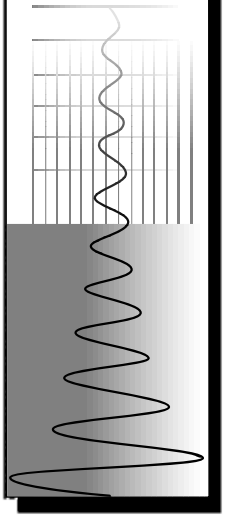
Measure



Measure® Serial Control User Manual

August 1996 Edition
Part Number 321005B-01

Internet Support

Email: measure.support@natinst.com
National Instruments Home Page: http://www.natinst.com
FTP Site: ftp.natinst.com

Bulletin Board Support

BBS United States: (512) 794-5422 or (800) 327-3077
BBS United Kingdom: 01635 551422
BBS France: 1 48 65 15 59

FaxBack Support

(512) 418-1111

Telephone Support (U.S.)

Tel: (512) 795-8248
Fax: (512) 794-5678

International Offices

Australia 03 9 879 9422, Austria 0662 45 79 90 0, Belgium 02 757 00 20, Canada (Ontario) 519 622 9310, Canada (Quebec) 514 694 8521, Denmark 45 76 26 00, Finland 90 527 2321, France 1 48 14 24 24, Germany 089 741 31 30, Hong Kong 2645 3186, Italy 02 413091, Japan 03 5472 2970, Korea 02 596 7456, Mexico 95 800 010 0793, Netherlands 0348 433466, Norway 32 84 84 00, Singapore 2265886, Spain 91 640 0085, Sweden 08 730 49 70, Switzerland 056 200 51 51, Taiwan 02 377 1200, U.K. 01635 523545

National Instruments Corporate Headquarters

6504 Bridge Point ParkwayAustin, TX 78730-5039 Tel: (512) 794-0100

Important Information

Warranty

The media on which you receive National Instruments software are warranted not to fail to execute programming instructions, due to defects in materials and workmanship, for a period of 90 days from date of shipment, as evidenced by receipts or other documentation. National Instruments will, at its option, repair or replace software media that do not execute programming instructions if National Instruments receives notice of such defects during the warranty period. National Instruments does not warrant that the operation of the software shall be uninterrupted or error free.

A Return Material Authorization (RMA) number must be obtained from the factory and clearly marked on the outside of the package before any equipment will be accepted for warranty work. National Instruments will pay the shipping costs of returning to the owner parts which are covered by warranty.

National Instruments believes that the information in this manual is accurate. The document has been carefully reviewed for technical accuracy. In the event that technical or typographical errors exist, National Instruments reserves the right to make changes to subsequent editions of this document without prior notice to holders of this edition. The reader should consult National Instruments if errors are suspected. In no event shall National Instruments be liable for any damages arising out of or related to this document or the information contained in it.

EXCEPT AS SPECIFIED HEREIN, NATIONAL INSTRUMENTS MAKES NO WARRANTIES, EXPRESS OR IMPLIED, AND SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. CUSTOMER'S RIGHT TO RECOVER DAMAGES CAUSED BY FAULT OR NEGLIGENCE ON THE PART OF NATIONAL INSTRUMENTS SHALL BE LIMITED TO THE AMOUNT THERETOFORE PAID BY THE CUSTOMER. NATIONAL INSTRUMENTS WILL NOT BE LIABLE FOR DAMAGES RESULTING FROM LOSS OF DATA, PROFITS, USE OF PRODUCTS, OR INCIDENTAL OR CONSEQUENTIAL DAMAGES, EVEN IF ADVISED OF THE POSSIBILITY THEREOF. This limitation of the liability of National Instruments will apply regardless of the form of action, whether in contract or tort, including negligence. Any action against National Instruments must be brought within one year after the cause of action accrues. National Instruments shall not be liable for any delay in performance due to causes beyond its reasonable control. The warranty provided herein does not cover damages, defects, malfunctions, or service failures caused by owner's failure to follow the National Instruments installation, operation, or maintenance instructions; owner's modification of the product; owner's abuse, misuse, or negligent acts; and power failure or surges, fire, flood, accident, actions of third parties, or other events outside reasonable control.

Copyright

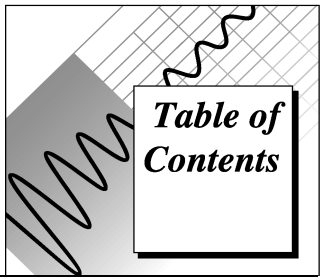
Trademarks

Measure® is a trademark of National Instruments Corporation.

Product and company names listed are trademarks or trade names of their respective companies.

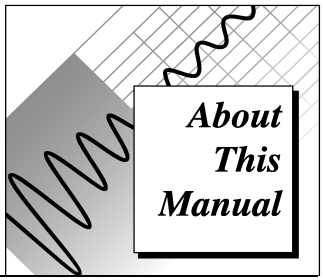
WARNING REGARDING MEDICAL AND CLINICAL USE OF NATIONAL INSTRUMENTS PRODUCTS

National Instruments products are not designed with components and testing intended to ensure a level of reliability suitable for use in treatment and diagnosis of humans. Applications of National Instruments products involving medical or clinical treatment can create a potential for accidental injury caused by product failure, or by errors on the part of the user or application designer. Any use or application of National Instruments products for or involving medical or clinical treatment must be performed by properly trained and qualified medical personnel, and all traditional medical safeguards, equipment, and procedures that are appropriate in the particular situation to prevent serious injury or death should always continue to be used when National Instruments products are being used. National Instruments products are NOT intended to be a substitute for any form of established process, procedure, or equipment used to monitor or safeguard human health and safety in medical or clinical treatment.



Figures

Tables



The *Measure Serial Control User Manual* describes how to install, set up, and use the Measure Serial Add-In for controlling serial instruments. This manual gives you specific information about using the Serial Add-In with Microsoft Excel.

Organization of This Manual

The *Measure Serial Control User Manual* is organized as follows.

- Chapter 1, *Introduction*, describes the procedures for installing and uninstalling Measure for Windows and for adding and removing the Serial Add-In.
- Chapter 2, *Getting Started with Serial Tasks*, explains how to get started with serial tasks.
- Chapter 3, *Serial Task Reference*, describes and outlines procedures for using every menu and dialog box available in the Serial Add-In.
- Chapter 4, *Using Measure Serial Tasks with VBA*, describes the functions that the Serial Add-In adds to Visual Basic for Applications (VBA), the programming language built into Microsoft Excel.
- Chapter 5, *Serial Technical Reference*, lists technical information about the Serial Add-In.
- Appendix A, *Serial Connector Pinouts*, lists the pin assignments of common serial connectors.
- Appendix B, *Error Messages*, describes the errors that can be encountered while using the Serial Add-In.

- Appendix C, *Troubleshooting*, provides help for some common problems encountered when working with serial instruments.
- Appendix D, *Customer Communication*, contains forms to help you gather the information necessary to help us solve technical problems you might have as well as a form you can use to comment on the product documentation.
- The *Glossary* contains an alphabetical list and description of terms used in this manual, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.
- The *Index* contains an alphabetical list of key terms and topics in this manual, including the page where you can find each one.

Conventions Used in This Manual

The following conventions are used in this manual:

bold	Bold text denotes a parameter, or the introduction of menus, menu items, or dialog box buttons or options.
italic	Italic text denotes emphasis, a cross reference, or an introduction to a key concept.
bold italic	Bold italic text denotes a note, caution, or warning.
`monospace`	Text in this font denotes text or characters that are to be literally input from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, variables, filenames, and extensions, and for statements and comments taken from program code.

» The » symbol leads you through nested menu items, and dialog box options to a final action. The sequence

Files»Page Setup»Options»Substitute Fonts

directs you to pull down the **File** menu, select the **Page Setup** item, select **Options**, and finally select the **Substitute Fonts** option from the last dialog box.

☞ **Note:** ***This icon to the left of bold italicized text denotes a note, which alerts you to important information***

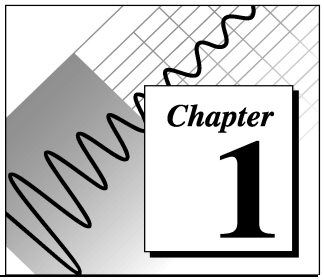
Related Documentation

The following documents contain information that you might find helpful as you read this manual:

- Campbell, Joe. *The RS-232 Solution: How to Use Your Serial Port. 2nd edition.* San Francisco: Sybex. 1989.

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help you if you have problems with them. To make it easy for you to contact us, this manual contains comment and technical support forms for you to complete. These forms are in Appendix D, *Customer Communication*, at the end of this manual.



Introduction

This chapter describes the procedures for installing and uninstalling Measure for Windows, and for adding and removing the Serial Add-In.

Installing Measure

If you have already installed Measure for Windows and want to add the Serial Add-In, skip below to the section *Manually Adding or Removing the Serial Add-In*.

Otherwise, to install Measure for Windows, insert the installation disk and run `a:\setup.exe` from the taskbar in Windows 95 or from the Program Manager for other versions of Microsoft Windows. Use the setup program to install the Data Acquisition Add-In, the Serial Add-In, the GPIB Add-In, or any combination of the three add-ins.

The setup program stores all the necessary files in a directory you specify and installs Measure as an Excel add-in.

Manually Adding or Removing the Serial Add-In

To add the Serial Add-In manually, complete the following steps.

1. Start Excel and select **Tools**»**Add-Ins...** which brings up the Serial Add-Ins dialog box, shown in Figure 1-1.
2. Click on the **Browse** button, and select the path where the setup program installed Measure. The default directory is `measure`.
3. Type `serial.xla` in the File Name edit box, and press Enter. The item `Measure Serial Add-In` appears in the list box.
4. Click on **OK** to close the Add-Ins dialog box.

You also can remove the Serial Add-In manually. To do so, complete the following steps.

1. From the Serial Add-Ins dialog box, shown in Figure 1-1, click on the checkbox next to the item `Measure Serial Add-In.`
2. When you have removed the check mark, click on **OK** to close the dialog box.

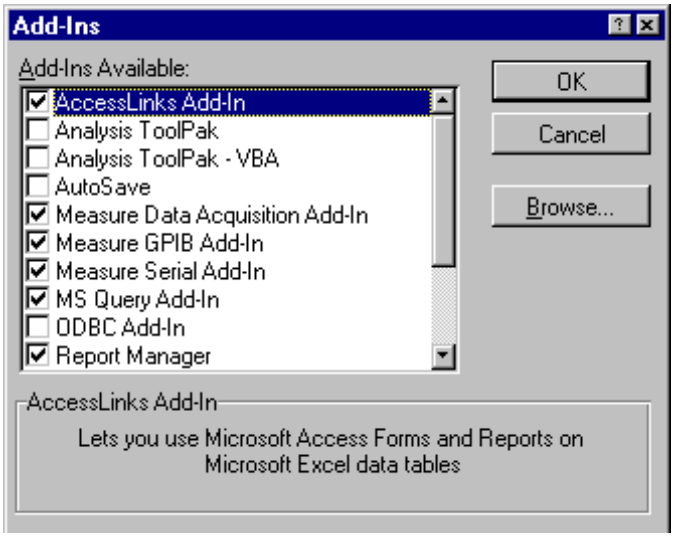


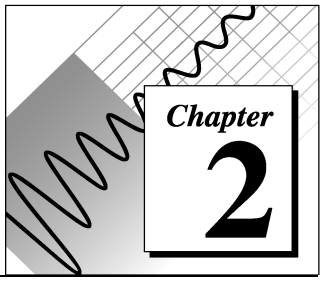
Figure 1-1. Serial Add-Ins Dialog Box

Uninstalling Measure

To uninstall Measure, complete the following steps.

1. Select Uninstall from the Measure program group.
2. Remove the Serial Add-In, the Data Acquisition Add-In, and the GPIB Add-In from the Add-Ins list in Excel, as shown in Figure 1-1.
3. Delete the entire directory in which Measure was installed. The default directory is `measure`.

Getting Started with Serial Tasks



This chapter explains how to get started with serial tasks. It describes instruments, tasks, and how the Serial Add-In of Measure for Windows allows you to communicate from MS Excel to instruments connected to a serial (COM) port of your computer. Measure sends commands and data to your instruments, and reads data from your instruments, and stores it in a spreadsheet.

In Measure, you communicate with serial devices by creating tasks. You can define one or more tasks for each instrument. Once you have created a task, you can run it from the Serial Tasks dialog box, from the Serial menu, or from any Visual Basic for Applications (VBA) code.

Throughout this chapter, examples and step by step instructions are given to help you get started with serial tasks.

Measure adds eight VBA functions to Microsoft Excel, allowing more sophisticated communications between your computer and the serial port device. For more information about those functions, see Chapter 4, *Using Measure Serial Tasks with VBA*.

Instruments

In Measure, an *instrument* is a name given to the serial port settings that allow interaction with a real instrument. You must set up these serial port settings before interaction is possible. You set up an instrument from the Instruments dialog box which is accessed by selecting **Serial»Instruments**.

After configuring an instrument, you can create tasks to interact with the instrument. Before using any real instrument with Measure, consult the manual for that instrument for instructions on its proper use.

The sections below present two examples of setting up and collecting data from an instrument.

Example— Configure the Fluke 45 Multimeter

This example shows how to set up a Fluke 45 Multimeter to work with Measure. The Fluke 45 Multimeter measures electrical characteristics like AC\DC voltage. Follow the steps in this example as a tutorial for Measure Serial Control. The workbook containing the example is distributed with Measure as file `fluke45.xls`.

To set up the Fluke 45 Multimeter, complete the following four steps.

1. Select **Serial**»**Instruments** to show the Serial Instrument Setup dialog box, shown in Figure 2-1.
2. Click on the **New** button and type the name of the instrument, `Fluke 45`.
3. Select the COM port for the Fluke 45 Multimeter from the Com Port list box in the section for Port Setup.
4. Select the appropriate communications settings. The Fluke 45 operates at 2400 baud, No parity, 8 data bits, 1 stop bit, and no flow control.

The Serial Instrument Set up for the Fluke 45 Multimeter should appear as shown in Figure 2-1.

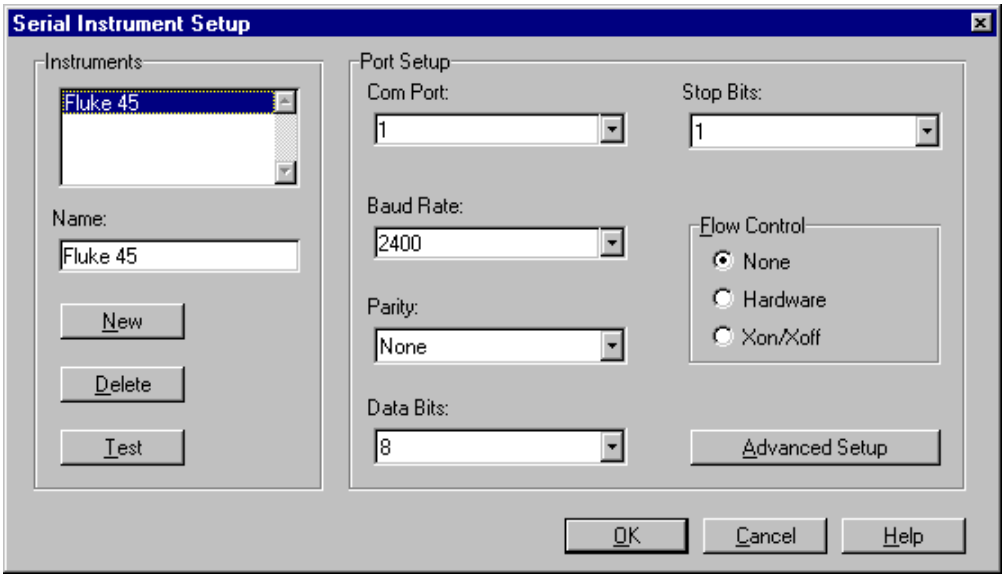


Figure 2-1. Serial Instrument Setup Dialog Box

Example— Test the Instrument Connection

After setting up the instrument, you can test that the instrument is connected and set up properly from the Instrument Set up dialog box.

1. Press the **Test** button to display the Instrument Test dialog box, shown in Figure 2-2. From this dialog box, you can send commands to the instrument and view its response.
2. In the Transmit field, type `val1?` and press Enter**.**
3. The Fluke 45 Multimeter should respond with the current voltage reading. If no response appears from the instrument, try clicking on the **Read Serial Port** button to read the port again. Of course, if you are just following these steps as a tutorial and do not actually have a Fluke 45 Multimeter, there will not be any response. If you do have the Fluke 45 Multimeter, and the instrument still does not respond within a few seconds, refer to Appendix C, *Troubleshooting*.
4. Close the Instrument Test dialog box, by clicking on the **OK** button.

The Serial Instrument Test dialog box should appear as shown in Figure 2-2.

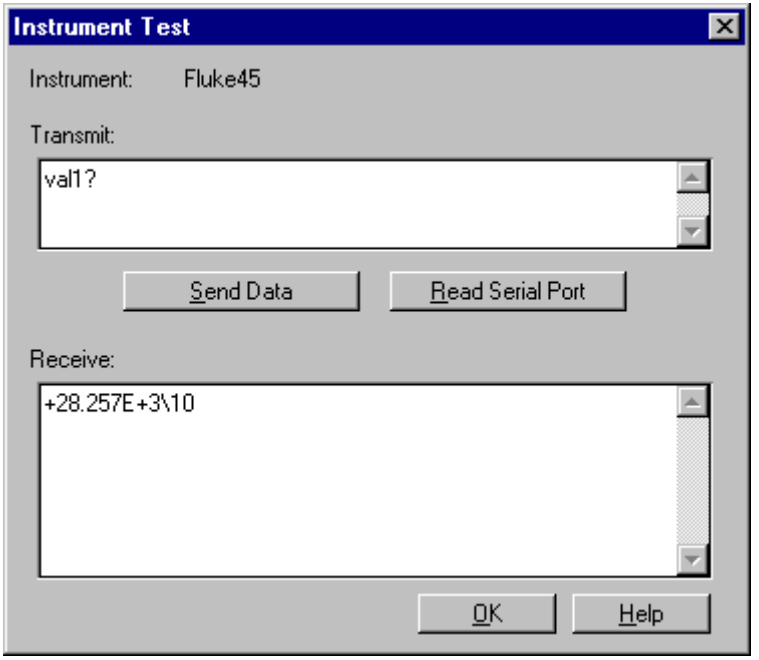


Figure 2-2. Testing the Fluke 45

Tasks

Operations performed on instruments are called *tasks*. There are two types of tasks: capture tasks and transmission tasks. Before you create a task, you must configure an instrument. To create a task, complete the following steps.

1. Select **Serial**»**Tasks** to open the Tasks dialog box.
2. Select the correct instrument from the Instrument drop-down box, and click on the **New Capture** or **New Transmit** button to open a dialog box to set up the task you want Measure to perform.

Capture Tasks

A capture task reads data from an instrument, parses the data into fields, and stores the data in a spreadsheet range.

A capture task is a repeating process that reads data from an instrument, parses the data into fields, and stores the data in a spreadsheet range. When a capture task begins, the following steps occur.

1. If the corresponding checkbox is set, the serial input buffer is cleared.
2. If an Initialization command is given, Measure sends it to the instrument.

A capture task is complete when each of the following steps occurs once for each row in the spreadsheet range.

3. If a command string is given, Measure sends it to the instrument.
4. Measure reads data from the instrument. If fields are defined for the data, the data is parsed into fields. If an end-of-line string is defined for the data, Measure continues to step 3 when the end-of-line string is encountered. If no end-of-line string is defined, Measure continues to step 3 when all the defined fields are read. Delimiting characters take precedence over end-of-line strings. If no end-of-line string is defined and no fields are defined, but you have specified a range to store the results, Measure waits for a Carriage Return (\13) or Line Feed (\10) signal from the device. When any of these standard termination characters are encountered, Measure puts all data before the termination characters in the specified worksheet cell, and throws away the termination characters.

5. The received data is stored in the current row of the given range. If the data was parsed into fields, each field is stored in one column of the current row. If no fields are defined, all received data is put in the first column of the current row. If no range is given, any data received is ignored.
6. If a response string is given, Measure sends it to the instrument.
7. If a delay is given, Measure waits the given number of milliseconds before continuing.
8. The sequence starts again at step 3, using the next row in the range to store the captured data. The task finishes when all rows in the range are used, or no range is given.

If no range is given, Measure executes the sequence one time, and ignores any data received from the instrument. This is a convenient way to send simple commands to the instrument.

Fields

When an instrument reads data using a capture task, often it is useful to parse the data and separate it into fields. A capture task allows you to parse captured data using delimiters (such as commas or semicolons) or by defining the width of each field. If no fields are defined, Measure places all data received into one cell before the end-of-line string is encountered.

Capture Tasks can parse with a delimiter you define, a particular width you define, or the default delimiter.

Parsing by Custom–defined Delimiters

Assume you have an instrument that returns a measurement of two coordinates, x and y. The instrument returns a string of the form `x,y\13\10`, where `x` and `y` each can be from 1 to 5 digits. In this case, the best parsing method is to use delimiters. A solution is to create two fields. The first field has a comma as a delimiter, and the second field has `\13\10` as its delimiter. In this case, no end-of-line characters are used because the fields you defined completely define the data sent by the instrument.

Parsing by Width

When an Ohaus scale is asked for its current weight, it responds with a 20 character string of the following format:

Field	Polarity	Weight	Blank	Mode	Stability	Address	Cr/Lf
Length	1	8	1	5	1	2	2

Picking out the weight field from this string is accomplished by parsing by width because you know the location and width of the data you want. There are several solutions. One solution is to create two fields, the first field being one character wide and the second field being eight characters wide. Additionally, the end-of-line character must be set to \13\10 to indicate the end of a string. All characters between the weight field and \13\10 are thrown away because no fields were defined for them. Another solution is to define three fields, the first field being one character wide, the second field being eight characters wide, and the third field being eleven characters wide. In this case, no end-of-line characters are necessary, because the string returned from the scale is 20 characters wide.

Parsing by the Default Delimiter

Using the default delimiter you can parse data into more fields than originally were defined. The default delimiter is especially useful when an instrument sends multiple fields delimited by the same delimiter. For example, data of the form `x1, x2, x3, x4, x5, x6, x7, x8, x9, x10` could be parsed in two ways. For example, you could create 10 fields, all delimited by commas. A simpler solution, however, would be to create no fields at all, but to set the default delimiter to a comma.

Notice the difference in the way Measure parses the data using each of the two solutions. In the first solution, when you create 10 fields, Measure reads 10 fields from the instrument, no matter how many columns in the range you provide to store the result. If an end of line character is encountered before all 10 fields are read, Measure stops reading the current row and continues with the next row. In the second solution, however, when you use a default delimiter, Measure continues to read fields for the current row until an end of line character is encountered or data for every column in the range has been read.

Transmission Tasks

A transmission task reads data from a spreadsheet range and sends the data to an instrument.

A transmission task is a repeating process that reads data from a spreadsheet and sends it to an instrument. When a transmission task begins, the following steps occur.

1. If the corresponding checkbox is set, the serial input buffer is cleared.
2. If an Initialization command is given, Measure sends it to the instrument.

A transmission task is complete when each of the following steps occurs once for each row in the spreadsheet range.

3. If a command string is given, Measure sends it to the instrument.
4. The data from the first column of the current row of the range is sent to the instrument. If no range is given, this step is skipped.
5. If an end-of-line string is given, Measure sends an end-of-line string to the instrument.
6. If a response string is given, Measure waits for the instrument to send the response string.
7. If a delay is given, Measure waits the given number of milliseconds before continuing.
8. The sequence starts again with step 3, using the next row in the range. The sequence completes when all rows in the range are used, or no range is given.
9. If a repeat count is given, steps 3-8 are repeated the given number of times.

If no range is given, Measure executes the sequence one time, and ignores any data received from the instrument. This is a convenient way to send simple commands to the instrument.

Example—Create an Instrument Capture Task

Now that you have configured and tested the instrument, you can create the necessary tasks. In this example, create a task to switch the multimeter to Volts DC mode. You can create either a capture task or a transmission task. In this case, complete the following steps to create a capture task.

1. Select **Serial**»**Tasks**.
2. Select **Fluke 45** from the **Instrument** drop-down list.
3. Click on the **New Capture** button, and the Capture Task dialog box appears, shown in Figure 2-3.
4. Type `Switch to Volts DC` in the Task Name field.
5. Type `vdc\13` in the **Transmit this command** string field.
6. Type `=>\13\10` in the **Wait for this end-of-line string** field.
7. Click on the **OK** button to close this dialog box, shown in Figure 2-3.

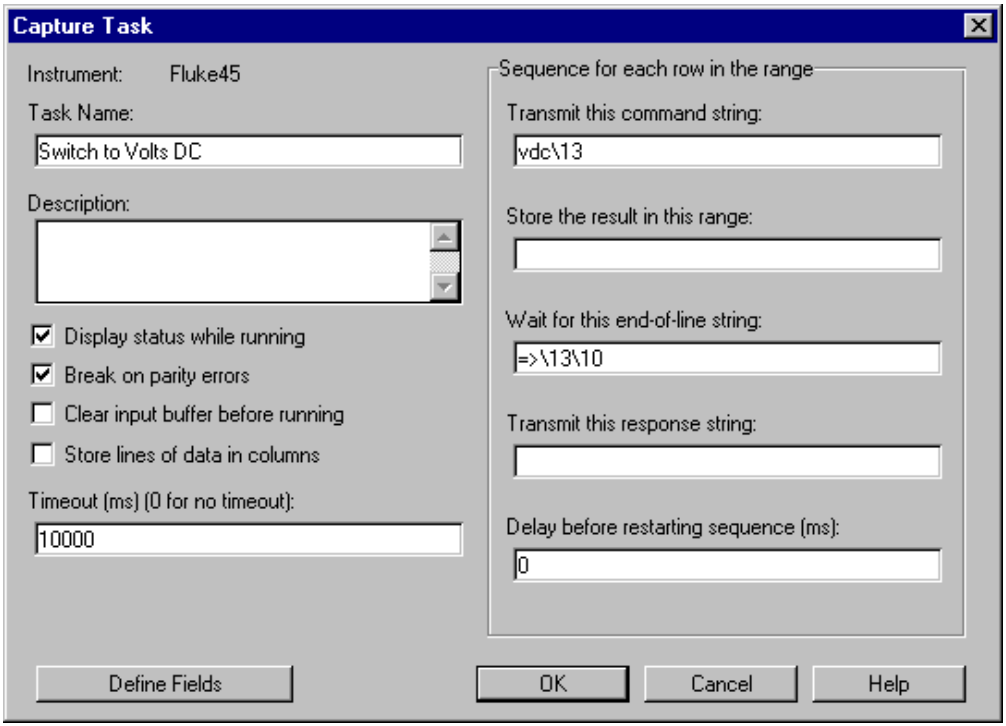


Figure 2-3. Capture Task Dialog Box for Creating a Switch to Volts Task

Example—Create an Instrument Read Task

Now, complete the following steps to create a task to capture the data.

1. Click on the **New Capture** button, and the Capture Task dialog box appears, shown in Figure 2-4.
2. Type `Read` in the **Task Name** field.
3. Type `val1?\13` in the **Transmit this command** string field.
4. Type `a1:a10` in the **Store the result in this range** field.
5. Type `\13\10=>\13\10` in the **Wait for this end-of-line** string field.
6. Type `1000` in the **Delay before restarting sequence** field.
7. Click on the **OK** button to close this dialog box.

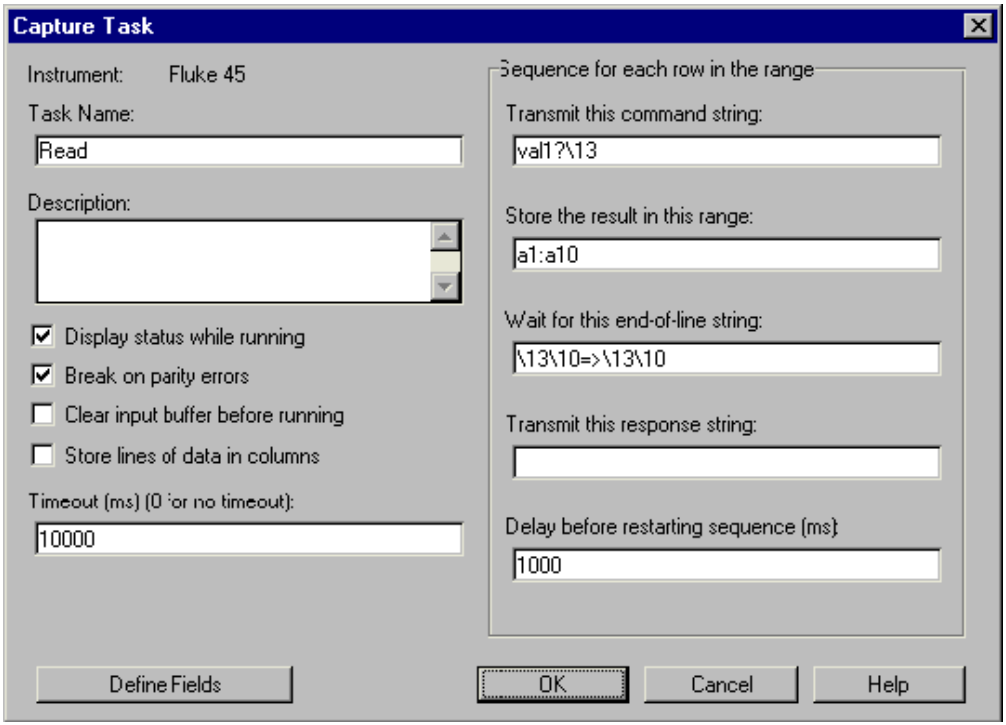


Figure 2-4. Capture Task Dialog Box for Creating a Read Task

Example—Run Your Serial Tasks

Two tasks are defined now from examples 1 and 2, Switch to Volts DC and Read.

To run the tasks from the Tasks dialog box, complete the following steps.

1. Highlight `Switch to Volts DC` and click on **Run** to run the task that tells the multimeter to measure volts DC.
2. Highlight `Read` and click on **Run** to run the task that reads 10 values from the multimeter.
3. When the Read task is finished, Measure copies the data received into the range `a1:a10`.
4. Click on **OK** to close the dialog box.

To run the tasks using VBA, complete the following steps.

1. Close the Tasks dialog box by clicking on **OK**.
2. Select **Macro** from the **Insert** menu in Excel.
3. Select **Module** from the popup menu that appears.
4. Type the following code in the module, as shown in Figure 2-5.

```
Sub Sample()
    Dim result as integer
    result = Application.Run (“Serial”, “Switch to
    Volts DC”)
    result = Application.Run (“Serial”, “Read”)
End Sub
```

Your computer screen should appear as shown in Figure 2-5.

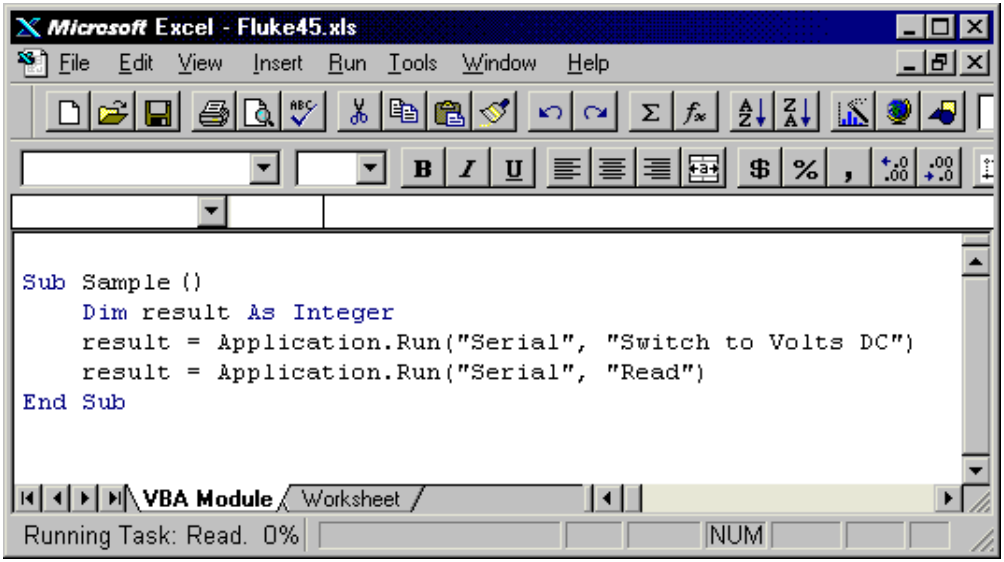


Figure 2-5. VBA code to read data from the Fluke 45

5. Select **Tools**»**Macro**.
6. Select **Sample** from the list box.
7. Click on **Run** to execute the subroutine.
8. Click on the tab at the bottom of the screen corresponding to the worksheet you were on when you added the module, as shown in Figure 2-5.
9. The data is in the range `a1:a10` on the worksheet.

Example—Add Tasks to the Serial Menu

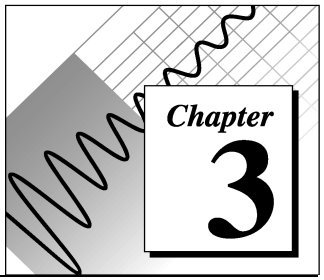
You can add tasks that are run often to the **Serial** menu. To add a task to the menu, complete the following steps.

1. Select **Serial**»**Tasks**.
2. Click on the **Edit Menu** button to display the Edit Menu Tasks dialog box. Use this dialog box to add or remove tasks. When both the Edit Menu Tasks and the Tasks dialog boxes are closed using their **OK** buttons, the tasks are added under the **Serial** menu.
3. To run a task, select it from the menu. When running tasks from the menu, the current selection on the spreadsheet is used as the range of the task. If there is no selection on the active spreadsheet, the range specified in the dialog box is used.

Communication Strings

When communicating with serial instruments, it often is necessary to specify characters that are difficult to print. A good example is the carriage-return character (ASCII 13). For this reason, anytime a string is requested in a text box, Measure accepts a special sequence of characters to specify unprintable characters. The sequence consists of a backslash (`\`) followed by up to three numbers representing the base10 ASCII value of the character. For instance, the carriage-return character (ASCII 13) is represented by the string `\13` or `\013`. To specify the common carriage-return line-feed pair, use the string `\13\10`. To specify the backslash character, use `\\`. For example, the string `\\\13` specifies a backslash and a carriage-return, while `\\13` specifies a backslash followed by a `1` and a `3`.

Serial Task Reference



This chapter describes and outlines procedures for using every menu and dialog box available in the Serial Add-In.

Serial Instrument Setup Dialog Box

Use the Serial Instrument Setup dialog box to configure the communication parameters of instruments that are used with Measure.

You can reach this dialog box by either selecting **Serial»Instruments** or clicking on the **Edit Instruments** button from the Tasks dialog box. Figure 3-1 shows the Serial Instruments Setup dialog box.

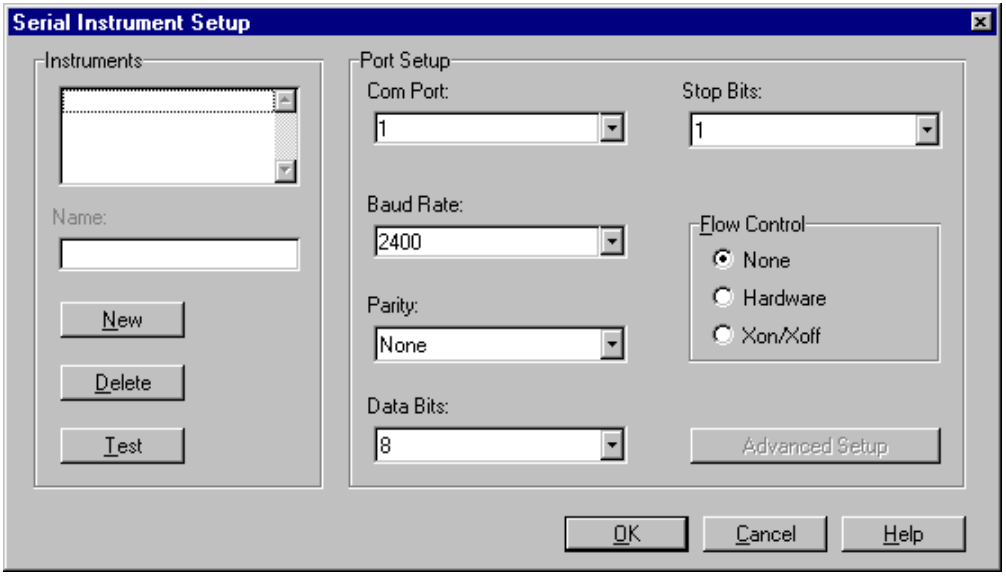


Figure 3-1. Serial Instrument Setup Dialog Box

The Instruments list box contains an entry for each instrument defined in Measure. The controls in the Port Setup group box apply to the instrument currently selected in the list box. Table 3-1, Serial Instruments Setup Options, provides a description of all the options available from the Serial Instruments dialog box.

Table 3-1. Serial Instrument Setup Options

Option	Description
New	Adds a new instrument. The maximum number of instruments is 50.
Delete	Deletes the currently selected instrument.
Test	Tests communications with the instrument.
Com Port	Sets the communications port that the instrument is connected to. The default setting is COM 1. The communications port is usually either 1 or 2, although any number between 1 and 32767 can be entered.
Baud Rate	Sets the baud rate (the speed of data transmission) for asynchronous communications. The baud rate roughly equals the number of bits transmitted per second. The baud rate that you select must match the baud rate of the other computer or device for communications to occur. Choices for the baud rate are 110, 300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 38400, 56000, 128000, and 256000. The default baud rate is 2400.
Parity	Selects the type of error-checking parity scheme to be used during communications. Parity is an optional feature that helps ensure that devices do not miss information that is sent or received. Parity checking is accomplished by sending an additional bit with the data, called the parity bit. The parity bit can be either one or zero, depending on the data and the parity setting. Parity between the computer and the device must match. The parity can be `None`, `Even`, `Odd`, `Space`, or `Mark`.
Data Bits	Selects the length of the data word. The number of bits or length of a data word is specific to each device. Check the documentation of the device to find the length of the data word it sends. The default number of data bits is 7. The number of data bits must be 5, 6, 7, or 8.
Stop Bits	Selects the number of stop bits for a data word. Stop bits are the additional bits that follow each data byte, signaling the end of the byte. The default number of stop bits is 1. The stop bits field must be either 1, 1.5, or 2.
Flow Control	Flow control is a means of regulating the flow of data between devices. It allows communications to occur between devices that process data at different rates. Hardware flow control uses pins in the serial interface to control and monitor data flow. Software flow control uses a special character to cause the sender to pause sending data and a different

Flow Control (continued)	character to cause the sender to resume sending data. The flow control setting must match the flow control that the instrument implements. For hardware flow control, be sure that the pin connections are correct for the two devices. Refer to Appendix A for additional information. For more flow control options, see the Advanced Setup dialog box.
Advanced Setup	Opens the Advanced Setup dialog box, which allows you to setup flow control, buffer size, parity error, and lag features.

Instrument Test Dialog Box

Use the Instrument Test dialog box to test communications between Measure and the instrument.

You can reach this dialog box, shown in Figure 3-2, by clicking on the **Test** button on the Instrument Setup dialog box.

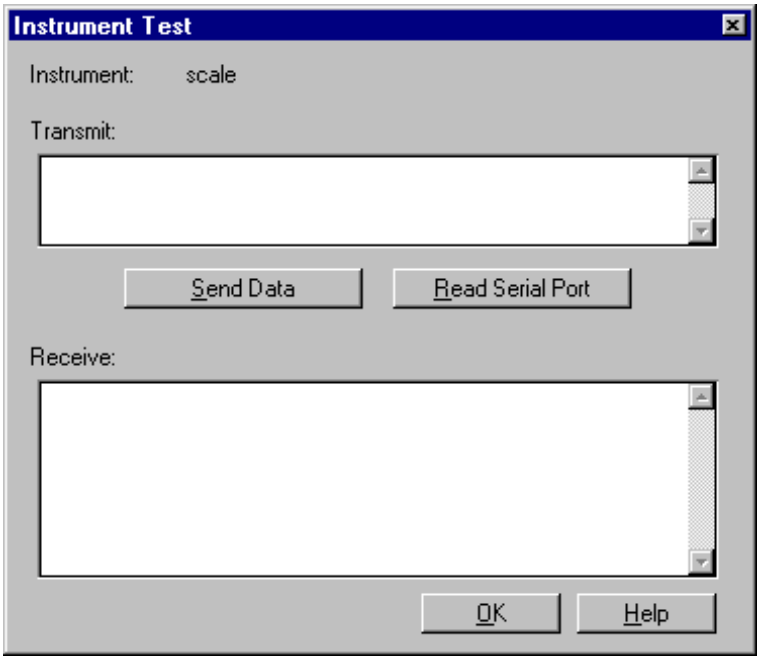


Figure 3-2. Instrument Test Dialog Box

Data typed in the Transmit edit box is sent to the instrument when you click on the **Send Data** button or press the Enter key while the cursor is in the Transmit edit box. If you press the Enter key, Measure sends the

text in the Transmit edit box along with the carriage-return/ line-feed string `\13\10` to the instrument.

After transmitting the data, Measure waits for about 1 second, then displays any data received from the instrument in the Receive edit box. Occasionally, the instrument takes more than 1 second to respond. In that case, press the **Read Data** button to query the instruments for data again.

Table 3-2, Instrument Test Options, provides a description of all the options available from the Serial Instruments Setup dialog box.

Table 3-2. Instrument Test Options

Option	Description
Transmit edit box	Type the text to send to the instrument in this edit box. When you press the Enter key, Measure sends the text in this edit box along with a carriage return/linefeed string \13\10 to the instrument. Measure then waits about 1 second, reads the serial port, and puts the results in the Receive edit box. If the instrument takes longer than 1 second to respond, click on the Read Serial Port button to read the data from the instrument.
Receive edit box	When data is read from the instrument, Measure puts it here. Typing in this edit box has no effect.
Send Data	Sends the data in the Transmit edit box. Measure sends the data, waits about 1 second, reads the serial port, and puts the results in the Receive edit box.
Read Serial Port	Forces Measure to read any data available from the instrument.. The data is added to the data in the Receive edit box

☞ **Note:** ***The Receive edit box displays only the first 255 characters received.***

Advanced Instrument Setup Dialog Box

Use the Advanced Instrument Setup dialog box to configure advanced communications parameters for an instrument.

You can reach this dialog box, shown in Figure 3-3, by clicking on the **Advanced Setup** button from the Serial Instrument Setup dialog box.

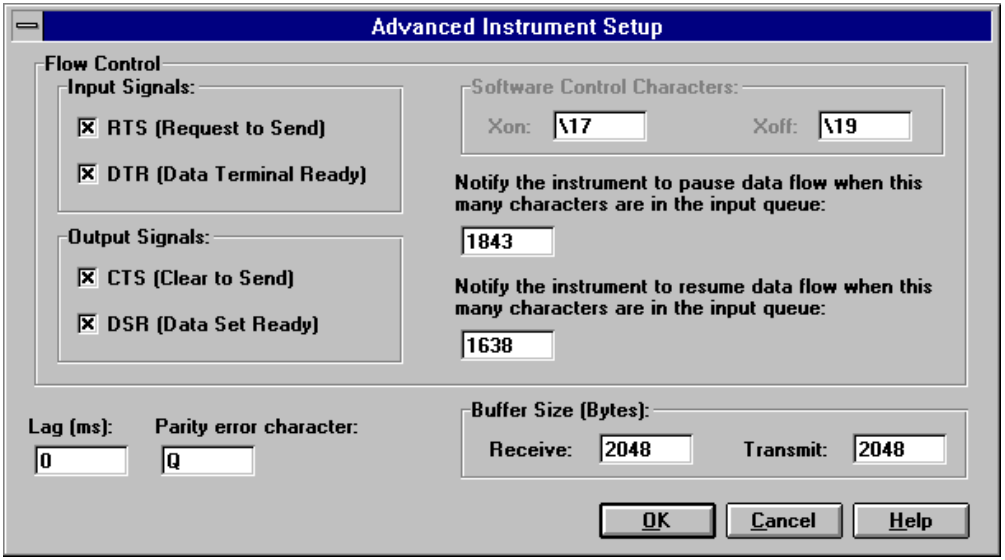


Figure 3-3. Advanced Instrument Setup Dialog Box

The options available from the Advanced Instrument Setup dialog box are shown in Table 3-3.

Table 3-3. Advanced Instrument Setup Options

Option	Description
Input Signals	Determines which signals Measure drives to control the flow of data from the instrument to the computer. If RTS is checked, Measure drives RTS low when it wants the instrument to pause sending data, and drives RTS high when it wants the instrument to continue sending data. The DTR checkbox behaves in the same manner.
Output Signals	Determines which signals Measure responds to when transmitting data to the instrument using hardware flow control. If CTS is checked, Measure sends data only when CTS is high. The DSR check box behaves in the same manner. If they are both checked, Measure sends data only when both CTS and DSR are high.
Software Control	Specifies the character used to pause or resume the transfer of data between Measure and the instrument when software flow control is in use.
Flow Control Points	Specifies at what point Measure asks the instrument to pause sending data and at what point Measure asks the instrument to resume sending data.

Buffer Sizes	Specifies the size of both the transmission buffer and the receive buffer. Measure buffers characters sent to or received from the instrument. A lower buffer size uses less memory.
Lag	Causes Measure to wait the given number of milliseconds between the transmission of successive characters. For example, when asked to transmit the string 123 with a lag of 100 ms, Measure transmits a 1, waits 100 ms, transmits a 2, waits 100 ms,... Time is accurate to approximately 100 ms.
Parity Error Character	Sets the parity error character. The character in this edit box is added to the input buffer ahead of any characters which are received with parity errors. For example, if the parity character is `*` and the data returned from the instrument is 123, Measure reads the string `1*23` if there is a parity error reading the 2. If you do not want to use this feature, leave this field blank. This edit box is only available if the instrument has a parity setting other than None.

Tasks Dialog Box

Use the Tasks dialog box, shown in Figure 3-4, to manage tasks associated with instruments. From this dialog box, you can create, run, edit, or delete tasks. Also, you can use the Serial Instrument Setup dialog box to edit instruments and the Menu Tasks dialog box to edit the menu.

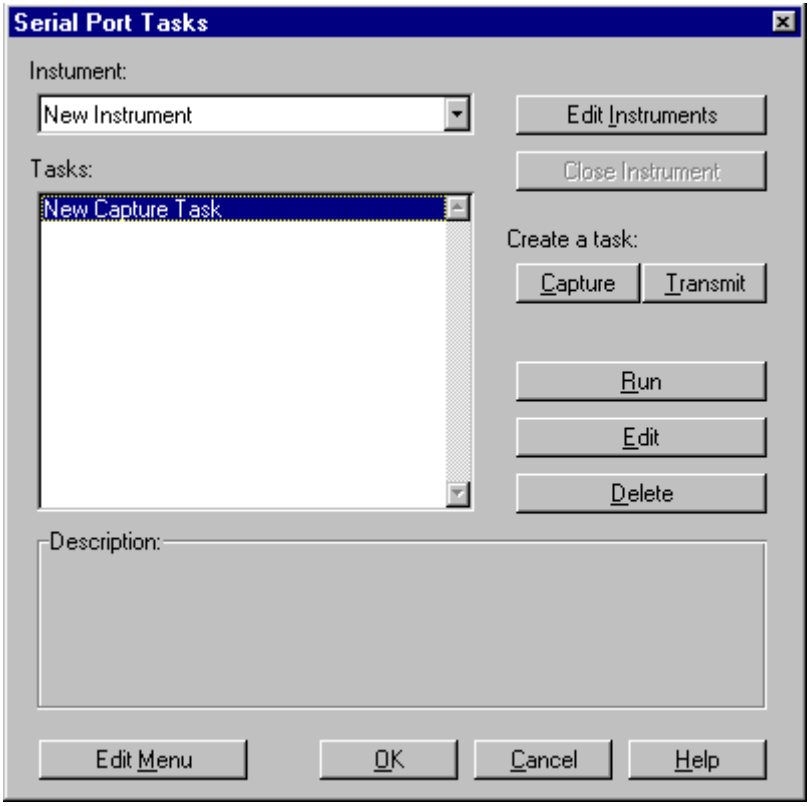


Figure 3-4. Serial Port Tasks Dialog Box

The options available from the Serial Port Tasks dialog box are shown in Table 3-4.

Table 3-4. Serial Port Task Options

Option	Description
Instrument list box	Contains all the instruments defined in Measure.
Tasks list box	Contains all the tasks defined for the currently selected instrument.
Edit Instruments	Edits the instruments defined in Measure.
Close Instrument	Closes the instrument selected in the instrument list box
New Capture	Creates a new capture task for the currently selected instrument. There is a maximum of 200 tasks per instrument.

New Transmit	Creates a new transmit task for the currently selected instrument. There is a maximum of 200 tasks per instrument.
Run	Runs the currently selected task.
Edit	Edits the currently selected task.
Delete	Deletes the currently selected task.
Description	Contains a description of the currently selected task.
Edit Menu	Edits the list of tasks that appear on the Serial menu.

Capture Task Dialog Box

Use the Capture Task dialog box, shown in Figure 3-5, to edit capture tasks. To reach this dialog box, click on **New Capture** from the Tasks dialog box, or select a capture task on the Tasks dialog box and click on the Edit button.

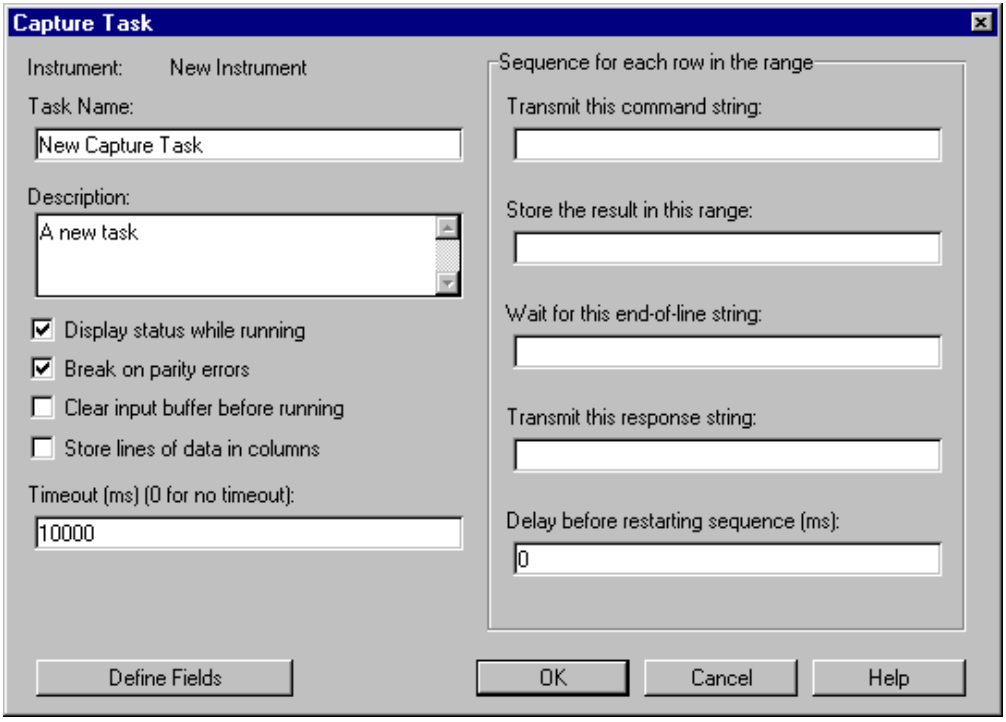


Figure 3-5. Capture Task Dialog Box

The options available from the Capture Task dialog box are shown in Table 3-5.

Table 3-5. Capture Task Dialog Box Options

Option	Description
Task Name	Type the task name here. No two tasks can have the same name.
Description	The description appears in the Description field of the Tasks dialog box, and if this task is added to the menu, the description appears on the status bar when the task is selected. This field can be left blank.
Display status	Determiones whether the Status dialog box while the task is running. Measure displays the current progress of a running task on the status bar regardless of the state of this checkbox.
Break on parity errors	Determines how Measure responds when a parity error occurs during communication. If checked, Measure stops the task and displays a dialog box indicating that a parity error occurred. Otherwise, Measure ignores parity errors while this task is running.
Clear Input Buffer	Determines if Measure will ignore data peviously stored in an input buffer. Measure stores data read from an instrument in an input buffer until the data is read by taks. Specifies whether Measure should send a Serial Clear command to the instrument before running the task.
Timeout	Determines how long Measure will wait for an instrument to send data. Setting the timeout to zero causes Measure to wait indefinitely. When Measure executes a task, clicking on Q interrupts that task.
Command string	Sets the command string is to be that sent to the instrument. This field can be left blank. Refer to the section in Chapter 2 on communications strings for help creating this string.
Result range	Determines the range that a task uses. The data read from the instrument is parsed into fields and stored in a row of this range. Measure executes the task sequence once for each row in this range. If this field is left blank, Measure executes this sequence once, ignoring any data that is read from the instrument. Leaving the range blank is useful for sending commands that set the instrument to a certain mode. See the section on Ranges for help on specifying the range.
End-of-line string	If no end-of-line string is defined, and no fields are defined, but you have specified a range to store the results, Measure waits for a Carriage Return (\13), or a Line Feed (\10) signal from the device. When any of these standard termination characters are encountered, Measure places all data before the termination characters in the specified worksheet cell, and throws away the termination characters.

Response string	Sets the string that Measure sends to the instrument after the end-of-line string is encountered or after all fields have been read if the end-of-line string was not defined. This field can be left blank.
Delay	Determines how long Measure waits before starting the process again with the next row in the range. Time is only accurate to approximately 100 ms.
Define Fields	Open the Define Fields dialog box.

Transmission Task Dialog Box

Use the Transmission Task dialog box, shown in Figure 3-6, to edit capture tasks. To reach this dialog box, click on **New Transmit** from the Tasks dialog box, or select a transmit task on the Tasks dialog box and click on the **Edit** button.

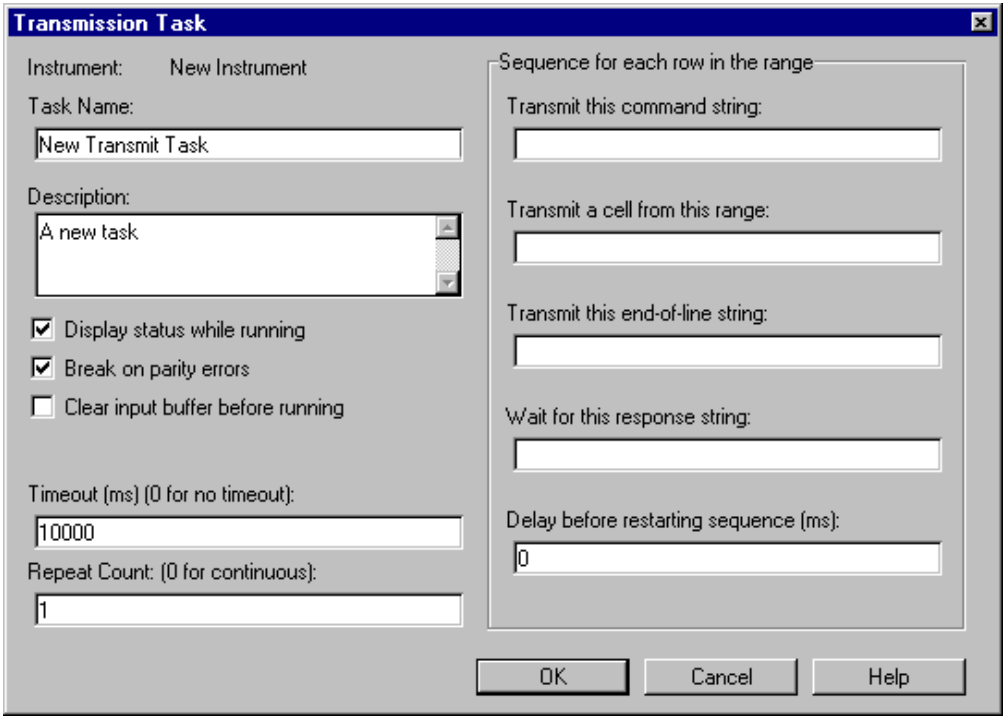


Figure 3-6. Transmission Task Dialog Box

The options available from the Transmission Task dialog box are shown in Table 3-6.

Table 3-6. Transmission Task Dialog Box Options

Option	Description
Task Name	Type the task name here. No two tasks can have the same name.
Description	Type a description of the task here. The description appears in the Description field of the Tasks dialog box, and if this task is added to the menu, the description appears on the status bar when this task is selected. This field can be left blank.
Display status	Determines if Measure displays the Status dialog box while the task is running. Measure displays the current progress of a running task on the status bar, regardless of the state of this checkbox.
Break on parity errors	Determines how Measure responds when a parity error occurs during communication. If checked, Measure stops the task and displays a dialog box indicating that a parity error occurred. Otherwise, Measure ignores parity errors while this task is running.
Clear Input Buffer	Determines if Measure ignores data previously stored in an input buffer. Specifies that Measure should send a Serial Clear command to the instrument before running the task.
Timeout	Determines how long Measure will wait for an instrument to send data. Setting the timeout to zero causes Measure to wait indefinitely. When Measure executes a task, clicking on Q interrupts the task.
Repeat Count	Determines how many times Measure runs a task. For example, setting the repeat count to 5 causes Measure to execute the task five times. If the repeat count is 0, Measure runs the task indefinitely. When Measure executes a task, clicking on Q interrupts the task.
Command String	Sets the comand that will be sent to the instrument. This field can be left blank. Refer to the section on communication strings for help in creating this string.
Transmission Range	Determines the range that a task uses. Measure executes the task sequence once for each row in this range. If the range is blank, Measure executes the sequence once. Leaving the range blank is useful for sending commands that set the instrument to a certain mode. See the Ranges section for help on specifying the range.
End-of-line String	Marks the end-of-line of data sent to the instrument. This field can be left blank. Refer to the section on Communication Strings for help creating this string.

Response String	Determines if Measure will wait for the instrument to respond with a response string. The timeout value determines how long Measure waits without signaling an error. If this field is blank, Measure skips this step of the sequence. Refer to the section on communication strings for help creating this string.
Delay	Determines how long Measure waits before starting the process again with the next row in the range. Time is accurate to approximately 100 ms.

Define Fields Dialog Box

Use the Define Fields dialog box, shown in Figure 3-7, to set up how the Serial Add-In parses data using a capture task.

To reach this dialog box, click on the **Define Fields** button from the Serial Capture Task dialog box.

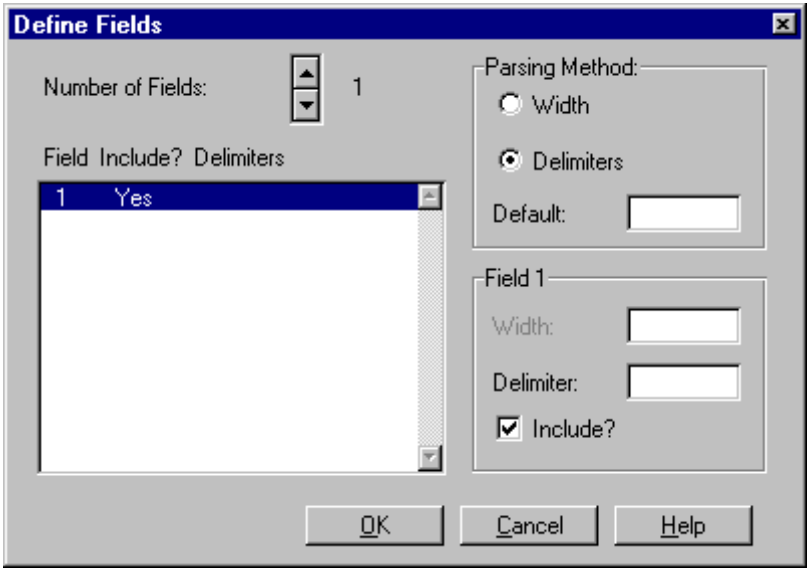


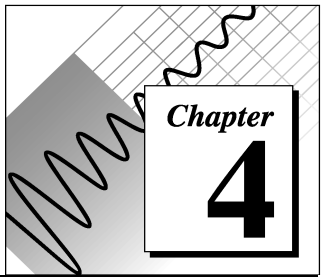
Figure 3-7. Define Fields Dialog Box

The options available from the Define Fields dialog box are shown in Table 3-7.

Table 3-7. Define Fields Dialog Box Options

Option	Description
Number of Fields	Determines how many fields the data breaks into.
List Box	Contains an entry for each field that has been defined.
Parsing Method: Width	If selected, Measure parses data into fields based on the width given for each field.
Parsing Method: Delimiters	If selected, Measure parses data into fields based on the delimiter for each field.
Default Delimiters	Sets the delimiter Measure uses by default.
Field: Delimiter	Sets the delimiter that Measure uses to determine the end of this field.
Field: Width	Sets the width of the currently selected field.
Include	Determines whether Measure should store the currently selected field in the spreadsheet or ignore it once it is read.

Using Measure Serial Tasks with VBA



This chapter describes the functions that the Serial Add-In adds to Visual Basic for Applications (VBA), the programming language built into Microsoft Excel.

Calling Functions from VBA

There are two ways to execute the VBA functions provided by the Serial Add-In.

1. Use the Excel method `Application.Run`.

As long as the Serial Add-In is added as an add-in, the functions are called using the following syntax.

```
result = Application.Run ("FunctionName",
argument1, argument2, argument3, ...)
```

A few examples are listed below.

```
result = Application.Run("Serial", "Read some
data", "sheet1!a1:a50")
```

```
result =
Application.Run("serial.xla!CloseInstrument",
"MyInstrument")
```

```
Application.Run "Serial", "Read some data"
' Note: ignores return value
```

2. Add a reference to the Serial Add-In, then call the functions directly.

To add a reference, you must have a module open instead of a worksheet. To insert a new module, select **Insert**»**Macro**»**Module**.

To add a reference to the Serial Add-In, select **Tools**»**References**. Put a check in the checkbox next to `serial.xla`, and click on **OK**.

Now, the functions from the Serial Add-In are called directly, as in the following examples.

```
result = RunTask("Read some data",
"sheet1!a1:a50")

result = CloseInstrument("MyInstrument")

RunTask "Read some data" ' Note: ignores return
value
```

☞ **Note:** ***The file*** `ser_cons.txt` ***contains the constants returned by the Measure VBA functions.***

Serial Add-In Functions

The Serial Add-In defines the following eight functions that are called from a VBA module.

- CloseInstrument
- FlushInputBuffer
- FlushOutputBuffer
- GetInputBufferLength
- GetMeasureError
- GetMeasureOpenError
- GetOutputBufferLength
- Serial

Each function is listed below with details of its use.

CloseInstrument

Closes the specified instrument if it is open. This command has no effect if the instrument is not open.

Syntax

```
Function CloseInstrument (sInstrumentName as string) as
                          Integer
```

Parameters

Parameter Name	Description
sInstrumentName	Name of the instrument to close.

Return Value

For a list of return values, see Table B-3, *Measure VBA Return Values*, in Appendix B, *Error Messages*.

FlushInputBuffer

Clears all characters not already removed from the input buffer of the specified instrument.

Syntax

```
Function FlushInputBuffer (sInstrumentName As String) As
                           Integer
```

Parameters

Parameter Name	Description
sInstrumentName	Name of the instrument.

Return Values

For a list of return values, see Table B-3, *Measure VBA Return Values*, in Appendix B, *Error Messages*.

FlushOutputBuffer

Clears all characters not already sent to the specified instrument yet.

Syntax

```
Function FlushOutputBuffer(sInstrumentName As String) As
                           Integer
```

Parameters

Parameter Name	Description
sInstrumentName	Name of the instrument.

Return Values

For a list of return values, see Table B-3, *Measure VBA Return Values*, in Appendix B, *Error Messages*.

GetInputBufferLength

Returns the number of characters waiting to be read from the input buffer of the specified instrument.

Syntax

```
Function GetInputBufferLength(sInstrumentName As String) As
                              Integer
```

Parameters

Parameter Name	Description
sInstrumentName	Name of the instrument.

Return Value

If positive, the number of characters waiting. If negative, see Table B-3, *Measure VBA Return Values*, in Appendix B, *Error Messages*.

GetMeasureError

This function should be called after a Measure function returns MEASURE_ERROR.

Syntax

```
Function GetMeasureError() as Integer
```

Parameters

This function has not parameters.

Return Value

If there was no error, 0 is returned. Otherwise, Measure returns a combination of error bits. For a list of return values, see Table B-1, *Communication Return Values*, in Appendix B, *Error Messages*.

GetMeasureOpenError

This function should be called after a call to the Measure function RunTask returns MEASURE_OPENERROR.

Syntax

```
Function GetMeasureOpenError() As Integer
```

Parameters

This function has no parameters.

Return Value

If there was no error, 0 is returned. Otherwise, Measure returns a negative value. For a list of possible return values, see Table B-2, *Open Instrument Return Values*, in Appendix B, *Error Messages*.

GetOutputBufferLength

Returns the number of characters waiting to be sent to the given instrument.

Syntax

```
Function GetOutputBufferLength (sInstrumentName As String)
                                As Integer
```

Parameters

Parameter Name	Description
sInstrumentName	Name of the instrument.

Return Value

If positive, The buffer length is the number of characters waiting. If negative, see Table B-3, *Measure VBA Return Values*, in Appendix B, *Error Messages*.

Serial

Executes the named task. If `sRange` is not given, the default range of the task is used. Otherwise, the given range is used.

Syntax

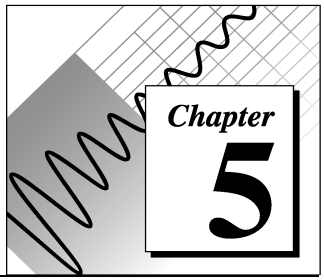
```
Function Serial (sTaskName As String, Optional sRange As
                 Variant, Optional ReferenceStyle as String) As
                 Integer
```

Parameters:

Parameter Name	Description
sTaskName	Name of the task to run
sRange	String representing the range to use when running the task. **sRange** should be of the form `sheetname!a1:a50`, where `sheetname!` is optional. If **sRange** is omitted, Measure uses the range defined for the task in the dialog box.
ReferenceStyle	Use either `xlA1` or `xlR1C1` to indicate the type of range address being passed into sRange. If this parameter is missing, Excel's current reference type is assumed.

Return Value

For a list of return values, see Table B-3, *Measure VBA Return Values*, in Appendix B, *Error Messages*.



Serial Technical Reference

This chapter lists technical information about the Serial Add-In.

Closing the Serial Port

When you run a task is run, Measure opens the serial port and leaves it open until one of the following events occurs.

1. You click on the Close Instrument button on the Serial Port Tasks dialog box.
2. You close Measure or Excel.
3. You open the Setup Instruments dialog box.
4. The VBA function `CloseInstrument` is called.
5. A task from another instrument using the same port is executed.
6. You switch workbooks from within Excel.

As long as the serial port is open, Measure buffers any data read from the instrument, even if a task is not running.

Time

Although times are specified in milliseconds, the accuracy is only approximately 100 ms. This increased delay is caused by the overhead and latency of Windows, Excel, and VBA.

Baud Rate and Character Format

The transmission speed of the Serial Add-In depends on the baud rate setting you have selected. The baud rate is the number of bits per second transferred through the serial port.

When setting the baud rate, it is helpful to consider the throughput, or characters per second, for transmitted or received data. There are many formats that a single character can have and the format of the character determines how many bits are needed to describe it. To calculate throughput, you need to know the format of the characters to be sent. Characters are generally made up of four groups or sets of bits, described in Table 5-1.

Table 5-1. Character Format Bits

Byte Position	Number of Bits
Start bit	always 1.
Parity bit	0 if no parity or 1 if any other parity setting.
Character bits	5, 6, 7, or 8 bits.
Stop bits	1, 1.5, or 2.

Once you determine the character length, you can use the following equation to calculate the theoretical throughput for any baud rate.

Throughput (characters per second) = baud rate (bits / sec) / character length (bits / character)

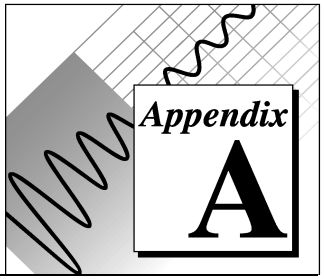
For example, at a baud rate of 2400 with a character length of 10 bits, 240 characters / second are transferred.

240 characters / sec = 2400 (baud) / 10 (bits / character)

The actual throughput can be less than the theoretical value depending on a number of other transmission settings. Any of the following can reduce the throughput rate.

- End-of-line string—Each time the end of a line is reached, the end-of-line string is transmitted, adding to the total character count.
- Response Character—Measure waits for the response character to be received after every line is transmitted before sending the next line, slowing transmission.

- Flow controls—If either Measure or the instrument has to pause data flow, transmission is slowed.
- Delay—The number of seconds added to the transmission after each end-of-line. The effect that a delay has on transmission throughput is a function of the number of lines of data that you are transmitting. Because delay works by delaying lines sent, the more lines that are sent, the more impact the delay has on throughput.
- Lag—The number of milliseconds the Serial Add-In is instructed to wait after each character is transmitted.



Serial Connector Pinouts

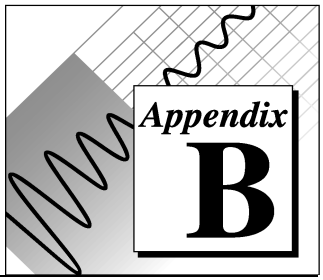
This appendix lists the pin assignments of common serial connectors. Notice that many instruments do not use all the pins. Also, many instruments have different pin assignments. Consult your instrument's documentation for the correct pin assignments.

Pin Assignments For the 9-Pin RS-232 Connector Generally Used on PCs

Pin	Function
1	Data Carrier Detect (DCD)
2	Received Data (RxD)
3	Transmit Data (TxD)
4	Data Terminal Ready (DTR)
5	Common (Must be connected)
6	Data Set Ready (DSR)
7	Request to Send (RTS)
8	Clear to Send (CTS)
9	Ring Indicator

Relevant Pin Assignments For a 25-pin RS-232 Connector

Pin	Function
2	Transmit Data (TxD)
3	Received Data (RxD)
4	Request to Send (RTS)
5	Clear to Send (CTS)
6	Data Set Ready (DSR)
7	Common (Must be connected)
8	Data Carrier Detect (DCD)
20	Data Terminal Ready (DTR)



Error Messages

This appendix describes the errors that can be encountered while using the Serial Add-In.

Communications Errors

The errors described in the following table can occur at any time while communicating with the instrument. When using VBA, the function `GetMeasureError` returns these error messages. Notice that the first column of the table contains the bit in base 10. For more information about this function, see Chapter 4, *Using Measure Serial Tasks with VBA*.

Table B-1. Communication Return Values

Return Value	Error	Description
1	CE_RXOVER	Input buffer overflow. This error occurs when the input buffer is full, and the device is sending data faster than it can be parsed and stored. Using flow control prevents input buffer overflow.
2	CE_OVERRUN	Input buffer overflow. This error occurs when a transmission rate is too fast. The next character from a device arrived before the previous character has been taken from the asynchronous port register and been placed in the buffer. Occasionally this error is caused by a baud rate setting that does not match the baud rate of the device. Check the documentation of the device to be sure you are using the correct baud rate.
4	CE_RXPARITY	Hardware detected a parity error. This could be caused by a genuine parity error, or by a parity setting that does not match the parity of the device. Check the documentation of the device and enter the correct setting.

8	CE_FRAME	A framing error occurred. This occurs when synchronization fails on a serial link.
16	CE_BREAK	Hardware detected a break condition.
32	CE_CTSTO	Timeout occurred while waiting for the CTS (clear-to-send) signal.
64	CE_DSRTO	Timeout occurred while waiting for the DSR (data-set-ready) signal.
128	CE_RLSDTO	RLSD (receive-line-signal-detect) timeout.
256	CE_TXFULL	The transmission queue was full when a function attempted to queue a character.
512	CE_PTO	A timeout occurred during an attempt to communicate with a parallel device.
1024	CE_IOE	I/O error on a parallel device.
2048	CE_DNS	Parallel device was not selected.
4096	CE_OOP	Out of paper on a parallel device.
32768	CE_MODE	A requested device mode is not available.

Errors Encountered While Opening an Instrument

The errors described in the following table can occur when an instrument is opened. When using VBA, the function `GetMeasureError` returns these error messages. For more information about this function, see Chapter 4, *Using Measure Serial Tasks with VBA*.

Table B-2. Open Instrument Return Values

Return Value	Error	Description
-1	IE_BADID	Invalid device identifier.
-2	IE_OPEN	The device is already open.
-3	IE_NOPEN	The device cannot be opened.
-4	IE_MEMORY	Insufficient memory for input and output buffers.
-5	IE_DEFAULT	The default parameters are invalid.
-10	IE_HARDWARE	The device is not available.

-11	IE_BYTESIZE	The byte size is invalid.
-12	IE_BAUDRATE	Invalid baud rate.

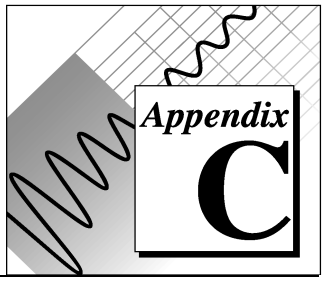
Measure VBA Errors

Calls to the VBA functions RunTask, CloseInstrument, FlushInputBuffer, FlushOutputBuffer, GetInputBufferLength, and GetOutputBufferLength return one of the values contained in the following table. For more information about these functions, refer to Chapter 4, *Using Measure Serial Tasks with VBA*.

Table B-3. Measure VBA Return Values

Return Value	Error	Description
0	MEASURE_OK	The command completed successfully
-1000	MEASURE_NOTFOUND	The given task or instrument was not found.
-1001	MEASURE_INVALIDRANGE	The given range is invalid.
-1002	MEASURE_TIMEDOUT	The task timed out while waiting for data from the instrument.
-1003	MEASURE_INTERRUPTED	The user interrupted the task.
-1004	MEASURE_PARITYERROR	A parity error occurred.
-1005	MEASURE_ERROR	An communications error occurred while communicating with the instrument. Call GetMeasureError to determine the error.
-1006	MEASURE_OPENERROR	An error occurred while opening the instrument. Call GetMeasureOpenError to determine the error.
-1007	MEASURE_INSTRUMENTNOTOPEN	The specified instrument is not open.

Troubleshooting



This appendix provides help for some common problems encountered when working with serial instruments.

When Measure does not control the instrument correctly, use the Test dialog box as outlined below.

1. Select **Serial»Instruments**.
2. Select the correct instrument in the Instruments list box.
3. Click on the **Test** button to display the Instrument Test dialog box.

The steps to take next depend on the instrument you are using. Look through the manual for your instrument and find a command string that the instrument responds to. For instance, the Fluke 45 multimeter accepts the command `val1?\13` and returns the value of the multimeter. The Ohaus scale accepts the command `P\13` and responds with a 20 character record containing the current weight.

To test the Fluke 45, complete the following steps.

1. Type `val1?\13` in the Transmit edit box.
2. Click on **Send Data**. If nothing appears in the Receive edit box, try clicking on **Read Serial Port**. If nothing appears in the Receive edit box, make sure the string you typed is recognized by the instrument. Be sensitive to case, for instance the command `P\13` may be correct, while `p\13` may not. Some instruments respond with an error string when they receive incorrect commands, while other instruments simply ignore unknown commands. If you are certain the instrument should respond to the string you typed, follow the steps below to help diagnose the problem.

Testing the Serial Port

One way to test a serial port is to disconnect the instrument and connect pins two and three from the serial port together. To do this test, complete the following steps.

1. Select **Serial»Instruments**. Click on **New** to create a new instrument.
2. Select the correct communications port and set the flow control field to `None`. Leave the other communications fields at their defaults.
3. Click on **Test** to display the Test Instrument dialog box. If you get an error, refer to the section below discussing what to do when this test fails. Otherwise, when the Test Instrument dialog box appears, type a few letters in the Transmit edit box, and click on the **Send Data** button. If all the parameters are set up correctly, the string you typed should appear in the Receive edit box. Notice that some characters in the Receive edit box might be printed as escape sequences. For example, space prints as `\32`, and Enter prints as `\13\10`.

If the string you typed appeared in the Receive edit box, one of the following problems is most likely the cause.

1. The cable is incorrectly wired or there is a loose connection. This is by far the most common problem encountered when working with serial instruments. Refer to the instructions that came with your instrument and the table of serial connector pinouts in this manual to correctly connect the instrument to the computer.
2. Flow control is set incorrectly, or the required flow control pins between the instrument and the computer are not connected correctly. Instruments vary widely in their use of flow control. Refer to the instructions that came with your instrument to determine which pins are used for flow control.
3. Parity, baud rate, data bits, or stop bits is set incorrectly. The instructions that came with your instrument should list the communications parameters that your instrument uses. The required parameters may be listed in the form 2400-O-7-1, meaning 2400 baud, odd parity, 7 data bits, and 1 stop bit.

If the string you typed did not appear in the Receive edit box, one of the following problems is likely the cause.

1. The communications port (com port) setting in Measure is incorrect or the com port is configured incorrectly in Windows. It is likely that you got the message, `Unable to open com port X, the device is not available`. Many computers have two serial (com) ports, accessed as com 1 and com 2. Under Microsoft Windows, the address and interrupt associated with each com port must be defined before the ports are used.

   To configure a com port in Windows, complete the following steps.

   a. Close Excel, find the Control Panel icon, and double-click on it.

   b. Find the Ports icon and double-click on it.

   c. If the port you want to use is not defined, click on the **Add** button to add a new port. Common settings for com 1 are: I/O Address: 3f8, IRQ: 4. Common settings for com 2 are: I/O Address: 2f8, IRQ: 3.

   d. If the port you want to use is defined, select the correct port and click on the **Settings** button, then click on the **Advanced** button. Refer to the common settings for com 1 and com 2 above to determine if your com ports are configured correctly.

2. If you get the message `Unable to open com port X, the device cannot be opened`, the com port you selected is in use by another program.

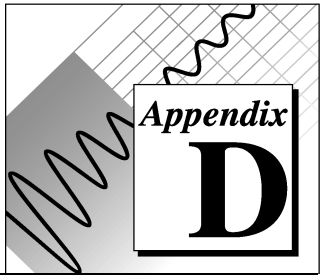
   In this situation, try the following steps until the problem is resolved.

   a. Close all other applications in Windows and try the test again.

   b. If closing all other applications does not work, try closing and restarting Excel.

   c. If restarting Excel still does not work, try quitting and restarting Windows.

Customer Communication



For your convenience, this appendix contains forms to help you gather the information necessary to help us solve technical problems you might have as well as a form you can use to comment on the product documentation. Filling out a copy of the *Technical Support Form* before contacting National Instruments helps us help you better and faster.

National Instruments provides comprehensive technical assistance around the world. In the U.S. and Canada, applications engineers are available Monday through Friday from 8:00 a.m. to 6:00 p.m. (central time). In other countries, contact the nearest branch office. You may fax questions to us at any time.

Electronic Services

Bulletin Board Support

National Instruments has BBS and FTP sites dedicated for 24-hour support with a collection of files and documents to answer most common customer questions. From these sites, you can also download the latest instrument drivers, updates, and example programs. For recorded instructions on how to use the bulletin board and FTP services and for BBS automated information, call (512) 795-6990. You can access these services at:

United States: (512) 794-5422 or (800) 327-3077
Up to 14,400 baud, 8 data bits, 1 stop bit, no parity

United Kingdom: 01635 551422
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

France: 1 48 65 15 59
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

FTP Support

To access our FTP site, log on to our Internet host, `ftp.natinst.com`, as anonymous and use your Internet address, such as `joesmith@anywhere.com`, as your password. The support files and documents are located in the /`support` directories.

FaxBack Support

FaxBack is a 24-hour information retrieval system containing a library of documents on a wide range of technical information. You can access FaxBack from a touch-tone telephone at the following number:

(512) 418-1111

E-Mail Support (currently U.S. only)

You can submit technical support questions to the appropriate applications engineering team through e-mail at the Internet addresses listed below. Remember to include your name, address, and phone number so we can contact you with solutions and suggestions.

```
MEASURE: measure.support@natinst.com      DAQ: daq.support@natinst.com
GPIB: gpib.support@natinst.com
```

Fax and Telephone Support

National Instruments has branch offices all over the world. Use the list below to find the technical support number for your country. If there is no National Instruments office in your country, contact the source from which you purchased your software to obtain support.

	 **Telephone**	 **Fax**
Australia	03 9 879 9422	03 9 879 9179
Austria	0662 45 79 90 0	0662 45 79 90 19
Belgium	02 757 00 20	02 757 03 11
Canada (Ontario)	519 622 9310	
Canada (Quebec)	514 694 8521	514 694 4399
Denmark	45 76 26 00	45 76 26 02
Finland	90 527 2321	90 502 2930
France	1 48 14 24 24	1 48 14 24 14
Germany	089 741 31 30	089 714 60 35
Hong Kong	2645 3186	2686 8505
Italy	02 413091	02 41309215
Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	95 800 010 0793	5 520 3282
Netherlands	0348 433466	0348 430673
Norway	32 84 84 00	32 84 86 00
Singapore	2265886	2265887
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 200 51 51	056 200 51 55
Taiwan	02 377 1200	02 737 4644
U.K.	01635 523545	01635 523154

Technical Support Form

Photocopy this form and update it each time you make changes to your software or hardware, and use the completed copy of this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Include additional pages if necessary.

Name _____

Company _____

Address _____

_____

Fax (___)_____ Phone (___)_____

Computer brand _____ Model _____ Processor _____

Operating system: Windows 3.1, Windows for Workgroups 3.11, Windows NT 3.1, Windows NT 3.5, Windows 95, other (include version number)_____

Version of Excel (look at Excel's About box): 5.0, 5.0c, other_____

Clock Speed _____MHz RAM _____MB Display adapter _____

Mouse _____yes _____no Other adapters installed _____

Hard disk capacity _____MB Brand _____

Instruments used _____

National Instruments hardware product model _____ Revision _____

Configuration _____

National Instruments software product _____ Version _____

Configuration _____

The problem is _____

_____

_____

_____

List any error messages _____

_____

_____

_____

The following steps will reproduce the problem _____

_____

_____

Hardware and Software Configuration Form

Record the settings and revisions of your hardware and software on the line to the right of each item. Complete a new copy of this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

National Instruments Products

Serial Hardware Revision _____

Interrupt Level of Hardware _____

DMA Channels of Hardware _____

Base I/O Address of Hardware _____

COM Driver Version _____

Other Products

Computer Make and Model _____

Microprocessor _____

Clock Frequency _____

Type of Video Board Installed _____

Operating System _____

Operating System Version _____

Operating System Mode _____

Programming Language _____

Programming Language Version _____

Other Boards in System _____

Base I/O Address of Other Boards _____

DMA Channels of Other Boards _____

Interrupt Level of Other Boards _____

For each instrument you are using:

Name of instrument _____

Manufacturer of instrument _____

Parity: None, Even, Odd, Mark, Space

Baud rate _____

Stop bits _____

Data bits _____

Flow control: Hardware, Software, None

Version of Measure: (look at the about box) _____

Documentation Comment Form

National Instruments encourages you to comment on the documentation supplied with our products. This information helps us provide quality products to meet your needs.

Title: *Measure® Serial Control User Manual*

Edition Date: August 1996

Part Number: 321005B-01

Please comment on the completeness, clarity, and organization of the manual.

_____

_____

_____

_____

_____

_____

_____

If you find errors in the manual, please record the page numbers and describe the errors.

_____

_____

_____

_____

_____

_____

_____

Thank you for your help.

Name _____

Title _____

Company _____

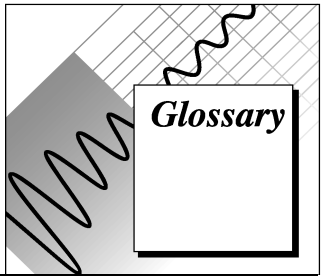
Address _____

_____

Phone (_____) _____

Mail to: Technical Publications
National Instruments Corporation
6504 Bridge Point Parkway
Austin, TX 78730-5039

Fax to: Technical Publications
National Instruments Corporation
(512) 794-5678



Prefix	Meaning	Value
p-	pico-	10^{-12}
n-	nano-	10^{-9}
µ-	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^{3}
M-	mega-	10^{6}

A

Add-In — A software package designed to integrate into Microsoft Excel.

Asynchronous — A method of data communications in which information is transmitted one character at a time. A start bit precedes each character and a stop bit follows each character. The start bit signals the beginning of the character transmission and the stop bit indicates its completion. The Serial Add-In uses asynchronous communications in its data exchanges.

B

Baud Rate — The transmission rate of characters expressed in bits per second. Since there are additional bits transmitted -- for example, stop bits -- the baud rate divided by ten is the approximate number of characters transmitted per second. For instance, 9600 baud is roughly equivalent to 960 characters / second.

Bit — A single value of 1 or 0. A byte consists of 8 bits.

Break	A signal sent to interrupt a remote device, usually to make the device stop processing and respond.
Byte	The standard method of representing numbers or characters in computers. Eight binary digits (bits) make up a byte.

C

Capture Task	A task used to retrieve data from an instrument and store it in a range in the Excel worksheet.
Command String	A string sent to an instrument.

D

Delay	Delay is the extra time that may be allotted to devices that are slow in responding to and processing an ongoing line. Usually, the extra time allows the device to respond to the line as a command.

E

Escape Sequence	A special string used to represent an unprintable character. For example, "\10" is the escape sequence for a linefeed character.

F

Field	A field is a division of a line of data. Lines are separated into fields using one of the Serial Add-In parsing techniques.
Flow Control	See Handshaking.

H

Handshaking	Handshaking is an agreed-upon standard used to facilitate two-way communications. In the Serial Add-In, software or hardware handshaking can be used. Handshaking allows a device to request that data transmission be paused when no more data can be accepted or resumed when the device is ready to receive more data.

I

Instrument	In Measure, a name given to information about the serial port settings of a real instrument.

L

Lag	Lag is the time between characters transmitted from the Serial Add-In to an instrument.
Line	A line is a unit of data demarcated by end-of-line strings. A line of data generally corresponds to a row of a transmit or capture range.

M

MB	megabytes of memory

P

Parallel Data Transmission	A form of data transmission in which information is sent as an entire character or byte at a time. See Serial Data Transmission.
Parity	A type of error-checking used in data transmission. The parity of two communicating devices must match.
Parse	Parsing consists of breaking up lines of data into smaller, more manageable units, called fields. In the Serial Add-In, you can parse a line of data based on width or using delimiters.

R

Range	A group of rows and columns on a spreadsheet.
Response	When capturing data from an instrument, the response is the character that Measure sends to the instrument after every line is received. When transmitting data to an instrument, the response is the character that Measure waits for from the instrument before sending another line of data.

RS-232 Protocol	A widely used standard for serial, asynchronous communications between a modem or other Data Communications Equipment (DCE) and associated Data Terminal Equipment (DTE). The standard has been developed by the Electronic Industries Association (EIA) and various manufacturers and users. The RS-232 protocol is present in the IBM PC hardware in the form of an asynchronous interface, or serial (COM) port.

S

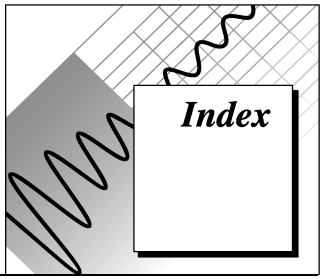
Serial Data Transmission	A form of data transmission in which information is sent one bit at a time. The Serial Add-In is a serial communications interface. See Parallel Data Transmission.
Start Bit	In asynchronous serial communications, the bit that signals the beginning of a character transmission.
Stop Bit	In asynchronous serial communications, the bit that signals the end of a character transmission.
Synchronous	A method of data communications in which a prearranged number of bits are transferred per second. Synchronization occurs before and after the transmission of blocks of data, rather than before and after every character. There are no start bits or stop bits, as there are in asynchronous communications. Transmitted bits either represent information or are parity bits. See Asynchronous.

T

Transmission Task	A task used to send data from an Excel worksheet to an instrument.

V

Visual Basic for Applications (VBA)	The programming language built into Microsoft Excel.



A

B

C

D

E

F

G

I

L

M

N

O

P

R

S

T

U

V

W