FTP AND FILE MANAGEMENT:

SNAP ULTIMATE I/O TRAINING CENTER SUPPLEMENT

Form 1450-041207—December, 2004

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OptoTutorial: FTP and File Management
Form 1450-041207—December, 2004

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Introduction

Lesson 1: File Management and Logging Data

Lesson 2: Saving Log Files to Flash

Lesson 3: FTP Server and Reading Uploaded Data

INTRODUCTION

ABOUT THIS TUTORIAL

This tutorial and its sample files are a supplement to the SNAP Ultimate I/O™ Learning Center (see Opto 22 form #1408), although the explanations apply to any SNAP Ultimate I/O system that has firmware version R5.0a (or higher) and ioControl™ version R5.0a (or higher).

The sample ioControl strategy (ULCs1450.idb) is ready for use with a SNAP Ultimate I/O Learning Center. If you are using this tutorial with a different configuration, please note the following:

Point	Description	Used in Lesson(s)	If your SNAP Ultimate I/O isn't connected to the Learning Center
00	Digital Input, Emergency	2, 3	In lesson 2, this point is used with point 01 to implement a write to Flash command. Invoking the Write to Flash feature from this momentary switch prevents accidental, excessive use of the write to flash. For this reason, substituting this switch with a different type of switch is not recommended. In lesson 3, this point initiates a demonstration. Substitute with any integer 32 variable. Set variable to true from Debug mode to simulate switched input.
01	Digital Input, POS	2	This point is used with point 00 to initiate a writing of files to Flash memory. Invoking the Write to Flash feature from this momentary switch prevents accidental, excessive use of the write to flash. For this reason, substituting this switch with a different type of switch is not recommended.
03	Digital Input, Photo Sensor	1, 2	The value of this point is read and written to a log file. Substitute with any digital input, digital output, or integer 32 variable.
04	Digital Output, Outside Light	3	This point is controlled by a recipe file uploaded to the brain. Substitute with any digital output or integer 32 variable.
05	Digital Output, Inside Light	3	Same as point 04.
06	Digital Output, Freezer Door Status	3	Same as point 04.
12	Analog Input, Store Temperature	1, 2	This point is read and written to a log file. Substitute with any analog point or float variable.

Installing the Sample Files

The sample strategy you will use with this tutorial is provided in before and after form:

- ULCs1450_before.zip: This is an ioControl strategy that you will complete during this tutorial.
- ULCs1450_after.zip: This is an example of the completed ioControl strategy from this tutorial.

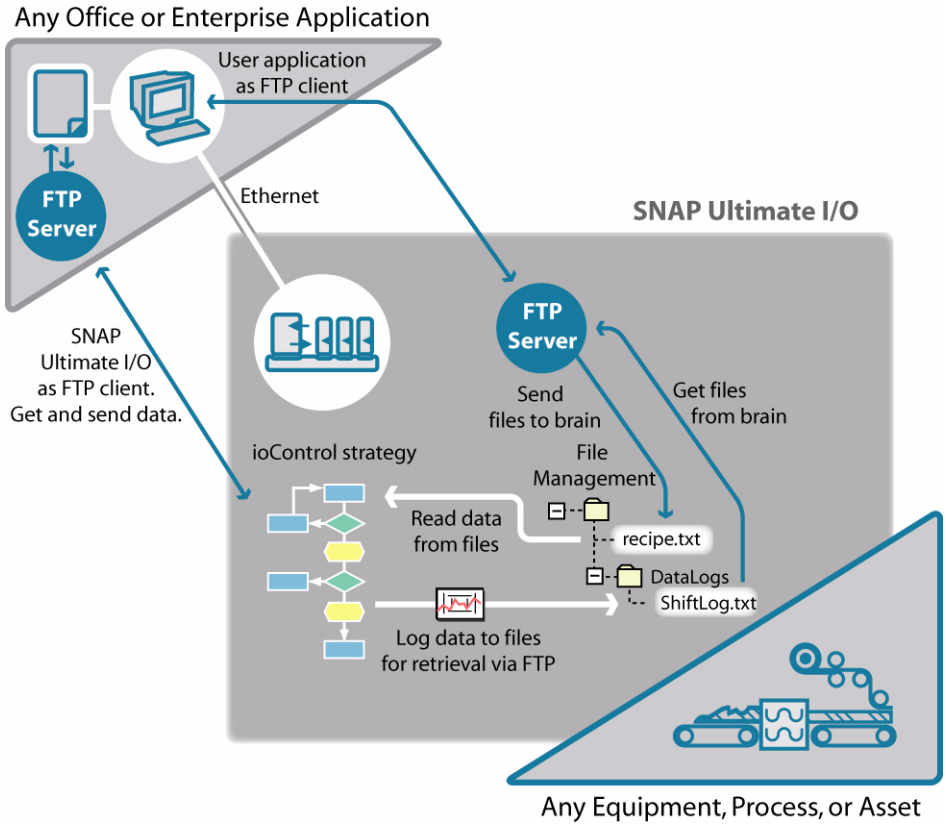
To prepare for the tutorial, unzip ULCs1450_before.zip in a directory of your choosing. ULCs1450_after.zip is provided for reference only.

Feature Overview

SNAP Ultimate I/O firmware provides FTP support, and ioControl provides file management. These features can be used in a variety of ways:

- A strategy running on a SNAP Ultimate I/O brain can store files in the brain's RAM or Flash memory.
- FTP clients can read files from and write files to the FTP server on the brain.
- The ioControl strategy can read files loaded to the brain from other sources.
- The ioControl strategy can retrieve files from other FTP servers.
- The ioControl strategy can send data in file or string format to an FTP server (e.g., to another SNAP Ultimate I/O brain).

The application profile below shows the various paths of information possible by using the FTP and file management features.



The above concepts are discussed in the following chapters:

- Lesson 1: File Management and Logging Data

  Activity 1: Logging and Retrieving Data
- Lesson 2: Saving Log Files to Flash

  Activity 2: Dynamically Controlling a Communication Handle and Storing Data to Flash
- Lesson 3: FTP Server and Reading Uploaded Data

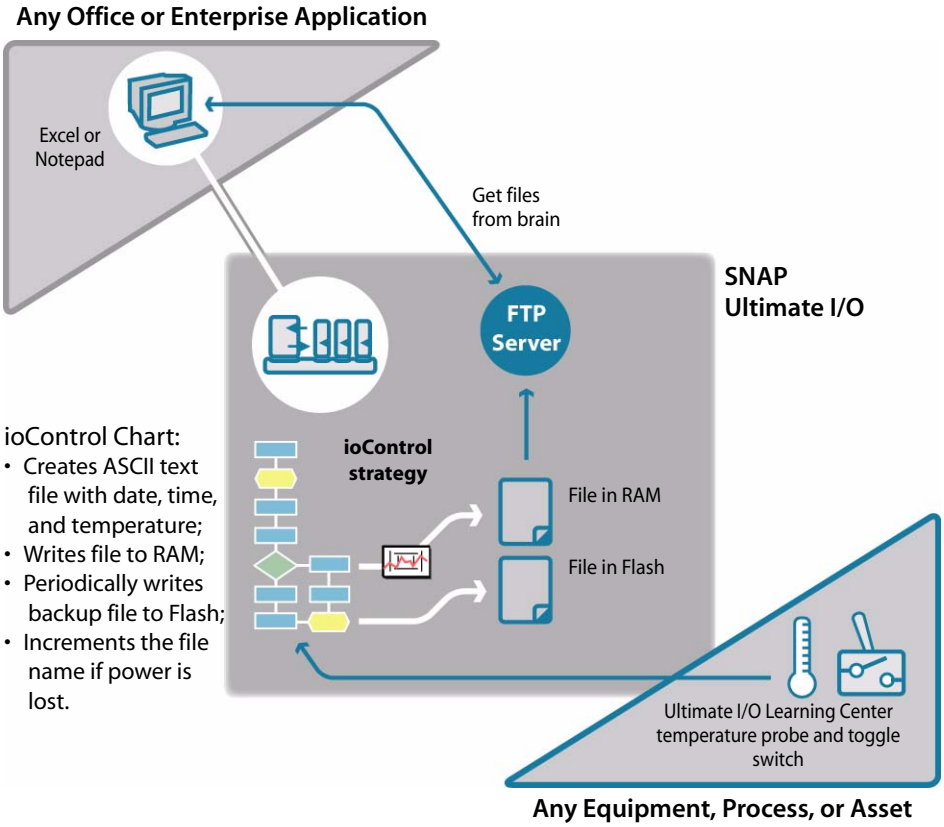
  Activity 3: Uploading and Parsing Files

LESSON 1: FILE MANAGEMENT AND LOGGING DATA

OVERVIEW

The ioControl strategy built in this lesson will demonstrate how to save data from ioControl in a ASCII text file on the brain, where the data can be accessed using FTP client applications.

In addition to using FTP and file management, the strategy will show how to create a permanent file in case of power loss and how to increment the file name to reflect a loss of power.



CONCEPTS

File Communication Handle

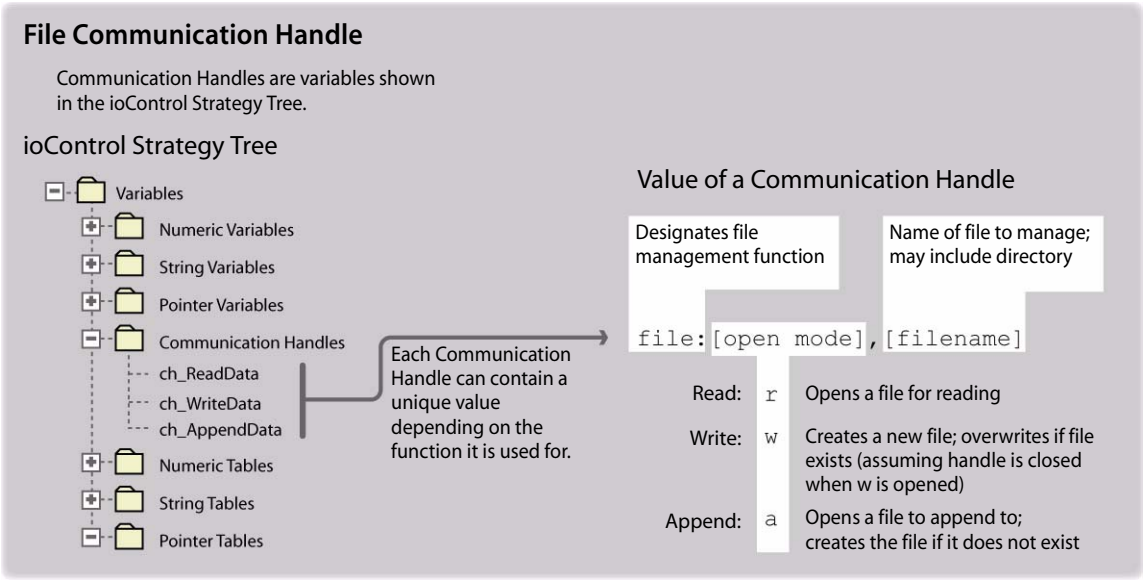
Any communication from within ioControl is established through variables called Communication Handles. In ioControl, reading, creating, and appending to files are forms of communication defined within Communication Handles. It is important to

know that Communication Handles are used to communicate with other Ethernet and serial devices, but this lesson focuses on using Communication Handles for file management.

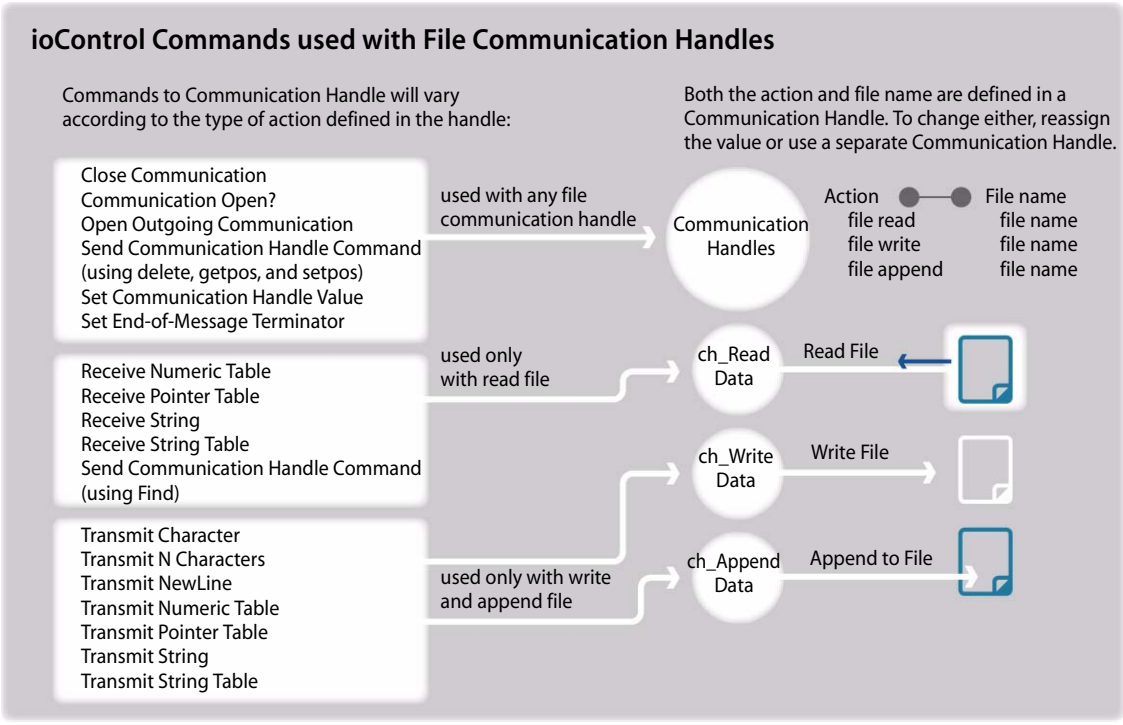
The value of a Communication Handle is a text string that provides the communication parameters between ioControl and the file on the brain. For example, a file communication handle may contain the following information:

```
file:a,logdata.txt
```

which tells ioControl to use the brain's file management to append information to a text file called logdata.txt. A file communication handle has the following parameters:



A file Communication Handle will begin with `file:r`, `file:w`, or `file:a` and be followed by a filename. Each of these support commands:



You can set the initial value of a Communication Handle using ioControl's Configuration mode, or you can use ioControl and OptoScript™ commands to set the value while the strategy is running. You will do both in this lesson, initially to create a file Communication Handle, and then to automatically increment the log file name.

Using a Communication Handle requires the following:

- Defining the Communication Handle
- Opening the Communication Handle and testing for errors
- Executing a command using the Communication Handle:

  File read commands:

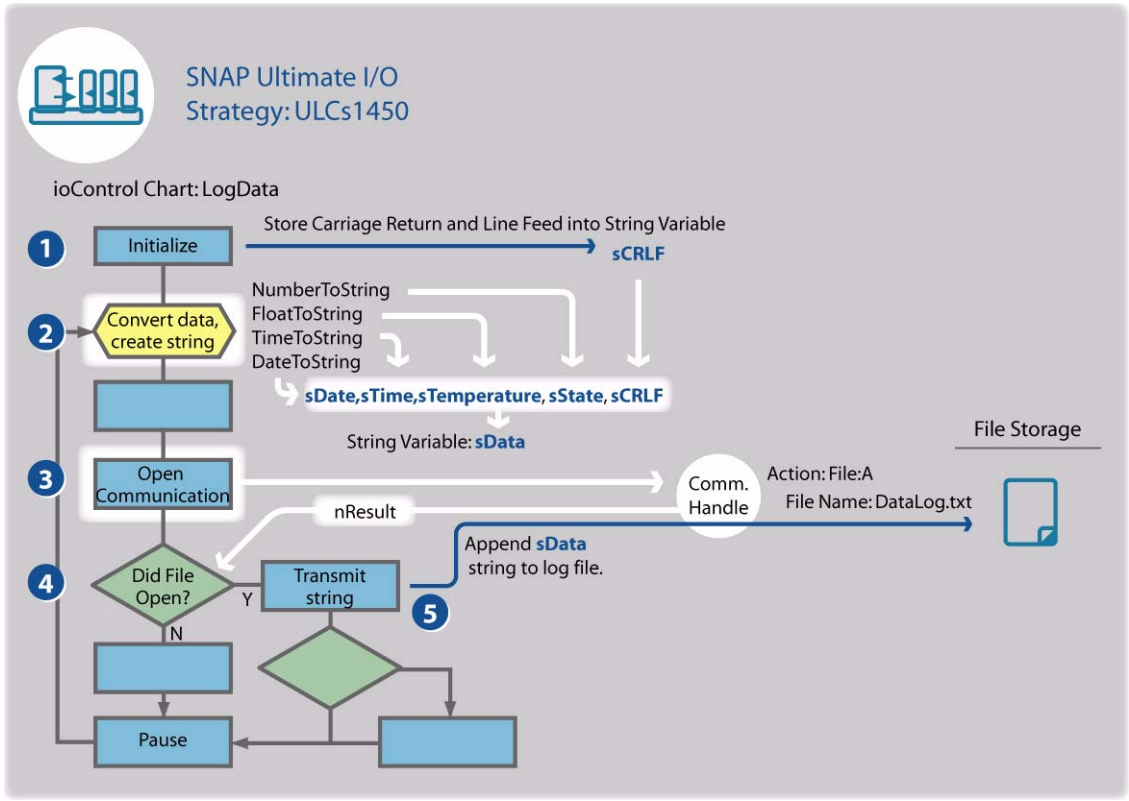
  - Receive Numeric Table
  - Receive Pointer Table
  - Receive String
  - Receive String Table,
  - Transfer N Characters
  - Send Communication Handle Command (delete, getpos, Setpos:<position>, Find:<mystring>)

  File write or file append commands:

  - Send Communication Handle Command (Find:<mystring>)
  - Transmit Character
  - Transmit New Line
  - Transmit Numeric Table
  - Transmit Pointer Table, Transmit String
  - Transmit String Table
- Closing the Communication Handle

LogData Chart

The LogData chart contains some basic functions as well as some empty blocks that serve as placeholders for functionality you will add in this and in following lessons. The diagram below describes the key functions this chart will perform when you complete lesson 1.



1	In this block you will create a string variable used to terminate the string sent to the data log. Your instructions will put ASCII codes 13 and 10, which correspond to a carriage return and a line feed, into the variable sCRLF.
2	You will use OptoScript to convert numerical, date, and time variables to strings and join the strings into one variable to send to the Communication Handle.
3	This block opens the Communication Handle. This action will return a value used to determine if the attempt to establish communication was successful. The result is stored in the integer variable nResult.
4	You will use the condition block to evaluate nResult. If it equals 0, then communication is established and the chart can begin writing to the log file.
5	The Transmit String command sends the contents of sData to the communication handle. The communication handle determines the action (appending) and the file name (DataLog.txt), which were defined as the initial value of the Communication Handle. The Append action will append the string or create a new file if the file doesn't exist.

ACTIVITY 1: LOGGING AND RETRIEVING DATA

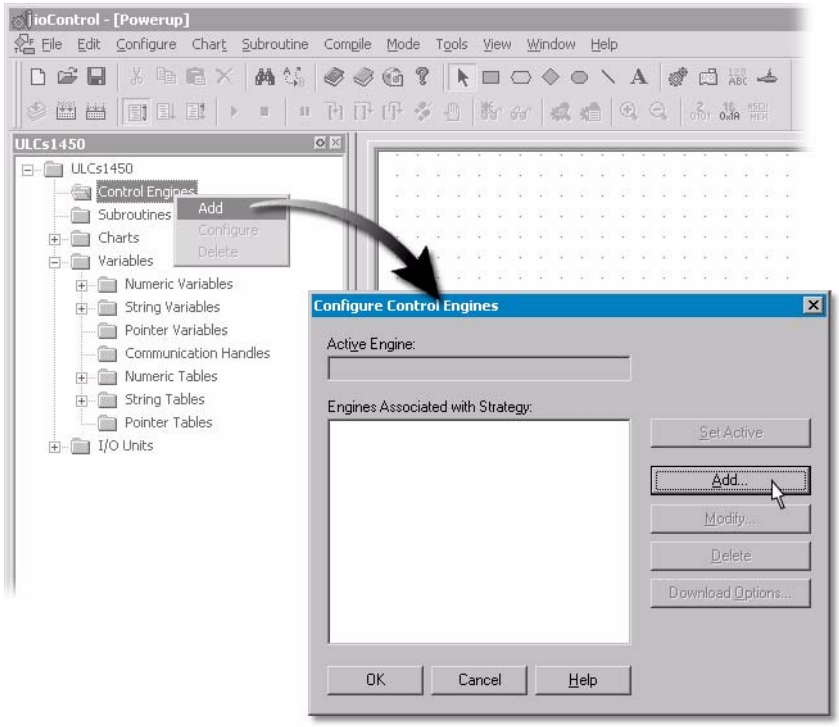
Preparation

The sample ioControl strategy is ready to use with SNAP Ultimate I/O Learning Centers. To use this strategy, you will need to modify the Control Engine.

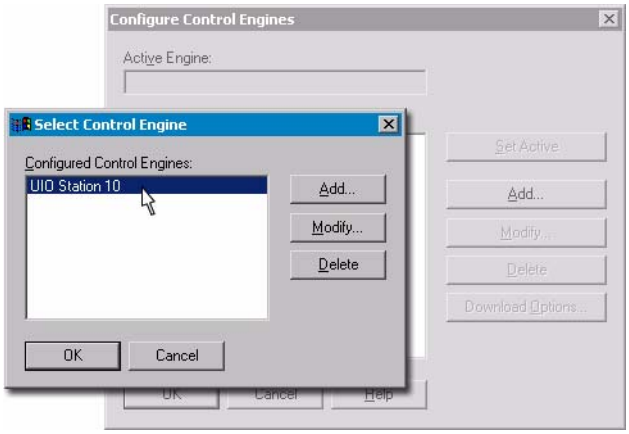
1. Open Strategy ULCs1450.idb in ioControl.

2. Add a Control Engine

a. In the strategy tree, right-click the Control Engines folder.
b. Click *Add*.



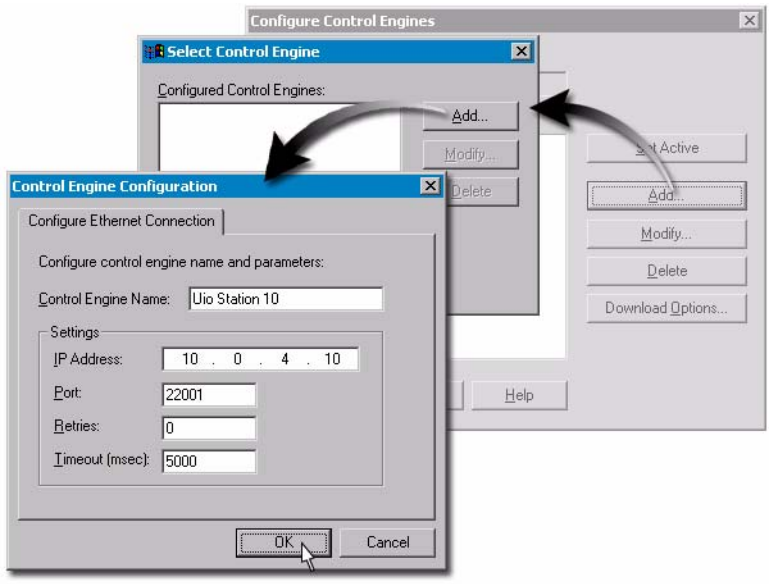
c. In the Configure Control Engines dialog box, click *Add*.



All control engines you have configured on your computer are shown in the Select Control Engines dialog box. If you do not have a control engine, see Creating a Control Engine below.

d. Select your Control Engine and click *OK*.

Creating a Control Engine



The Control Engine configuration for a SNAP Ultimate I/O brain requires a name and IP address.

Use a Communication Handle

Communication Handles can be assigned an initial value and their value can be reassigned using chart commands or OptoScript. Here you will assign the initial value. Later, you will use OptoScript to reassign the value.

1. Define the value of a Communication Handle.

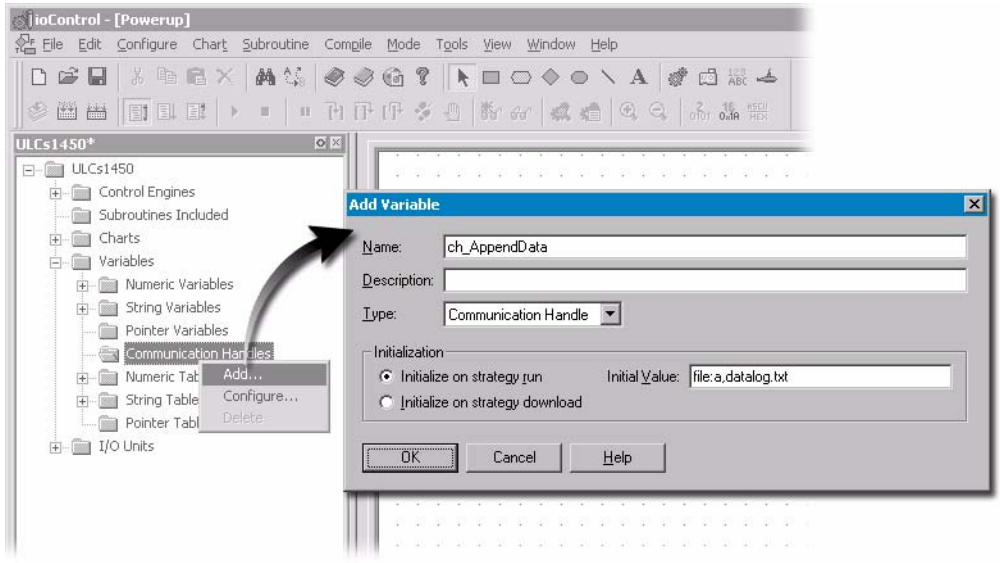
a. Right-click Communication Handles.
b. Click *Add*.
c. In the Add Variable dialog box, type the following:

   In the Name field, type `ch_AppendData`

   (Throughout this tutorial, ch_ will be used to name Communication Handles.)

d. In the Initial Value field, type `file:a,datalog.txt`

   NOTE: Type the text as show here and use all lowercase letters.



e. Click *OK*.

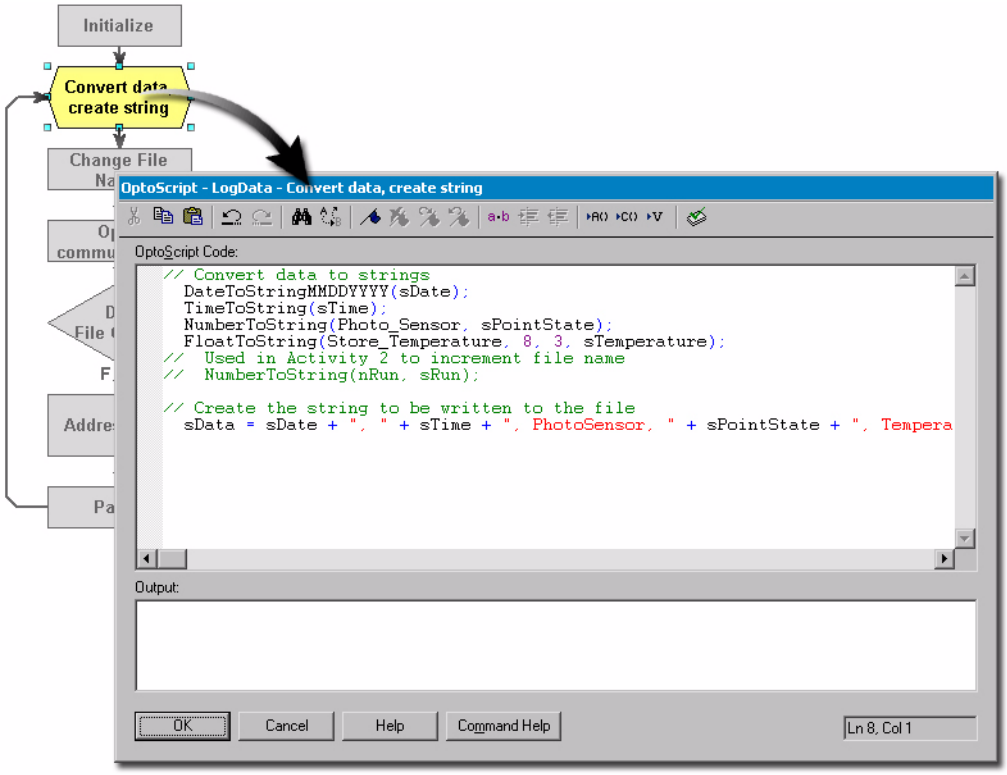
2. Open the LogData chart.

a. In the Strategy Tree, expand the Charts folder.
b. Under Charts, double-click LogData.

3. Convert the Data to Strings.

Before any data can be written to an ASCII file, the data must be converted to string format. ioControl provides several commands for converting data, several of which are shown in the Script block Convert Data, Create String. If you are using a SNAP Ultimate I/O Learning Center, you will not need to make any changes to this block, but converting data is an essential step, so it is recommended that you examine how this is done.

a. Double click the block Convert data, create string.



This script block converts the date, time, digital input point 3 (Photo_Sensor) and analog input point 12 (Store_Temp) to string values. The conversion of nRun to a string is commented out and will be used in Activity 2.

If you have a SNAP Ultimate I/O Learning Center, make no changes to this block. If you are using this strategy with different points, see "Modifying the Sample Strategy" on page 13, for how to modify these lines of OptoScript:

```
NumberToString(Photo_Sensor, sPointState);
FloatToString(Store_Temperature, 8, 3, sTemperature);
```

The following line joins the contents of variables sData, sTime, sPointState, sTemperature, sCRLF into one variable:

```
sData = sDate + ", " + sTime + ", PhotoSensor, " + sPointState + ", Temperature, " + sTemperature +
sCRLF;
```

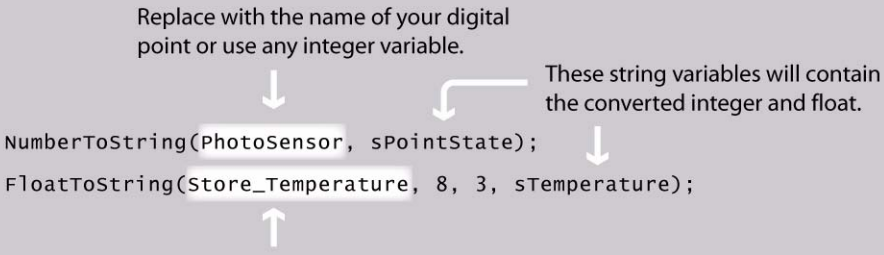
In addition, the optional descriptions PhotoSensor and Temperature are included. Being text, these descriptions appear in red.

b. If you are using a non-Learning Center configuration, you may wish to edit the red text to describe your points; otherwise, make no changes to the script.
c. Click *OK* to close the OptoScript editor.

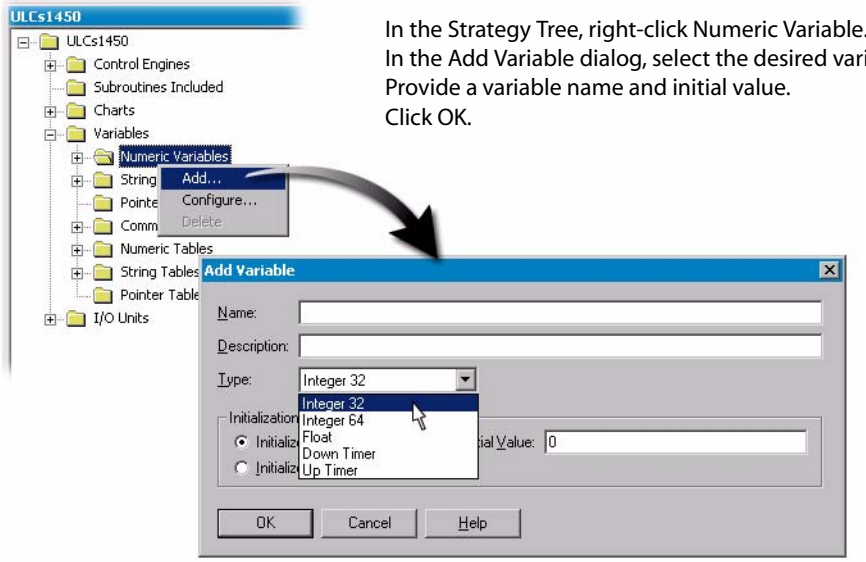
Modifying the Sample Strategy

NOTE: If you do not have an Ultimate I/O Learning Center, you will need to modify the strategy so that the sample points cited in the OptoScript match points on your system. Points 3 and 12 of the Ultimate I/O Learning Center are used in this example.

OptoScript Block: Convert Data, Create String:



Creating an Integer or Float Variable

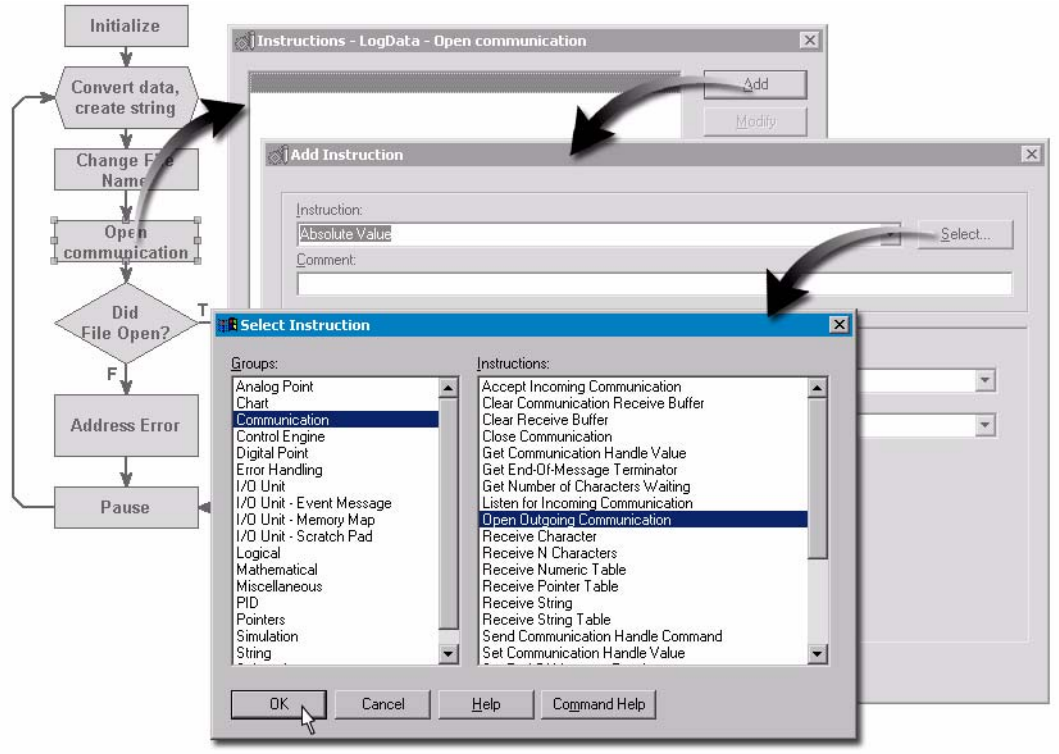


In the Strategy Tree, right-click Numeric Variable.
In the Add Variable dialog, select the desired variable type.
Provide a variable name and initial value.
Click OK.

4. Open the Communication Handle.

a. Double-click the block Open Communication.
b. In the Instructions dialog box, click *Add*.

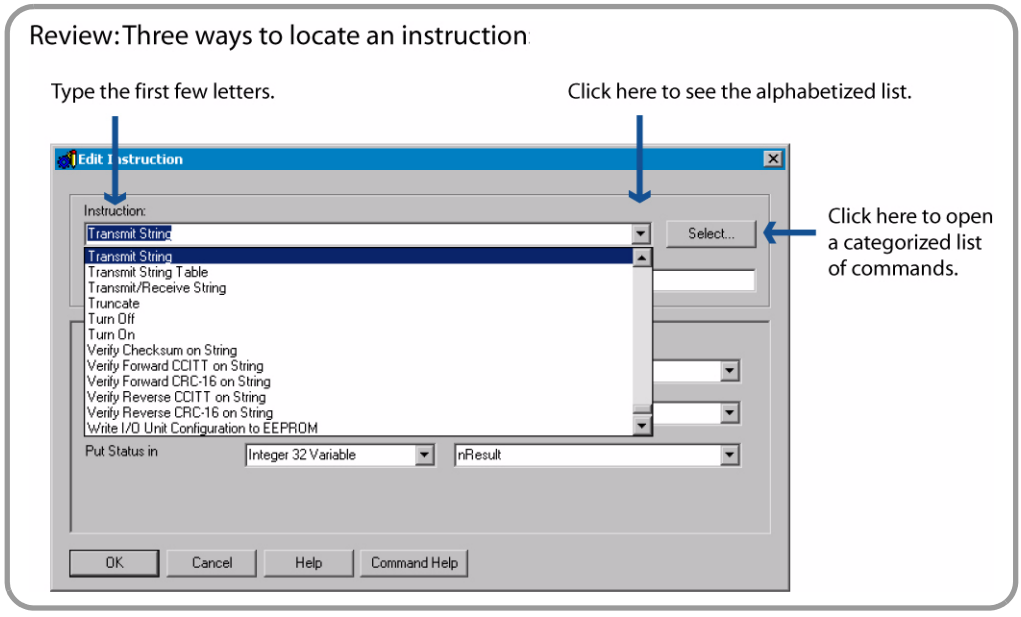
c. In the Add Instruction dialog box, click *Select*.



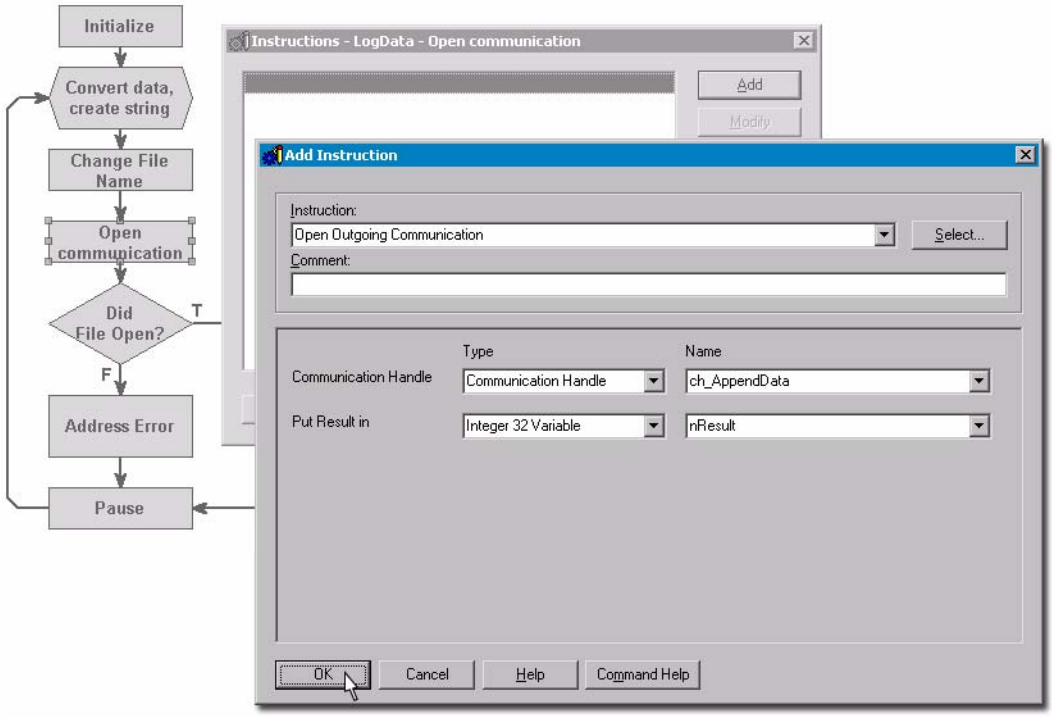
The Select Instruction dialog box shows all the commands you would use with a Communication Handle.

d. In the Select Instruction dialog box, select *Communication* in the Groups list and then select the instruction *Open Outgoing Communication*.

e. Click *OK* to close the Select Instruction dialog box.



f. In the Add Instruction dialog box, select the following:
Communication Handle: *ch_AppendData*
Put Result In: *nResult*

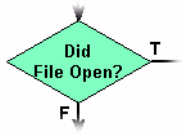


The variable nResult is an Integer 32 variable that has already been created. By putting the result into this variable, you can test the success of this command by reading this variable.

g. Click *OK* to close the Add Instruction dialog box.
h. Click *Close* to close the Instructions dialog box.

5. Test the result of Open Communication.

The Did File Open? block reads the value of nResult. If the value is 0, you can assume that the communication handle was opened successfully and you can write to the Communication Handle.



Make no changes to this block, because the command you need has already been created.

Possible Errors

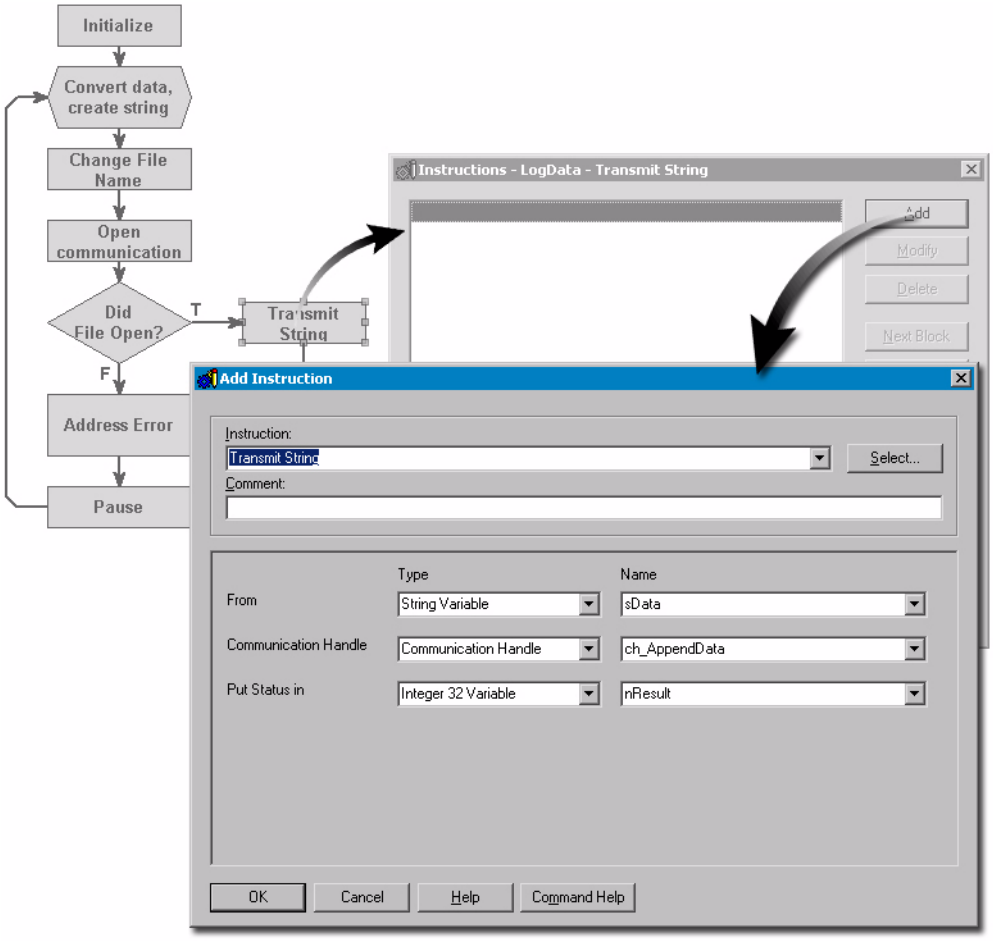
The sample strategy shows how to check the success of the Open Communication command before transmitting data. In your application, you would create actions suitable to the type of errors you may encounter. Here are a few examples:
0 = Success.
-47 = Invalid connection. Make sure the same IP address is not already open.
-49 = No more connections are available. Maximum number of connections already in use.
-50 = Open connection timeout. Could not establish connection within the timeout period.
-78 = No destination given. When sending a file via FTP, use Send Communication Handle Command to specify the name of the file on the remote server.
-446 = FTP: Login failed. Check user name, password, and maximum number of logins on server.
-447 = FTP: Connection failed. Check IP address and port.
-448 = FTP: Could not create session. Check IP address and port.

6. Write data to the Communication Handle.

You will add two commands to the Transmit String block. At this point, the Communication Handle is open, so you can transmit data using a Transmit String command. Then, you will close the Communication Handle.

a. Double-click the block Transmit String.

b. In the Instructions dialog box, click *Add*.



c. In the Add Instruction dialog box, select the following:

Instruction: *Transmit String*

From: *sData* (NOTE: Make sure you choose *sData* and not *sDate*.)

Communication Handle: *ch_AppendData*

Put Status In: *nResult*

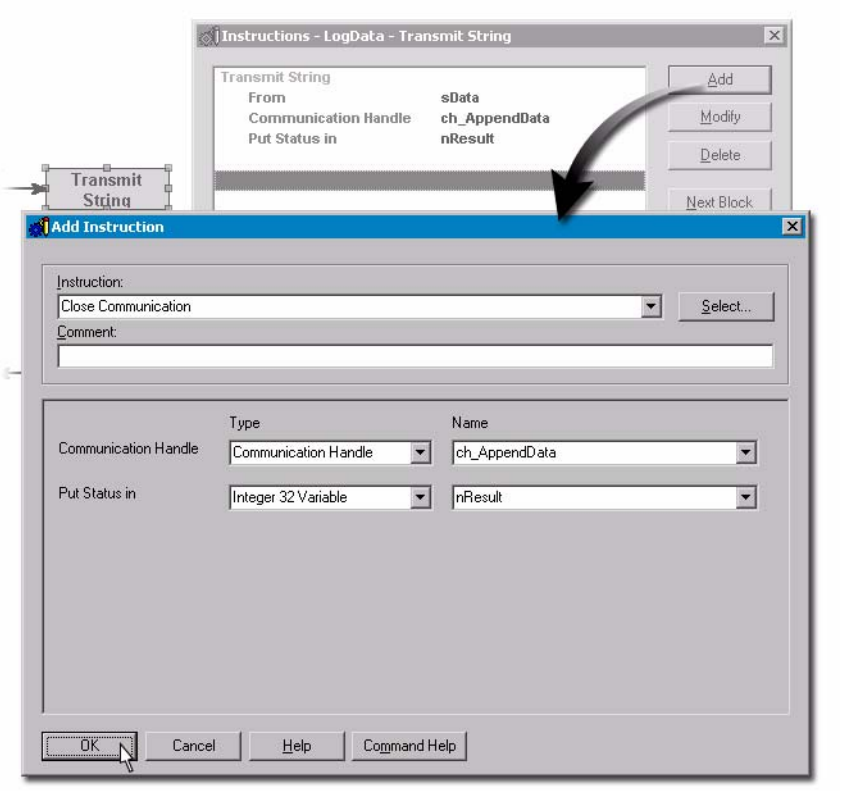
d. Click *OK* to close the Add Instruction dialog box.

e. Keep the Instructions dialog box open.

7. Close the Communication Handle.

At this point, you do not need to keep the Communication Handle open, so you will add an instruction to close it.

a. In the Instructions window, click *Add*.



b. In the Add Instruction dialog box, select the following:

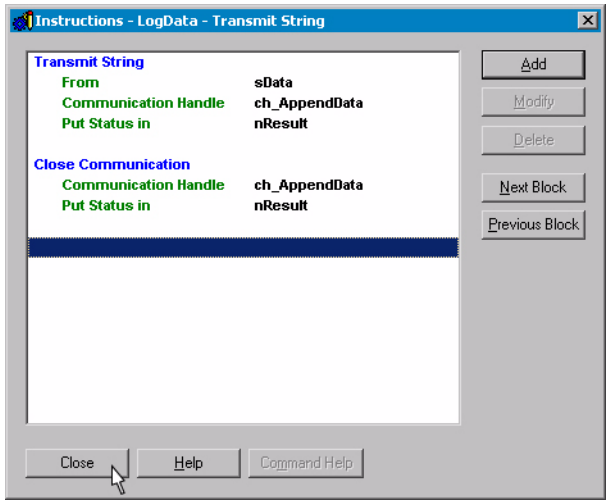
Instruction: *Close Communication*

Communication Handle: *ch_AppendData*

Put Result in: *nResult*

c. Click *OK* to close the Add Instruction dialog box.

d. Click *Close* to close the Instructions dialog box.



Your strategy is ready to be downloaded and compiled.

8. Compile your strategy.

Choose *Compile* ⟶ *Compile All: ULCs1450*

Log Data

The strategy creates a text file and appends the date, time, temperature and point state every five seconds.

1. Make sure your SNAP Ultimate I/O Learning Center is turned on and connected to the network.

2. Download and run the strategy.

a. Choose menu command *Mode* ⟶ *Debug*.
b. Acknowledge all download messages.
c. Choose *Debug* ⟶ *Run*.

3. Allow the strategy to run at least 30 seconds to log data.

While the strategy is running, flip the Photo Sensor switch and hold the temperature probe so the data will vary.

4. Stop the strategy.

a. Choose *Debug* ⟶ *Stop*.

View the Data Log

The data logs created on the SNAP Ultimate I/O brain can easily be opened using any FTP client application, such as Notepad or Excel. The following shows how to open the log file in Notepad:

1. Start Notepad.

Choose *Start* ⟶ *Programs* ⟶ *Accessories* ⟶ *Notepad.*

2. Open the data log.

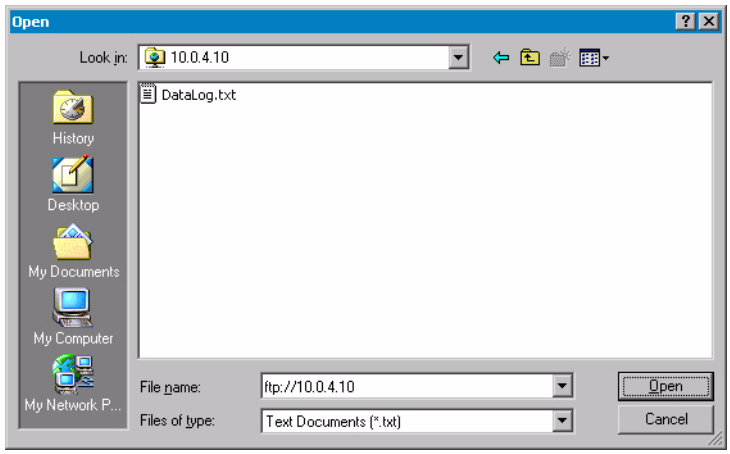
a. From the File menu, choose *Open*.
b. In the File name field, type the FTP address of your brain as follows:

```
ftp://10.0.4.10
```

NOTE: Substitute the 10.0.4.10 with the IP address of your brain.

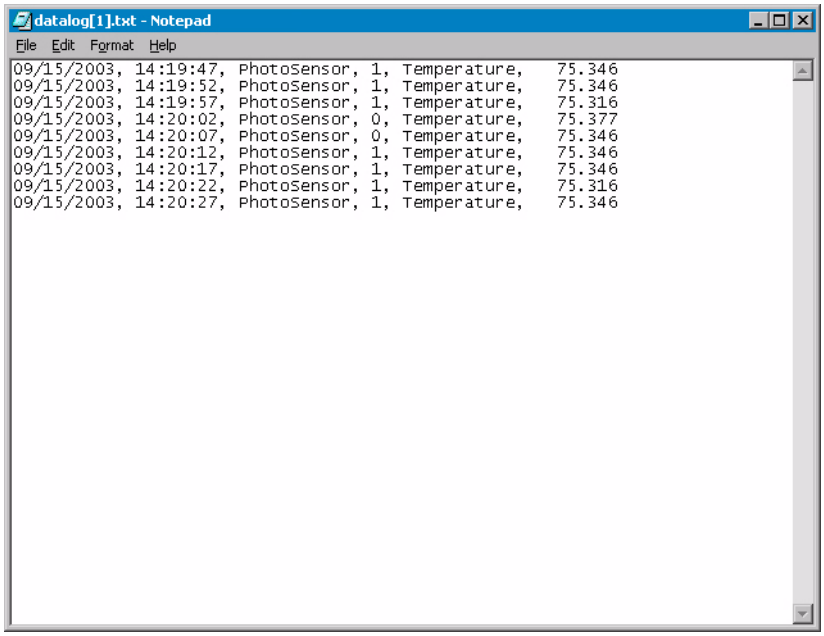
c. Click *Open*.

This will display all files on the brain.



NOTE: Accessing the FTP site from Notepad copies the files to your workstation. Therefore, to ensure that you are retrieving the latest files, it is important to re-enter the FTP address when you wish to open a file.

d. Select a data log file and click *Open*.



The data is now ready for use in your application.

In Lesson 2, you will continue working with the LogData chart to add some features that will backup up your DataLog in the event of a power failure.

LESSON 2: SAVING LOG FILES TO FLASH

OVERVIEW

In Lesson 1, you used a Communication Handle to write data to a text file on the brain. The Communication Handle was given an initial value that described the file management operation and the filename to act upon. Assigning an initial value is suitable in many cases. However, you may wish to have ioControl make decisions that result in the need to change the function of the Communication Handle. For example, if your system is saving log files, and the power was interrupted, you could increment a number in the file name to indicate that DataLog 2 represents a break in operation from DataLog 1.

In this lesson you will complete the LogData chart by adding the following:

- A persistent variable that is incrementally increased each time the strategy starts.
- OptoScript code that dynamically assigns a file name using the value of the persistent variable.
- A command that sets the value of your communication handle.
- A command that saves files in RAM to Flash.

CONCEPTS

Flash, RAM, and Persistent Memory

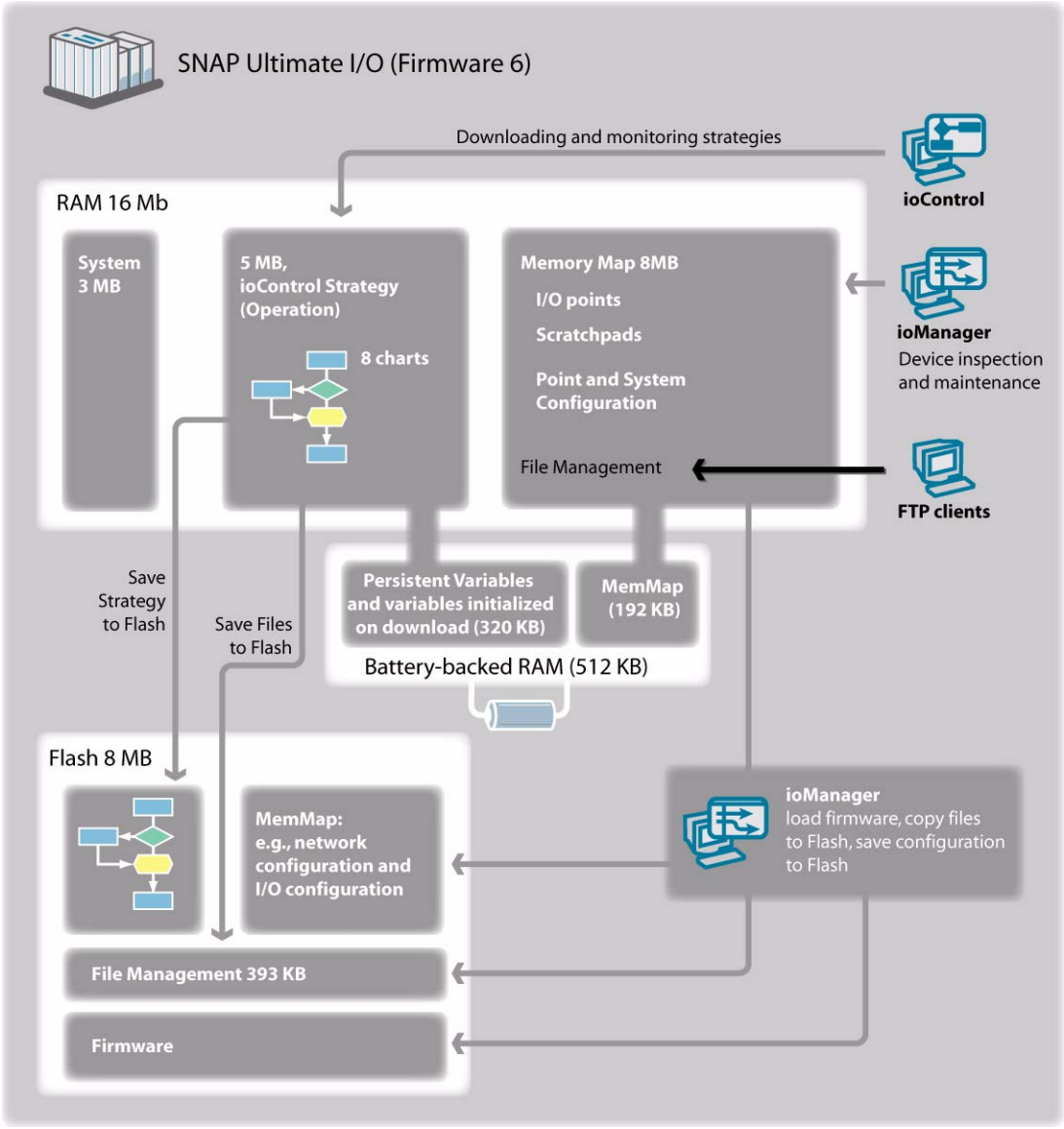
The SNAP Ultimate I/O brain provides permanent and temporary memory. The permanent area (Flash) typically is used to save the brain's firmware, configuration settings, application-ready strategy, and custom files. The RAM memory is the brain's normal operating memory and will contain much of the same information as the Flash, but the RAM memory is not saved when the brain is turned off or reset. In addition to Flash and RAM, the brain supplies non-volatile, battery-backed RAM, of which 320 MB is available for persistent variables (ioControl variables, such as integers, floats, tables, explicitly configured as persistent) and for variables that are initialized on download.

If you have information in your strategy that is not part of the configuration information already in permanent storage and must be saved in the event of a power loss (assuming an uninterruptable power supply is not an option) you have two options:

- Put data into the appropriate type of persistent variable. This method has a 256 KB limit, which is adequate for many applications; a persistent float or integer table could hold 65,536 elements.
- Store data in a file on the brain and then implement a Store To Flash command from ioControl. This method must be used with caution. Flash memory has an inherent limitation on how many times it can be written to. It is written to every time you save a strategy or configuration settings to Flash, and in normal use, you would never reach the limit. However, it's possible to design a programming loop

that repeats a Save to Flash command on a short interval. Left running, such a loop could conceivably exhaust the Flash.

A logical scenario in which you would use a Save to Flash command from ioControl is monitoring for an unusual condition. For example, you could have a point monitor a current draw on your primary power source and sense a shift in load to an uninterruptable power supply. Upon sensing that main power is lost, your strategy could write data to Flash and send a variety of warning messages via email, ioDisplay alarm, FTP, etc.



In this lesson, you create a persistent variable that will count power cycles and implement a command that will save your log file to Flash.

The following commands can be implemented from ioControl:

- Erase Files in Permanent Storage

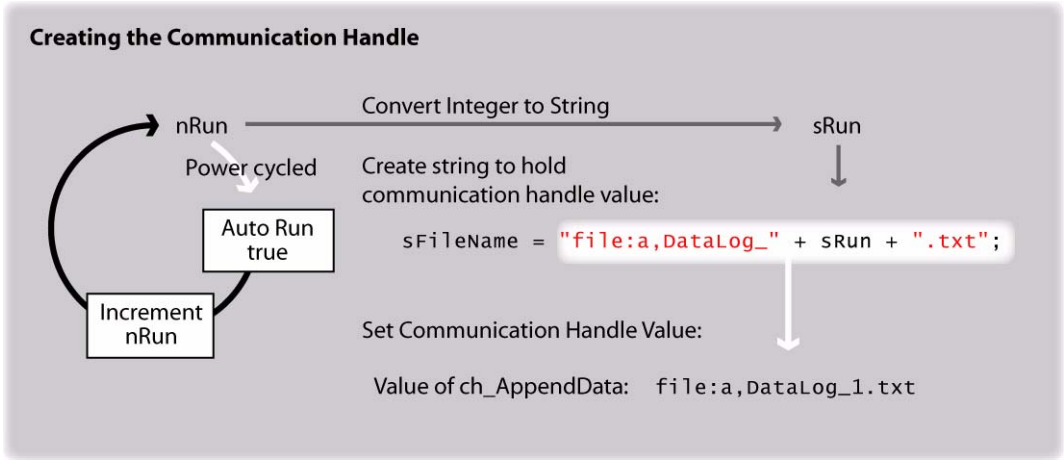
- Save Files to Permanent Storage (NOTE: Subdirectories and files in them are not stored to Flash.)
- Load Files From Permanent Storage

Dynamic Change of a Communication Handle

In the previous lesson you saw that a Communication Handle is a variable containing communication parameters as text strings. For example, the Communication Handle ch_AppendFile contains the following:

```
file:a,datalog.txt
```

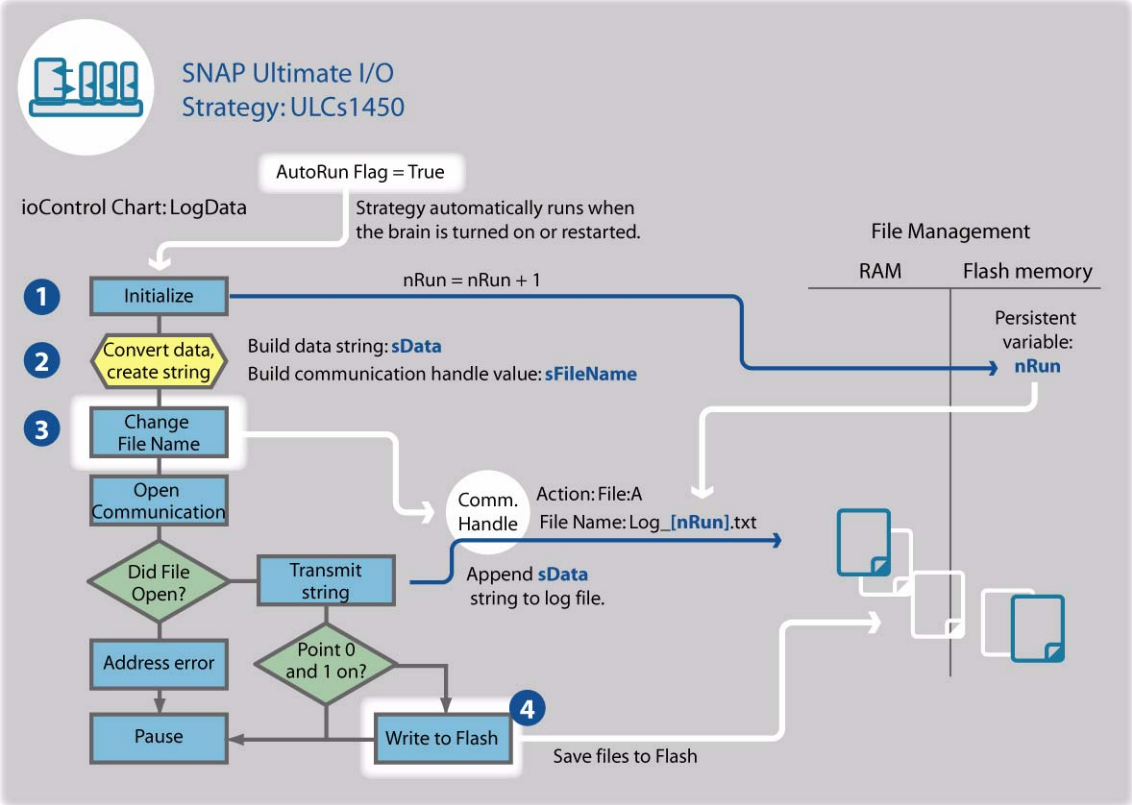
The `file` parameter tells ioControl to use the I/O Unit's file management and is followed by an append instruction and a filename. You can use ioControl instructions to set the value of any Communication Handle. In this lesson, the persistent variable nRun is stored in non-volatile RAM and is incremented each time the strategy starts. By converting this variable to a string and inserting it into a file name, you can dynamically change the file name within a Communication Handle.



The result is that each time the brain is started, a new log file with a numerically incremented file name will be created.

LogData Chart

In the previous lesson, you implemented the core functions of the LogData chart. In this lesson, you will add a few features so that the chart will function as described below.



1	This block already creates a string variable used to terminate the string sent to the data log. In this lesson you will add a command that increments the persistent variable nRun.
2	This block already coverts the data to strings and makes ready a string variable to send to the Communication Handle. In this lesson you will use the same method to to build the file name.
3	This block will assign the contents of a variable created in the previous block to the Communication Handle, effectively changing the file name if the strategy has been restarted.
4	When both the Emergency and POS switches are on, this block implements the Write to Flash command.

ACTIVITY 2: DYNAMICALLY CONTROLLING A COMMUNICATION HANDLE AND STORING DATA TO FLASH

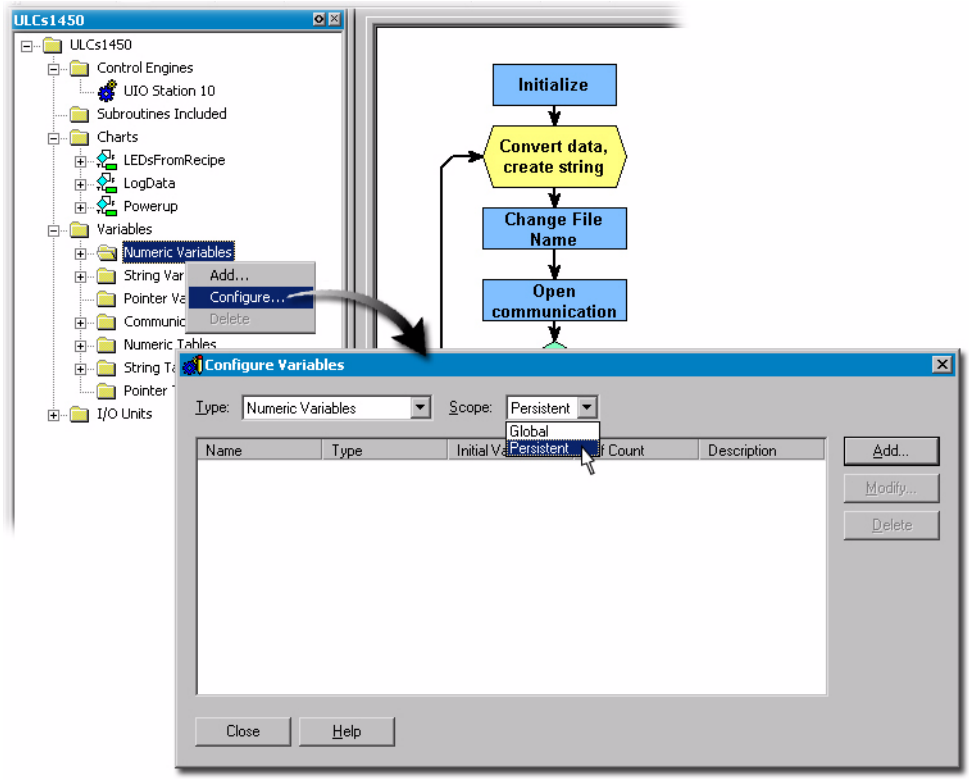
Automatically Incrementing the File Name

1. Return to Configure mode.

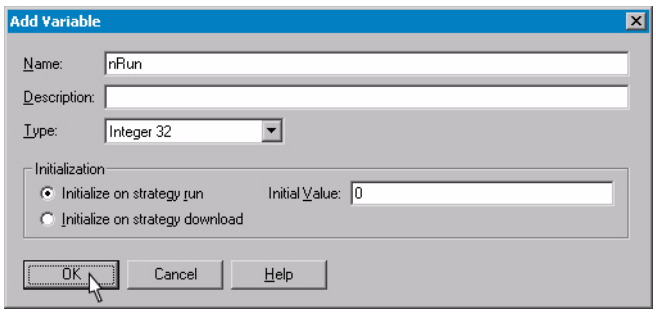
a. Choose *Mode* ⟶ *Configure*.

2. Create a Persistent variable.

a. In the Strategy Tree, right-click the Numeric Variables folder.
b. Click *Configure*.
c. In the Configure Variables dialog box, select *Persistent* from the Scope list box.



d. Click *Add* to open the Add Variable dialog box.
e. In the Name field, type nRun.
f. In the Type field, select Integer 32.
g. In the Initial Value field, type `0`.
h. Click *OK* to close the Add Variable dialog box.



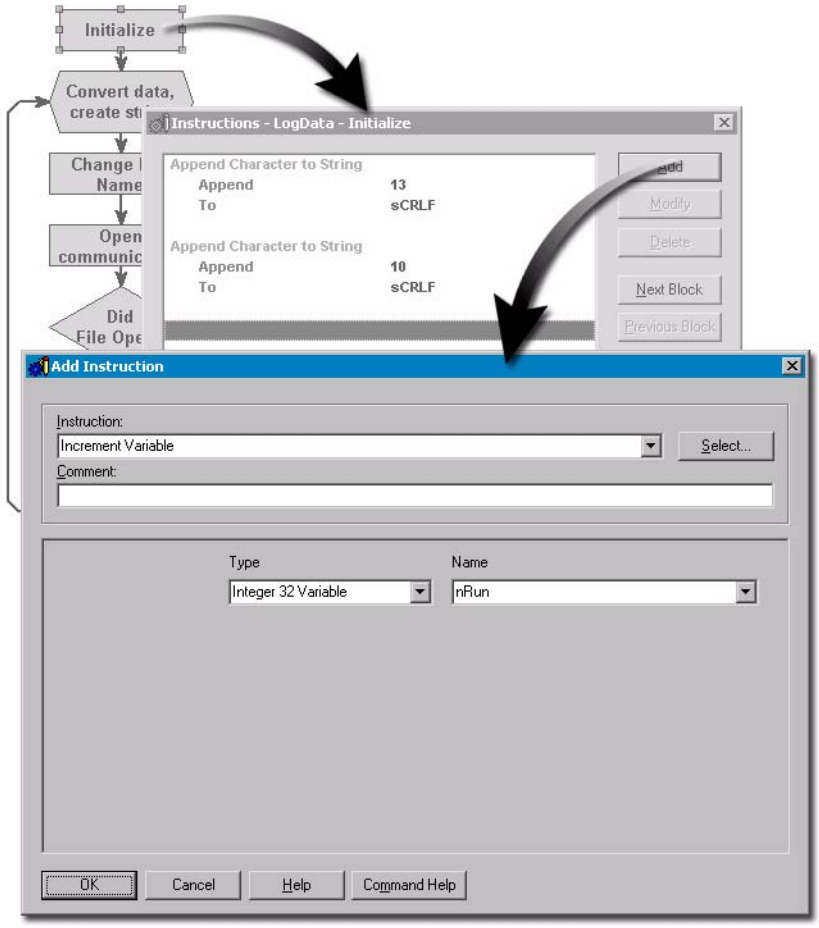
i. Close the Configure Variables dialog box.

3. Add Increment Variable command to Initialize block.

a. Double-click the Initialize block.

You will add one instruction. It does not matter which sequence the instructions appear in this block, but this example adds the new instruction to the end of the list.

b. Click below the last instruction.
c. Click *Add*.



d. In the add instruction dialog box, choose the following:

Instruction: *Increment Variable*

Name: *nRun*

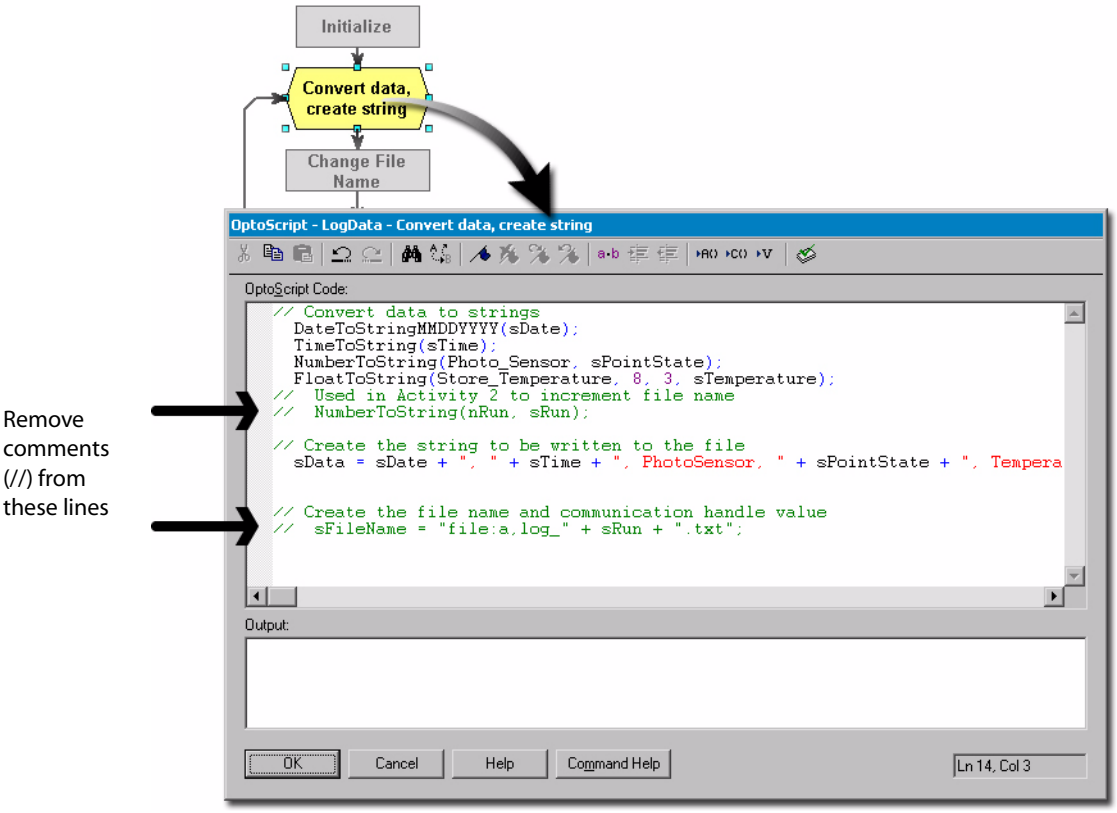
e. Click *OK* to close the Add Instruction dialog box.
f. Click *Close*.

Each time the strategy is started (presumably, when the brain is restarted and Auto Run is active) the LogData chart will run and increase the value of nRun by 1.

4. Increment File Name in a Variable.

To create a new Communication Handle containing a dynamically incremented file name, you will need to join the strings. This operation is easy in OptoScript and needs to happen before the Change File Name block. Therefore, it will be simplest to add the new commands to the existing script block Convert Data, Create String. (Note: You could also create a new OptoScript block and place it between the Convert data and Change File Name blocks, but the code you need to add has already been written for you in the Convert data, create string block.)

a. Double-click the script block Convert Data, Create String.



b. Delete the slashes that precede the following lines

```
//  NumberToString(nRun, sRun);
//  sFileName = "file:a,log_" + sRun + ".txt";
```

Your script should appear as follows:

```
// Convert data to strings
  DateToStringMMDDYYYY(sDate);
  TimeToString(sTime);
  NumberToString(Photo_Sensor, sPointState);
  FloatToString(Store_Temperature, 8, 3, sTemperature);
//  Used in Activity 2 to increment file name
  NumberToString(nRun, sRun);
```

```
// Create the string to be written to the file
  sData = sDate + ", " + sTime + ", PhotoSensor, " + sPointState + ", Temperature, " +
sTemperature +  sCRLF;
// Create the file name and communication handle value
  sFileName = "file:a,DataLog_" + sRun + ".txt";
```

c. Click *OK* to close the OptoScript editor.

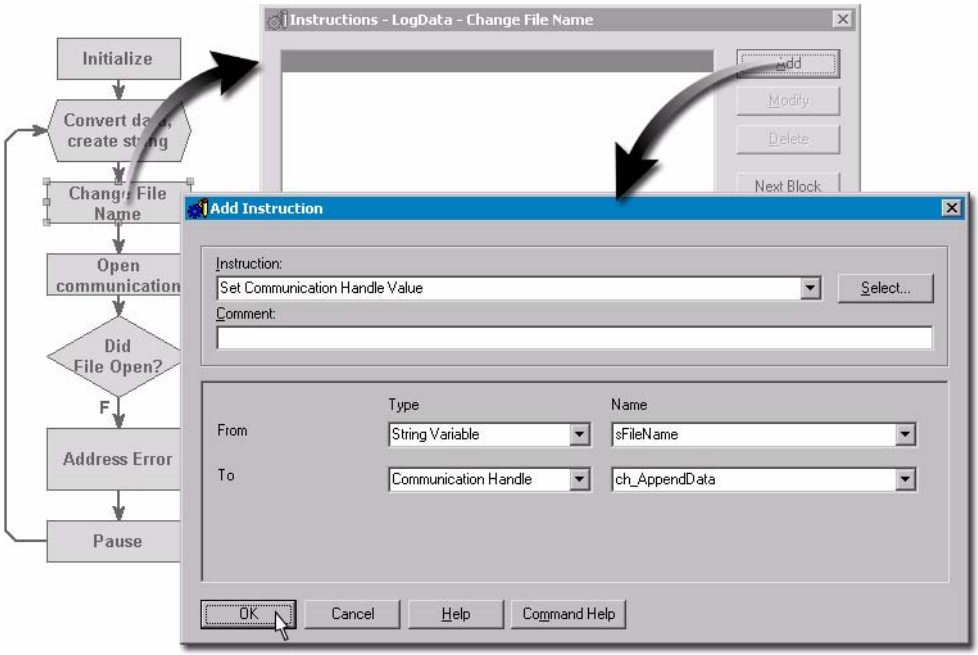
5. Assign new value to Communication Handle.

a. Open Change File Name block.
b. Click *Add*.
c. Select the following:

Instruction: *Set Communication Handle Value*

From: *String Variable – sFileName*

To: *Communication Handle – ch_AppendData*



d. Click *OK* to close the Add Instruction dialog box.
e. Click *Close* to close the Instructions dialog box.

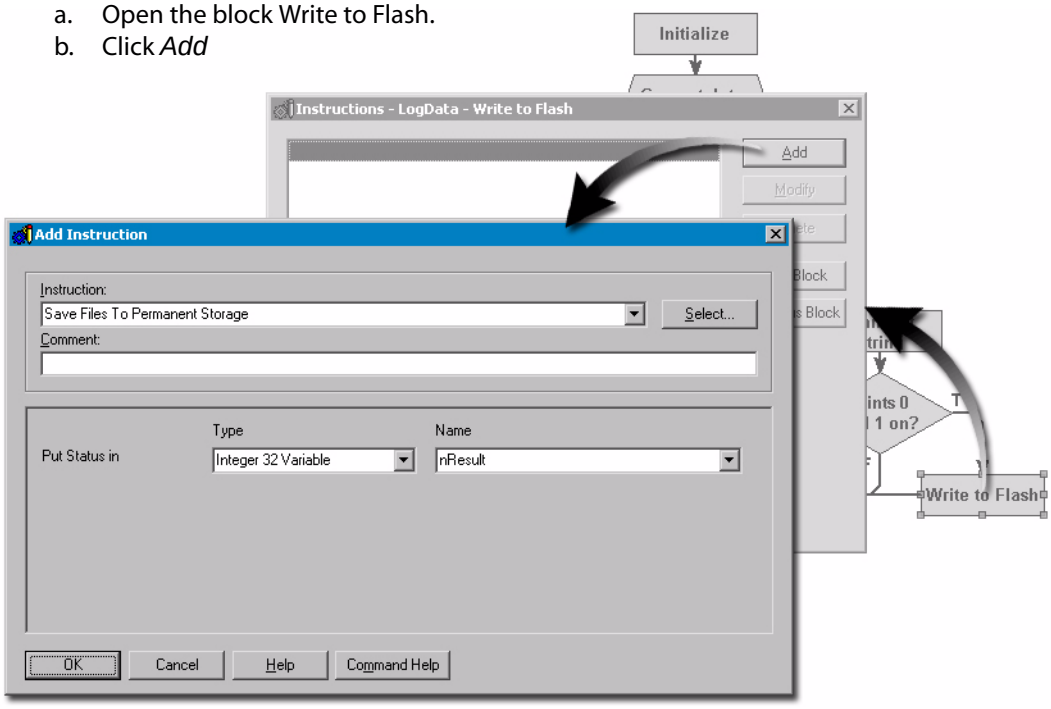
Saving a Log File to Flash

If desired, you can save a log file to Flash where it will be preserved should the brain lose power. The OptoScript implementing this feature has been commented out. Implementing an automated Write to Flash should be done cautiously: Flash memory has a limit to how many times it can be written to. Though the limit is high, an automatic loop repeating at a short interval could reach this limit if left running.

To write your log file to flash, do the following:

1. Save Files to Flash.

a. Open the block Write to Flash.
b. Click *Add*



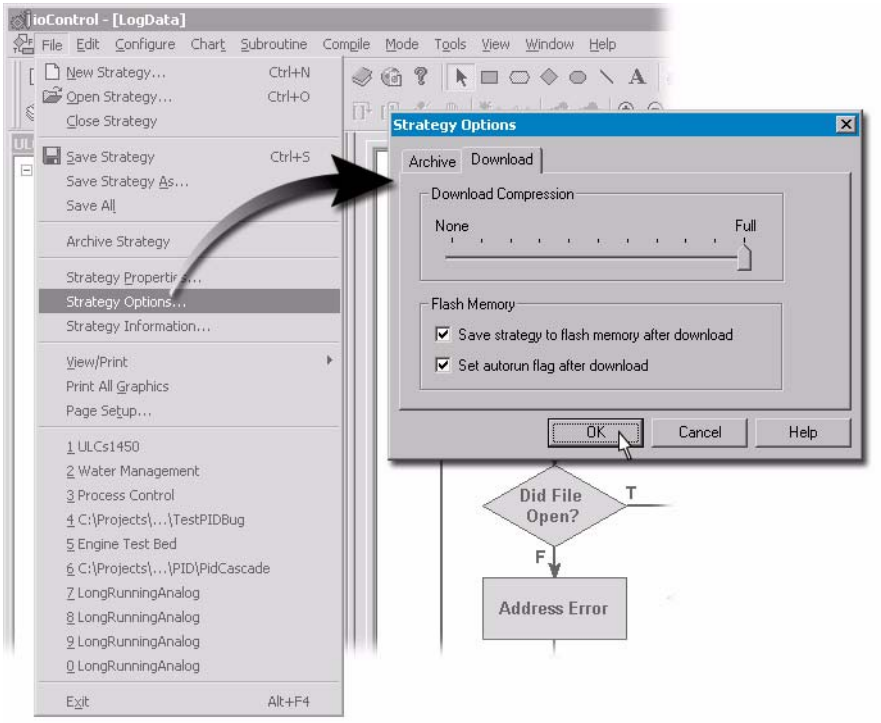
c. In the Add Instruction dialog box, select the following:
   Instruction: *Save Files to Permanent Storage*
   Put Status In: *Integer 32 Variable – nResult*
d. Click *OK* to close the Add Instruction dialog box.
e. Click *Close*.

2. Enable the Save to Flash and AutoRun options.

This step will ensure that your strategy is saved across a restart.

a. Select *File* ⟶ *Strategy Options.*

b. Click the *Download* tab.



c. Under Flash Memory, first select *Save strategy to flash memory after download.*
   Selecting this option enables the Set AutoRun option.
d. Click *Set AutoRun flag after download.*
e. Click *OK* to close the Strategy Options dialog box.

Test Your Changes

1. Download and run your strategy.

a. Choose *Mode* ⟶ *Debug.*
b. Choose *Debug* ⟶ *Run.*
   Allow the strategy to run for a few minutes.
   (Note: AutoRun takes effect after the strategy is running.)

2. Allow your strategy to log data.

Your strategy is logging data from the Photo Sensor switch and the temperature probe.

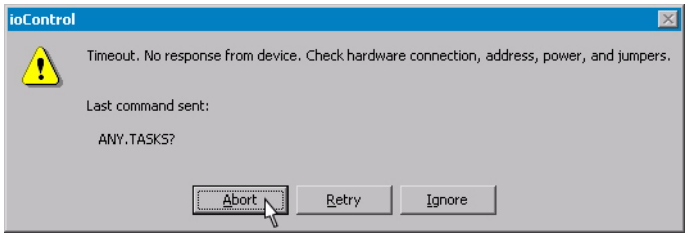
3. Turn on the Emergency and POS switches.

Simultaneously, hold both switches down for a few seconds.

4. Restart your strategy.

a. Turn off your SNAP Ultimate I/O Learning Center.
   The power switch is below the power cord connection.

ioControl will provide a timeout warning.



b. Select Abort; this will return ioControl to Configure mode.
c. Turn your Learning Center back on.

   Since you set the AutoRun flag, the strategy should restart after the brain is restarted.

Accessing files that have been saved to Flash is no different from accessing the files on RAM, the only difference is that log files will be preserved when the power to the brain is turned off.

5. Start Notepad.

6. Open the data log.

Note that files may be shown from previous sessions. These files may have been downloaded to your computer during the previous FTP session and may not be current. It is recommended that you reenter the connection to the brain's FTP to ensure that you are offered the most recent files residing on the brain.

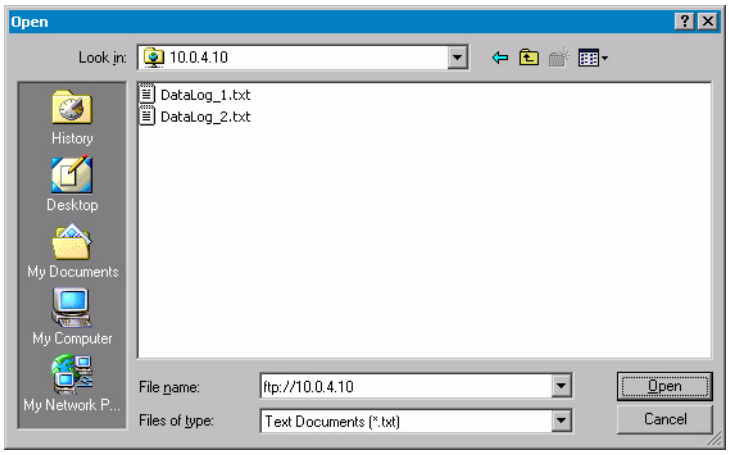
a. From the File menu, choose *Open*.
b. In the Open dialog box, type the following:

```
ftp://10.0.4.10
```

   NOTE: Substitute 10.0.4.10 with the IP address of your brain.

c. Click *Open*.

   This will display all files on the brain.



The files on the brain reflect the restarts. In the example above, DataLog_1.txt was created when the strategy was downloaded and represents the file that was

copied to Flash before the loss of power. DataLog_2.txt was created after the brain was restarted.

Disable AutoRun and Saving to Flash

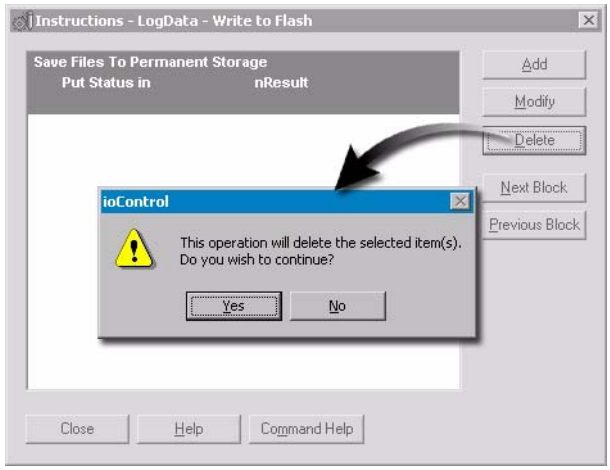
You will not need to save to flash to complete the following lessons.

1. Disable AutoRun.

a. In Configure mode, choose *File* ⟶ *Strategy Options*.
b. Click *Download*.
c. Deselect the options under Flash Memory.

2. Disable the Save To Flash command.

a. Open the block Write To Flash.
b. Select the Save Files to Permanent storage command.
c. Click *Delete*.
d. Click *Yes*.
e. Close the Instructions dialog box.



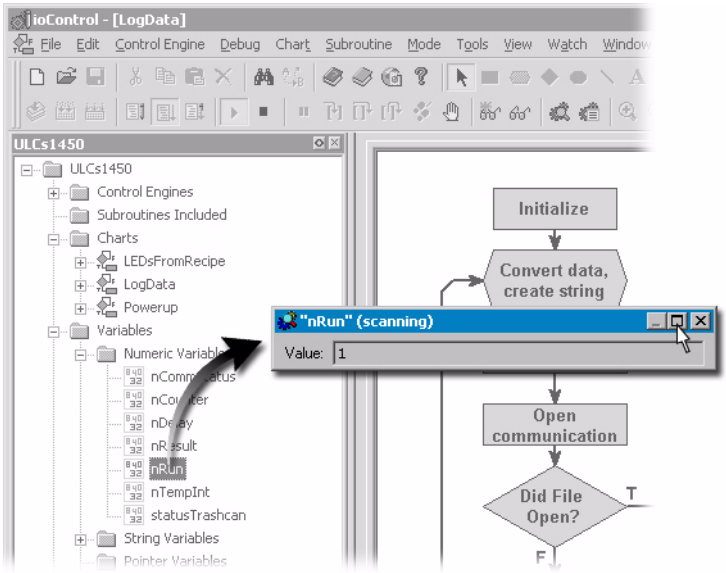
3. Download and run your strategy.

This will replace the previous strategy.

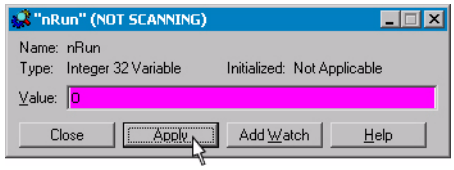
4. Reset nRun.

a. Make sure the strategy is running.

b. In the Strategy Tree under Numerical Variables, double-click *nRun*.



c. Expand the nRun Scanning dialog box.
d. In the Value field, type `0`.



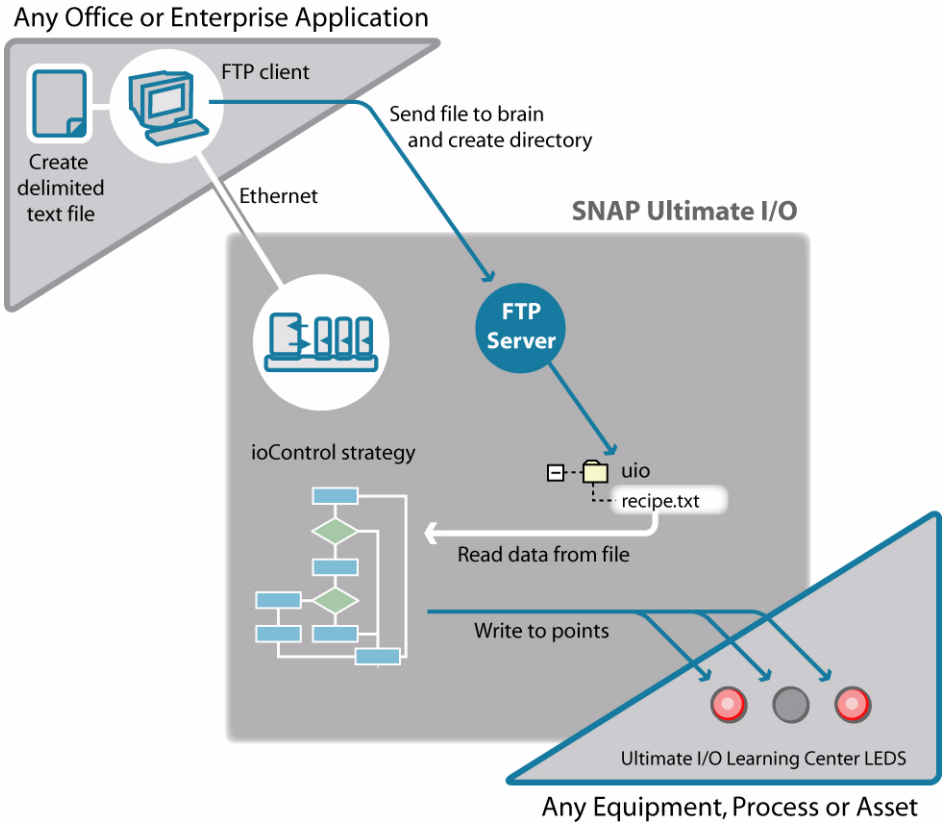
e. Click *Apply*.
f. Click *Close*.

5. Return to Configure mode.

LESSON 3: FTP SERVER AND READING UPLOADED DATA

OVERVIEW

In this lesson, you will modify the chart LEDsFromRecipe so it will parse a comma-delimited ASCII file (recipe.txt) uploaded to the brain. The values contained in recipe.txt are converted to integers and then written to digital output points 5 (Outside_Light), 6 (Inside_Light), and 7 (Freezer_Door_Status). This example converts strings to integers but the same methods can easily be adapted to convert strings to float variables to control analog output points.

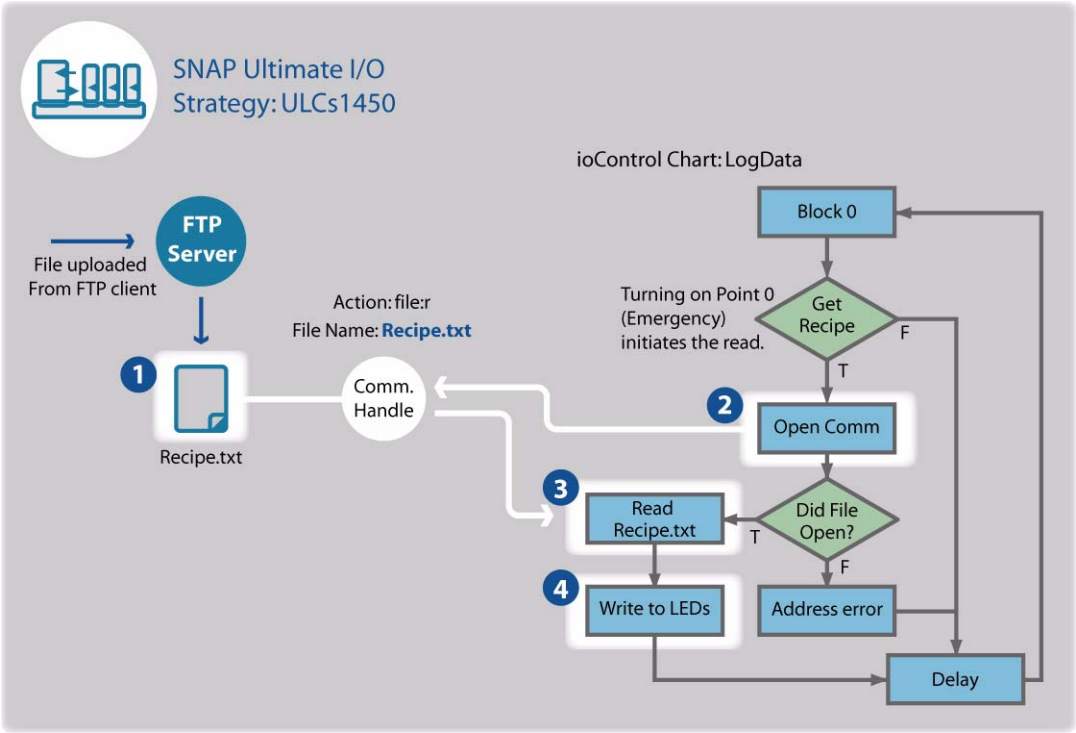


CONCEPTS

How the Sample Chart Works

The LEDsFromRecipe chart will respond to the SNAP Ultimate I/O Learning Center's Emergency switch to initiate the commands that will read a text file, parse it, and

control the LEDs (digital output points 4, 5, and 6). The diagram below describes the key functions this chart will perform when you complete lesson 3.



1	A text file containing three values, each followed by a comma delimiter, is loaded to the brain using the brain's FTP server.
2	When the Emergency button is held down, ioControl sets the value of the Communication Handle, establishes communication, and sets the end-of-message terminator.
3	The Communication Handle buffer contains the contents of the file. A receive string table command puts the contents into a string table using the end-of-message terminator to separate table elements.
4	The values in the string table are converted to integers and then moved to the digital output points.

Uploading a File to the Brain

Any FTP client can upload a file to the Ultimate I/O brain. Files can be uploaded to the brain's root directory or to subdirectories.

In this lesson, you will use ioManager as your FTP client application to create a directory on the brain and upload a text file to this directory.

Communication Handle Read Commands

A Communication Handle is used to read a file from the brain. The Communication Handle contains the *file*,*r* parameters to indicate the read function, followed by the file

name. If the file resides in a subdirectory, the subdirectories are included in the file name. For example:

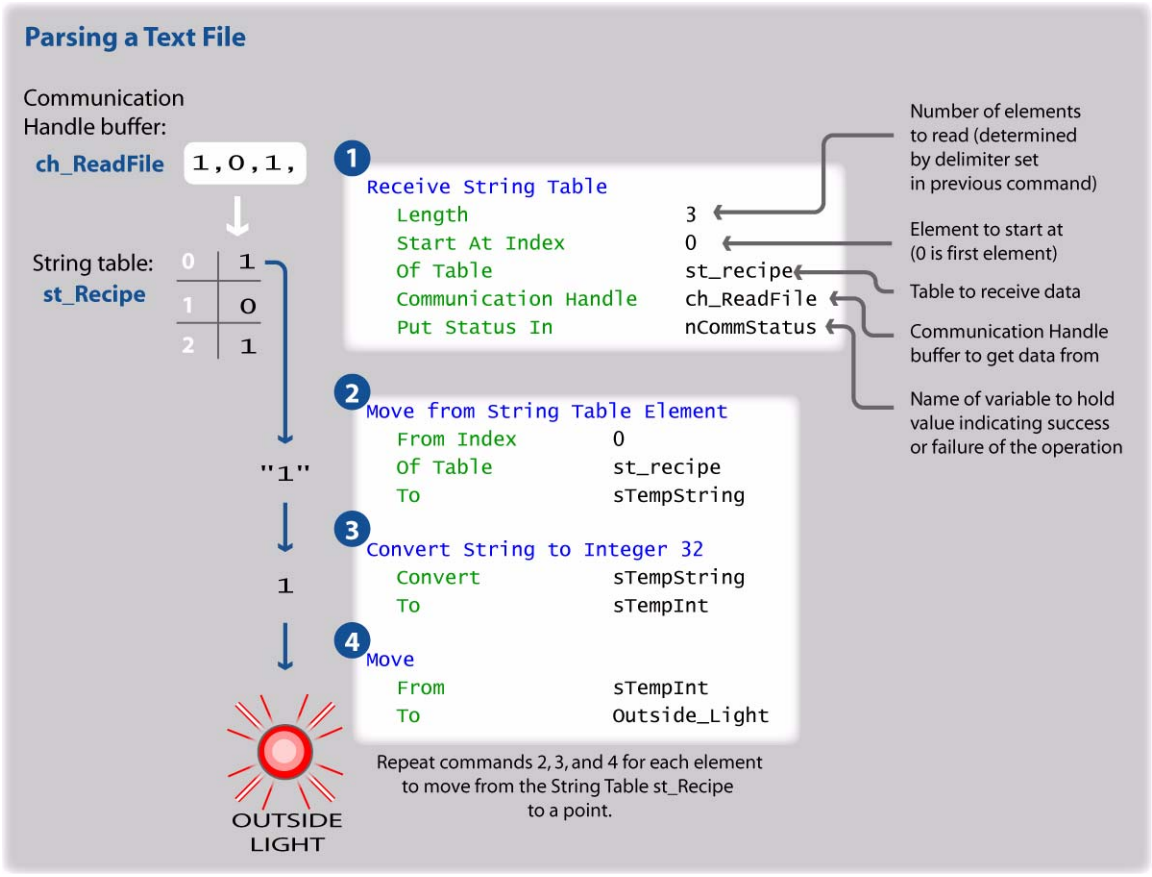
```
file,r:recipe.txt
file,r:\directory\recipe.txt
```

When using a read Communication Handle:

- Pay careful attention to case; the Communication Handle is case-sensitive.
- Set End-of-Message (EOM) Terminator after the Communication Handle is opened. The character is represented by an ASCII value (see the ASCII table under "String Commands" in Chapter 10 of the *ioControl User's Guide*, form #1300). Common EOMs include a comma (character 44) and a colon (character 58). The default EOM is a carriage return (character 13).
- Close communication when finished.

Parsing a Text File

The illustration below shows four ioControl instructions used to move data from the Communication Handle buffer to a point.



This lesson also presents a simpler method using OptoScript:

```
for nCounter = 0 to 2 step 1
nt_recipe[nCounter] = StringToFloat(st_recipe[nCounter]);
```

```
next

Outside_Light = nt_recipe[0];
Inside_Light = nt_recipe[1];
Freezer_Door_Status = nt_recipe[2];
```

The first three lines replace 6 of the ioControl instructions by creating a loop that converts each string to a float while putting the value into a table.

The last three lines move individual values from the Integer 32 table to digital points.

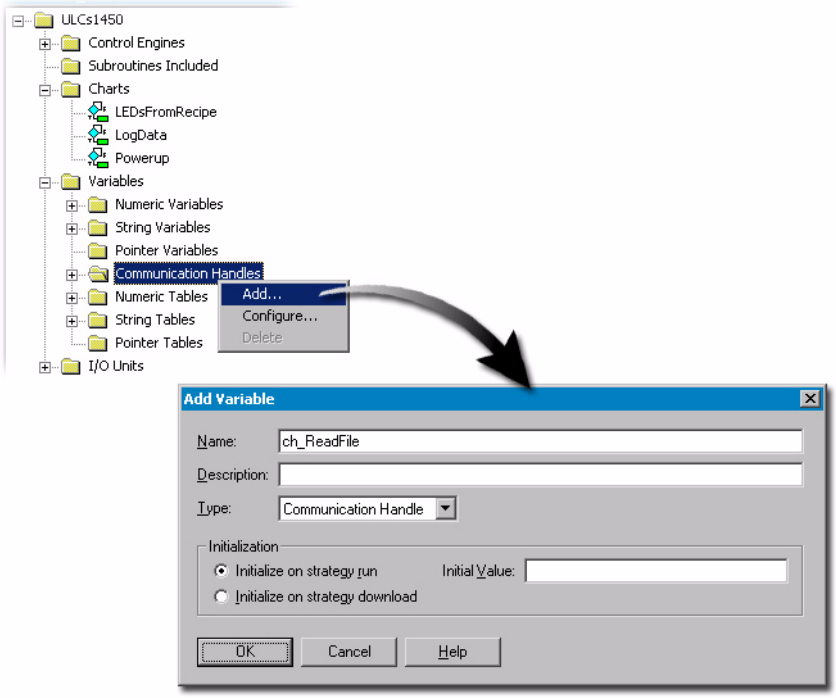
ACTIVITY 3: UPLOADING AND PARSING FILES

Reading a File through a Communication Handle

1. Make sure that you are in Configure mode.

2. Create Communication Handle.

a. In the strategy tree, right-click the Communication Handles folder.
b. Click *Add*.



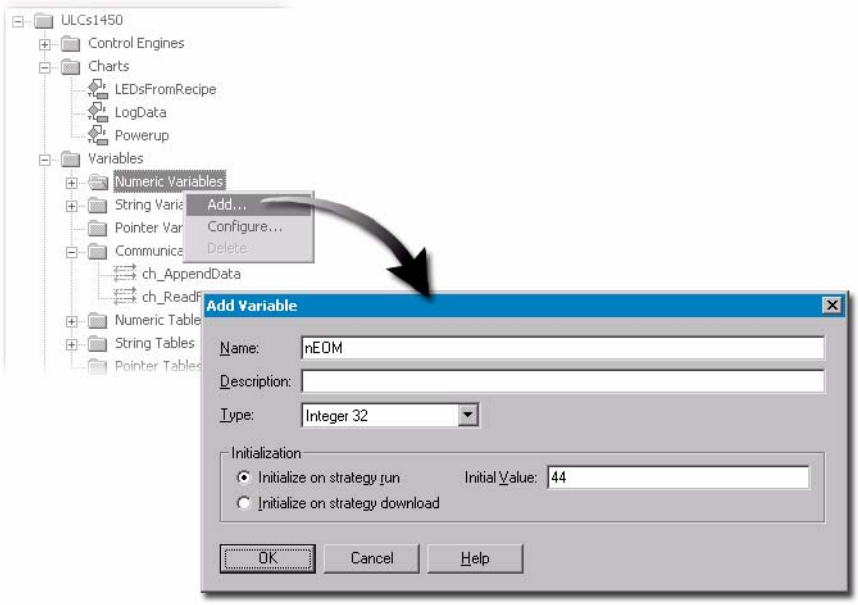
c. In the name field, type `ch_ReadFile`.

NOTE: You will use a Set Value of Communication Handle command to assign the value, so you don't need to configure an initial value here.

d. Click *OK* to close the Add Variable dialog box.

3. Create variable for End-of-Message Terminator.

a. In the strategy tree, right-click the Numeric Variables folder.
b. Click *Add*.



c. In the Add Variable dialog box, provide the following information:
   Name: `nEOM`
   Type: *Integer 32*
   Initial Value: `44`
   (44 is the ASCII character for a comma.)
d. Click *OK* to close the Add Variable dialog box.

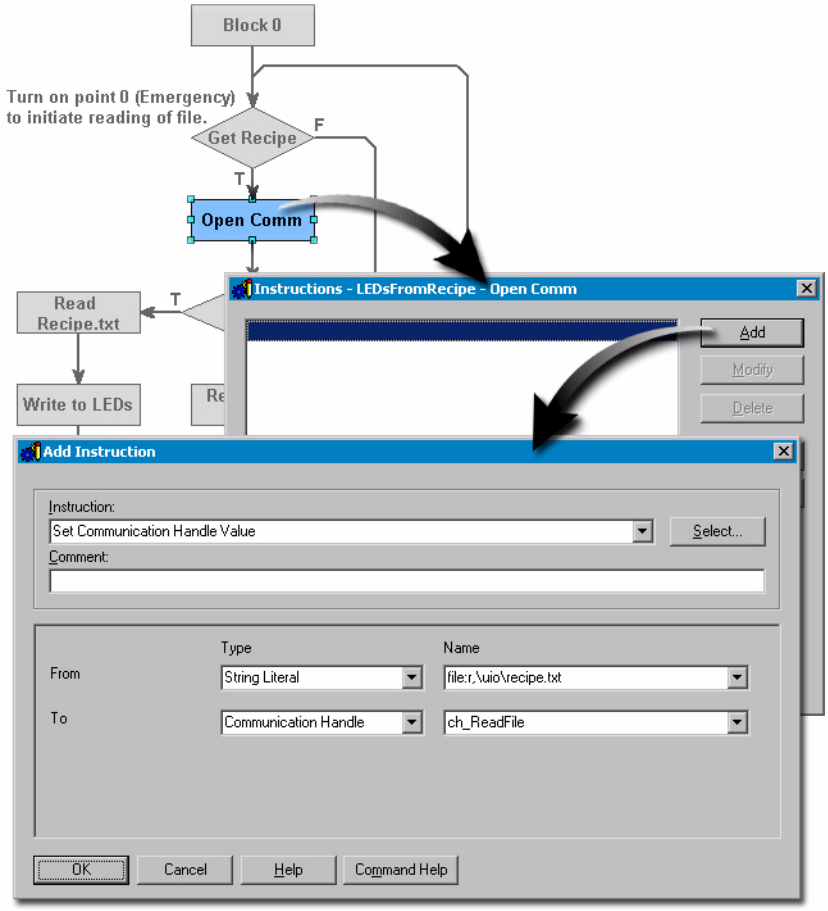
4. Open the LEDsFromRecipe chart.

a. In the Strategy Tree, expand the Charts folder.
b. Double-click LEDsFromRecipe.

5. Add Instructions to Open Communication block.

a. Double-click the Open Comm block.

b. Click *Add*.

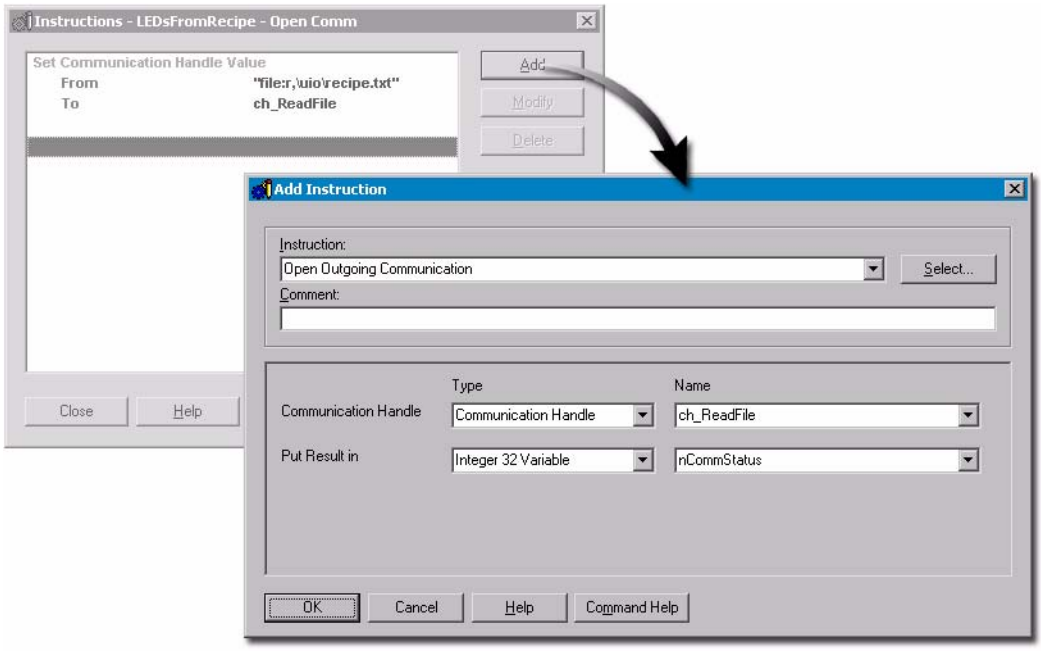


c. In the Add instruction dialog box, select the following information:
   Instruction: *Set Communication Handle Value*
   From: *String Literal* – `file:r,\uio\recipe.txt`
   (NOTE: Type the text exactly as shown, using all lowercase letters.)
   To: *Communication handle – ch_ReadFile*
d. Click *OK*.
e. Leave the Instructions dialog box open.

6. Open Outgoing Communication.

a. In the Instructions dialog box, click below the Set Communication Handle Value.

b. Click *Add*.

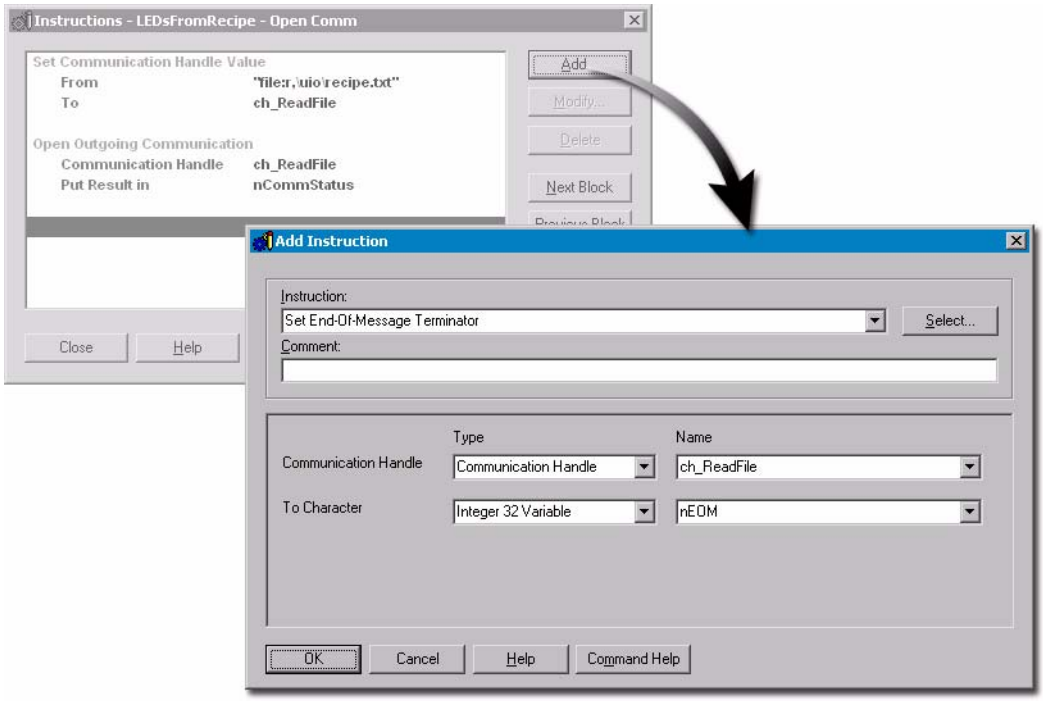


c. In the Add Instruction dialog box, select the following information:
   Instruction: *Open Outgoing Communication*
   Communication Handle: *ch_ReadFile*
   Put Result In: *Integer 32 Variable – nCommStatus*
d. Click *OK*.
e. Leave the Instructions dialog box open.

7. Set End-of-Message Terminator.

a. In the Instructions dialog box, select below the Open Outgoing Communication instruction.

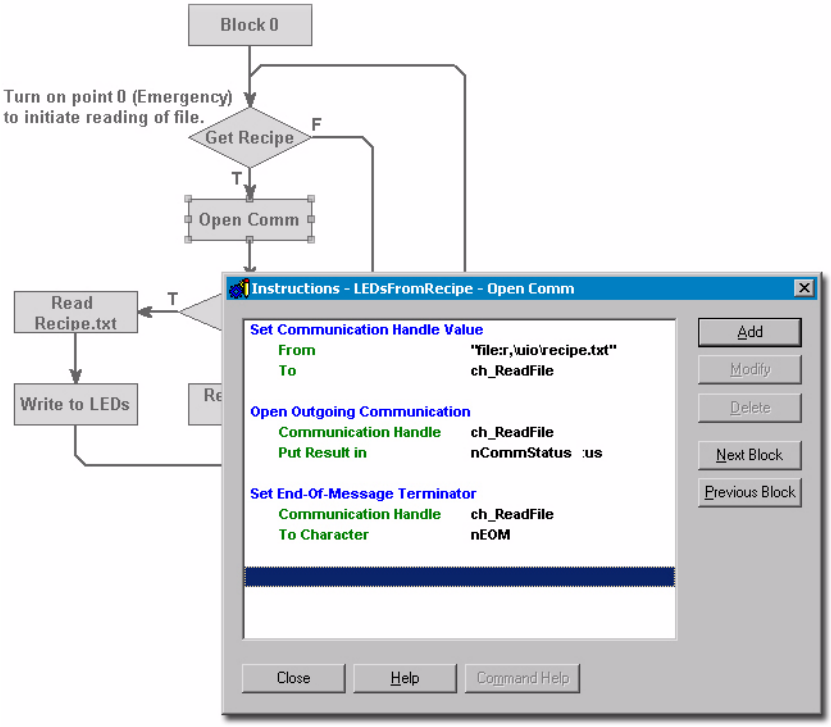
b. Click *Add*.



c. Select the following information:
   Instruction: *Set End-Of-Message Terminator*
   Communication Handle: *ch_ReadFile*
   Put Status In: *Integer 32 Variable – nEOM*

d. Click *OK*.

When you are finished, you should have the following instructions in the order shown below.

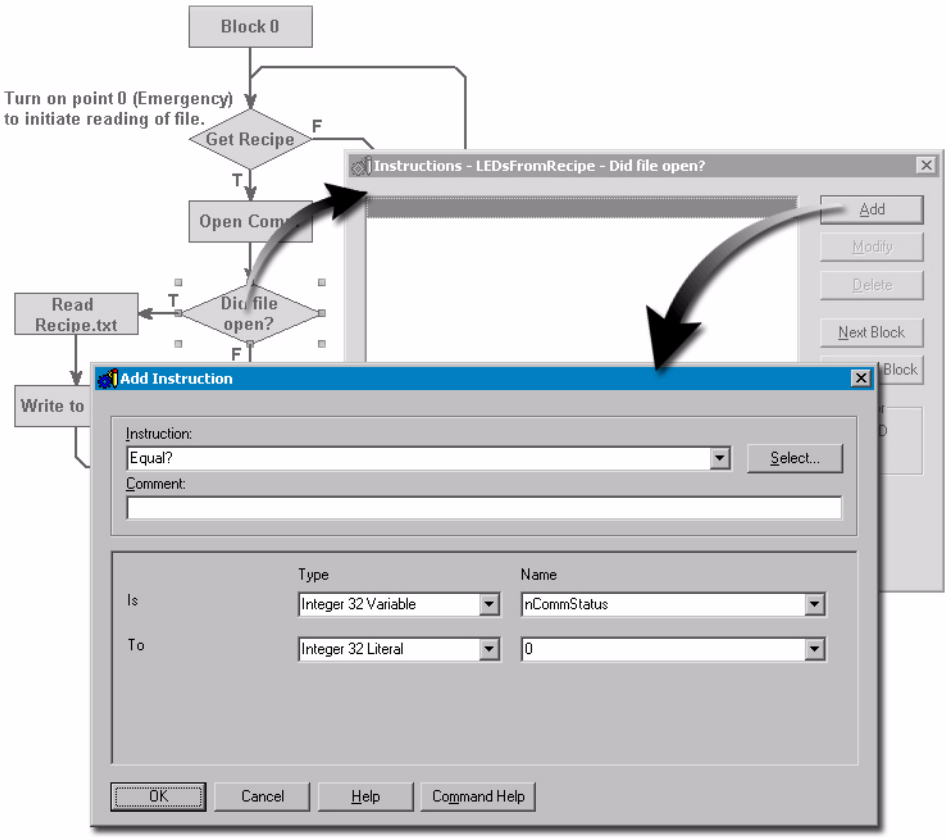


e. Click *Close*.

8. Test communication.

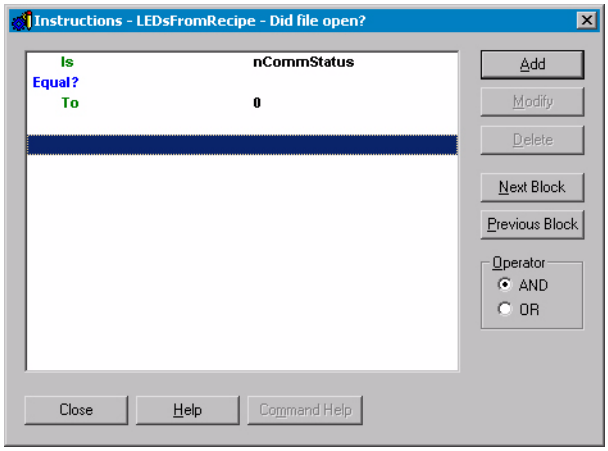
a. Double-click the Did File Open? condition block.

b. In the Instructions dialog box, click *Add*.



c. In the Add Instructions dialog box, provide the following information:
Instruction: *Equal?*
Is: *Integer32 Variable – nCommStatus*
To: *Integer 32 Literal – 0*

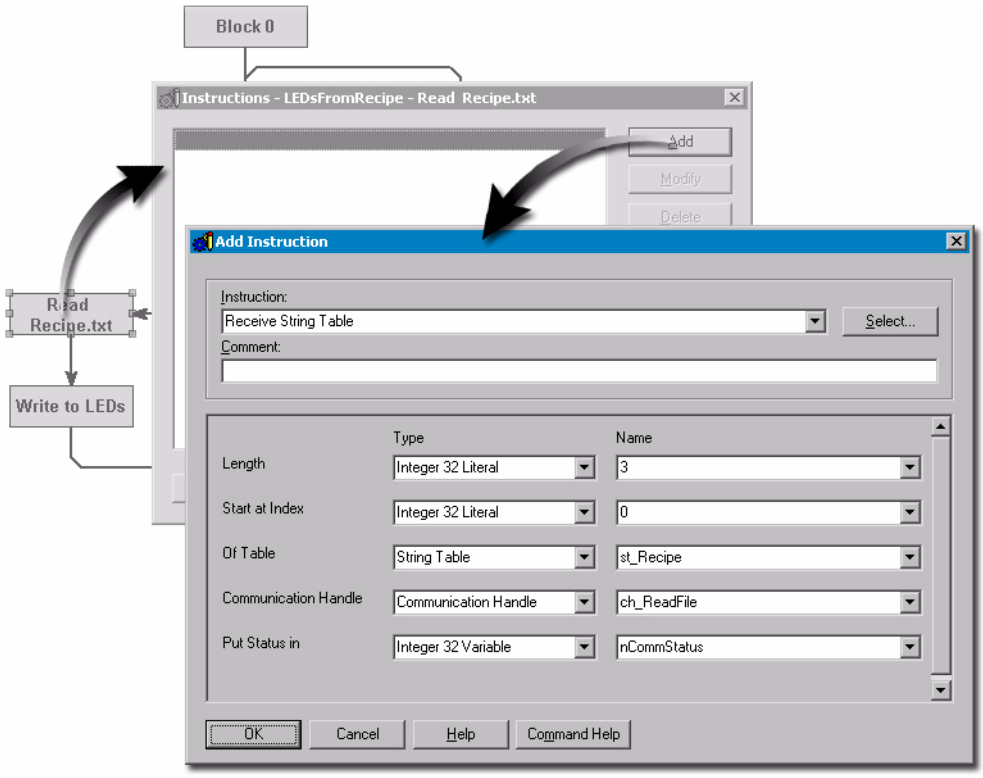
d. Click *OK*.



e. Click *Close*.

9. Receive String table.

a. Double-click the Read Recipe block.
b. In the Instructions dialog box, click *Add*.

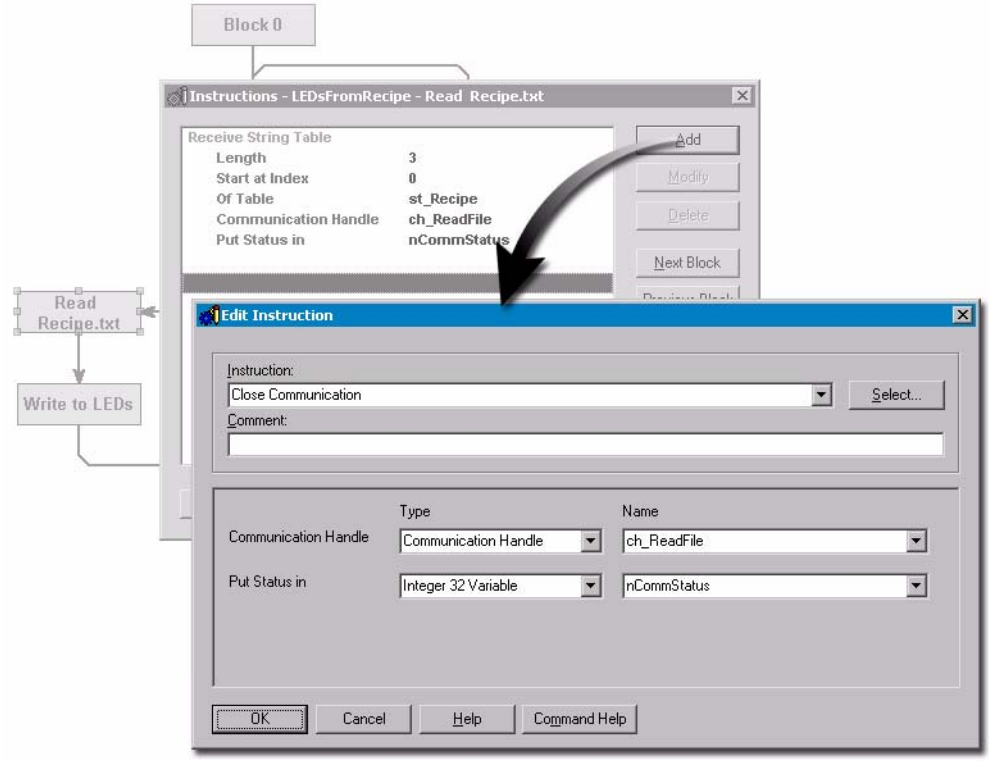


c. In the Add Instruction dialog box, provide the following information:
   Length: *Integer 32 Literal – 3*
   Start at Index: *Integer 32 Literal – 0*
   Of Table: *String Table – st_Recipe*
   Communication Handle: *ch_ReadFile*
   Put Status in: *nCommStatus*
   (NOTE: You may need to scroll the window to see all the options.)
d. Click *OK*.
e. Leave the Instructions dialog box open.

10. Close communication.

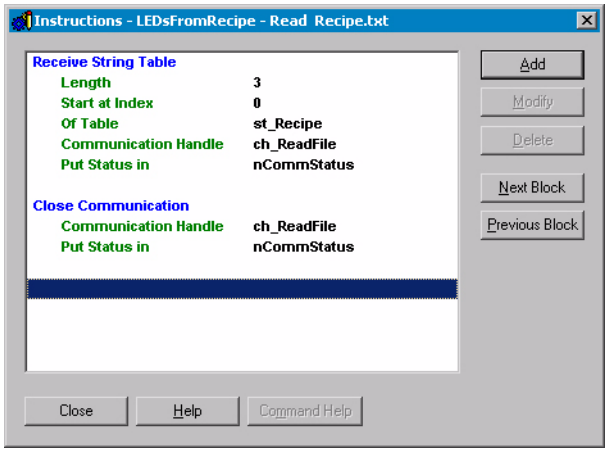
a. In the Instructions dialog box, select below the Receive String Table instruction.

b. Click *Add*.



c. Select the following information:
Instruction: *Close Communication*
Communication Handle: *ch_ReadFile*
Put Status in: *Integer 32 Variable – nCommStatus*

d. Click *OK*.
Your Instructions should appear as follows:



e. Click *Close*.

Parse a Data File

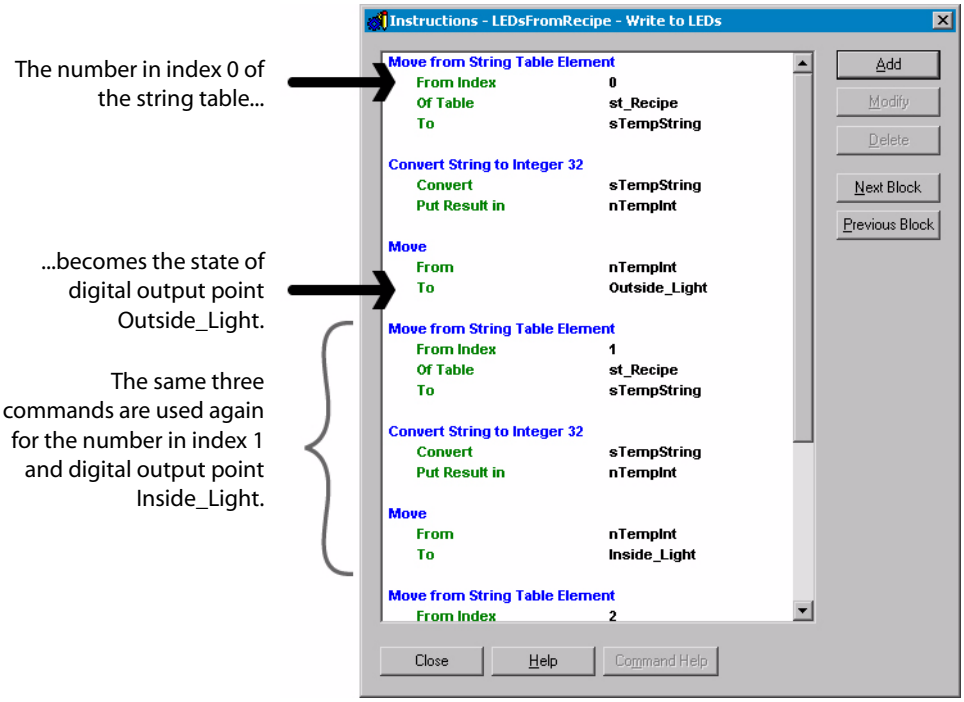
The chart shows two ways to extract the data from the Communication Handle buffer. In each case, the following must occur:

- The string data residing sequentially (e.g., "1,0,1,") in the Communication Handle must be put into a table.
- A specific string value must be converted from its string format to a numerical value.
- The numerical value is applied (moved) to the point.

1. Examine ioControl commands.

a. Double-click the Write To LEDs block.

The instructions in this block are ready to use; you do not need to make changes. Three instructions are used in three sets, as shown here.



NOTE: If you do not have a Learning Center, you'll need to make sure that the Move commands cite digital output points configured on your SNAP Ultimate I/O. If you do not have three points to control, remove all but the first three commands.

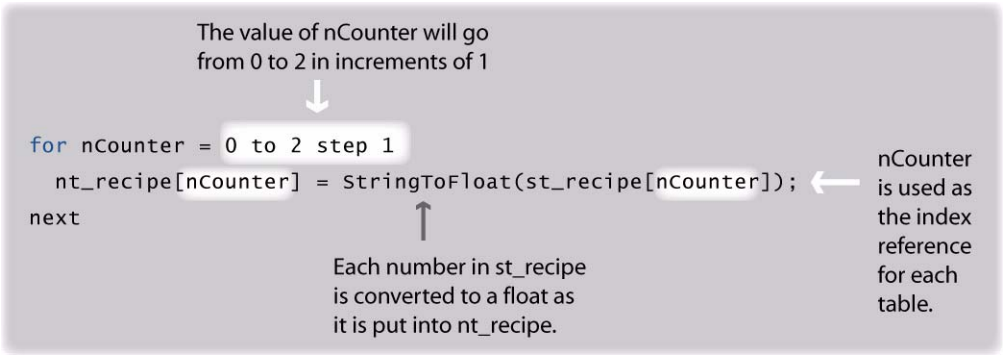
b. Click *Close*.

2. Examine OptoScript.

As an alternative to ioControl instructions, you can use the OptoScript sample that is provided (expand the chart window if the OptoScript block isn't shown). The advantage of the OptoScript is that is uses fewer steps.

a. Double-click Write to LED (Alternative).

The first three lines (not counting the comment in line 1) use a repeating loop that puts the text into the string table and coverts it to a number.



Setting the digital points to the value of the elements in nt_recipe, becomes a simple action of assigning the desired table value to each point:

```
Outside_Light = nt_recipe[0];
Inside_Light = nt_recipe[1];
Freezer_Door_Status = nt_recipe[2];
```

b. Close the OptoScript editor.

3. Choose block

a. If you wish to use the ioControl instructions, make no changes.
b. If you wish to use the OptoScript, redraw the chart so that the OptoScript block is used instead of the instruction block (both blocks are named Write to LEDs).

Create and Upload a File

1. Create a comma-delimited file.

a. Open Notepad.
b. Type the following in a new file:

```
1,0,1,
```

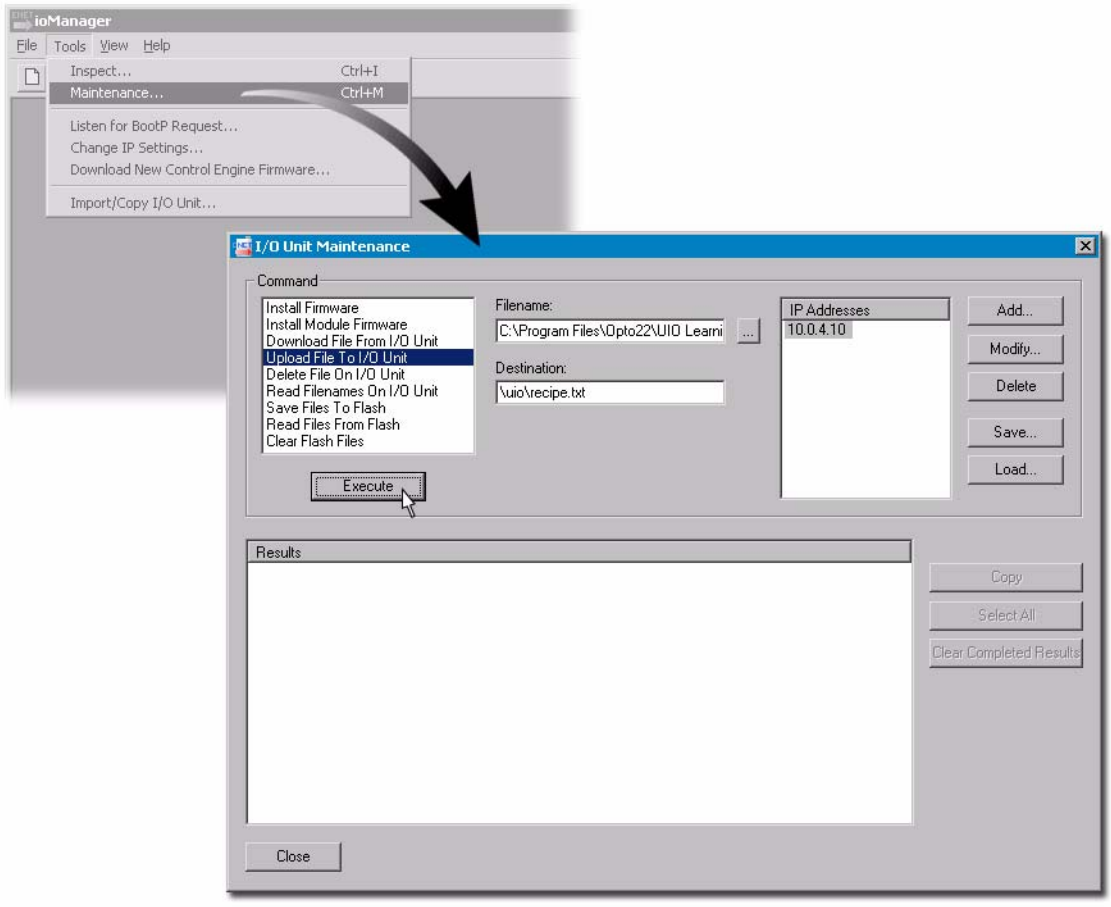
Make sure you include a comma after each number, and do not use spaces between numbers and commas.

c. Save your file as `recipe.txt`.

2. Upload recipe.txt using ioManager.

a. Start ioManager.

b. From the ioManager application window, chose *Tools* ⟶ *Maintenance.*.



c. In the Command Field, select *Upload File to I/O Unit*.
d. In the File Name field, type the path and file name of recipe.txt you just created, or use the browse button to locate the file recipe.txt.
e. In the destination field, type the following:

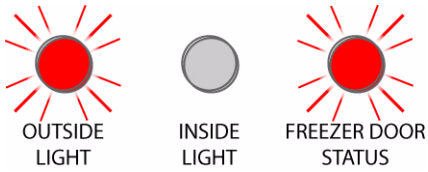
   `\uio\recipe.txt`

   (NOTE: The path and file name must correspond to the path and file name cited within the Communication Handle.)
f. Select the IP address of your brain. (NOTE: if your brain's IP address is not listed, click *Add* and type the IP address in the Add IP Address dialog box.)
g. Click *Execute*.

Test Your Strategy

1. **Download and run your strategy.**

2. **Hold down the emergency switch for at least a second.**



Notice that your LEDs are now on or off depending on the values contained in recipe.txt.

To change the states of the points, edit recipt.txt on your computer, upload it to the brain, and then hold down the emergency switch again.