 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^2C 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^2C 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^2C Bus master operations, the Message Manager can also perform I^2C 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

Click, Start | Programs | iPort Utility Pack | uninstall.

Follow the on screen instructions.

Part 3

Programmer's Reference

ASCII Command Interface Definitions

Programmer's Quick Start

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

1 Install the iPort/AI 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^2C 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/AI Status Report. Note: All iPort/AI 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/AI's communications Flow Control to match your terminal.

5 Enter **/Ixx[CR]** (xx = 02…FE even) to set iPort/AI's Own I^2C Slave Address.

6 Enter **/O[CR]** to Open the iPort/AI Connection. The iPort/AI does not need to be connected to an I^2C Bus to open a connection.

7 Enter **/Dxx[CR]** (xx = 00…FE even) to select a Destination I^2C Slave Address

8 Enter **/Ttext[CR]** (text = ASCII or Hex-Equivalent ~00…~FF) to Master Transmit a message to the current Destination I^2C Slave device

9 Enter **/Rn[CR]** (n = 0…32767) to Master Read a message from the current Destination I^2C Slave device.

iPort/AI 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	**iPort/AI Reset** This command resets the iPort/AI to its default state.
//[CR]	**Status Display** Display iPort/AI status information.
/C[CR]	**Close I^2C Connection** Disconnect from the I^2C Bus.
/Dxx[CR]	**Set Destination I^2C Slave Address** Set the destination I^2C Slave Address for subsequent Master Transmit or Receive operations.
/E[0|1][CR]	**Echo/Prompt Control [0 = Off, 1 = On]** Enable/Disable data entry echo and prompts.
/F[0|1][CR]	**Flow Control [0 = XON/XOFF, 1 = RTS/CTS]** Select RS-232 communication handshaking protocol.
/G[0|1][CR]	**I^2C General Call Control [0 = Disabled, 1 = Enabled]** Enables/Disables iPort/AI response to I^2C Bus General Call (00) messages.
/H[0|1][CR]	**Hex Only Display Control [0 = Disabled, 1 = Enabled]** Controls display format of received message data.
/Ixx[CR]	**Set iPort/AI's Own I^2C Slave Address** Sets iPort/AI's own I^2C Slave Address. iPort/AI will respond to I^2C Bus messages sent to this address.
/M[CR]	**Command Menu Display** Displays iPort/AI's Command Menu
/O[CR]	**Open I^2C Connection** Activates iPort/AI as an I^2C device attached to the bus.

/*Rnnnn[CR]	**Master Read Message** Read the specified number of data bytes from the current Destination I^2C Slave device. * = No Stop for Repeated Start (requires firmware V2.00+)
/Stext[CR]	**Slave Transmit Message** Write the specified data bytes to a requesting I^2C Master Receiver device.
/*Ttext[CR]	**Master Transmit Message** Master Transmit the specified data bytes to the current Destination I^2C Slave device. * = No Stop for Repeated Start (requires firmware V2.00+)

Synchronous Interface Events

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

iPort/AI Reset

Reset iPort/AI 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^2C 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. * ‘iPort/AI Ready
Default Setting: None

Status Display

Display iPort/AI status.

Command: //[CR] 'Status Display
Response:
iPort/AI I²C Host Adapter w/ASCII Interface Vxx.xx
Copyright © xxxx, Micro Computer Control Corp.
Visit our Web Site at: http://www.mcc-us.com

Destination I²C Slave Address (xxH)
Echo/Prompt (Disabled)
Flow Control (XON/XOFF)
Hex Only Display (Enabled)
I²C Connection (Closed)
General Call (Enabled)
iPort's own Slave Address (xxH)

Close I²C Connection

Disconnect iPort/AI from the I²C Bus.

Command: /C[CR] 'Close I²C Connection
Response: /CCC[CR] 'Close Connection Complete
Default Setting: 'Closed

Set Destination I²C Slave Address

Set the destination I²C Slave Address (Hex 0,2...FE) for all subsequent Master Transmit or Receive operation.

Command: /Dxx[CR] 'Set Destination I²C Slave Address
Response 1: * 'iPort/AI 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/AI Ready
Default Setting:	Off

RS-232 Flow Control

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

iPort/AI implements either XON/XOFF (by default) or RTS/CTS flow control protocols. Flow control is used by the iPort/AI 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 x11) is used to enable the flow of data. XOFF (Hexadecimal x13) 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/AI Ready
Default Setting: XON/XOFF

I^2C General Call Control

Enables or disables iPort/AI response to I^2C Bus General Call (Address x00) messages.

Command: /G[0|1][CR] 'I^2C General Call [0 = Disabled, 1 = Enabled]
Response: * 'iPort/AI 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^2C message data bytes are displayed in Hex (~00…~FF) format. When disabled, received I^2C 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/AI Ready
Default Setting: Enabled

Set iPort/AI's Own I^2C Slave Address

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

Command: /Ixx[CR] 'Set iPort/AI's Own I^2C Slave Address
Response 1: * 'iPort/AI Ready
Response 2: /I89[CR] 'Invalid Command Argument
Default Setting: 6E

Command Menu Display

Display iPort/AI's command menu.

Command: /M[CR] 'Command Menu Display
Response:
iPort/AI Command Menu Syntax: [Select], (Optional), xx=[00..FE], n=[1..32767]

//	Status Display
/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/AI's Own I2C Slave Address
/M	Menu Display
/O	Open I2C Connection
/(*)Rn	Master Rx Message *=No Stop
/S(text)	Slave Tx Message
/(*)T(text)	Master Tx Message *=No Stop

Open I^2C Connection

Activates iPort/AI as an active device on the I^2C Bus.

Command: /O[CR] 'Open I^2C Connection
Response: /OCC[CR] 'Open Connection Complete
Default Setting: Closed

Master Read Message

This command causes iPort/AI to read the specified number of data bytes from the currently selected Destination I^2C Slave Address with or without generating an I^2C 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 I²C Slave device indicates the number of additional trailing bytes that are available to read. The iPort/AI 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 I²C Slave Address, the specified number of bytes are read. The iPort/AI acknowledges all bytes read except the last. If not disabled, the message is then terminated with an I²C Stop condition.

Sending Master Receive messages with No Stop allows the Master to retain exclusive control of the I²C 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 I²C 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/AI is Busy, Command Ignored
Response 4: /I83[CR]	' I²C 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/AI in response to a Slave Transmit Request (/STR). This command causes iPort/AI to write the specified data bytes to the requesting I²C 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 I²C Bus, the iPort/AI outputs a Slave Transmit Request to its Host device, and

initiates an I²C 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 I²C Bus.

Note 2: The tilde (~) character and the Carriage Return (CR) characters are used as special marker characters within all iPort/AI 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/AI automatically translates "Hex equivalent" characters to their single-byte value for transmission across the I²C 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 I²C Slave Address with or without generating an I²C 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/AI transmit 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/AI automatically translates "Hex equivalent" characters to their single-byte value for transmission across the I^2C Bus.

All entered data bytes are transmitted to the Destination I^2C 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^2C Stop condition.

Sending Master Transmit messages with No Stop allows the Master to retain exclusive control of the I^2C 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^2C 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/AI is Busy, Command Ignored
Response 4: /I83[CR]	' I^2C 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 String

Asynchronous Interface Events

Asynchronous Events are those iPort/AI interface activities initiated by the iPort/AI I^2C Host Adapter in response to activities on the I^2C Bus.

Slave Transmit Request

This event is caused by the reception of an I^2C Bus Slave Transmit message directed at the current iPort/AI'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^2C Bus, the iPort/AI outputs a Slave Transmit Request to its Host device, and initiates an I^2C 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^2C Bus.

Slave Receive Complete

This event is caused by the reception of an I^2C Bus Slave Receive message directed at the current iPort/AI'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^2C Bus Slave Receive message directed at the I^2C General Call Address (00), when iPort/AI'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/AI Ready
Prompt: * ‘iPort/AI Ready

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

Slave Not Acknowledging

Prompt: /SNA[CR] ‘Slave Not Acknowledging

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

iPort/AI Busy

Prompt: /I81[CR] ‘iPort/AI Busy

Cause: Host attempted a Master operation while iPort/AI was busy. Host should process any active slave events and repeat the last command.

I^2C Bus Arbitration Loss

Prompt: /I83[CR] ‘I^2C Arbitration Loss Detected

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

I^2C Bus Error Detected

Prompt: /I84[CR] ‘I^2C Bus Error Detected

Cause: iPort/AI has detected an error condition on the I^2C Bus. Host should repeat the last command or issue an iPort/AI Reset command.

I^2C Bus Time-out Detected

Prompt: /I85[CR] ‘I^2C Bus Time-out Detected

Cause: iPort/AI issues this response when it detects a byte transfer delay greater than 1 second. No corrective action is taken by the iPort/AI regarding I^2C Bus activity. No host computer response is required, but this event can be used to detect possible bus problems.

iPort/AI Connection Closed

Prompt: /I88[CR] ‘iPort/AI Connection is Closed.

Cause: The host computer is attempting to perform an I^2C Bus message operation while the iPort/AI Connection is Closed. The Host should issue an Open I^2C Connection command before attempting to perform I^2C 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/AI Command

Prompt: /I8F[CR] ‘Invalid iPort/AI Command

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

Host. The Host should reissue the correct command.

iPort/AI RS-232 Receive Buffer Overflow (*New for V2.00*)

Prompt: /I90[CR] ‘iPort/AI RS-232 Receive Buffer Overflow

Cause: This event normally indicates that data sent to the iPort/AI via the RS-232 serial port has been lost. Check your Host Computer’s Serial Port Flow Control (XON/XOFF, or Hardware) to make sure it matches current iPort/AI Flow Control. Also, check if Host Computer’s FIFO buffers in the 16550 UART are enabled. If so, reduce or disable Transmit Data Buffering.

Example Code

The following examples are written in MS Visual Basic V3 for Windows using the serial communications control (MSCOMM.VBX). It can be used as a guide in implementing iPort/AI interface programs in other programming languages and operating environments.

Note: Example code is available online at: www.mcc-us.com

iPort/AI Reset

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

iPort/AI Initialization

```
Comm1.Output = "/f0"       'Set iPort/AI XON/XOFF Flow Control
Comm1.Output = Chr$(13)

Comm1.Output = "/i70"          'Set iPort/AI'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/AI 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/AI 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 "
' Test for iPort/AI 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/AI Response Messages

ElseIf (StrComp(iPortResp$, "****") = 0) Then
    TextBox.Text = "* iPort/AI 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/AI 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/AI 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/AI Command"

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

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

iPort/AI Revision Report

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

Revision: V2.00

1. Add internal enhancements to improve operation in multi-master systems.
2. Add RS-232 port receive buffer overflow report (/I90).
3. Add No Stop (*) option to Master Transmit (/T) and Master Receive (/R) commands to support I^2C Repeated Start operations.

Revision: V1.10

1. Add General Call notification (See General Call Receive Complete).
2. Add support for variable length Master Receive messages (See Master Read Message).
3. Add communication handshaking protocol selection (See Flow Control).
4. Make XON/XOFF the default communication handshaking protocol (See Flow Control).
5. Change the Open I^2C Connection response from "*" to "/OCC[CR]".
6. Change the Close I^2C Connection response from "*" to "/CCC[CR]".

Revision: 1.00

1 Initial Release

Additional Information

For additional information on the I^2C Bus, please refer to the following:

“What is I^2C?”
www.mcc-us.com/I2CBusTechnicalOverview.pdf

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

"The I^2C and How to Use It"
www.mcc-us.com/i2chowto.htm

"80C51-Based 8-Bit Microcontroller" Data Handbook.
Philips Semiconductors, Tel. (800)227-1817

"I^2C Peripherals for Microcontrollers" Data Handbook.
Philips Semiconductors, Tel. (800

Appendix A - I²C Connector Information

Interface Connector and Plug Information

MCC uses two (2) different connectors and plug assemblies. We have found these parts to be compatible.

I²C Receptacle Connectors

Molex SEMCONN ACCESS.bus Receptacle Connector

Molex Part # 15-83-0064

AMP SDL (Shielded Data Link) Connectors for ACCESS.bus

AMP Part # 4-943197-1

I²C Plug Connectors

Molex SEMCONN ACCESS.bus Plug

Molex Part # 15-83-1564

AMP SDL (Shielded Data Link) Plug for ACCESS.bus

Bush	Amp Part # 520851-1
Ferrule	Amp Part # 520433-1
SDL (Shell)	Amp Part # 520461-1
SDL (Shell)	Amp Part # 520460-1
SDL	Amp Part # 4-520424-1

The following I²C Cables are available from MCC

MCC Part #	CAB4	I²C Interface Cable, 48inches (4ft)
MCC Part #	CAB8	I²C Interface Cable, 96 inches (8ft)
MCC Part #	CAB16	I²C Interface Cable, 192 inches (16ft)
MCC Part #	CABCL	I²C and SMBus Clip Lead Cable