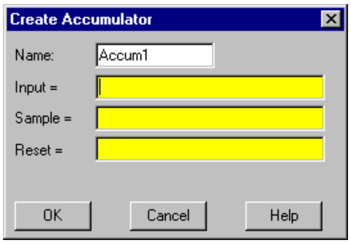
2 System Objects

This chapter describes Lookout*Direct* System object classes, listed in alphabetical order. Input parameter syntax and data members are documented for each object class, along with a description of the functionality of each object class.

Accumulator

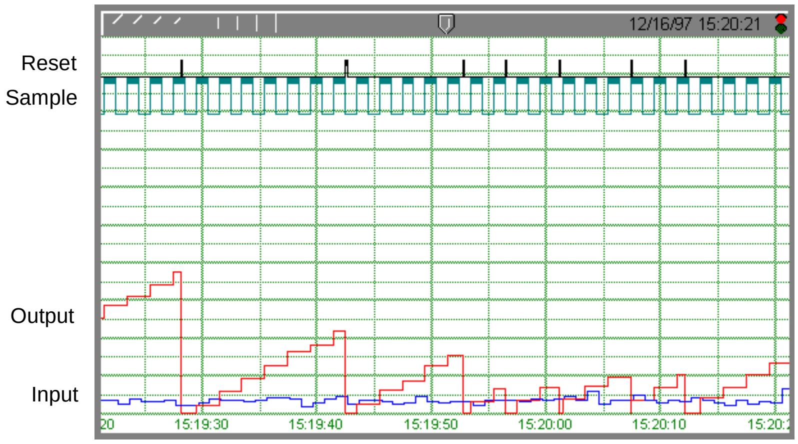
Accumulator is a numeric totalizer. It samples the numeric **Input** any time the **Sample** value transitions from off to on, adding each new sample to the previous running total. It resets the totalized value to zero when **Reset** transitions from off to on.



Name: Accum1
Input =
Sample =
Reset =

Input is a numeric expression while **Sample** and **Reset** are logical expressions.

The following HyperTrend demonstrates the relationship between **Input**, **Sample**, and **Reset**.



Accumulator Data Members

Table 2-1. Accumulator Data Members

Data Members	Type	Read	Write	Description
(implicit)	numeric	yes	no	Current totalized value, totalized since the most recent Reset signal. Updated at the defined Sample rate.

Comments **Reset** could be a regular pulse interval created by a Pulse timer, as shown in the dialog box in Figure .

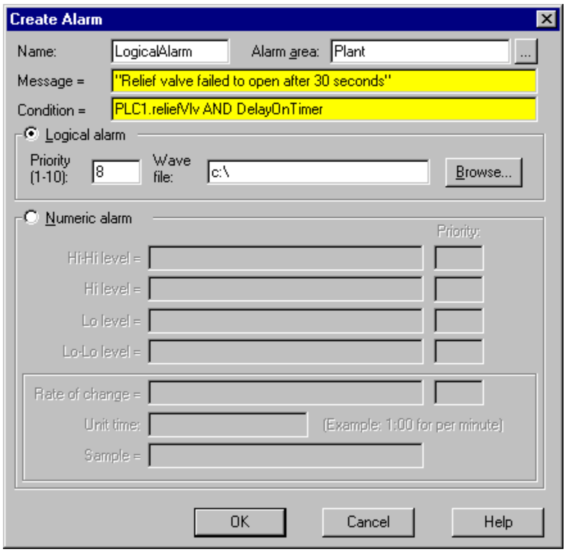
The Counter object class totalizes a number of logical events and the Integral object class totalizes rates. Use Accumulator to totalize numeric variables.

Related Objects *Average, Minimum, Maximum, Sample*

Alarm

Alarm is a flexible and powerful object class you use to create various logical- and numeric-triggered alarms that are displayed in the alarm window.

Note You should first read about the Lookout*Direct* alarm system in Chapter 9, *Alarms*, in the *LookoutDirect Developer's Manual* to aid you in designing the most efficient alarming scheme for your application.


Create Alarm

Name: LogicalAlarm Alarm area: Plant

Message = "Relief valve failed to open after 30 seconds"

Condition = PLC1.reliefVlv AND DelayOnTimer

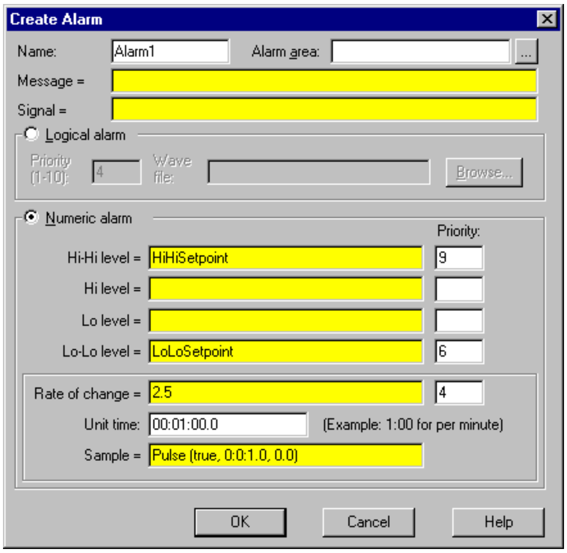
[● Logical alarm] Priority (1-10): 8 Wave file: c:\

○ Numeric alarm

There are two basic alarm types: Logical and Numeric. **When Logical alarm** is selected, Lookout*Direct* prompts you to enter a logical expression in the **Condition** field. It then uses the logical **Condition** to trigger and reset the alarm. If the alarm **Condition** is true, the alarm is active, and if the condition is false, the alarm goes inactive. You can also connect an audio **Wave file** to individual logical alarms. See *Playwave* for additional information.

Lookout*Direct* queues alarm `.wav` files, with up to 100 files in the queue. Each alarm `.wav` file plays completely before the next file plays. If more than 100 alarms fill the queue, new alarms cancel the currently playing files and begin playing instead.

When you pick the **Numeric** alarm selection, the name of the Condition field changes to **Signal**. This prompts you to enter a numeric expression in the field against which your various alarm setpoints are measured. **Hi-Hi**, **Hi**, **Lo**, and **Lo-Lo** are all numeric expressions. **Rate of change** generates an alarm when the signal is actively changing by the set amount for the period of time between any two **Sample** pulses. The **Unit time** setting determines the time units for the rate of change.


Create Alarm

Name: Alarm1

Alarm area:

Message =

Signal =

Logical alarm

Priority (1-10): 4

Wave file:

Numeric alarm

		Priority:
Hi-Hi level =	HiHiSetpoint	9
Hi level =		
Lo level =		
Lo-Lo level =	LoLoSetpoint	6
Rate of change =	2.5	4

Unit time: 00:01:00.0 (Example: 1:00 for per minute)

Sample = Pulse (true, 0:0:1.0, 0.0)

Alarm area specifies the group name associated with the alarm object. All previously defined groups appear in the list box and may be selected with the mouse.

Priority ranges from 1 to 10 where 10 is the most important.

Message is a text expression whose result is displayed in the alarm window when this object generates an alarm. If alarm style is numeric, the relevant alarm trigger prefixes your message (for example, HiHi level: *Alarm message*). See Chapter 9, *Alarms,* in the *LookoutDirect Developer's Manual* for additional information.

Alarm Data Members

Table 2-2. Alarm Data Members

Data Members	Type	Read	Write	Description
active	logical	yes	no	Result of logical alarm status. True if alarm is active and false if alarm is inactive.
hi	logical	yes	no	Result of numeric alarm hi data member status.
hihi	logical	yes	no	Result of numeric alarm hihi data member status.
lo	logical	yes	no	Result of numeric alarm lo data member status.
lolo	logical	yes	no	Result of numeric alarm lolo data member status.
rate	logical	yes	no	Result of numeric alarm rate data member status.

Comments A common alarm condition is caused by a measured value going out of an acceptable range. For example, a storage tank whose level is too low or too high can generate several alarms: `Hihi: Tank level is out of range`, or `Lo: Tank level is out of range`. If you use a numeric style alarm to trigger the alarm and if the tank level fluctuates or "jitters" around the alarm level settings, a new alarm record is generated in the alarm window each time the tank level fluctuates above or below the level settings. To alleviate this condition, you could use the Neutralzone object to filter out minor tank fluctuations.

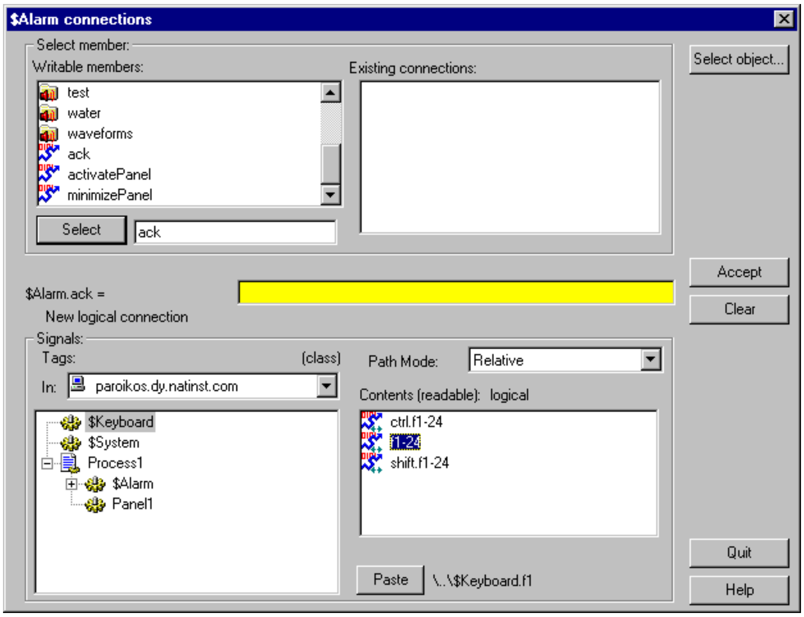
Note Alarms can also be defined through parameter settings on object data members. Many times, this is the most efficient method of defining and creating alarm conditions. See *Database-Generated Alarms* in Chapter 9, *Alarms*, in the *LookoutDirect Developer's Manual*, and *Editing Object Databases* in Chapter 4, *Using LookoutDirect*, in the *Getting Started with LookoutDirect* manual.

$Alarm

$Alarm is a global object. It makes available global alarm data such as the number of currently active alarms.

You can use $Alarm data members just like other data members. By inserting an expression you can display the number of active alarms in any particular group. Or, by connecting a pushbutton to an acknowledge data member, operators can acknowledge alarms through pushbutton selection.

Assume, for example, that you want to create a pushbutton that acknowledges all alarms. First create a pushbutton object. Next, use the **Object»Edit Connections…** command to connect the pushbutton (`Pb1`) to the `.ack` data member of $Alarm. Such a connection is shown in the following illustration.


$Alarm connections

Select member:

Writable members:
test
water
waveforms
ack
activatePanel
minimizePanel

Select: ack

Existing connections:

$Alarm.ack =
New logical connection

Signals:
Tags: (class)
In: paroikos.dy.natinst.com

$Keyboard
$System
Process1
$Alarm
Panel1

Path Mode: Relative
Contents (readable): logical
ctrl.f1-24
f1-24
shift.f1-24

Paste \..\$Keyboard.f1

The expression `(Pb1)` acknowledges all active alarms any time the pushbutton is depressed. You could make similar connections to acknowledge individual alarm areas.

You can define new alarm areas through Alarm objects and by modifying object database parameters. As you create each new alarm area, Lookout*Direct* adds new readable and writable data members to the $Alarm object. $Alarm data members are described in the following table.

$Alarm Data Members

Table 2-3. $Alarm Data Members

Data Member	Type	Read	Write	Description
ack	logical	no	yes	Upon transition from FALSE to TRUE, acknowledges all alarms.
Ackselected	logical	no	yes	Upon transition from FALSE to TRUE, acknowledges all selected alarms.
ActivatePanel	logical	no	yes	Calls Alarm Window upon transition from FALSE to TRUE, making it visible on the screen.
Active	numeric	yes	no	Total number of currently active alarms (that is, alarm conditions that still exist).
Groupname	text	yes	no	Alarm area name associated with the most recent alarm.
Groupname.ack	logical	no	yes	Upon transition from FALSE to TRUE, acknowledges all alarms within the specified group.
Groupname.active	numeric	yes	no	Number of currently active alarms within the specified group.
Groupname.unacked	numeric	yes	no	Number of unacknowledged alarms within the specified group.
Message	text	yes	no	Text of the message of the most recent alarm
MinimizePanel	logical	no	yes	Closes Alarm Window upon transition from FALSE to TRUE, changing it to an icon.
Priority	numeric	yes	no	Alarm priority associated with the most recent alarm.

Table 2-3. $Alarm Data Members (Continued)

Data Member	Type	Read	Write	Description
Priority01.active – Priority10.active	numeric	yes	no	Number of currently active alarms of the specified priority.
Priority01.unacked – Priority10.unacked	numeric	yes	no	Number of unacknowledged alarms of the specified priority.
Silence	logical	no	yes	Turns off alarm sounds when set to TRUE.
Name	text	yes	no	Object name associated with the most recent alarm.
Unacked	numeric	yes	no	Total number of unacknowledged alarms (that is, alarm conditions that have not yet been acknowledged).
Update	logical	yes	no	Pulses high every time there is a new alarm.

Comments Groupname in the preceding table represents the name of any specified alarm area. The $Alarm object contains an `.active`, `.unacked`, and `.ack` data member for every alarm area.

Using $Alarm with Other Objects

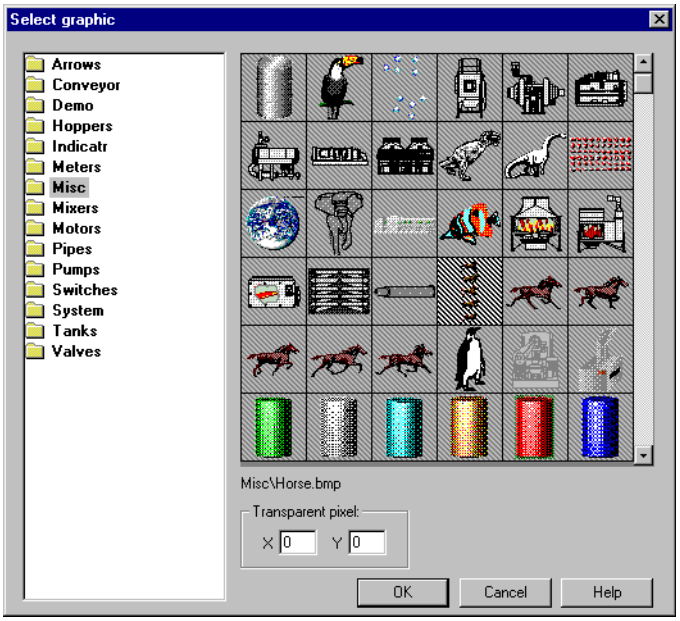
Every time a new alarm appears in Lookout*Direct*, `$Alarm.Message`, `$Alarm.Name`, `$Alarm.Groupname`, and `$Alarm.Priority` are updated with the appropriate information for the new alarm. Then `$Alarm.Update` pulses high to alert you that those four data members contain fresh values.

These data members can serve many purposes, but they are specifically designed to work with the Pager object class. In a typical application, you could use `$Alarm.Update` to initiate a page, possibly including the other four data members in the text of the page. With this system you can also filter which alarms you want to page, and which alarms the pager ignores.

Animator

The Animator object class provides full graphical animation including horizontal and vertical motion, dynamic resizing and visibility, dynamic symbol sequencing and programmable color changes.

When you first create an animator object, the **Select graphic** dialog box appears.



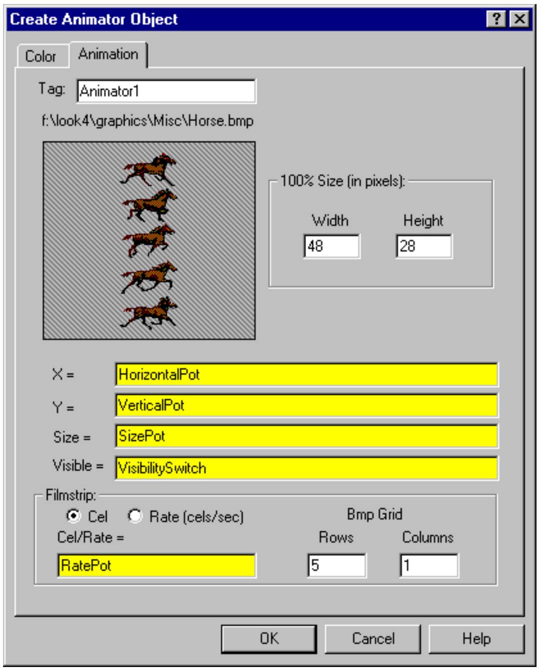
Misc\Horse.bmp

X 0 Y 0

Select the graphic you want to animate. To animate colors, you must select a Windows Metafile (`.wmf`). A moving animation must have the series of images you want to animate arranged in a single bitmap so that each cell of the animation can be defined by a grid of rows and columns.

Animations

To create a moving animation, select the Animation name.


Create Animator Object

Color | Animation

Tag: Animator1

f:\look4\graphics\Misc\Horse.bmp

100% Size (in pixels):

Width: 48 Height: 28

X = HorizontalPot

Y = VerticalPot

Size = SizePot

Visible = VisibilitySwitch

Filmstrip:

[✓ Cel] Rate (cels/sec)

Cel/Rate = RatePot

Bmp Grid

Rows: 5 Columns: 1

The graphic file you select determines what images appear on the screen. You delineate the images in a bitmap graphic by dividing it into a grid of **Rows** and **Columns**. In the preceding illustration, the single column is `48` pixels **W**ide and each row is `28` pixels **H**igh. Conceivably, the grid *could* consist of 32,000 cells. 100 cells would be more practical.

Each grid cell is a filmstrip image. Internally, the Animator assigns a cell number to each image. It normally plays the filmstrip by progressing from left to right and top to bottom, from the lowest cell number to the highest cell number.

The **Rate (cells/sec)** selection you use to specify a frequency at which the Animator progresses from one cell image to the next. The rate value can be positive or negative and can range from `0.0000005` (one frame every 23.148 days) to `100` frames per second.

If the rate value is negative, the Animator plays the filmstrip backwards, starting at the last cell.

You can use the **Cell** selection in the definition dialog box to identify a particular cell number to display. For example, you might use this selection to display a specific image when a PLC register is equal to a particular value. This is similar to the multistate object, but can provide many more states, depending on the number of cells in the bitmap.

The **X** and **Y** parameters specify the horizontal and vertical position of the image, respectively. These numeric parameters range from `0` to `100`, and together provide the X-Y position of the image as a percent of the Animator dimension on a control panel.

Size is a numeric parameter that ranges from `0` to `100` percent, where `100` percent is the full size of a single cell as specified by **W** and **H**.

Visible is a logical parameter that causes to the image to appear when it goes true and disappear when it goes false.

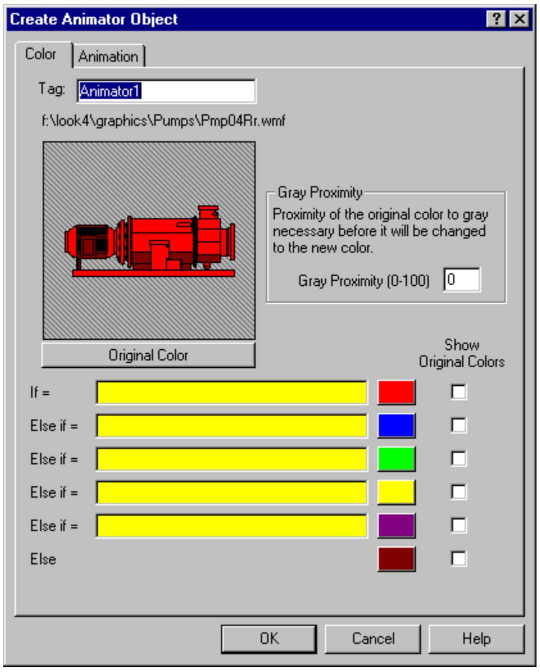
Color Animation

To create color changes programmatically, select the **Color** tab.

With this option, you can set the color map on a `.wmf` graphic using a series of five logical conditions and a default state. If no condition is true, the default state (or color map) is imposed.

You can choose a custom color map by clicking on the color sample associated with each logical condition. You can then select any color from the palette available on your computer.

Select the **Show Original Colors** box if you want the original color map of the `.wmf` file to be imposed for that condition.



Tag: Animator1

f:\look4\graphics\Pumps\Pmp04Rr.wmf

Gray Proximity

Proximity of the original color to gray necessary before it will be changed to the new color.

Gray Proximity (0-100) 0

Gray Proximity determines the color saturation point at which the selected color replaces an original color. When this parameter is set to `0`, most colors change. When this parameter is set to `100`, most colors will not change. You can test the effects of this setting by putting your cursor over the color button and observing the change in the graphic displayed in the dialog box window.

Notice that the if and else if statements are evaluated in sequence. If several conditional expressions are true at once, Multistate displays the graphic associated with the first true expression.

For instance, if your **If** parameters use less-than comparisons, such as `PumpSpeed<50`, the following **Else if** parameter must have a larger comparison value, such as `PumpSpeed<75`. If you use a smaller comparison value, such as `PumpSpeed<25`, the color change will not take place. In other words, the comparison values must be used from smallest to largest.

In the same way, if you are using greater-than comparisons, such as `PumpSpeed>50`, you must list your comparison values from largest to smallest, so that the next **Else If** parameter would have to be something like `PumpSpeed>25`.

Put **If** parameters using equality, such as `PumpSpeed=50`, before parameters using inequalities.

A few minutes experimentation should help you understand the interactions of the color choice conditions.

Animator Data Members

Table 2-4. Animator Data Members

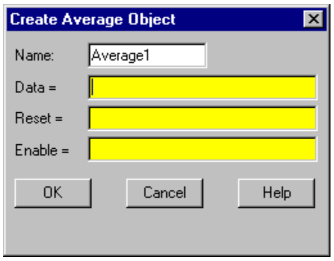
Data Member	Type	Read	Write	Description
none	—	—	—	Animator objects do not have data members

Comments Consider using an Integral object instead of a Counter/Pulse combination when trying to achieve smooth animation.

Related Objects *DialGauge*, *Gauge*, *Multistate*, *Pipe*, *Spinner*

Average

Average actively calculates the average value of **Data** over time. Average is only active when the **Enable** expression is true and resets to zero when the **Reset** expression transitions from off to on. Average also maintains an array of up to 35 previous averaged values. If **Enable** is left blank, the object always actively calculates the average.



Data is a numeric expression while **Reset** and **Enable** are logical expressions.

Average Data Members

Table 2-5. Average Data Members

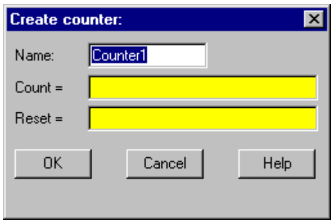
Data Members	Type	Read	Write	Description
(implicit)	numeric	yes	no	Current average calculated since the most recent Reset signal. Updated approximately once per second.
1 – 35	numeric	yes	no	Previous average values. Signal 1 is the most recent prior average since the Reset signal went high.
DataReset	logical	no	yes	Upon transition from FALSE to TRUE, resets to zero all data members—including the current average and all previous averages.

Comments The **Reset** expression could be a regular pulse interval created by a TimeOf*xxxx* timer, so that the pulse is synchronized to the top of the hour or day. For example, if you want to calculate the daily average flow rate, use the output signal from a TimeOfDay timer or a daily Spreadsheet object to reset the average calculation at the beginning of each day. If you want to calculate the average flow rate only when a pump is running, use the input signal from the pump motor relay in the **Enable** parameter.

Related Objects *Minimum*, *Maximum*

Counter

Counter counts the number of times that the **Count** expression transitions from off to on. The digital display shows the number of pulses counted so far, and is updated approximately once per second—however, it can receive and count multiple pulses within a given second. The counter can count to just under 4,503,600,000,000,000 or 142,710 years worth of pulses at one pulse per second. When the **Reset** expression transitions from off to on, the counter resets to zero.



Both **Count** and **Reset** are logical expressions.

Counter Data Members

Table 2-6. Counter Data Members

Data Member	Type	Read	Write	Description
(implicit)	numeric	yes	no	numeric total of pulse count

Comments You should not use Counters to count external pulse signals that cycle more often than about once per second. For higher counting speeds, use the accumulator capabilities built into your PLC.

Related Objects *Accumulator*, *Integral*

DataTable

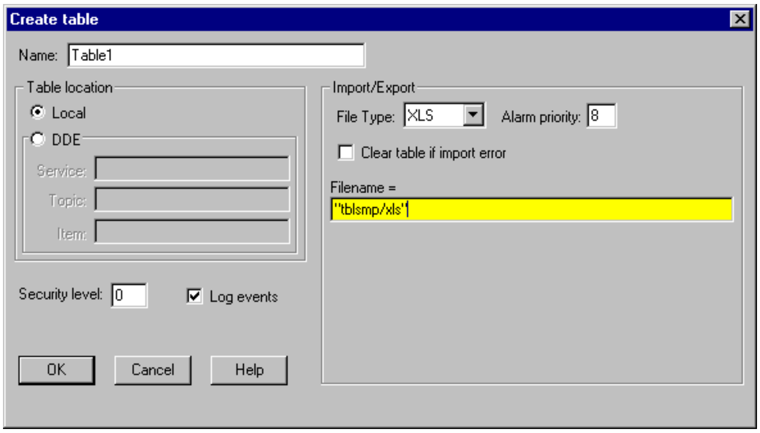
DataTables are used in the following applications:

- Multiplexing various data sources into a single display template.
- Importing or exporting large quantities of data to other applications using DDE. (Unlike the DdeTable, the DataTable provides bidirectional DDE communications. See *DdeTable*.)
- Networking multiple Lookout*Direct* nodes (see Chapter 5, *Networking*, in the *LookoutDirect Developer's Manual*).

A DataTable contains a matrix of rows and columns, much like a spreadsheet. Each column is represented by a letter (A – IV). Each row is represented by a number (1 – 1,000). Letter-number combinations represent intersections of rows and columns. Such intersections are called cells. Any given cell contains a value. A cell value can be numeric, logical, or textual.

Note DataTables are advanced tools that require a mastery of Lookout*Direct* object databases. Make sure you understand editing, connecting to, and using object databases and aliases before creating a DataTable object. See Chapter 4, *Using LookoutDirect*, and Chapter 5, *Developer Tour*, in the *Getting Started with LookoutDirect* manual for more information on object databases.

The following dialog box appears when you create a DataTable:



Name: Table1

Table location: [✓ Local] DDE

File Type: XLS
Alarm priority: 8
☐ Clear table if import error
Filename = "tblsmp/xls"

Security level: 0
☑ Log events

Specify **DDE** parameters if you want to use the DataTable to exchange large quantities of data from an external source (such as Excel) continuously, with both Lookout*Direct* and the other program running.

See Chapter 6, *Dynamic Data Exchange*, of the *LookoutDirect Developer's Manual* for more information on DDE connections to other programs.

Specify **Local** if you are using the DataTable to import or export data from Lookout*Direct* into or out of a static file. Also specify **Local** if you are using the DataTable to multiplex various signals into a single display or graphic template.

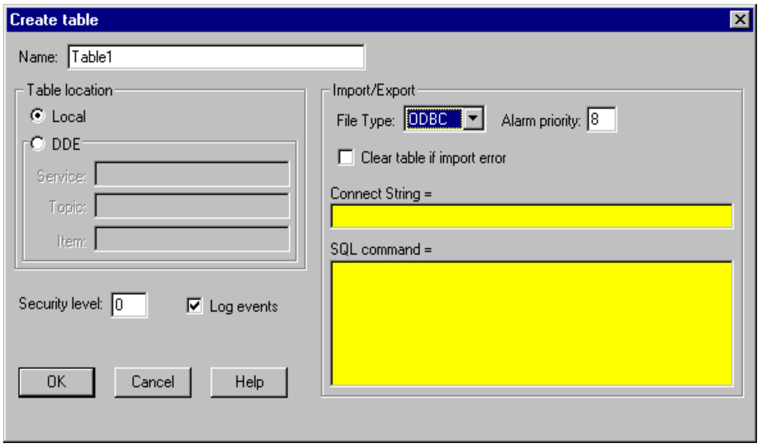
To exchange data with another DataTable running in another Lookout*Direct* process, you can use ordinary Lookout*Direct* connections.

The export and import data members control the transfer of data between Lookout*Direct* and a Microsoft Excel spreadsheet. The spreadsheet filename must be entered in the **Import/Export** section of the **Create table** dialog box.

Note The data table import and export data members only work with Microsoft Excel Version 4 at this time. This feature does not work with Excel Version 5 or greater.

Instead of entering a file name in the **Import/Export** dialog box, you can enter a Lookout*Direct* expression in the **Filename** field. You can then import and export different files using a switch setting, a text entry box, or some other expression input. If something goes wrong with the transfer of data, including data corruption, Lookout*Direct* reports an alarm.

Click on the **Clear table if import error** checkbox to clear the DataTable before importing either from a spreadsheet or an ODBC database. This only affects what happens if there is an error during the import. If there are no errors during the import, the imported data always replaces the old data in the table. However, if the checkbox is selected, the DataTable is always cleared before starting an import, so that, if an error occurs, the DataTable is left empty. If the checkbox is not checked and an error occurs, the old data is left in the table.



Name: Table1

[✓ Local] DDE

File Type: ODBC   Alarm priority: 8

☐ Clear table if import error

Security level: 0   ☑ Log events

The **Connect String=** field specifies the DataSource Name (DSN) as well as any other parameters needed by the ODBC driver to make the connection to your chosen data source.

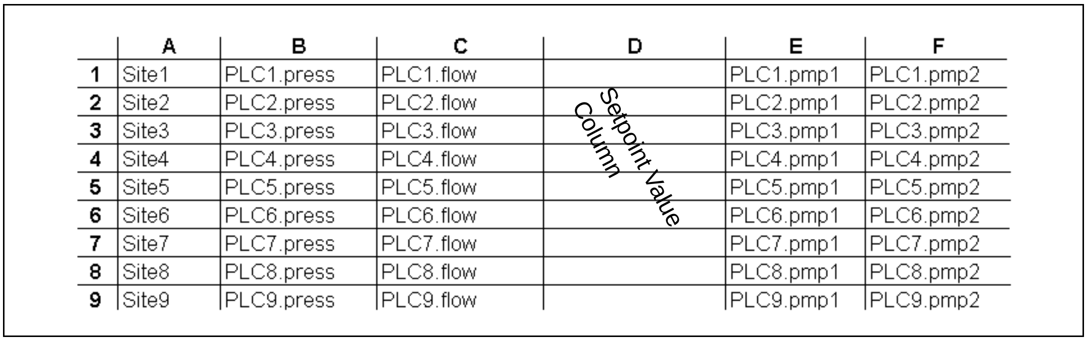
The **SQL command=** field is where you enter the SQL string you want to pass to the ODBC driver.

Use the **Clear table if import error** checkbox to clear the DataTable before importing either from an ODBC database or a spreadsheet. This only affects what happens if there is an error during the import. If there are no errors during the import, the imported data always replaces the old data in the table. However, if the checkbox is selected, the DataTable is always cleared before starting an import, so that, if an error occurs, the DataTables left empty. If the checkbox is not checked and an error occurs, the old data is left in the table.

Multiplexing Displays and Graphics

You can use DataTables to multiplex signals into a single control panel, used as a template. For instance, assume you have nine identical pump stations. At each site you have a single PLC monitoring the pressure, flow rate, and status of two pumps. You are also controlling an analog output with an operator setpoint from Lookout*Direct*. Instead of developing nine identical control panels in Lookout*Direct*, you can build just one panel and multiplex the signals from the nine sites into a single set of graphics.

The following figure is a graphical representation of the connections for a possible DataTable.



	A	B	C	D	E	F
1	Site1	PLC1.press	PLC1.flow		PLC1.pmp1	PLC1.pmp2
2	Site2	PLC2.press	PLC2.flow		PLC2.pmp1	PLC2.pmp2
3	Site3	PLC3.press	PLC3.flow		PLC3.pmp1	PLC3.pmp2
4	Site4	PLC4.press	PLC4.flow		PLC4.pmp1	PLC4.pmp2
5	Site5	PLC5.press	PLC5.flow		PLC5.pmp1	PLC5.pmp2
6	Site6	PLC6.press	PLC6.flow		PLC6.pmp1	PLC6.pmp2
7	Site7	PLC7.press	PLC7.flow		PLC7.pmp1	PLC7.pmp2
8	Site8	PLC8.press	PLC8.flow		PLC8.pmp1	PLC8.pmp2
9	Site9	PLC9.press	PLC9.flow		PLC9.pmp1	PLC9.pmp2

Note At this time there is no actual view in Lookout*Direct* for you to see this table. It is a representation, not a screen capture of a Lookout*Direct* dialog box or display element.

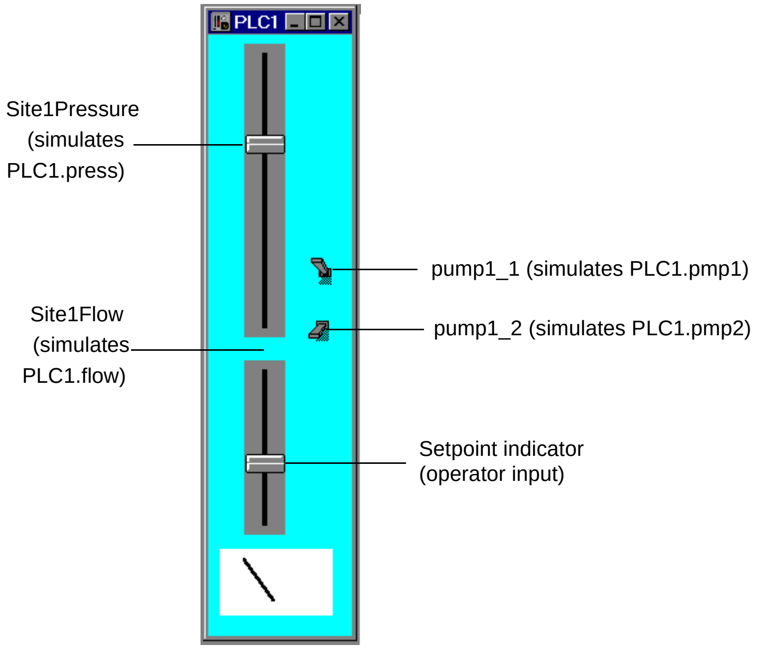
Each row of the table is connected to the site name, the data you want to keep track of from the PLC at that site, and a place for the operator setpoint data for that site.

Notice the names of the nine PLCs (`PLC1, PLC2…`). Each value has an alias (`press`, `flow`, `pmp1`, `pmp2`). Each cell represents a connection made from that PLC output to the that cell of the DataTable.

The open column D represents the connection of a single Pot object called `Setpoint` to the column—not to individual cells. This way Lookout*Direct* only changes the value of a cell in column D when that particular row has been made active. You connect the individual cells in column D (D1 through D9) to the correct holding registers (outputs) on the respective PLCs. For example, `Table1.D1` would be connected to the appropriate data member of `PLC1 — Table1.D2` to the appropriate data member of `PLC2`, and so on. In other words, when you intend to multiplex signals to a panel through a data table connect inputs from a PLC or RTU to individual cells. Connect operator setpoints (outputs) to columns.

DataTable Example

To practice using a DataTable, you can create a PLC simulator as shown in the following illustration. You can use a separate control panel for each PLC output simulator, or place all the objects you make on one panel.


PLC1
Site1Pressure (simulates PLC1.press)
Site1Flow (simulates PLC1.flow)
pump1_1 (simulates PLC1.pmp1)
pump1_2 (simulates PLC1.pmp2)
Setpoint indicator (operator input)

Use two slider pots as your pressure and flow outputs, and two switches as the on/off indicators for pumps one and two. You can use the dial gauge at the bottom to check the operator input, `Setpoint`. Instead of connecting the cells of your data table to PLC outputs, you connect directly to the Lookout*Direct* objects, named after the outputs for clarity.

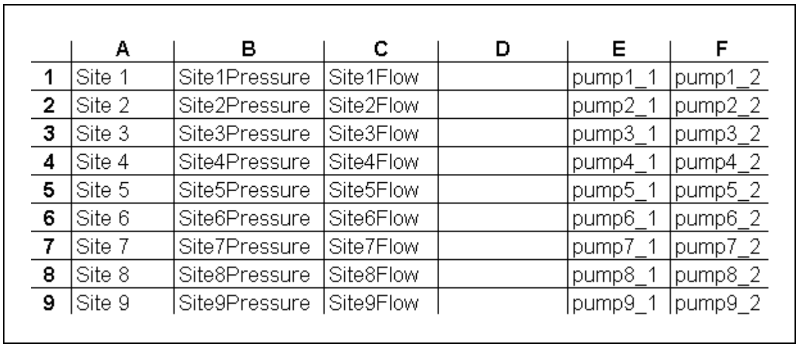
You should create at least three sets of PLC input/output simulators. The following example refers to the 9 PLCs mentioned in the *Multiplexing Displays and Graphics* section, but you can explore using a data table using 2 or 3 simulators.

Connect specific DataTable cells from the `D` column to the Setpoint indicator for each PLC simulator.

After you have built your simulators, open a new Control Panel to use as your display and create a DataTable. You will create the rest of the display in a later step.

When it first appears, the DataTable contains the number 0. This indicates the contents of cell A1. You can increase the size of the display window, but you cannot show the entire array of data in the table. You can view the contents of any cell in column A by clicking on the window when you are in run mode. Selecting the contents of that cell activates that row of the data table.

Enter text expressions into the cells of column A to act as your table index. For example, enter the string `"Site 1"` as the connection to your DataTable `A1.txt` data member. Connect the outputs of your PLC simulators to the cells in the B, C, E, and F columns shown in the following figure. You will connect an operator input to the entire column D, and than later connect individual cells in the D column to your PLC simulators.



	A	B	C	D	E	F
1	Site 1	Site1Pressure	Site1Flow		pump1_1	pump1_2
2	Site 2	Site2Pressure	Site2Flow		pump2_1	pump2_2
3	Site 3	Site3Pressure	Site3Flow		pump3_1	pump3_2
4	Site 4	Site4Pressure	Site4Flow		pump4_1	pump4_2
5	Site 5	Site5Pressure	Site5Flow		pump5_1	pump5_2
6	Site 6	Site6Pressure	Site6Flow		pump6_1	pump6_2
7	Site 7	Site7Pressure	Site7Flow		pump7_1	pump7_2
8	Site 8	Site8Pressure	Site8Flow		pump8_1	pump8_2
9	Site 9	Site9Pressure	Site9Flow		pump9_1	pump9_2

Connecting Signals to DataTables

To connect a value to a particular cell or column within a DataTable, use the **Object»Edit Connections…** command. Select the specific data member of the DataTable to be written, and identify the data member of the source object.

Connecting to Cells

The value from `Site1Pressure` is numeric. To write the value of `Site1Pressure` into cell `B1`, connect the simulated output to `B1`—not `B1.logical` or `B1.txt`. The **Edit connection** dialog box is shown in the following illustration.

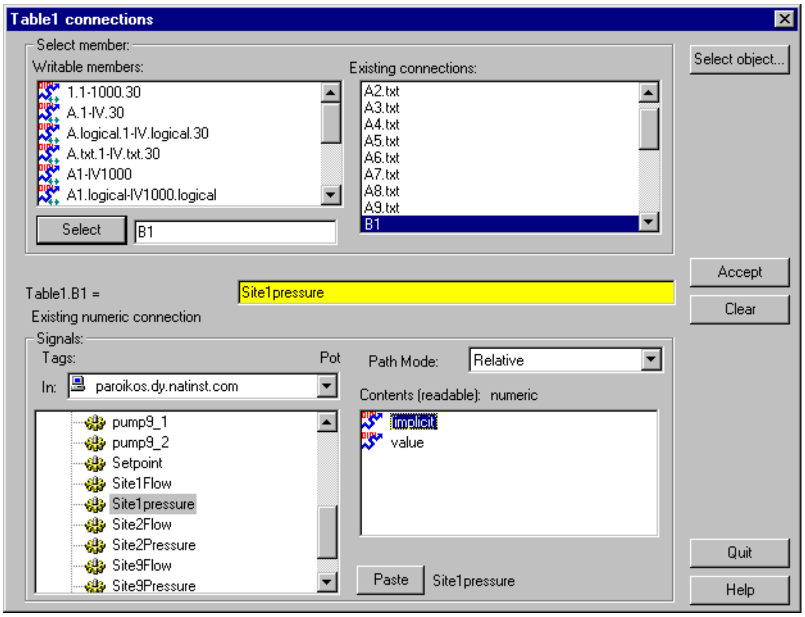


Table1 connections

Select member:

Writable members:
1.1-1000.30
A.1-IV.30
A.logical.1-IV.logical.30
A.txt.1-IV.txt.30
A1-IV1000
A1.logical-IV1000.logical

Select B1

Existing connections:
A2.txt
A3.txt
A4.txt
A5.txt
A6.txt
A7.txt
A8.txt
A9.txt
B1

Table1.B1 = Site1pressure

Existing numeric connection

Signals:

Tags: Pot

In: paroikos.dy.natinst.com

pump9_1
pump9_2
Setpoint
Site1Flow
Site1pressure
Site2Flow
Site2Pressure
Site9Flow
Site9Pressure

Path Mode: Relative

Contents (readable): numeric

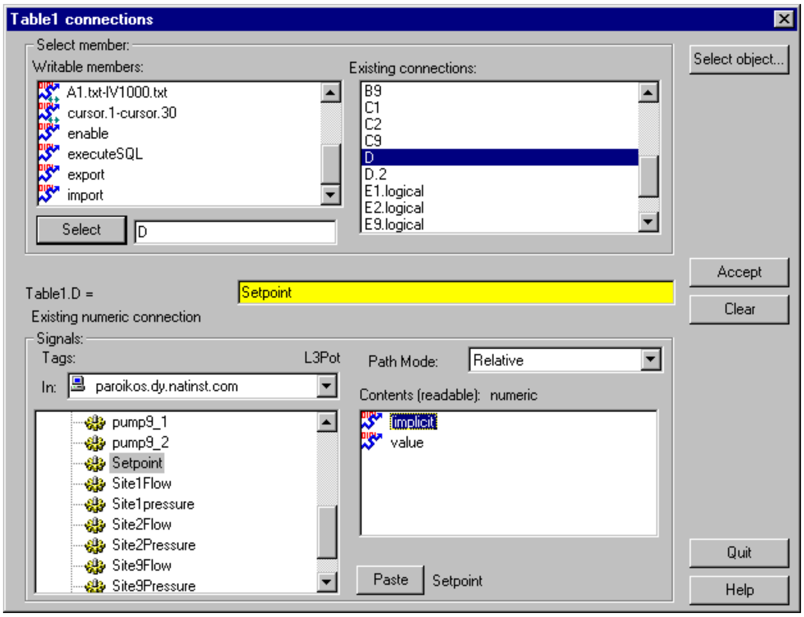
implicit
value

Paste Site1pressure

After you establish a connection to a cell, the value within the cell changes any time the expression changes. Any time the value of `Site1Pressure` changes, the value within cell `B1` changes.

Connecting to Columns

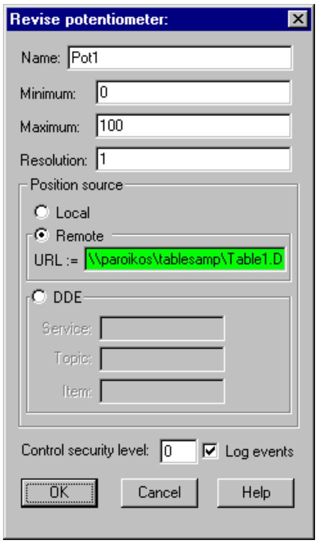
To connect the value of the `Setpoint` potentiometer to column D, select `D`—not `D.logical` or `D.txt`—as shown in the following illustration. As with the previous value, you use `D` because you are using a numerical value. There is no number following the `D` because you are connecting to a column, not a cell.



Once a connection to a column is established, the value within the cell *at the currently selected row* changes when the expression changes. So, if you activate row 4 and change the value of `Setpoint` changes, the value within cell `D4` changes. No other cells are affected until you move the cursor to activate another row and the operator adjusts the pot.

Reading a Cell Value Back to a Lookout*Direct* Object

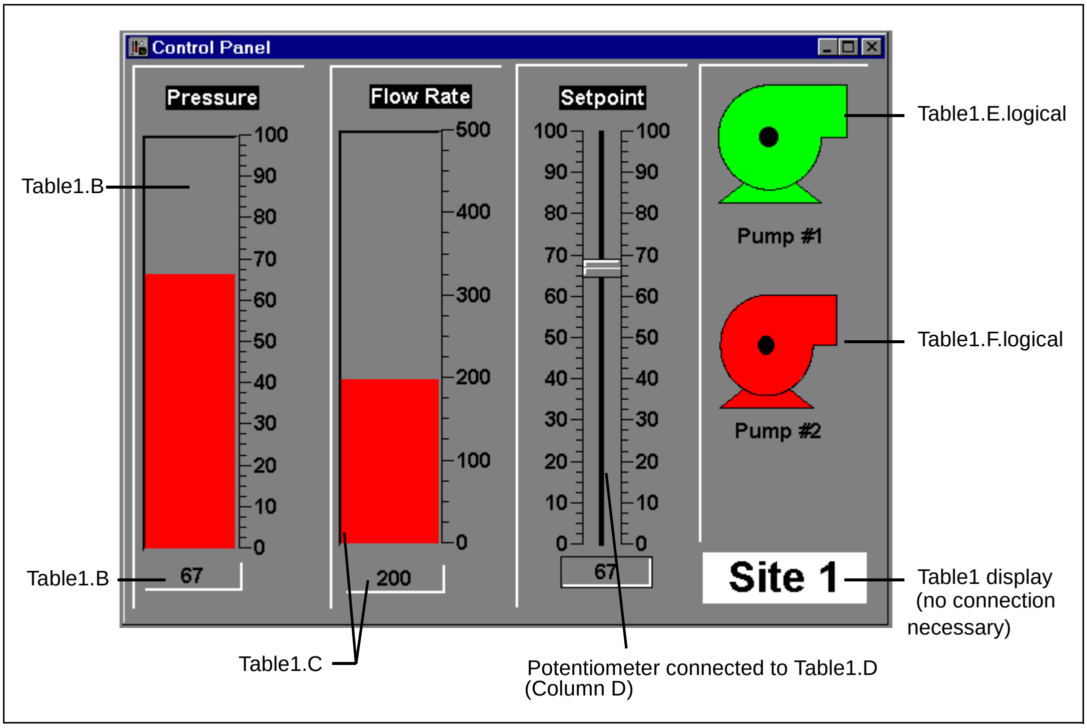
When you connect the display panel potentiometer called `Setpoint` to `Table1.D`, you should configure your pot with the appropriate **Remote** parameter to ensure that it automatically adjusts to track the value in any cell (within the specified column) when the cursor moves to a new row.


Revise potentiometer:

Name: Pot1
Minimum: 0
Maximum: 100
Resolution: 1
Position source
Local [✓ Remote]
URL := \\paroikos\tablesamp\Table1.D
DDE
Service:
Topic:
Item:
Control security level: 0 [✓ Log events]

The Display Panel

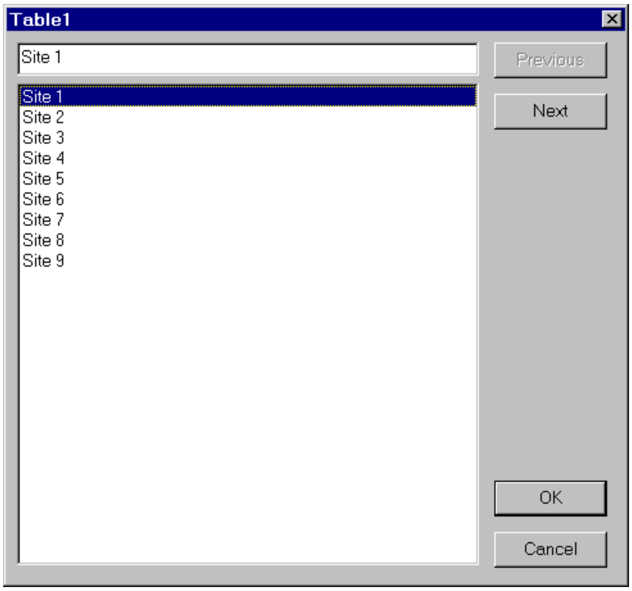
Now that your DataTable (called `Table1`) is complete, you can return to your display panel (where you placed the DataTable object initially) and begin to build a single control panel that allows you to multiplex the data from your PLCs. A sample panel is shown in the following illustration.



Instead of using expressions that reference the actual values from your driver objects to display values, use the column names from `Table1`. For instance, the bar graph and numeric readout for Pressure both represent the expression `Table1.B`. The actual value for `Table1.B` depends on the what row is currently active in the DataTable. In the illustration row 1 is active, so all the expressions return the value in their respective columns at row 4. The callouts in the picture indicate how the control panel was developed. All are Lookout*Direct* expressions except the Pot and the DataTable, which are displayable objects.

Operating Your Multiplexed Panel

The plate in bottom right corner of the control panel is the DataTable object (`Table1`). To view a different site with the control panel (that is, to activate a different row, thereby selecting a different PLC), click on `Table1` and the following dialog box should appear.



This list box gets the row names from Column A in the Data Table

By selecting a site, you connect your control panel to the PLC at that site. This is referred to as moving the cursor to that row.

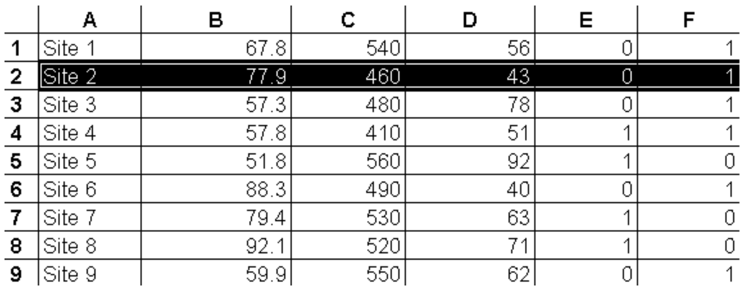
DataTable Cursors

The cursor is a DataTable pointer that you can move from row to row to activate the values in the cells of that row. There are several methods for controlling the location of the cursor:

- Connect a numeric expression to the `cursor` data member. A typical example would be to connect a potentiometer (minimum = 1, maximum = the number of rows in table, resolution = 1) to the cursor.
- Connect logical expressions to appropriate row numbers. A typical example would be to create a pushbutton for every row and then connect them to their respective row numbers.

- Use the display (list box) built into the DataTable object. A typical example was described previously where you connected text values to cells in column A and then displayed the table as a plate.

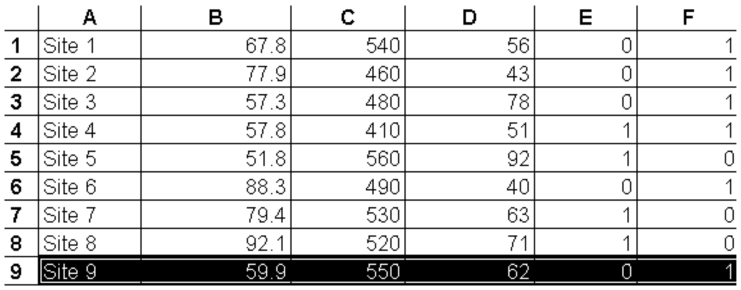
The following example provides a graphical representation of a DataTable (called `Table1`) showing typical values within its many cells. You can create a multiplex effect in Lookout*Direct* by referencing column names and then selecting the row with the information you want to use. If you reference column names (instead of individual cells), the DataTable outputs only the values within the currently selected row. If you reference individual cells, the DataTable outputs the current value within the cell—no matter where the cursor is.



	A	B	C	D	E	F
1	Site 1	67.8	540	56	0	1
2	Site 2	77.9	460	43	0	1
3	Site 3	57.3	480	78	0	1
4	Site 4	57.8	410	51	1	1
5	Site 5	51.8	560	92	1	0
6	Site 6	88.3	490	40	0	1
7	Site 7	79.4	530	63	1	0
8	Site 8	92.1	520	71	1	0
9	Site 9	59.9	550	62	0	1

Outputs =	**Site2**	**77.9**	**460**	**78**	**0**	**1**

The value of cell B2 is currently 77.9. Therefore, the `Table1.B` data member is also 77.9. If you move the cursor to row 9, the value of `Table1.B` changes to 59.9, as shown.



	A	B	C	D	E	F
1	Site 1	67.8	540	56	0	1
2	Site 2	77.9	460	43	0	1
3	Site 3	57.3	480	78	0	1
4	Site 4	57.8	410	51	1	1
5	Site 5	51.8	560	92	1	0
6	Site 6	88.3	490	40	0	1
7	Site 7	79.4	530	63	1	0
8	Site 8	92.1	520	71	1	0
9	Site 9	59.9	550	62	0	1

Outputs =	**Site9**	**59.9**	**550**	**62**	**0**	**1**

Using Multiple Cursors

The previous description assumes you are using just one cursor. But a DataTable can have up to 20 cursors. Multiple cursors allow you to select multiple rows at the same time. When using multiple cursors, you also use multiple names for each column. For a given column, each name is associated with a given cursor. If you are using two cursors in the previous example (`cursor` and `cursor.2`), you can reference the column name of a given column as follows:

Table 2-7. Column Names

	A	**B**	**C**	**D**	**E**	**F**
cursor	A.txt	B	C	D	E.logical	F.logical
cursor.2	A.txt.2	B.2	C.2	D.2	E.logical.2	F.logical.2

Earlier, when you were using just one cursor, you connected the value of a potentiometer called `Setpoint` to column D. Subsequently the value of `Setpoint` was written to the cell at the row selected by the cursor. But when there are multiple cursors, you have to select which cursor you are writing to. Thus, depending on how you want your table to work, you might connect the potentiometer to both `Table1.D` and `Table1.D.2`.

DataTable Data Members

Table 2-8. DataTable Data Members

Data Members	Type	Read	Write	Description
executeSQL	logical	no	yes	Imports data from an ODBC database into the DataTable when value goes high, using the connect string and SQL command you enter in the Create/modify DataTable dialog box.
(implicit)	DdeTable	no	no	Not displayable in Lookout*Direct*, but it can be referenced by a DDE link from another application.

Table 2-8. DataTable Data Members (Continued)

Data Members	Type	Read	Write	Description
1.1–1000.20	logical	no	yes	Specifies row (1, 2, 3, …1000) or specifies row.cursor (for example, 24.2 is the selector for row 24, cursor 2). Upon transition from false to true, the specified cursor moves to specified row.
A.1–IV.20	numeric	yes	yes	Specifies column names (for example, A, B, C…IV) or specifies column names and associated cursor numbers (such as, A.1, B.1, A.2, B.2, and so on.) *Read*—returns a numeric value from the cell specified by the column and currently selected row of the indicated cursor. *Write*—writes a numeric value into the cell specified by the column and currently selected row of the indicated cursor.
A.logical.1 – IV.logical.20	logical	yes	yes	Specifies column names (for example, A.logical, B.logical, C.logical, …IV.logical) or specifies column names and associated cursor numbers (such as, A.logical.1, B.logical.1, A.logical.2, B.logical.2, and so on.) *Read*—returns a logical value from the cell specified by the column and currently selected row of the indicated cursor. *Write*—writes a logical value into the cell specified by the column and currently selected row of the indicated cursor.

Table 2-8. DataTable Data Members (Continued)

Data Members	Type	Read	Write	Description
A.txt.1 – IV.txt.20	text	yes	yes	Specifies column names (for example, A.txt, B. txt, C. txt, …IV. txt) or specifies column names and associated cursor numbers (such as, A. txt.1, B. txt.1, A. txt.2, B. txt.2, and so on.) *Read*—returns a text value from the cell specified by the column and currently selected row of the indicated cursor. *Write*—writes a text value into the cell specified by the column and currently selected row of the indicated cursor.
A1 – IV16384	numeric	yes	yes	Specified cell interpreted as numeric value
A1.logical –IV16384.logical	logical	yes	yes	Specified cell interpreted as logical value
A1.txt –IV16384.txt	text	yes	yes	Specified cell interpreted as text value
Cursor.1 – Cursor.20	numeric	yes	yes	Specifies the currently selected row of the indicated cursor.
enable	logical	yes	yes	If TRUE (the default), enables DDE. If FALSE, disables DDE. The default value is on. The input is ignored for non-DDE TextEntry objects.
export	logical	no	yes	When this input transitions from false to true, the Lookout*Direct* data table is exported to the designated spreadsheet file.
import	logical	no	yes	When this input transitions from false to true, the Lookout*Direct* data table imports data from the designated spreadsheet.

Table 2-8. DataTable Data Members (Continued)

Data Members	Type	Read	Write	Description
Modified	logical	yes	no	Pulses TRUE when any cell value in the DataTable changes.
Update	logical	yes	no	Pulses each time the cursor changes rows. Often used to “call up” a control panel.

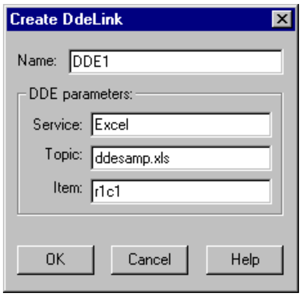
Related Objects *DdeTable*, *DdeLink*

DdeLink

DdeLink creates a unidirectional Dynamic Data Exchange (DDE) link to another application. The other application could be running on the same computer or on another computer over a network. DdeLink objects provide an easy way to *import* remote values into Lookout*Direct*. See Chapter 5, *Dynamic Data Exchange*, in the *LookoutDirect Developer's Manual* for more information on DDE. For each DdeLink object you define, Lookout*Direct* creates a separate link to the other application. If you need to import large quantities of data, you should use the DdeTable or DataTable object. See *DdeTable* and *DataTable* for more information.

DdeLinks on Same Computer

If you are importing values from another application running on the same computer, your DDE parameters will look similar to the ones in the following illustration.



Name: DDE1

DDE parameters:

Service: Excel

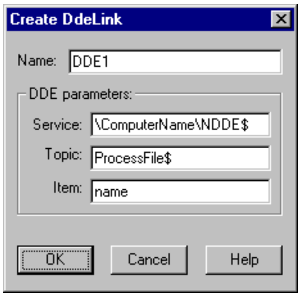
Topic: ddesamp.xls

Item: r1c1

Service specifies the application name, **Topic** specifies the file, and **Item** points to the individual value (r1c1 refers to the cell at row1, column1. Unfortunately, Excel does not support the more convenient A1 cell references with DDE).

DdeLinks to Remote Computer

If you are importing values from another application running on a remote computer, your DDE parameters will look similar to the ones in the following illustration.


Create DdeLink

Name: DDE1

DDE parameters:

Service: \ComputerName\NDDE$

Topic: ProcessFile$

Item: name

Notice the differences in the **Service**, **Topic**, and **Item** parameters. The backslashes (`\\`) and dollar signs (`$`) are standard requirements for making network connections in Microsoft Windows. `ComputerName` specifies the network name of the computer you are connecting to. If you are connecting to a value in another Lookout*Direct* application, `ProcessFile` is the Lookout*Direct* file name running on the remote computer, and `Name` refers to the name you are linking to.

DdeLink Data Members

Table 2-9. DdeLink Data Members

Data Members	Type	Read	Write	Description
(implicit)	numeric	yes	no	DDE link interpreted as numeric value.
enable	logical	yes	yes	If TRUE (the default), enables DDE. If FALSE, disables DDE. This input is ignored for non-DDE TextEntry objects.
hot	logical	yes	no	Status of DDE link.
logical	logical	yes	no	DDE link interpreted as logical value.
txt	text	yes	no	DDE link interpreted as text value.

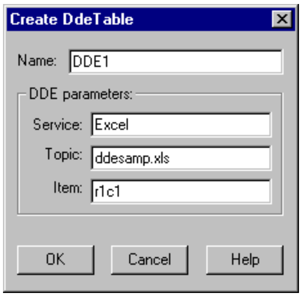
Related Objects *DdeTable*, *DataTable*

DdeTable

DdeTable creates a unidirectional Dynamic Data Exchange (DDE) link to another application. The other application could be running on the same computer or on another computer over a network. See Chapter 5, *Dynamic Data Exchange*, in the *LookoutDirect Developer's Manual* for more information on DDE. You can use DdeTable to *import* large quantities of data from other applications. The table format is much more efficient at transferring data than the Link format because a table can contain hundreds or even thousands of data points that all share a single link. On the other hand, the link format can only transfer a single value per link—and every link requires a certain amount of CPU overhead. If you are only importing a relatively small amount of data, you may find the DdeLink technique easier to implement.

DdeTable on Same Computer

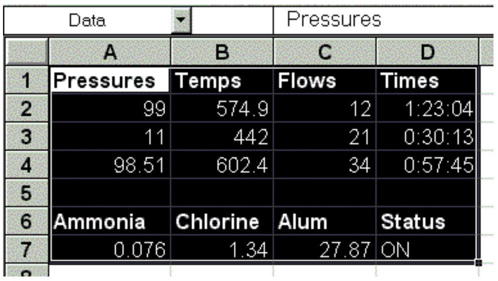
If you are importing values from another application running on the same computer, your DDE parameters will look similar to the ones in the following figure.



Name: DDE1
Service: Excel
Topic: ddesamp.xls
Item: r1c1

Service specifies the application name, **Topic** typically specifies the file, and **Item** specifies the particular data item name.

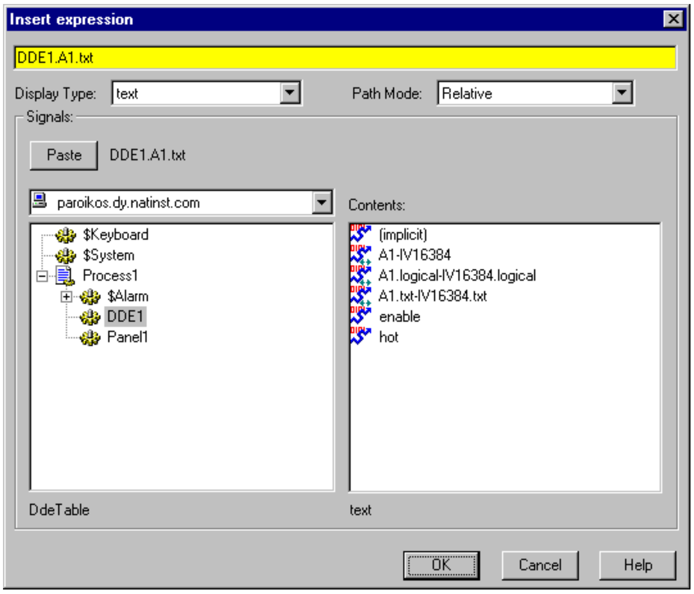
The following example shows an Excel spreadsheet with the highlighted range named Data.



Data		Pressures	
A	B	C	D
Pressures	Temps	Flows	Times
99	574.9	12	1:23:04
11	442	21	0:30:13
98.51	602.4	34	0:57:45
Ammonia	Chlorine	Alum	Status
0.076	1.34	27.87	ON

You can now display any value in the range Data with this Lookout*Direct* DdeTable object.

Select **Insert»Expression...** and then choose the DdeTable data member corresponding to the Excel spreadsheet cell containing the value you want to display. Make sure that the type of data member you select matches the type data in the spreadsheet cell.



Insert expression

DDE1.A1.txt

Display Type: text

Path Mode: Relative

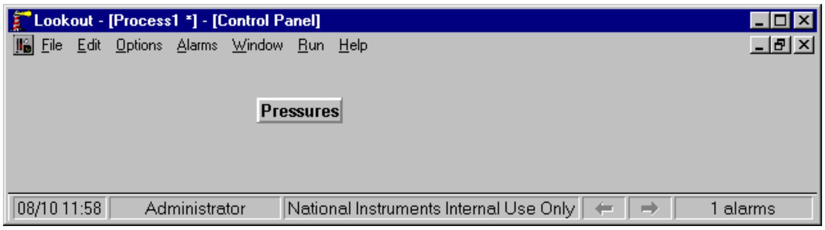
Signals:

Paste DDE1.A1.txt

paroikos.dy.natinst.com

Contents:

Notice the reference for the displayed item in the Lookout*Direct* status bar.



Lookout - [Process1 *] - [Control Panel]

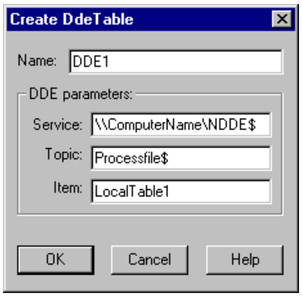
File Edit Options Alarms Window Run Help

Pressures

08/10 11:58 | Administrator | National Instruments Internal Use Only | 1 alarms

DdeTable to Remote Computer

Using the DdeTable object over a network is somewhat different from the previous example.



Create DdeTable

Name: DDE1

DDE parameters:

Service: \\ComputerName\NDDE$

Topic: Processfile$

Item: LocalTable1

OK Cancel Help

Notice the differences in the **Service**, **Topic**, and **Item** parameters. The backslashes (`\\`) and dollar signs (`$`) are standard requirements for making network connections in Windows. `ComputerName` specifies the network name of the computer you are connecting to. If you are connecting to a DdeTable or DataTable in another Lookout*Direct* application, `ProcessFile` is the Lookout*Direct* file name running on the remote computer, and `LocalTable1` refers to the DdeTable or DataTable object you are linking to.

DDETable Data Members

Table 2-10. DdeTable Data Members

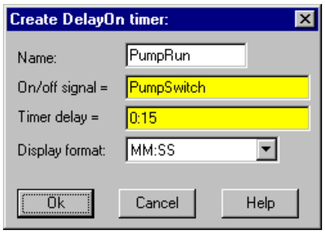
Data Members	Type	Read	Write	Description
(implicit)	numeric	yes	no	Cell A1 interpreted as a numeric value
A1 – IV16384	numeric	yes	no	Specified cell interpreted as a numeric value
A1.logical – IV16384.logical	logical	yes	no	Specified cell interpreted as a logical value
A1.txt – IV16384.txt	text	yes	no	Specified cell interpreted as a text value
enable	logical	yes	yes	If TRUE (the default), enables DDE. If FALSE, disables DDE. This input is ignored for non-DDE TextEntry objects.
hot	logical	yes	no	Status of DDE link

Related Objects *DataTable*, *DdeLink*

DelayOff

DelayOff is an adjustable delay timer. When **On/off signal** transitions to off, the **Timer delay** begins to count down. At the end of the delay countdown, the output signal turns off. **On/off signal** must remain off during the time delay period for the output signal to turn off. The output immediately turns on when the **On/off signal** turns on.

Timer delay can range from 0.0 seconds to several years, and the effective resolution is 0.1 seconds over the entire range. The timer display digitally shows the time delay remaining, and is updated approximately once per second. If the **On/off signal** is high, the timer display shows `on`. If the **Timer delay** period has expired, the display shows `off`.


Create DelayOn timer:

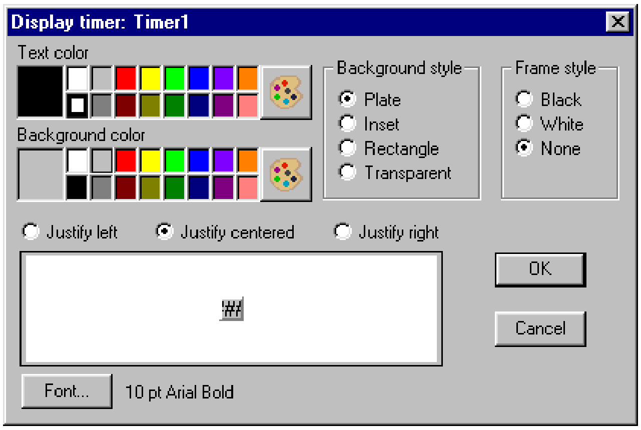
Name: PumpRun

On/off signal = PumpSwitch

Timer delay = 0:15

Display format: MM:SS

The **On/off signal** is a logical expression while **Timer delay** is a numeric expression. Normally, this is a simple time constant such as 0:20—twenty seconds. See *Numeric Data Members* in Chapter 2, *Introduction*, of the *Getting Started with LookoutDirect* manual for information on entering time constants.


Display timer: Timer1

Text color

Background color

Background style: [✓ Plate] Inset Rectangle Transparent

Frame style: Black White [✓ None]

Justify left [✓ Justify centered] Justify right

Font... 10 pt Arial Bold

DelayOff Data Members

Table 2-11. DelayOff Data Members

Data Member	Type	Read	Write	Description
(implicit)	logical	yes	no	Logical timer value

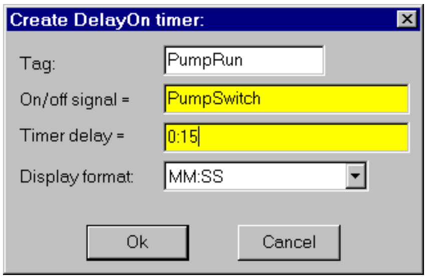
Comments The DelayOff timer can prevent a pump from short-cycling.

Related Objects *DelayOn*, *Interval*, *OneShot*, *Pot*, *TextEntry*

DelayOn

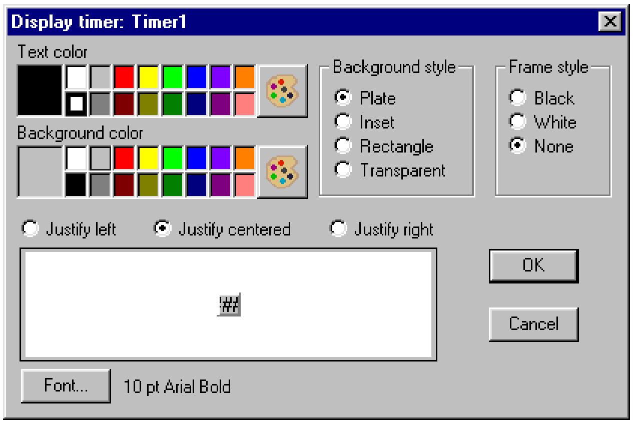
DelayOn is an adjustable delay timer. When **On/off signal** transitions to on, the **Timer delay** begins to count down. At the end of the delay countdown, the output signal turns on. **On/off signal** must remain on during the time delay period for the output signal to turn on. The output immediately turns off when the **On/off signal** turns off.

Timer delay can range from 0.0 seconds to several years, and the effective resolution is 0.1 seconds over the entire range. The timer display digitally shows the time delay remaining and is updated approximately once per second. The timer display shows `off` when the **On/off signal** is low. If the **Timer delay** period has expired, the display shows `on`.


Create DelayOn timer:

Tag: PumpRun
On/off signal = PumpSwitch
Timer delay = 0:15
Display format: MM:SS

The **On/off signal** is a logical expression while **Timer delay** is a numeric expression. Normally, this is a simple time constant such as 0:20—twenty seconds. See *Numeric Data Members* in Chapter 2, *Introduction*, of the *Getting Started with LookoutDirect* manual for information on entering time constants.



Background style: [✓ Plate] Inset Rectangle Transparent

Frame style: Black White [✓ None]

Justify left [✓ Justify centered] Justify right

10 pt Arial Bold

DelayOn Data Members

Table 2-12. DelayOn Data Members

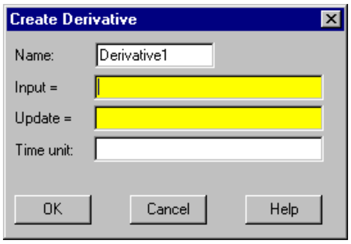
Data Member	Type	Read	Write	Description
(implicit)	logical	yes	no	Logical timer value

Comments The DelayOn timer can be used to prevent pumps from cycling too often, to allow one operation to complete before another begins, or to require a condition to exist for a period of time before an alarm is activated.

Related Objects *DelayOff*, *Interval*, *OneShot*, *Pot*, *Text Entry*

Derivative

Derivative can also be called a rate of change object—it calculates the rate of change of the incoming numeric input signal. You can use this class to calculate the rate at which a tank is filling or draining, or to convert a changing totalized flow value into a flow rate. The output units are in Input Units/Time Unit.



Name: Derivative1
Input =
Update =
Time unit:

The previous example calculates the rate of change in the water level of a tank. Lookout*Direct* polls the RTU connected to the tank level transmitter every 5 minutes, so this example uses the RTU update data member as the Update pulse for the Derivative object. Tanklevel is in feet and Time unit is 1 minute, so the output result is in feet per minute.

Input is the numeric expression you are monitoring for rate of change.

Update can be a logical expression or numeric constant. If you specify **Update** as a numeric constant, it creates an internal pulse timer with a pulse period of the specified time and a pulse duration of zero. See *Numeric Data Members* in Chapter 2, *Introduction*, of the *Getting Started with LookoutDirect* manual for information on entering time constants. If you specify **Update** as a logical variable, the variable should pulse at the frequency you want to use.

The **Update** expression triggers the calculation of a new rate-of-change based on the **Input** value at the prior **Update**, and the current **Input** value. The current **Input** value is then stored as the prior **Input** value for the next calculation. The **Update** period should be greater than the refresh rate of the incoming signal; or if the Input is generated directly by external I/O, the update data member generated by the PLC object should be used. If the **Update** period is less than the **Input** refresh rate, the rate of change calculation fluctuates erratically between zero and a high value.

Time unit is a numeric expression used as the basis for unit time on the Input signal. For instance, if the rate of change should be in feet per minute, the Input signal would be feet, and **Time unit** would be one minute (entered as 1:00). Typically the **Time unit** is one second (0:01), one minute (1:00), one hour (1:00:00), or one day (1:00:00:00). However, you can specify any unit, such as 5:23 (a rate of change in Input units per five minutes and 23 seconds).

Derivative Data Members

Table 2-13. Derivative Data Members

Data Member	Type	Read	Write	Description
(implicit)	numeric	yes	no	Rate of change

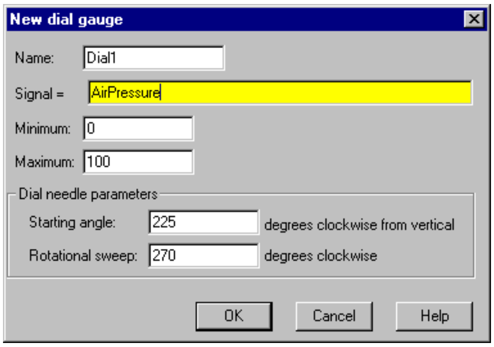
Comments Derivative performs the inverse function of Integral—you can theoretically run a signal through an Integral object and then a Derivative object (or vice versa) and you would end up with the original signal. (Discretization of the time calculations by the computer may cause the final and original signals to differ somewhat).

It is important to consider the resolution of the process variable measured by the PLC when determining the Update period for this object. For instance, if a pressure transmitter connected to a PLC only has a resolution of 0.5 psi and you want to measure rates down to 1 psi/minute, the Update pulse must be greater than 30 seconds even if the PLC is polled once per second (i.e., 0.5 psi/1 psi/min. = 30 sec.). For this application, the Update pulse should probably be about two minutes.

Related Objects *Integral*

DialGauge

The DialGauge object class displays a numeric signal as a sweeping needle on an analog gauge or dial.



Name: Dial1

Signal = AirPressure

Minimum: 0

Maximum: 100

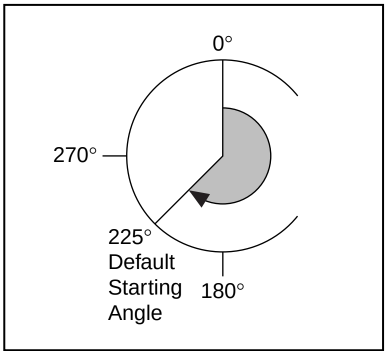
Dial needle parameters

Starting angle: 225 degrees clockwise from vertical

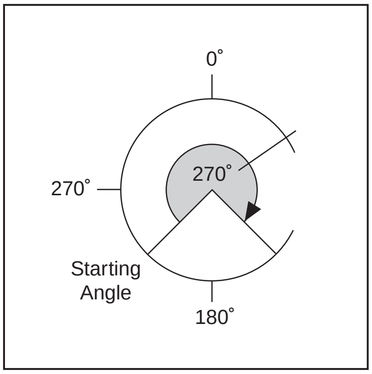
Rotational sweep: 270 degrees clockwise

Signal is a numeric expression.

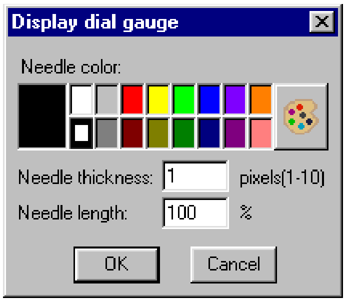
Starting angle indicates the position of the needle when the **Signal** is at its **Minimum** value. As shown here, you specify the starting needle position by counting the degrees clockwise from vertical.



Rotational sweep specifies the number of degrees clockwise that the needle will rotate as the **Signal** approaches the **Maximum** value. As shown in the diagram here, you count the **Rotational sweep** in degrees clockwise from the **Starting angle**.



After you specify the DialGauge definition parameters, Lookout*Direct* presents a display parameters dialog box, as shown here. You use this dialog box to specify needle color, thickness, and length.

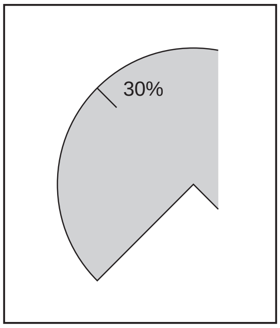


Needle thickness: 1 pixels(1-10)

Needle length: 100 %

Needle thickness defines how wide your needle will be. Thickness can range from one pixel (hairline) to 10 pixels wide.

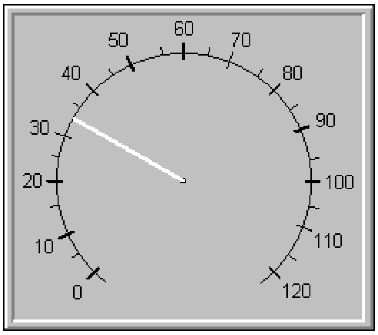
Needle length specifies the length of the needle as a percent of the radius. At 30 percent, for example, only the outer tip of the needle is visible—you cannot see the part of the needle closest to the origin. At 100 percent, the needle extends the full radius of the circle.



DialGauge Data Members

Table 2-14. DialGauge Data Members

Data Members	Type	Read	Write	Description
(implicit)	numeric	yes	no	Current value of signal parameter



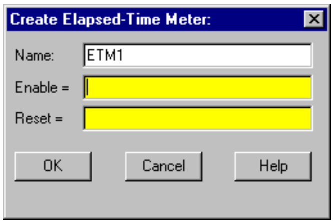
Comments The DialGauge object class only displays a needle. You may wish to enhance it with a corresponding scale or dial face as shown. You can create a scale or dial face by importing one from a graphics package. See *Creating Custom Graphics* in Chapter 2**,** *Graphics*, in the *LookoutDirect Developer's Manual* for more information.

Note If you choose to import a scale or dial face from an external package, you should use a bitmap instead of a metafile.This makes the display refresh cleaner when the needle changes position.

Related Objects *(expression)*, *Gauge*

ElapsedTime

ElapsedTime is an elapsed time meter or “hour meter” that totals the amount of time the **Enable** expression is on. If **Enable** is the logical constant `ON`, the meter reflects the time since the process was started. If a **Reset** expression is specified, the meter resets to zero the moment **Reset** transitions from off to on. The display always shows the elapsed time, and is updated approximately once per second.



Name: ETM1
Enable =
Reset =

ElapsedTime Data Members

Table 2-15. ElapsedTime Data Members

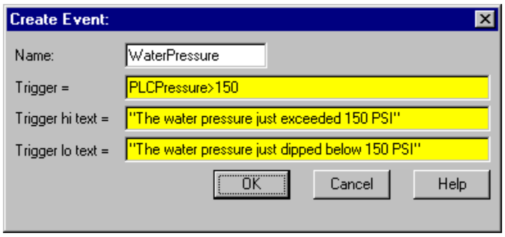
Data Member	Type	Read	Write	Description
(implicit)	numeric	yes	no	Total elapsed time—updated once per second, while meter is running

Comments ElapsedTime meters are used primarily to record the amount of time that individual pieces of equipment have been running. It is also straightforward to set up an alarm that sounds when a particular device has been operating for a certain time and needs routine servicing. The plant operator could then perform the service and reset the ElapsedTime meter with a pushbutton.

ElapsedTime can also record the amount of time a particular device is operated each day and you can record the resulting time to a daily Spreadsheet which you can then use to automatically reset the meter after the data is permanently recorded.

Event

Event is a flexible and powerful object class you can use to define event messages that are triggered based on a user-defined logical expression. Lookout*Direct* logs such events to the Citadel database and you can subsequently print and archive them. See Chapter 7, *Logging Data and Events*, in the *LookoutDirect Developer's Manual* for more information on logging events.



Name: WaterPressure
Trigger = PLCPressure>150
Trigger hi text = "The water pressure just exceeded 150 PSI"
Trigger lo text = "The water pressure just dipped below 150 PSI"

When the result of the **Trigger** logical expression transitions from FALSE to TRUE, it logs the result of the **Trigger hi text** expression as an event in the `EVENT.DAT` file. When the results of the **Trigger** expression transitions from TRUE to FALSE, it logs the results of the **Trigger lo text** expression as an event.

Event Data Members

Table 2-16. Event Data Members

Data Member	Type	Read	Write	Description
none	—	—	—	Event objects do not have data members

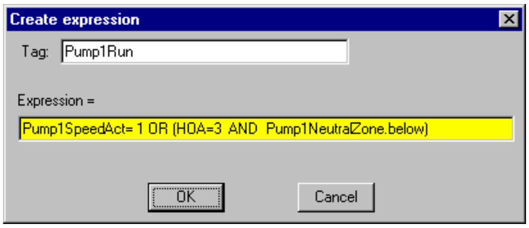
Comments For each event logged, Lookout*Direct* records the date and time, the name of the user currently logged on, and the expression text.

Although event messages are shown for both **Trigger hi text** and **Trigger lo text**, you do not have to include text in both fields.

(expression)

Named expressions, shown as (expression)s, are flexible, powerful real-time calculators. They create and calculate the result of spreadsheet-style formulas that include a mixture of constants and signals from other objects. There are over fifty built-in functions that you use in expressions, including logical, mathematical, statistical, text and trigonometric functions. See Chapter 2, *Expressions*, in the *LookoutDirect Developer's Manual* for more information on expressions and expression functions.

Named expressions can be short and simple, or extremely complex with several signal inputs, function calls, and multiple levels of parentheses. A single expression may incorporate text, logical, and numeric calculations. The variable type returned by the outermost function or operator in the expression determines the signal type generated by the expression.



Tag: Pumр1Run

Expression =

Pump1SpeedAct= 1 OR (HOA=3 AND Pump1NeutralZone.below)

Note You typically use (expression) objects when you need to define a unique condition that is used multiple times throughout your application.

When you define an (expression) object (as opposed to inserting an intrinsic expression), you create a unique name for your expression and can therefore reference the output signal generated from the expression in other expressions or objects. Instead of defining the same expression in many places, you create it one time and use its name any time you need this expression.

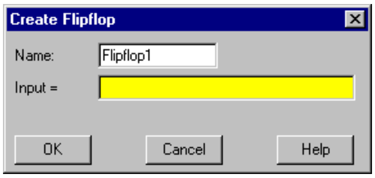
Note The expression may not express a **condition**.

Table 2-17. Expression Data Members

Data Member	Type	Read	Write	Description
(implicit)	numeric, logical, or text	yes	no	Value of expression. The variable type returned by the outermost function or operator in the expression determines the signal type generated by the expression.

Flipflop

Flipflop changes its logical output signal from on to off, or from off to on when the **Input** signal goes high. The output signal does not change when the signal goes low. **Input** is a logical expression.



Name: Flipflop1
Input =

Flipflop Data Member

Table 2-18. Flipflop Data Member

Data Member	Type	Read	Write	Description
(implicit)	logical	yes	no	Current state

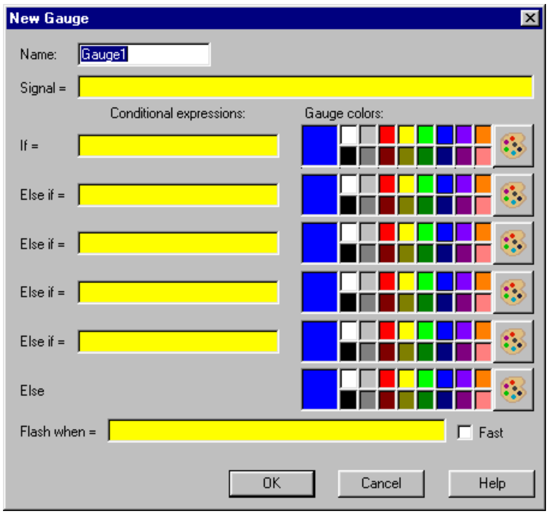
Comments Flipflop can be used to alternate the operation of two pumps, or when connected to a pushbutton, provides a pushbutton on/off control device.

Related Objects *LatchGate*

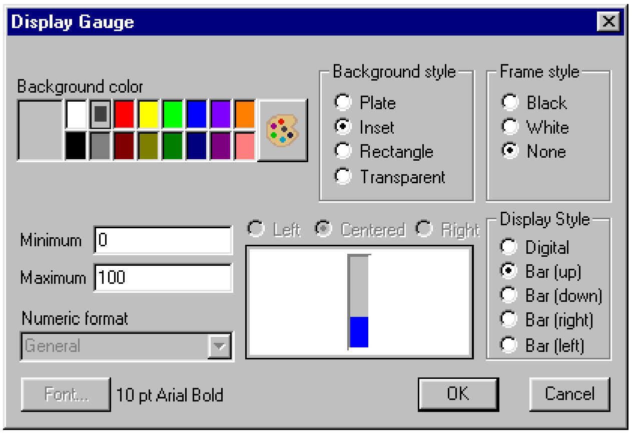
Gauge

Gauge displays the **Signal** expression in digital or bar graph format. Gauge display parameters change depending on the values of the **Conditional expressions**. Gauge determines which colors to display based on the order and current status of your conditional expressions. For instance, if several conditional expressions are true at once, Gauge displays the color associated with the first true expression.

You can use the **Transparent** background style with numeric expressions and gauges displayed as bar graphs. This means you can have bar graphs with transparent backgrounds.



Conditional expressions and **Flash when** are logical expressions while **Signal** is a numeric expression. The **Fast** option instructs the Gauge to flash faster when enabled than when disabled.



Background style: Plate, [✓ Inset], Rectangle, Transparent

Frame style: Black, White, [✓ None]

Minimum: 0

Maximum: 100

Numeric format: General

Left, [✓ Centered], Right

Display Style: Digital, [✓ Bar (up)], Bar (down), Bar (right), Bar (left)

10 pt Arial Bold

Gauge Data Members

Table 2-19. Gauge Data Members

Data Member	Type	Read	Write	Description
(implicit)	numeric	yes	no	Numeric value of Gauge

Comments You should use a Gauge object when you need a bar graph or digital display to change colors and/or flash upon certain conditions. If you do not need either of these capabilities, you should display a bar graph or digital value with the **Insert»Expression…** command.

HyperTrend

A HyperTrend object displays a trend graph on a control panel. It plots any number of logical and numeric trend lines.

HyperTrends provide instant access to both real-time and historical data in a single graph. For each plot line, they combine both real-time and historical data into a seamless, contiguous trace of data. See *Citadel Historical Database* in Chapter 7, *Logging Data and Events*, in the *LookoutDirect Developer's Manual*.

Note There has been an important change in the way Lookout*Direct* logs data to the Citadel database to be displayed on the HyperTrend object.

In Lookout*Direct* 3.*xx*, creating a trend line in a HyperTrend object automatically logged the requested data to the database.

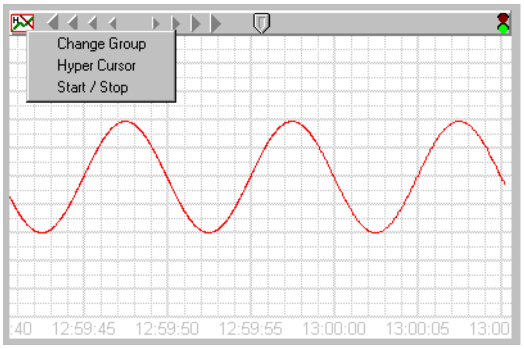
In Lookout*Direct* 4, you must select the Log to historical database option in the Edit Database dialog box for any data you want to display in a HyperTrend object before you can display the data. This is because logging must be configured in a Lookout*Direct* Server process, while trending is typically done in a separate Lookout*Direct* client process.

You can log information by connecting to a symbolic link, but only if the data source the symbolic link represents has had the Log to historical database option selected.

You can use HyperTrends to pan and zoom both the X axis and the Y axis, enabling dynamic adjustment of the vertical and horizontal resolutions of each plot line on the graph. Using this feature, you can, for example, zoom into a particular area of focus on the trend.

The graph scrolls from right to left, plotting current, real-time signals at the right end of the graph.

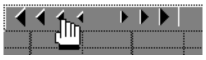
The icon in the upper left of the display accesses a menu you can use to change the group of traces being plotted, activate the cursor, and start or stop scrolling. The arrow-shaped buttons make it easy for you to scroll the trend graph forward and back in time. It provides instant access to data that has scrolled off the left end of the graph (that is, historical data stored in the Citadel database).



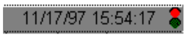
The button bar includes scroll arrows, a cursor button, date, time, and a stop and go light. Use the scroll arrows to move back and forth through time-the bigger the arrow button you select, the further the trend jumps in time. The scroll arrows also function much like a horizontal slider. Click on them and slide the mouse left and right while holding down the mouse button. The further you slide the cursor from dead center, the faster the trend scrolls in that direction.

Use the date and time indicators to choose a specific month, day, year, hour, minute, or second. If you click on the lower part of the hour, for example, it jumps back in time by one hour.

If you click on the upper part of the hour, it jumps ahead by one hour.



It works the same way for month, day, year, minute and second.



The stop & go light on the button bar is either red or green. If the light is green, it indicates the far right edge of the trend window displays the current time.

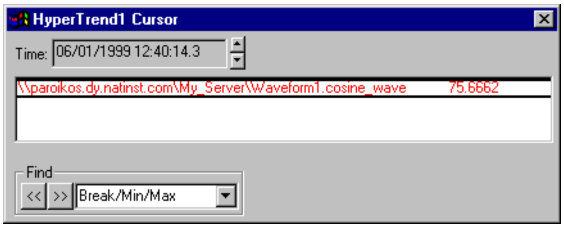
When you scroll back in time or if you click on the light when it is green, it changes to red, indicating that the trend is temporarily frozen in time. The date and time appears in the button bar indicating the exact time at the far right edge of the trend window. As you scroll back and forth through time, the data and time changes accordingly.

If you click on the light when it is red, the trend jumps back to current time and starts scrolling while plotting real-time values.

Note The Citadel database continues to log data no matter what state the HyperTrend is in. You do not lose any data when it is in "historical" mode (that is, when the HyperTrend is not scrolling in real-time).

When you click on the cursor button, a vertical cursor bar appears in the center of the graph along with an associated cursor dialog box. The dialog box indicates the value of each trend line at the current location of the cursor. As you drag the cursor bar left and right on the trend graph, the values in the pop-up change to reflect the new cursor location.

You can select how the trend line values are shown by choosing a format through the cursor control menu.

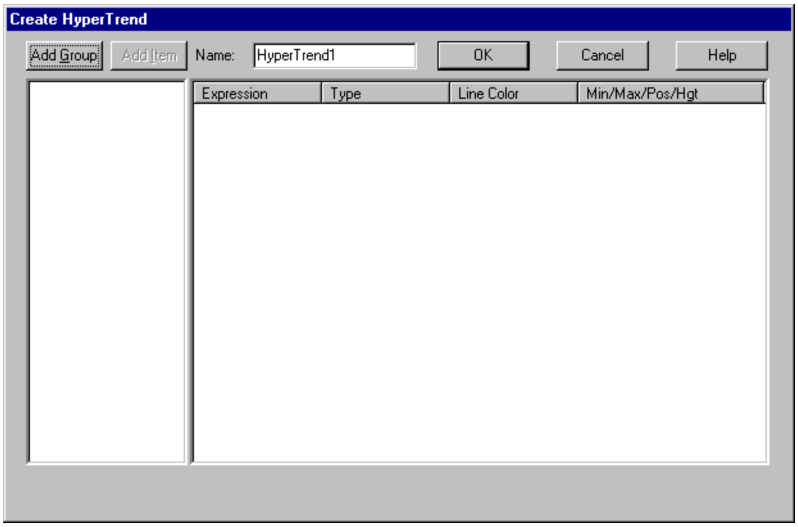


\\paroikos.dy.natinst.com\My_Server\Waveform1.cosine_wave 75.6662

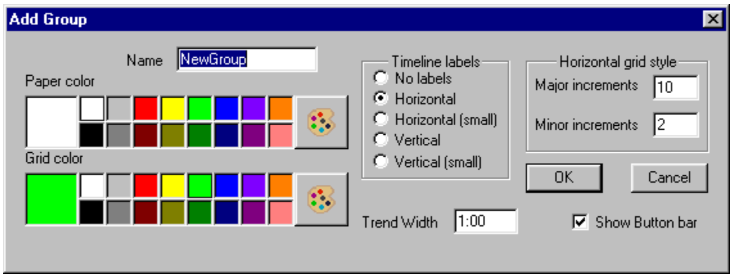
Time indicates the current location of the cursor bar. The increment and decrement buttons beside the field move the cursor left and right in the trend graph. Choose the size of the incremental move by clicking on the desired portion of the date/time. The hour portion is selected in the previous example, so each time you click on the increment or decrement button, the cursor bar jumps ahead or back by an hour. It works the same way for any portion of the date and time.

Use the **Find** combo box to search for a break in the trend line, a signal peak or valley, or a specific value. For example, you can find the last instance in which a process control limit value was exceeded. To find the last time a trend line crossed a specific value, choose the desired trend line by clicking on it in the list box, select **Value** in the **Find** combo box, enter the desired value, and clock on the scroll back button.

To create a hypertrend object, choose **Object»Create** or right-click on a process in the object explorer and select **New Object**. Select **HyperTrend**. The following dialog box appears.



First you must create a group of trends. Double-click on the **AddGroup** button. The following dialog box appears.



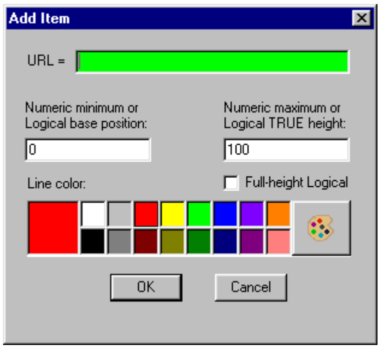
Configuring the group sets the appearance of the HyperTrend object when it displays traces from that group. You can set different paper and grid colors for different groups to help operators distinguish between them.

Give your group a name that clearly identifies it. Be sure to set the **Trend Width** for the period of time you want under observation for that group. Graphs may have a default width, or time span, of anywhere from two seconds to four years. The default **Trend Width** in the example dialog box indicates a time span of 1:00:00 or one hour. See *Numeric Data Members* in Chapter 2, *How LookoutDirect Works*, of the *Getting Started with LookoutDirect* manual for more information on entering time constants. After creating the HyperTrend object, you can make the trend width adjustable by connecting a numeric signal to the TrendWidth data member.

Major increments specifies the number of heavy horizontal grid lines on a trend graph. This value is independent of the range of any trend expressions.

Minor increments specifies the number of light horizontal grid lines between the major increment grid lines on a trend graph. This value is independent of the range of any trend expressions.

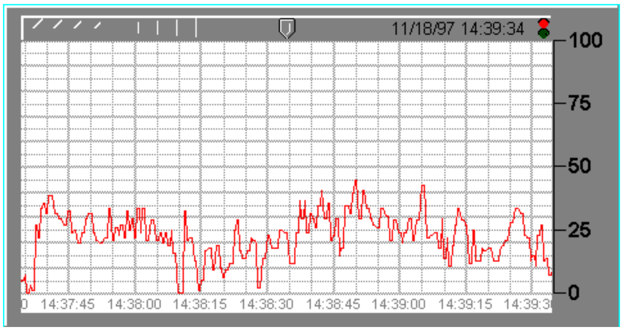
After you create a group, you must add individual items. Right-click on the group you want to add a trace to. Select **Add Item** (or click on the **Add Item** button). The following dialog box appears.


Add Item
URL =
Numeric minimum or Logical base position:
0
Numeric maximum or Logical TRUE height:
100
Line color:
Full-height Logical
OK
Cancel

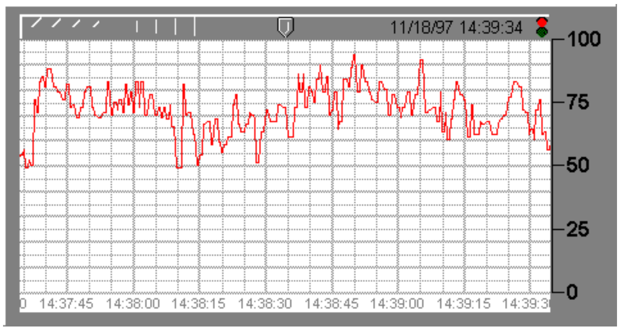
Right-clicking in the URL field displays the object selection dialog box covering all the registered computers running Lookout*Direct* on your network. Select the computer and process generating the value you want to display on your HyperTrend chart. See the URLs section for more information on this type of Lookout*Direct* connection.

Minimum and **Maximum** set the scale for the trace on your display. If you are charting a logical data member, position and height set the base display line and the height of the trace from that point when your signal goes TRUE. **Minimum** is the bottom of the graph while **Maximum** is the top of the graph, regardless of the range of the expression. These settings create an imaginary vertical scale and affect each expression independently.

For example, take two numeric expressions, both of which range from 0 to 50. Set the **Minimum** and **Maximum** to 0 and 100 on the first expression, and -50 and 50 on the second. The first expression plots in the bottom half of the chart while the second expression plots in the top half of the chart, even though they both fluctuate between 0 and 50.

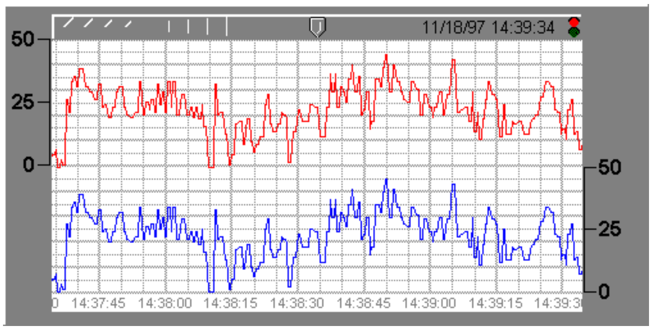


This figure shows the imaginary scale of the first expression (where min. = 0 and max. = 100). Because the expression ranges from 0 to 50, it is plotted in the bottom half of the graph.

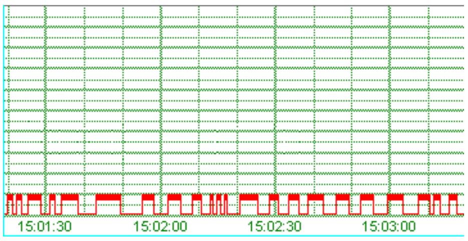


This figure shows the imaginary scale of the second expression (where min. = -50 and max. = 50). Because the expression ranges from 0 to 50, it is plotted in the top half of the graph.

When both expressions are entered on a single trend graph, you get the following effect. Notice the custom scales at either end of the graph.



If you select Logical for the expression type, the minimum and maximum settings changes to **Position** and **Height**. These two values now represent a number between 0% and 100%, and determine the baseline location of the trend line and its unit height when the expression goes TRUE.



Use **Insert»Scale** to label the values being charted according to your minimum and maximum settings.

Comments HyperTrend objects access data from the Citadel database. Think of them as windows into your historical database. See Chapter 5, *Developer Tour* in the *Getting Started with LookoutDirect* manual, and Chapter 7, *Logging Data and Events*, in the *LookoutDirect Developer’s Manual*, for more information on specifying a point to be logged to the Citadel database.

HyperTrends are updated as quickly as once per second, depending on screen resolution, the size of the graph, and the trend width setting. Computers with slow display adapters may slow down considerably when you display a large trend graph. On slower computers with slow display cards (no graphics coprocessor), consider limiting the size of your HyperTrends to less than one fourth the screen size.

HyperTrend Data Members

Table 2-20. HyperTrend Data Members

Data Members	Type	Read	Write	Description
ActiveGroup	numeric	yes	yes	Sets which of the HyperTrend trace groups is active.
Enable1– Enable 999	logical	yes	yes	When TRUE, the identified trend line is visible. When FALSE, the trend line hidden. The default value is TRUE. Trend lines are identified by the group number followed by the item number, so Enable1.2 would refer to item 2 in group 1.
Height1 – Height999	numeric	yes	yes	Specifies the amplitude or height of the identified trend line (distance from baseline) when the logical expression goes TRUE. Height should be between 2 and (100 minus position). Trend lines are identified by the group number followed by the item number, so Height1.2 would refer to item 2 in group 1.
Max1 – Max999	numeric	yes	yes	Specifies the top of the graph for the identified numeric trend line (the value of the trended line when it is at 100 percent of the Y axis). Trend lines are identified by the group number followed by the item number, so Max1.2 would refer to item 2 in group 1.
Min1 – Min999	numeric	yes	yes	Specifies the bottom of the graph for the identified numeric trend line (the value of the trended line when it is at zero percent of the Y axis). Trend lines are identified by the group number followed by the item number, so Min1.2 would refer to item 2 in group 1.

Table 2-20. HyperTrend Data Members (Continued)

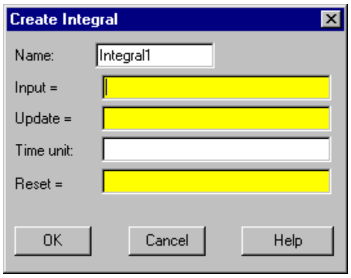
Data Members	Type	Read	Write	Description
Pos1 – Pos999	numeric	yes	yes	Specifies the baseline location of the identified logical trend line. Baseline position should range should be 1–98. (pos1 is associated with trend line 1) Trend lines are identified by the group number followed by the item number, so Pos1.2 would refer to item 2 in group 1.
TrendWidth	numeric	yes	yes	Specifies the span of time that the X axis covers.
UseButtonBar	logical	yes	yes	When TRUE, the HyperTrend button bar becomes visible on the control panel. When FALSE, it is invisible. The default value is TRUE.
Visible	logical	yes	yes	When TRUE, the HyperTrend becomes visible on the control panel. When FALSE, it is invisible. The default value is TRUE.

Converting Lookout*Direct* 3.*xx* HyperTrends to Lookout*Direct* 4

If you convert a process created in a version of Lookout*Direct* earlier than 4.0 which contains a HyperTrend object that is displaying a complex expression, Lookout*Direct* automatically creates a named (expression) for the converted HyperTrend to chart. To maintain your legacy HyperTrend objects you must use or replace these (expression) objects.

Integral

Integral is a totalizer—it totals the numeric **Input** signal. This class is typically used to total a measured flow rate.



Input is the numeric expression that you want to totalize or integrate.

Update can be a logical expression or numeric constant. If you specify **Update** as a numeric constant, it creates an internal Pulse timer with a pulse period of the specified time and a pulse duration of zero. See *Numeric Data Members* in Chapter 2, *How LookoutDirect Works*, of the *Getting Started with LookoutDirect* manual for information on entering time constants. If you specify **Update** as a logical variable, the variable should pulse at the desired frequency.

The **Update** expression extrapolates an interim total based on the current total and the most recent Input value. The interim total is then sent out as the output. The total is calculated using the trapezoidal numeric integration technique, and the total is corrected any time the incoming signal is refreshed.

Time unit is a numeric expression used as the basis for unit time on the Input signal. For instance, if the Input rate is in units of gallons per minute, the Time unit should be entered as one minute (1:00) so the totalized flow is in gallons. Typically the Time unit is one second (0:01), one minute (1:00), one hour (1:00:00), or one day (1:00:00:00). However, you can specify any unit, such as 5:23 (a rate of change in Input units per five minutes and 23 seconds).

Reset is a logical expression that resets the totalizer value to zero upon transition from OFF to ON.

Note Integral does not have a display parameters dialog box. You can easily display the result of the Integral output signal by referencing its data member in an expression.

Integral Data Members

Table 2-21. Integral Data Members

Data Member	Type	Read	Write	Description
(implicit)	numeric	yes	no	Totalized value

Comments The **Update** pulse forces the calculated total to continue changing between Input signal updates. For example, if a remote RTU that is monitoring a flow rate is polled every ten minutes, the **Update** pulse could be set at five seconds so the operator can watch the totalized flow continue to change on the screen as an extrapolated value. The corrected totalized value is calculated any time the **Input** signal refreshes—in this case, every ten minutes.

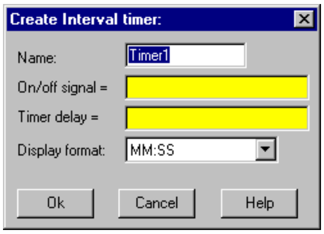
If totalized values are logged to a spreadsheet on a daily basis, for example, and the total should be reset at the end of every day, use the update pulse generated by the Spreadsheet object to reset the total—this guarantees that the total is recorded before the totalizer is reset. The example on the previous page totalizes the hourly flow for permanent data logging by a spreadsheet object named HourlySheet. Notice that the spreadsheet update pulse `HourlySheet.logged` is used to reset the totalizer.

Related Objects *Accumulator*, *Counter*, *Derivative*

Interval

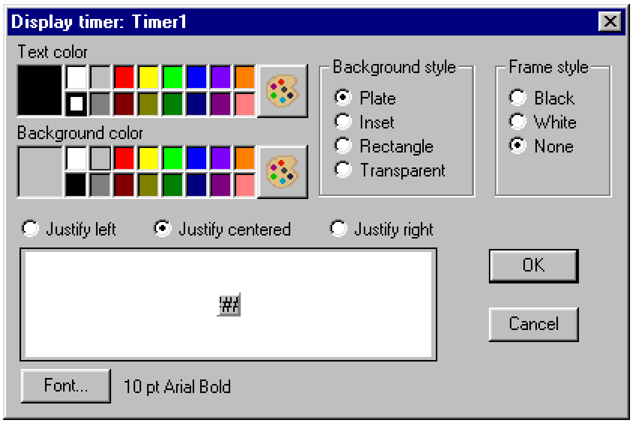
Interval is an adjustable delay timer. When **On/off signal** transitions to on, its output turns on and the **Timer delay** begins to count down. At the end of the delay countdown, the output signal turns OFF. If **On/off signal** is dropped at any time, the output signal turns OFF, and the timer is reset.

Timer delay can range from 0.0 seconds to several years, and the effective resolution is 0.1 seconds over the entire range. The timer display digitally shows the time delay remaining. It is updated approximately once per second. If the **On/off signal** is low, or the time delay period has expired, the timer display shows `OFF`.



Name: Timer1
On/off signal =
Timer delay =
Display format: MM:SS

The **On/off signal** is a logical expression while **Timer delay** is a numeric expression. Normally, this is a simple time constant such as 0:20 (twenty seconds). See *Numeric Data Members* in Chapter 2, *How LookoutDirect Works*, of the *Getting Started with LookoutDirect* manual for information on entering time constants.



Background style: [✓ Plate] Inset Rectangle Transparent
Frame style: Black White [✓ None]
Justify left [✓ Justify centered] Justify right
10 pt Arial Bold

Interval Data Members

Table 2-22. Interval Data Members

Data Member	Type	Read	Write	Description
(implicit)	logical	yes	no	Logical timer value

Comments The Interval timer can be used to enforce a maximum run time for a pump.

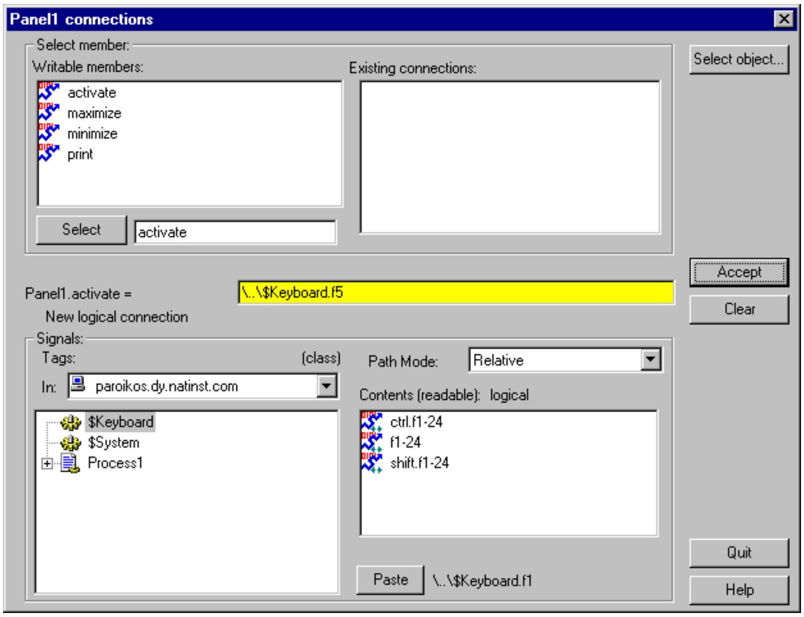
Related Objects *DelayOff*, *DelayOn*, *OneShot*, *Pot*, *TextEntry*

$Keyboard

$Keyboard is a global object. Its data members represent the keyboard function keys. Unlike other object classes in which you can create several objects of the same class, you cannot create or delete $Keyboard objects, but you can use the one supplied.

You can use the $Keyboard global object to perform such functions as calling a particular control panel, activating a batch sequence, or acknowledging alarms by pressing a key.

Think of $Keyboard data members (which represent function keys on the keyboard) as Lookout*Direct* pushbuttons. Just as you can connect a pushbutton to the activate data member of a panel, you can also connect a $Keyboard data member to the activate data member of a panel. Such a connection is shown in the following illustration.



Select: activate

Panel1.activate = \..\$Keyboard.f5

New logical connection

In: paroikos.dy.natinst.com

Path Mode: Relative

Contents (readable): logical

Paste \..\$Keyboard.f1

The logical expression, `$Keyboard.F1` calls up Panel1 any time a user presses the F1 key on the keyboard. Similar connections could be made to other panels. You can easily connect a different panel to each function key.

Just as easily, you can connect a function key to a batch process trigger. When the key is pressed, (that is, when the `$Keyboard` data member goes TRUE) the batch is activated—reading batch ingredients from a recipe object, opening and closing valves, starting mixers, bottling finished material, and so on.

You might also connect a function key to `$Alarm.ack`. This would enable users to acknowledge alarms through a single keystroke.

$Keyboard Data Members

$Keyboard has 72 readable data members. Each data member represents a unique key sequence, described in the following table.

Table 2-23. $Keyboard Data Members

Data Member	Type	Read	Write	Description
Ctrl-F1 - Ctrl-F24	logical	yes	no	Each of these 24 data members represent a function key, F1 – F24—when pressed in conjunction with the Ctrl key. A given data member returns logical TRUE when the Ctrl key and function key are pressed together and FALSE when the keys are released.
F1 - F24	logical	yes	no	Each of these 24 data members represent a function key, F1 – F24. A given data member returns a logical TRUE when its associated function key is pressed and FALSE when the key is released.
Shift-F1 - Shift-F24	logical	yes	no	Each of these 24 data members represent a function key, F1 – F24—when pressed in conjunction with the Shift key. A given data member returns logical TRUE when the Shift key and function key are pressed together and FALSE when the keys are released.

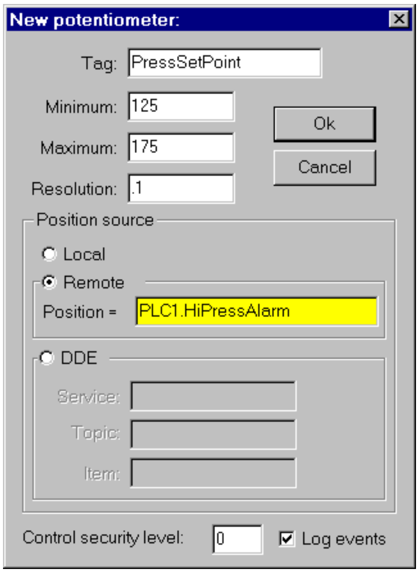
Comments $Keyboard function keys are global in nature. Any time F1 is pressed, the `$keyboard.F1` signal goes TRUE—regardless of what panel the user is looking at. If you want a function key to be unique from one control panel to the next, use the Panel object class function key data member. See *Panel* object class definition for more information.

Related Objects *L3Pushbutton, Pushbutton*

L3Pot

L3Pot is a potentiometer that you use to change numeric setpoint values. You can display pots on a control panel as a knob, vertical slider, horizontal slider, increment/decrement pushbuttons, or digital entry. You can also use pots as multiple-position switches.

If you change the background color of a panel and add a Pot object displayed as a slider, its color is always gray. To change the background color of a Pot to match your panel, select the Pot object, then pick **Change»Background Color** from the menu.


New potentiometer:

Tag: PressSetPoint

Minimum: 125

Maximum: 175

Resolution: .1

Position source

Local [✓ Remote] DDE

Position = PLC1.HiPressAlarm

Service:

Topic:

Item:

Control security level: 0

Log events [✓]

Minimum is the lowest value signal the Pot will generate.

Maximum is the highest value signal the Pot will generate.

Resolution is the smallest increment of change, or detent spacing the Pot supports.

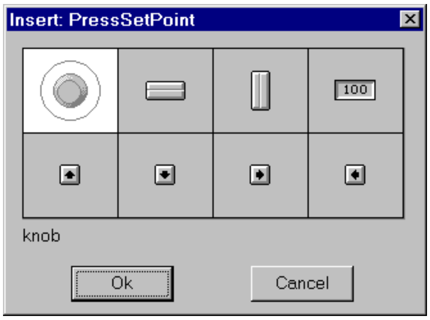
Position source determines where the value of the Pot resides. **Local** indicates the value of the Pot lies within the object itself—on the control panel.

Remote pots get their values from a remote source, often the register on a controller they are connected to. Adjusting the Pot changes the value in the register, and changing the value in the register adjusts the Pot. In effect, the Pot is tracking a remote value. This is especially useful when you want to prevent Lookout*Direct* from changing the value of setpoints or registers upon initial startup, or reconnection of lost communication. When you use this style Pot you are creating a kind of looped signal. Half the loop is formed when you connect the controller register to the Pot with the **Position** expression, while the second half is formed when you connect the Pot output signal to the controller register. **Position** is a numeric expression. Do not forget to complete the second half of the loop with the **Object»Edit Connections…** command.

Much like Remote Pots, **DDE** (Dynamic Data Exchange) Pots get their values from a remote source. This could be a cell in a spreadsheet, another DDE aware application, or a second copy of Lookout*Direct* running on the network. The last DDE parameters used on any object automatically become the default values for any new DDE object. See Chapter 5, *Dynamic Data Exchange*, of the *LookoutDirect Developer's Manual* for more information on Service, Topic, and Item parameters.

Control security level specifies the minimum security level operators must have to gain access to this individual object, and thus control it.

The **Log events** option creates a permanent audit trail for the object—who did what and when. All adjustments of the Pot are logged to disk, including the time of the adjustment, the operator account name, and what adjustment was made. See Chapter 7, *Logging Data and Events*, in the *LookoutDirect Developer's Manual* for more information on event logging.



Note You can modify the background color on vertical and horizontal sliders with the **Change»Background color…** menu command. You can modify the font and font color of digital pots using Change commands.

L3Pot Data Members

Table 2-24. L3Pot Data Members

Data Member	Type	Read	Write	Description
(implicit)	numeric	yes	no	Current value
decrement	logical	no	yes	When this data member value transitions from FALSE to TRUE, the implicit value of the Pot object decreases by the Pot **Resolution** amount.
enable	logical	no	yes	If TRUE (the default), enables DDE. If FALSE, disables DDE. The default value is on. This input is ignored for non-DDE TextEntry objects.
enterValue	logical	no	yes	Under specific circumstances, when this value transitions from FALSE to TRUE, pops up a **Enter new value** dialog box for an operator to use in entering a value for the pot. See the note following the table for more detailed information. The enterValue data member is designed for use under unusual circumstances, in particular when pointing devices are not available on a computer running Lookout*Direct*. Because of its unusual operation, this data member should not be used unless it is necessary for hardware reasons.
increment	logical	no	yes	When this data member value transitions from FALSE to TRUE, the implicit value of the Pot object increases by the **Resolution** amount.
visible	logical	no	yes	When FALSE, the Pot object cannot be seen on the display panel. When TRUE, the Pot can be seen and controlled.

Note When the **`enterValue`** input transitions from **`FALSE`** to **`TRUE`**, and
if the Pot is visible,
if Lookout*Direct* is not in edit mode, and
if the Pot has at least one digital display,

The **Enter new value** dialog box pops up so an operator can input a value, just as if he had clicked on the digital display.

The numeric format and position used for the dialog box are based on the digital display for a pot.

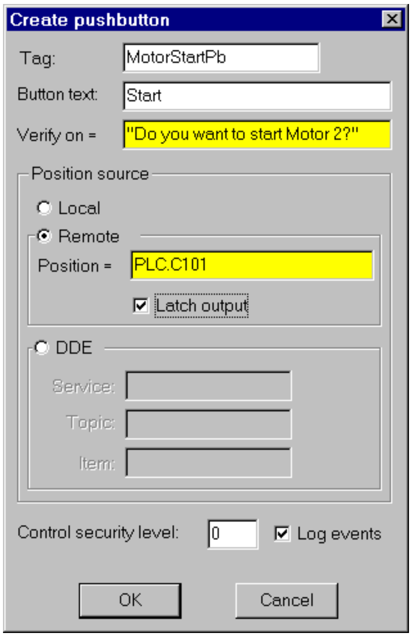
Even if the panel containing the Pot digital display is inactive, the **Enter new value** dialog box will pop up. You can prevent this by predicating the **`enterValue`** input on the panel's **`active`** data member.

Comments Potentiometers are one of the most common control objects used in process controls. Using Pots, a plant operator can make setpoint changes with the mouse. L3Pots also work well as HOA switches. To create an HOA switch with a Pot, specify the minimum as 1, the maximum as 3, and the resolution as 1.

The increment and decrement data members enable quick connection of pot objects to $Keyboard and Panel function keys, and screen Pushbuttons. These are often used to control Pot objects when Lookout*Direct* is running on an industrial PC platform that has restricted or no mouse functionality.

L3Pushbutton

L3Pushbutton generates a logical signal for receipt by other objects. A pushbutton changes state when you position the cursor over it and press the mouse button, trackball, touchscreen, or space bar. The pushbutton remains depressed and the output signal remains high until you release the button. If a **Verify on** message is defined, the operator must first acknowledge the message, then the output signal goes high, *but only momentarily*.

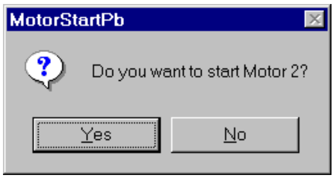

Create pushbutton

Tag: MotorStartPb
Button text: Start
Verify on = "Do you want to start Motor 2?"
Position source
[✓ Remote] Local
Position = PLC.C101
☑ Latch output
DDE
Service:
Topic:
Item:
Control security level: 0
☑ Log events

OK Cancel

Button text displays the specified text on the pushbutton.

Use **Verify on** to create a dynamic text expression to be displayed in a message dialog box. See Chapter 6, *Security*, in the *LookoutDirect Devloper's Manual* for more information on security.


MotorStartPb

Do you want to start Motor 2?

Yes No

Position source determines where the value of the pushbutton resides. **Local** indicates the value of the pushbutton lies within the pushbutton itself—on the control panel. If the pushbutton is not depressed its signal is OFF, if depressed its signal is ON.

Remote pushbuttons get their values from a remote source, often the register in a controller they are connected to. Depressing the pushbutton changes the status of the register, and changing the status of the register depresses the pushbutton.

The **Remote** option is especially useful when you want to prevent Lookout*Direct* from changing the value of setpoints or registers upon initial startup, or reconnection of lost communication. When you use this style of pushbutton you are creating a sort of looped signal. Half the loop is formed when you connect the controller register to the pushbutton with the Position expression, while the second half is formed when you connect the pushbutton output signal to the controller register. Position is a logical expression. Do not forget to complete the second half of the loop with the **Object»Edit Connections…** command.

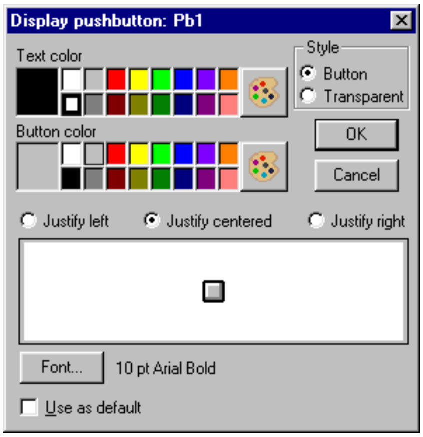
When you select the **Remote** option, you can choose whether or not the pushbutton latches its output. The **Latch output** check box configures Lookout*Direct* for controlling a latching-relay.

When a user clicks on a pushbutton that has latching selected, the pushbutton remains depressed, sending an ON signal (TRUE or high) until the Remote Position signal turns ON. Assume for example that an operator clicks on `MotorStartPb`, configured previously. The pushbutton remains pushed in, sending a TRUE signal, until PLC.C101 goes TRUE. As soon as PLC.C101 goes TRUE, the pushbutton releases.

Much like Remote pushbuttons, **DDE** (Dynamic Data Exchange) pushbuttons get their values from a remote source. This could be a cell in a spreadsheet, another DDE aware application, or a second copy of Lookout*Direct* running on the network. See Chapter 5, *Dynamic Data Exchange*, in the *LookoutDirect Developer's Manual* for information on **Service**, **Topic**, and **Item** parameters.

Control security level specifies the minimum security level operators must have to gain access to this individual object, and thus control it. See Chapter 6, *Security*, in the *LookoutDirect Developer's Manual* for more information on security.

The **Log events** option creates a permanent audit trail for the object—who did what and when. Any depression of the pushbutton is recorded to disk, including the time the button was depressed, and the operator's account name. See Chapter 7, *Logging Data and Events*, in the *LookoutDirect Developer's Manual* for more information on logging events.



Style: [✓ Button] Transparent

Justify left [✓ Justify centered] Justify right

Font: 10 pt Arial Bold

Use as default: ☐

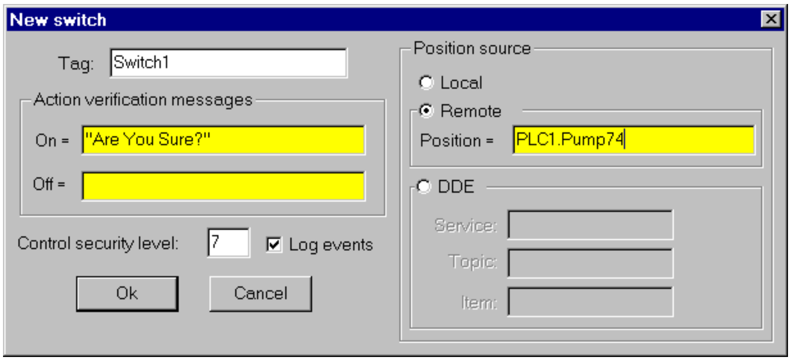
L3Pushbutton Data Members

Table 2-25. L3Pushbutton Data Members

Data Members	Type	Read	Write	Description
(implicit)	logical	yes	no	Value of object (TRUE when button is depressed)
enable	logical	no	yes	If TRUE (the default), enables DDE. If FALSE, disables DDE. The default value is on. This input is ignored for non-DDE TextEntry objects.
visible	logical	no	yes	When FALSE, the pushbutton cannot be seen on the display panel. When TRUE, the button can be seen and controlled.

L3Switch

L3Switch generates a logical signal for receipt by other objects. Switches change state when you click on them with a mouse button, trackball, touchscreen, or space bar on your keyboard.



Tag: Switch1

Action verification messages

On = "Are You Sure?"

Off =

Control security level: 7

[✓] Log events

Position source

○ Local

[✓ ● Remote]

Position = PLC1.Pump74

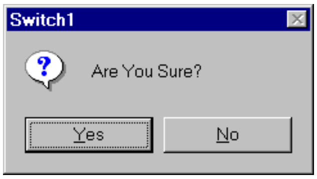
○ DDE

Service:

Topic:

Item:

Use **Action verification messages** to create dynamic text expressions to be displayed in message dialog boxes. See Chapter 6, *Security*, in the *LookoutDirect Developer's Manual* for more information on security.



Are You Sure?

Position source determines where the value of the switch resides. **Local** indicates the value of the switch lies within the object itself—on the control panel. If the switch is up the signal is ON, if down the signal is OFF.

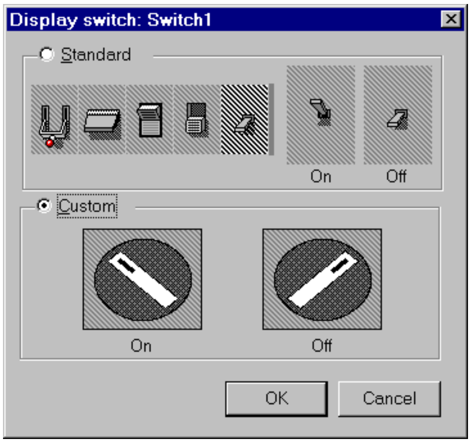
Remote switches get their values from a remote source, often the register on a controller they are connected to. Flipping the switch changes the status of the register, and changing the status of the register flips the switch.

The **Remote** option is especially useful when you want to prevent Lookout*Direct* from changing the value of setpoints or registers upon initial startup, or reconnection of lost communication. When you use this style switch, you are creating a sort of looped signal. Half the loop is formed when you connect the controller register to the switch with the **Position** expression, while the second half is formed when you connect the switch output signal to the controller register. Notice **Position** is a logical expression. Do not forget to complete the second half of the loop with the **Object»Edit Connections…** command.

Much like Remote switches, **DDE** (Dynamic Data Exchange) switches get their values from a remote source. This could be a cell in a spreadsheet, another DDE aware application, or a second copy of Lookout*Direct* running on the network. See Chapter 5, *Dynamic Data Exchange*, in the *LookoutDirect Developer's Manual* for more information on **Service**, **Topic**, and **Item** parameters.

Control security level specifies the minimum security level operators must have to gain access to this individual object, and thus control it.

The **Log events** option creates a permanent audit trail for the object—who did what and when. All adjustments of the switch are logged to disk, including the time the switch was flipped, the operator's account name, and the direction the switch was flipped. See Chapter 7, *Logging Data and Events*, in the *LookoutDirect Developer's Manual* for more information on event logging.


Display switch: Switch1

Standard [✓ Custom]

You can replace the standard switch types with custom graphic symbols. If you decide to use custom graphics, you must specify both symbol parameters, **On** and **Off**. See Chapter 2, *Graphics*, in the *LookoutDirect Developer's Manual* for more information on creating custom graphic symbols and the use of Transparent pixels.

L3Switch Data Members

Table 2-26. L3Switch Data Members

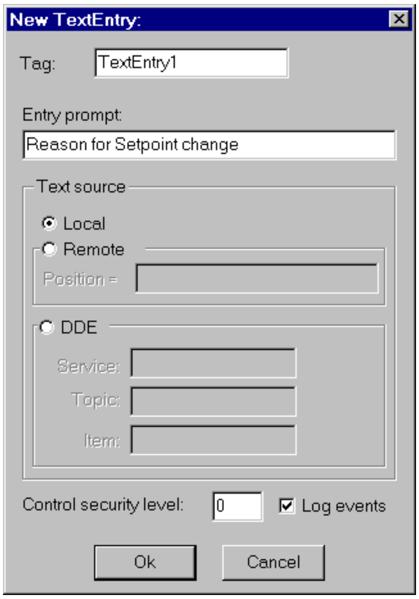
Data Members	Type	Read	Write	Description
(implicit)	logical	yes	no	L3Switch Position
enable	logical	no	yes	If TRUE (the default), enables DDE. If FALSE, disables DDE. The default value is ON. This input is ignored for non-DDE L3TextEntry objects.
visible	logical	no	yes	When FALSE, the switch object cannot be seen on the display panel. When TRUE, the switch can be seen and controlled.

Comments If a switch with more than two positions is needed, use a Radiobutton object instead.

Related Objects *L3Pushbutton, L3Pot, Pushbutton, Pot*

L3TextEntry

With L3TextEntry you can manually enter textual notes with the keyboard. These notes may contain any combination of numeric and alphanumeric characters; however, the result of your entry is converted to a text value. Just like any other text expression in Lookout*Direct*, your note can be logged to disk, connected to other data members that accept text signals, and so on. The note is saved and displayed as a single line entry—you cannot embed carriage returns into the message.


New TextEntry:

Tag: TextEntry1

Entry prompt: Reason for Setpoint change

Text source: [✓ Local] Remote DDE

Position =

Service:

Topic:

Item:

Control security level: 0

[✓ Log events]

Entry prompt is the text that appears at the top of the text entry dialog box when an operator selects the text entry pushbutton.

Text source determines where the user-entered text resides. **Local** indicates the user-entered text lies within the object itself—on the control panel.

Remote indicates that the user-entered text resides in a remote source, such as a text expression or another TextEntry object.

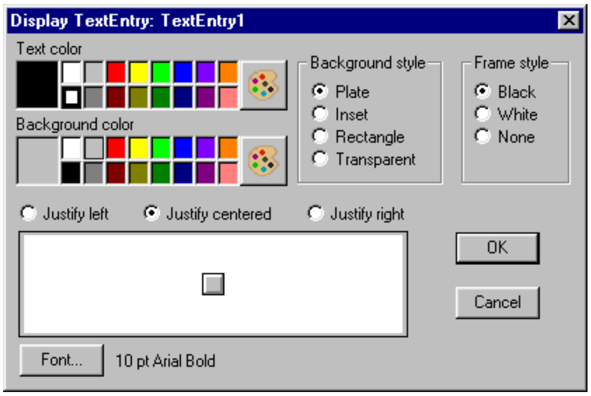
Much like **Remote** TextEntry objects, **DDE** TextEntry objects get their values from a remote source. This is the option you use to tie the text to a cell in a spreadsheet, a database lookup table, or any DDE aware application—including a second copy of Lookout*Direct* running on the network. See Chapter 5, *Dynamic Data Exchange*, in the *LookoutDirect Developer's Manual* for more detailed information on **Service**, **Topic** and **Item**.

Note The last DDE parameters used on any object automatically become the default values for any new DDE object.

Control security level specifies the minimum security level operators must have to gain access to this individual object, and thus control it.

The **Log events** option creates a permanent audit trail for the object—who did what and when. When selected, all text entries in this object are logged to disk. Each entry includes the time of the entry, the operator's account name, and what entry was made. See Chapter 7, *Logging Data and Events*, in the *LookoutDirect Developer's Manual* for more information on event logging.

Lookout*Direct* presents the following display parameters dialog box after you define the object. It lets you define the text font and presentation style.



Background style: [✓ Plate] Inset Rectangle Transparent

Frame style: [✓ Black] White None

Justify left [✓ Justify centered] Justify right

10 pt Arial Bold

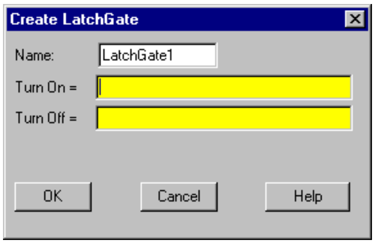
L3TextEntry Data Members

Table 2-27. L3TextEntry Data Members

Data Members	Type	Read	Write	Description
(implicit)	text	yes	no	Current, user-entered text
enable	logical	no	yes	If TRUE (the default), enables DDE. If FALSE, disables DDE. The default value is ON. This input is ignored for non-DDE TextEntry objects.

LatchGate

LatchGate is latched on and off by two incoming signals. It retains the state of the signal that most recently went high, regardless of the state of the other signal. When the **Turn Off** signal transitions from OFF to ON, the LatchGate output goes OFF until the **Turn On** signal transitions from OFF to ON. The output signal does not change when either incoming signal transitions from ON to OFF. Both **Turn Off** and **Turn On** are logical expressions.



Name: LatchGate1

LatchGate Data Members

Table 2-28. LatchGate Data Members

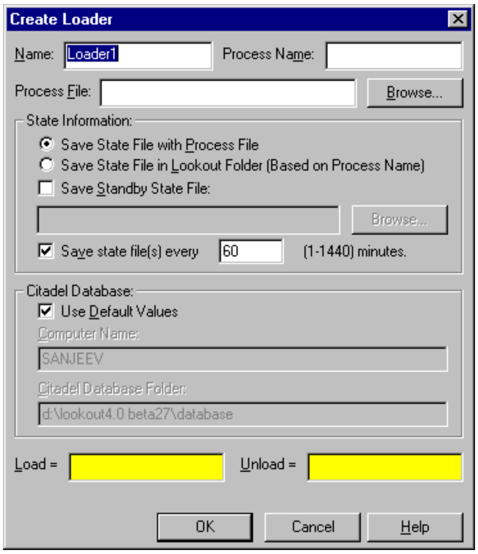
Data Member	Type	Read	Write	Description
(implicit)	logical	yes	no	Logical output signal value

Comments Two pushbuttons connected to the **Turn On** and **Turn Off** expressions of a LatchGate create pushbutton start/stop controls for a pump or other device.

Related Objects *Flipflop*

Loader

Use the Lookout*Direct* Loader to load or unload a Lookout*Direct* process in response to a logical trigger. Using a Loader object in conjunction with a Monitor object is how you create failover redundancy with Lookout*Direct*. See Chapter 10, *Redundancy*, in the *LookoutDirect Developer's Manual* for more information on redundancy.



Create Loader

Name: Loader1
Process Name:
Process File:
State Information:
- [✓ Save State File with Process File]
- Save State File in Lookout Folder (Based on Process Name)
- Save Standby State File:
- [✓ Save state file(s) every] 60 (1-1440) minutes.

Citadel Database:
- [✓ Use Default Values]

Computer Name: SANJEEV
Citadel Database Folder: d:\lookout4.0 beta27\database

Load =
Unload =

You may notice that the information in the **State Information** and **Citadel Database** sections of this dialog box are the same as those areas in the **Create Process** dialog box and, in the case of the **Citadel Database** section, the **System Options** dialog box. Just as the **Citadel Database** section of the **Create Process** dialog box overrides the system database location settings for a particular process, any settings you make in the Loader object for database location or saving of state files override both system defaults and whatever settings you may have made when you created the process being loaded.

Process Name is the name that the process runs under when you open the **Process File**. You can use a process name other than the one used when the process file loaded was created.

Process File is the name of the file this Loader object will load when activated. You must enter a complete path to the file. You can specify a file from another computer on your network, but you must map the location on the remote computer as a network drive on your own computer first.

The **State Information** section of this dialog box lets you set where Lookout*Direct* saves state files for the process just loaded, and under what name the files are saved.

Select **Save State File with Process File** to save the state file in the location where the process file was opened.

Select **Save State File in Lookout***Direct* **Folder** to save the state file in the Lookout*Direct* folder of the copy of Lookout*Direct* your are currently running. The state file name is the same as the process name.

Select the **Save Standby State File** checkbox to save one or more extra copies of the state file in a location of your choosing. Enter a complete path, including state file name, to each location you want to save a state file. If you are saving the state file to more than one backup or alternative location, separate the paths with the vertical bar (`|`) operator symbol.

Check the **Save State File(s) every** *`NNNN`* **(1-1440) minutes** option to set the frequency with which Lookout*Direct* saves the state file. The Lookout*Direct* default is 60 minutes.

The **Citadel Database** section sets the location of the Citadel database that Lookout*Direct* logs data to for the process you load. If you check the **Use Default Values** checkbox, Lookout*Direct* uses the default location set in the **System Options** dialog box of any instance of Lookout*Direct* running the process.

If you enter a computer name and a path on that computer to a specific folder, Lookout*Direct* logs data to that location on that computer, no matter what computer is running the process.

To designate a specific computer and path for your process to log data to, enter the fully qualified network name for the target computer in the **Computer Name** field, and the complete path to the target database directory in the **Citadel Database Folder** field.

Load is the logical signal you use to activate the Loader and load the process.

Unload is the logical signal you use to activate the Loader and unload the process you loaded earlier.

The Loader can only load one process at a time, and can only load a process to run inside the instance of Lookout*Direct* currently running the process that contains the Loader.

To load multiple processes with one trigger, you must use multiple Loader objects.

Loader Data Members

Table 2-29. Loader Data Members

Data Member	Type	Read	Write	Description
SaveWithProcess	logical	yes	no	When TRUE, Lookout*Direct* saves a state file in the same location as the process file it contains the state for.
DatabaseComputer	text	yes	no	Sets the computer on which Lookout*Direct* saves Citadel database files.
DatabaseFolder	text	yes	no	Sets the folder in which Lookout*Direct* saves Citadel database files.
Failure	logical	yes	no	Monitor this data member to be alerted if a load attempt fails.
Failuretext	text	yes	no	Returns the reason for a failure to load the process designated by the loader.
Load	logical	yes	yes	Triggers the loader to load the designated process file.
ProcessFile	text	yes	no	Name of the process the loader loads when activated.
ProcessName	text	yes	no	Specifies the process name a loaded process runs under.
SavePeriod	numeric	yes	no	Sets how often, in minutes, that Lookout*Direct* saves the state file for the loaded process.
SaveWithLookout*Direct*	logical	yes	no	When TRUE, Lookout*Direct* saves the state file in the Lookout*Direct* directory, using `ProcessName` as the name for the state file as well.

Table 2-29. Loader Data Members

Data Member	Type	Read	Write	Description
StandbyFile	text	yes	no	Complete path to the location in which you want Lookout*Direct* to save copies of the state file.
Unload	logical	yes	yes	Triggers the loader to unload the designated process.

Loader Error Messages

Load: No process file specified

Specify a process file in the **ProcessFile** field.

Load: No process name specified

Name your process in the **ProcessName** field.

Load: Process already exists: *loadername.processname*

The process specified by your Loader object is already running under that name in this instance of Lookout*Direct*. Only one process may run under each process name.

Load: No state file specified

You must specify state file information for any process you load with a Loader object.

Load: Invalid process name

You have chosen an invalid process name. See the *Object Names* section in Chapter 4, *Using LookoutDirect*, of your *Getting Started With LookoutDirect* manual for detailed information on valid Lookout*Direct* process and object names.

Load: Invalid database computer name

The computer name you have entered in the **ComputerName** field is not registered as being a part of your Lookout*Direct* network. Check the spelling of the name or register the computer through the Lookout*Direct* Object Explorer or the Lookout*Direct* Connection Browser.

Load: Invalid database folder

Check the path you have entered in the **Citadel Database Folder** field to make sure the path you entered does exist on the computer specified in the **ComputerName** field.

Load: Can't open process file *processfilename*

Lookout*Direct* was unable to open the file `processfilename`. Check to see that the file exists in the specified location and has not been corrupted.

Unload: No process name specified

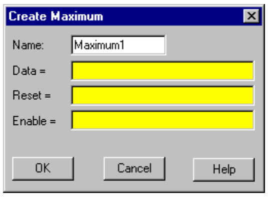
Enter the name of the process you want to unload in the **Process Name** field.

Unload: Process not found

Lookout*Direct* must be running a process with the name specified in the **Process Name** field for the Loader to unload a process. If no process with the specified name is running when the Loader attempts to unload a process, Lookout*Direct* returns this error message.

Maximum

Maximum actively calculates the maximum value of **Data** over time. Maximum is only active when the **Enable** expression is TRUE. It resets to zero when the **Reset** expression transitions from OFF to ON. Maximum also maintains an array of up to 35 previous maximum values. If **Enable** is left blank, the object always actively calculates the maximum. **Data** is a numeric expression while **Reset** and **Enable** are logical expressions.



Note Maximum does not have a display parameters dialog box. However, you can easily display Maximum by referencing it in an expression.

Maximum Data Members

Table 2-30. Maximum Data Members

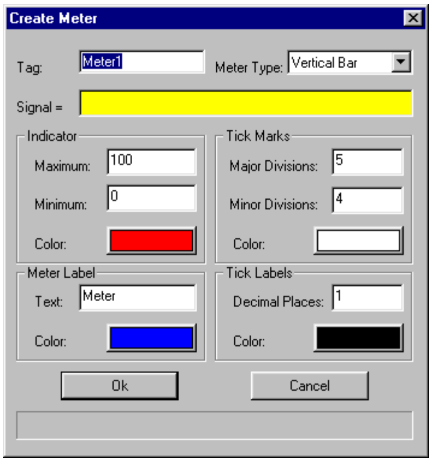
Data Members	Type	Read	Write	Description
(implicit)	numeric	yes	no	Current maximum value
1 – 35	numeric	yes	no	Previous maximum values. Signal 1 is the most recent prior maximum since the Reset expression went high.
DataReset	logical	no	yes	Upon transition from FALSE to TRUE, resets to zero all data members—including the current maximum value and all previous maximum values.

Comments The **Reset** interval could be a regular pulse interval created by a TimeOf*xxxx* timer, so that the pulse is synchronized to the top of the hour or day. For example, if you want to calculate the daily maximum flow rate, use the output signal from a TimeOfDay timer or a daily Spreadsheet object to reset the maximum calculation at the beginning of each day.

Related Objects *Average*, *Minimum*, *Sample*, *SampleText*

Meter

The Meter object displays the Signal expression in a vertical bar graph format or as a sweeping needle on a speedometer dial. Meter display values change depending on the derived numeric value of the Signal expression.



Tag: Meter1 Meter Type: Vertical Bar

Signal =

Indicator
Maximum: 100
Minimum: 0
Color:

Tick Marks
Major Divisions: 5
Minor Divisions: 4
Color:

Meter Label
Text: Meter
Color:

Tick Labels
Decimal Places: 1
Color:

Minimum is the lowest value signal the pot will generate.

Indicator parameters include Maximum and Minimum which define the span of the signal to be displayed. The Indicator Color is the color of the needle or vertical bar fill.

MeterLabel parameters allow for a Text label to be assigned during the meter configuration and the text Color to be selected.

Tick Marks options include parameters for the number of Major Divisions and the number of Minor Divisions along with a selection for the color of the divisions.

Note The Minor Divisions are the number of minor ticks between each two major divisions. Thus 5 Major Divisions and 4 Minor Divisions will result in whole number divisions, similar to 11 Major Divisions and 4 Minor Divisions.

Tick Labels options include parameters for the number of Decimal Places to be displayed on the numeric label of the Major Divisions along with a selection for the color of the numeric label.

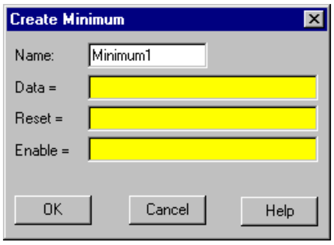
Meter Data Members

Table 2-31. Maximum Data Members

Data Members	Type	Read	Write	Description
(implicit)	numeric	yes	no	Current value of signal parameter

Minimum

Minimum actively calculates the minimum level of **Data** over time. Minimum is only active when the **Enable** expression is TRUE. It resets to zero when the **Reset** expression transitions from OFF to ON. Minimum also maintains an array of up to 35 previous minimum values. If **Enable** is left blank, the object is always actively calculating the minimum. **Data** is a numeric expression while **Reset** and **Enable** are logical expressions.



Name: Minimum1
Data =
Reset =
Enable =

Note Minimum does not have a display parameters dialog box. You can easily display the Minimum value referencing it an expression.

Minimum Data Members

Table 2-32. Minimum Data Members

Data Members	Type	Read	Write	Description
(implicit)	numeric	yes	no	Current minimum value
1 – 35	numeric	yes	no	Previous minimum values. Signal 1 is the most recent prior minimum since the Reset expression went high.
DataReset	logical	no	yes	Upon transition from FALSE to TRUE, resets to zero all data members—including the current minimum value and all previous minimum values.

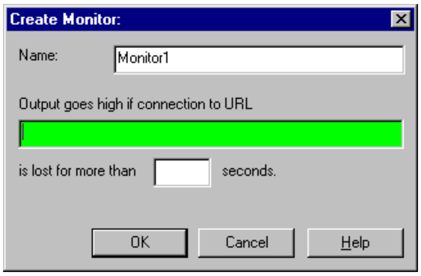
Comments The **Reset** interval could be a regular pulse interval created by a TimeOf*xxxx* timer, so that the pulse is synchronized to the top of the hour or day. For example, if you want to calculate the daily minimum flow rate, use the output signal from a TimeOfDay timer or a daily Spreadsheet object to reset the minimum calculation at the beginning of each day.

Related Objects *Average*, *Maximum*, *Sample*, *SampleText*

Monitor

The Lookout*Direct* Monitor object is integral to Lookout*Direct* redundancy. The Monitor object maintains a connection with a data member in any process you want to watch from another computer or process. If the data flow from that source stops, the Monitor signals the halt, allowing you to respond.

Using a Monitor object in conjunction with a Loader object is how you create failover redundancy with Lookout*Direct*. See Chapter 10, *Redundancy*, in the *LookoutDirect Developer's Manual* for more information on redundancy.



In the **Output goes high** field enter a data member in the process you want to monitor. If the data quality of that expression goes bad for more than the number you enter in the **seconds** field, the monitor goes high (TRUE), letting you know there is a problem with the process.

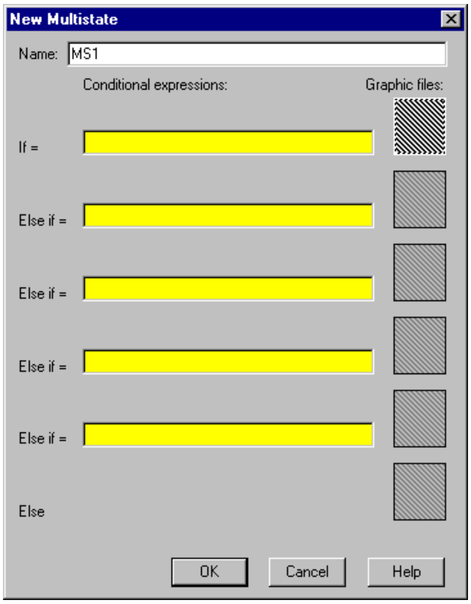
Monitor Data Members

Table 2-33. Monitor Data Members

Data Member	Type	Read	Write	Description
(implicit)	logical	yes	no	Goes TRUE when the data member the Monitor is watching cannot be accessed after a specified length of time.
timeout	numeric	yes	no	The length of time in seconds that the data member being monitored must be unavailable before the Monitor goes TRUE.

Multistate

Multistate displays different graphics on a control panel as dictated by the values of **Conditional expressions**. You can use up to six **Graphic files**, but at least one is required. Multistate determines which graphic to display based on the order and current status of your **Conditional expressions**. If several **Conditional expressions** are true at once, Multistate displays the graphic associated with the first true expression.



Conditional expressions must result in logical values (TRUE or FALSE). See the *Animator* section for more information about constructing logical statements. Double-click in a **Graphic file** box to select the graphic you want to use.

Multistate Data Members

Table 2-34. Multistate Data Members

Data members	Type	Read	Write	Description
none	—	—	—	Multistate objects do not have data members

Comments By creating several graphic images that depict a sequence of events, Multistate can be used to create animation sequences on control panels such as hydraulic pistons moving back and forth. A more typical use of Multistate is for three-color pilot lights, where green represents running, red represents stopped, and yellow represents failed, for example.

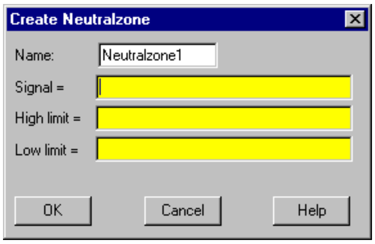
For smooth, high speed animations, use the Animator object.

Related Objects *Animator*

Neutralzone

Neutralzone is an ON/OFF Controller. It functions the way a home air conditioning thermostat does; if the temperature rises above a certain level, the `above` data member goes TRUE (turning the A/C on). When it drops below a lower temperature, the `below` data member goes TRUE (turning the A/C off).

When the incoming **Signal** value rises above both **Low limit** and **High limit**, the data member `above` turns on, and the data member `below` turns off. When the incoming **Signal** value drops below both **Low limit** and **High limit,** `above` turns off, and `below` turns on. The `above` and `below` data members do not change state when the signal value falls back within the two limits (within the neutral zone). **Signal**, **High limit**, and **Low limit** are all numeric expressions.



Name: Neutralzone1
Signal =
High limit =
Low limit =

The previous discussion assumes numeric constants for both limits. However, you could use variable setpoint signals from Pot objects so an operator could dynamically adjust Neutralzone behavior.

Note Neutralzone does not have a display parameters dialog box. You can easily display the result of Neutralzone output signals by referencing its data members in an expression.

Neutralzone Data Members

Table 2-35. Neutralzone Data Members

Data Members	Type	Read	Write	Description
above	logical	yes	no	ON if signal is greater than both limits, OFF if signal is less than both limits, and does not change if signal is between both limits
below	logical	yes	no	ON if signal is less than both limits, OFF if signal is greater than both limits, and does not change if signal is between both limits

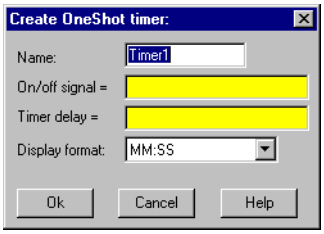
Comments You can use this object to turn pumps on and off or open and close valves based on line pressures or tank levels. Neutralzone objects prevent pumps from cycling on and off around a single setpoint, just as an air conditioning thermostat prevents your home air conditioner from incessantly starting and stopping.

Often the term deadband is mistakenly used to describe a neutral zone. However, deadbands refer to the amount of change a numeric value must travel in the reverse direction before the output numeric value begins to change.

OneShot

OneShot is an adjustable delay timer. When **On/off signal** transitions to on, the output signal goes TRUE and the **Timer delay** begins to count down. At the end of the delay countdown, the output signal goes FALSE.

Unlike the Interval timer, the OneShot timer output remains on for the **Time delay** period even if **On/off signal** goes FALSE. So a OneShot timer requires only a momentary signal to begin the **Timer delay** period. Pulsing the **On/off signal** during the time delay period does not extend the time delay period of a OneShot timer.

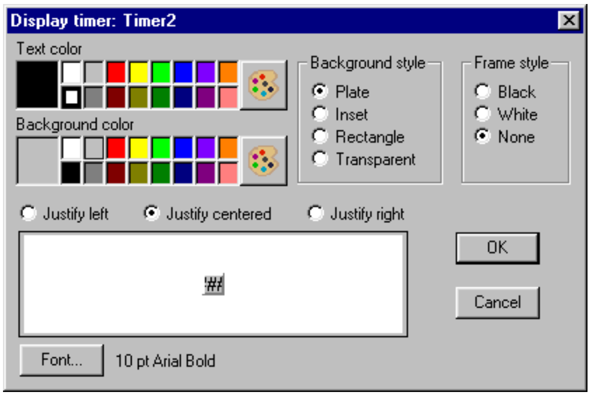


Name: Timer1
On/off signal =
Timer delay =
Display format: MM:SS

The **On/off signal** is a logical expression while Timer delay is a numeric expression. Normally, this is a simple time constant such as 0:20 (twenty seconds). See *Numeric Data Members* in Chapter 2, *How LookoutDirect Works*, of the *Getting Started with LookoutDirect* manual for information on time constants.

Timer delay can range from 0.0 seconds to several years. The effective resolution is 0.1 seconds over the entire range.

The object is represented on a control panel by showing the time delay remaining in the format defined by the **Display format** parameter. It is updated approximately once per second. If the delay period has expired, it shows `OFF`.



Background style: [✓ Plate] Inset Rectangle Transparent

Frame style: Black White [✓ None]

Justify left [✓ Justify centered] Justify right

10 pt Arial Bold

OneShot Data Members

Table 2-36. OneShot Data Members

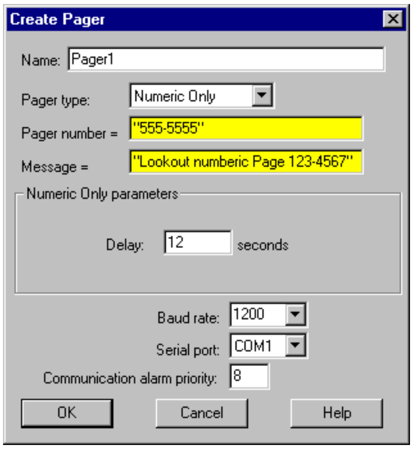
Data Member	Type	Read	Write	Description
(implicit)	logical	yes	no	Logical timer value

Comments You can use the OneShot timer to hold a valve open for a set period of time after a pushbutton is pressed, or to prevent pump starts from occurring too rapidly in succession.

Related Objects *DelayOff*, *DelayOn*, *Interval*, *Pot*, *TextEntry*

Pager

Pager is an object class Lookout*Direct* uses to contact a numeric or alphanumeric pager through a modem, sending a message to the pager.


Create Pager

Name: Pager1

Pager type: Numeric Only

Pager number = "555-5555"

Message = "Lookout numberic Page 123-4567"

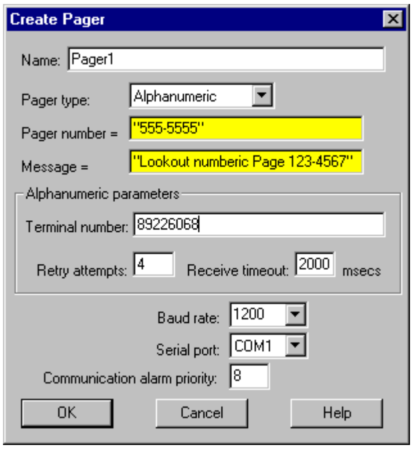
Numeric Only parameters

Delay: 12 seconds

Baud rate: 1200

Serial port: COM1

Communication alarm priority: 8


Create Pager

Name: Pager1

Pager type: Alphanumeric

Pager number = "555-5555"

Message = "Lookout numberic Page 123-4567"

Alphanumeric parameters

Terminal number: 89226068

Retry attempts: 4 Receive timeout: 2000 msecs

Baud rate: 1200

Serial port: COM1

Communication alarm priority: 8

Pager type determines whether the Pager object operates in numeric only or alphanumeric mode. A detailed description of the operation of these two modes follows.

Pager number is the phone number of the pager you want to contact. When the Pager object is in **Alphanumeric** mode, this number corresponds to the pager ID number.

Message is the message you want to send to the pager. Notice that in **Numeric Only** mode only numeric characters are sent.

Delay is how long the Pager object waits after dialing the pager number before it dials the message number. This parameter is valid in **Numeric Only** mode only.

Terminal number is the phone number of the remote paging terminal you want to contact. This parameter is valid in **Alphanumeric** mode only.

Retry attempts specifies the consecutive number of times Lookout*Direct* attempts to establish communications with a device if it is not getting a valid response. After it tries the number of **Retry attempts** specified, the Pager object generates an alarm and releases the COM port. Refer to Chapter 3, *Serial Communications,* in the *LookoutDirect Developer's Manual* for more information. This parameter is valid in **Alphanumeric** mode only.

Receive timeout is the time delay Lookout*Direct* uses in waiting for a response from a device before retrying the request. This parameter is valid in **Alphanumeric** mode only.

Baud rate indicates the baud rate Lookout*Direct* uses to communicate with the modem and paging terminal.

Serial port specifies which COM port Lookout*Direct* uses to communicate with your modem. You must have this COM port configured as dial-up under **Options»Serial Ports**.

Communication alarm priority determines the priority level of alarms generated by the Pager object. You can relate such alarms to communications with the modem or with the remote paging terminal.

Pager Data Members

Table 2-37. Pager Data Members

Data Member	Type	Read	Write	Description
Message	text	no	yes	Pager message
Phone	text	no	yes	Individual pager phone number or Page ID number
Send	logical	no	yes	Sends the message on transition from FALSE to TRUE

Pager Object Modes

Numeric Only

In **Numeric Only** mode, the Pager object establishes a connection with your local modem. Once this connection has been established and the pager number dialed, the Pager object waits for the time specified by **Delay**, then dials the number that is the message. Because the `Message` data member is a text value, the Pager object in **Numeric Only** mode omits any non-numeric characters from the message when it is sent.

Alphanumeric Mode

In **Alphanumeric** mode, the Pager object actually establishes a connection with a remote paging terminal, then transmits an alphanumeric message using Telocator Alphanumeric Protocol (TAP) version 1.8. TAP is an industry standard protocol for paging terminals that accept alphanumeric pages. Alphanumeric messages are limited to 250 characters. The text value in the `Message` data member will be truncated to this length if it is longer.

Pager Serial Port Settings

Notice that there are two different retry settings that affect the operation of the Pager object in **Alphanumeric** mode. The retry settings in the Pager object dialog box govern serial communications with the remote paging terminal. This means that after the two modems have connected and finished handshaking, and the serial transaction is underway, each individual frame is timed by the **Receive timeout** setting, and retried the number of times specified by **Retry attempts**.

These retry settings will not dial the phone number again if the remote paging terminal for some reason does not answer or is busy, which happens occasionally. This setting and other important modem settings (including the AT initialization string that the Pager object must use on your modem) can be found in **Option»Serial Ports**, and should be chosen carefully. These settings are important in both Pager object modes.

Note You may have to increase your **Receive Gap** setting from its default of 5 to something closer to 20 or 25. You must also have your COM port configured as dial-up.

Pager Queueing

The Pager object queues up to 10 messages in either mode. If the object is in the process of sending out a page and the `Send` data member goes high again, the current value of the `Message` data member will be queued and sent out when the Pager object has time. Messages that are already in the queue will not be duplicated.

Pager Status Messages

Paging terminal refused logon

Alphanumeric only error code

Paging terminal forced disconnect

Alphanumeric only error code

Paging terminal NAKed block transmission

Alphanumeric only error code

Paging terminal abandoned block transmission

Alphanumeric only error code

No response within timeout period

This means that the modem is not responding to Lookout*Direct* requests.

Queue full

The paging queue currently has 10 pages in it, and will not accept any more until at least one of those pages is successfully sent.

Garbled response

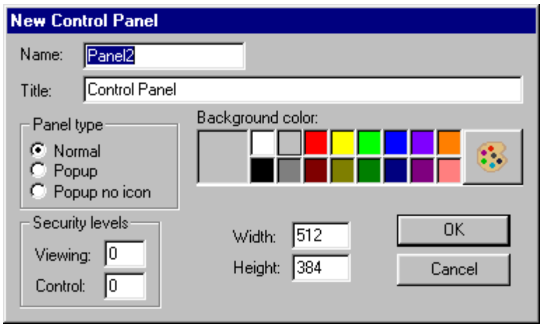
A response from the modem was corrupted or in an unrecognizable form.

Panel

Panel is a unique object class that accepts display members of other objects. Panels (Control panels) are a window into your process you can use to monitor and control your system by flipping switches, depressing pushbuttons, and turning knobs.

There is no limit as to the number of control panels you can create in Lookout*Direct* or the number of objects or graphics that you can display on a given panel. Control panels can be any size, and you can display them within the Lookout*Direct* workspace in various states (maximized, normal, minimized).

Create control panels with the **Object»Create…** command or with the **Insert»Control panel…** command. Both commands deliver the same result.


New Control Panel

Name: Panel2

Title: Control Panel

Panel type: [✓ Normal] Popup Popup no icon

Security levels — Viewing: 0 Control: 0

Width: 512 Height: 384

There are three distinct panel types: **Normal**, **Popup**, and **Popup no icon**.

A **Normal** control panel can be maximized, normal size, or minimized within the Lookout*Direct* workspace. When you activate a **Normal** panel it appears at the size defined by its **Height** and **Width**. When you maximize a **Normal** panel, it fills the Lookout*Direct* workspace. When you minimize a **Normal** panel it appears as an icon. The **Normal** option is typically selected for full-sized control panels.

Popup control panels can either be in a popup state or minimized (they cannot be maximized). When you activate a **Popup** panel it appears at the size defined by its **Height** and **Width**. When a Popup control panel is activated, it remains on top of all other panels until it is minimized. When you minimize a **Popup** panel it appears as a bar at the bottom of the Lookout*Direct* screen.

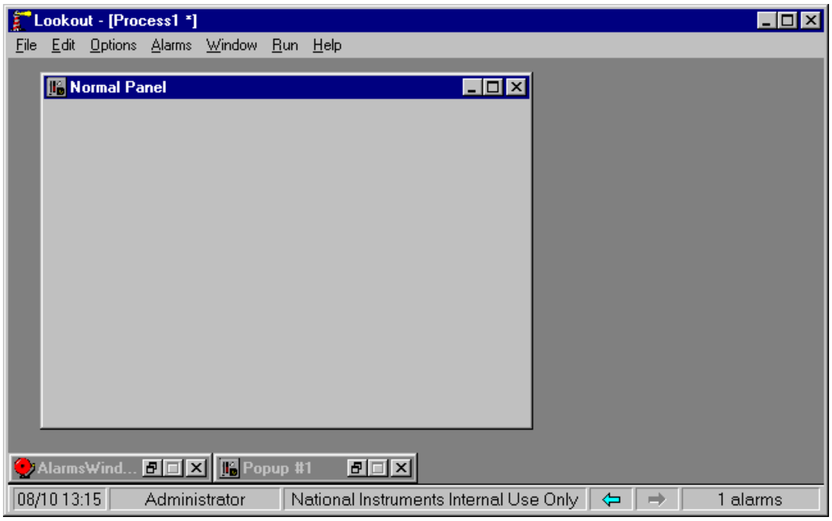
Popup no icon control panels are identical to **Popup** panels except they are not represented by icons when minimized. When you minimize a **Popup no icon** panel it disappears from the Lookout*Direct* workspace.

Note Because **Popup no icon** control panels are not represented by icons, they use less memory. (Microsoft Windows allocates a fixed amount of memory to each icon.) If you are experiencing memory problems when running a Lookout*Direct* application that has many control panels, consider converting your **Popup** panels to **Popup no icon**.

Normal panels and Popup panels can be chosen by selecting their icon, using the **Window** menu command. **Popup no icon** control panels cannot; they can only be accessed by triggering their `activate` data member.

The **Security levels** settings are globally applied to a given control panel. The **Control** security level works in conjunction with all individual object security levels on that panel. The higher security level of the two is used to determine if an operator has control over the object. For example, consider a single Switch object with a security level of 4 that is displayed on two panels. The first panel has a control level of 6 and the second panel has a control level of 2. Only level 6 and higher operators are able to flip the switch on the first panel; however, level 4 and higher operators have control over the same switch on the second panel.

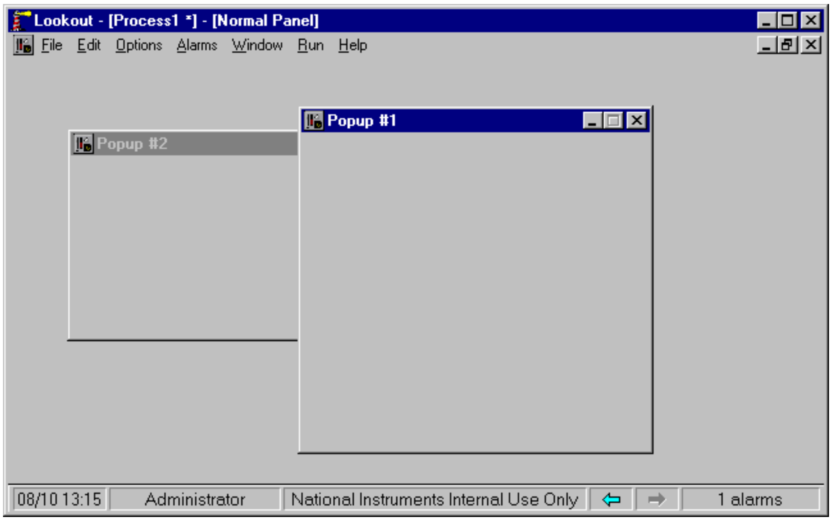
Viewing security can hide entire control panels from low level operators. This parameter affects the entire control panel. As an example take a control panel with a viewing security level of 6. If a level 5 (or lower) operator logs on, he is unable to see the control panel. In fact, he does not even know it exists because it is not listed in the **Window** menu and it is not shown as an icon. If a level 6 (or higher) operator logs on, the control panel instantly becomes available for display. This feature is useful for hiding panels that are rarely used or that contain sensitive information.



This example shows a **Normal** control panel in a normal state and a **Popup** control panel in a minimized state. The **Normal** panel could easily be minimized or maximized by hitting the appropriate arrow button.

The following example is a typical scenario involving full screen control panels with multiple popup panels displayed at once.

This configuration maximizes the amount of information that you can display at once; and it allows you to have any number of different combinations of control panels displayed on your monitor.


Lookout - [Process1 *] - [Normal Panel]
File Edit Options Alarms Window Run Help
Popup #2
Popup #1
08/10 13:15
Administrator
National Instruments Internal Use Only
1 alarms

This example displays a **Normal** control panel in a maximized state and two **Popup** control panels in a “popped up” state.

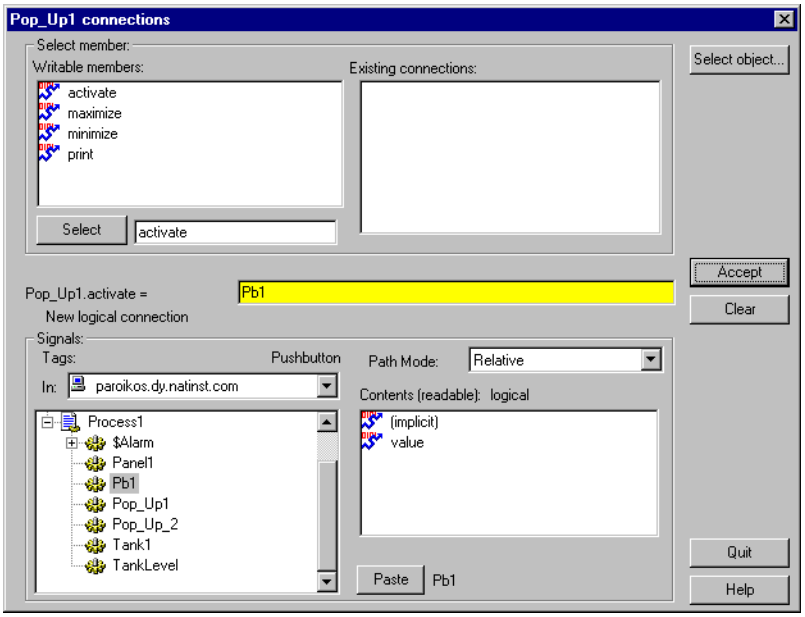
Manipulating Panels

Lookout*Direct* control panels utilize the Microsoft standard Multiple Document Interface (MDI) techniques. You manipulate Lookout*Direct* windows the same way you do other windows in the Microsoft Windows environment.

Panel Switching

It is common to have several or even dozens of control panels. Creating a methodology for moving between your panels can be as simple or as elaborate as you want. One effective method utilizes pushbuttons that invoke other control panels. You connect the pushbutton output signal to the activate or maximize data member of the control panel(s) you want to affect. When the button signal goes high the respective panel(s) appear.

The following example shows a single pushbutton and X with its output signal connected to two **Popup** control panels. The pushbutton is inserted on a third maximized panel.


Pop_Up1 connections

Select member:
Writable members:
activate
maximize
minimize
print

Existing connections:

Select: activate

Pop_Up1.activate = Pb1

New logical connection

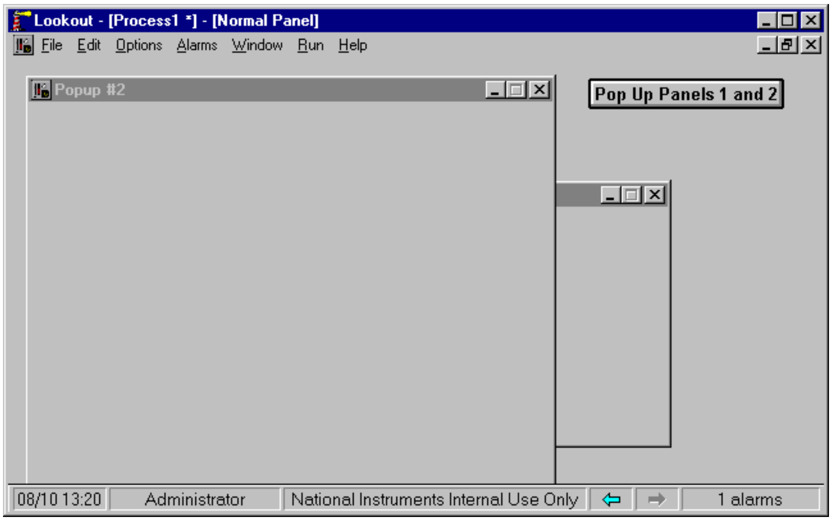
Signals:
Tags: Pushbutton
In: paroikos.dy.natinst.com

Process1
$Alarm
Panel1
Pb1
Pop_Up1
Pop_Up_2
Tank1
TankLevel

Path Mode: Relative
Contents (readable): logical
(implicit)
value

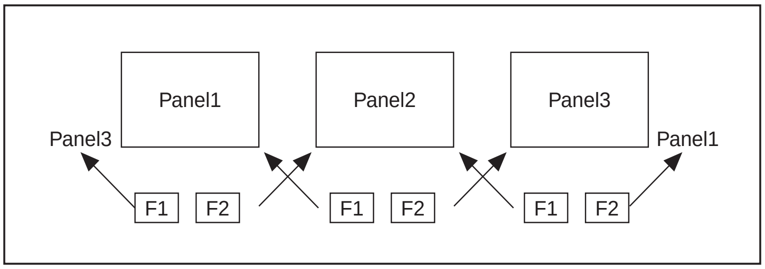
Paste Pb1

When you toggle out of Edit Mode and depress the button, both **Popup** control panels instantly appear, as shown in the following illustration. Of course you could have connected the pushbutton to another **Normal** panel instead, and it would have appeared as the new maximized panel.


Lookout - [Process1 *] - [Normal Panel]
File Edit Options Alarms Window Run Help
Popup #2
Pop Up Panels 1 and 2
08/10 13:20
Administrator
National Instruments Internal Use Only
1 alarms

As you can imagine, there is no limit to the number of connections between various signals and control panels. In fact, you can create complex expressions/alarms that automatically call up specific control panels.

Another way to move between panels is through the use of function keys. Like the $Keyboard object, each panel has its own set of data members representing the function keys F1 – F24. The following example shows the F2 data member of Panel1 connected to the activate data member of Panel2. The F2 data member of Panel2 is also connected to the activate data member of Panel3. This way an operator can depress F2 to page forward through several panels.



In similar fashion, the F1 data member of Panel3 is connected to the activate data member of Panel2 and the F1 data member of Panel2 is connected to the activate data member of Panel1. So now, `Panel2.activate = Panel1.F2 OR Panel3.F1`. An operator can depress F2 to page forward through the control panels and F1 to page back through the control panels.

Special Considerations for “Home Panel”

To ensure users do not get lost when switching between panels, you might define one panel as your master control panel, or home panel or computer main menu. You could connect the activate data member of your home panel to $Keyboard.Shift.F1, or perhaps to a pushbutton object. If connected to the function key, any time the user presses <SHIFT-F1> (no matter what panel he or she is looking at), the home panel is called, returning the operator to a familiar control panel.

You might also want the home panel to maximize upon startup. If you have already created a pushbutton to call the home panel, you can connect it to the `maximize` data member.

The exclamation point (`!`) instructs Lookout*Direct* to use the opposite of the pushbutton value. At startup, the pushbutton is not depressed so its value is FALSE. But because you are using the opposite of the pushbutton value, Panel1.maximize is TRUE at startup. Any time a user depresses `CallHomePb` after this connection is made, nothing happens until the pushbutton is released—at which time the panel is called.

Panel Print

You can easily print a control panel using the **Print Panel** command. This function works equally well for both Normal and Popup panel types.

Print the contents of a panel by clicking on the panel control menu and then on **Print Panel**, or by connecting a logical expression to the `Print` data member of the desired control panel. A panel does not have to be visible to be printed.

Note Certain metafiles look different on the printed page than they do on the display screen. This means that parts of layered objects sometimes appear opaque on the screen, but translucent when drawn on paper.

Note When you print a **Normal** panel, it is printed at its defined **Height** and **Width** parameters. If you define a panel whose **Height** and **Width** are at the default

400 × 300 pixel setting, maximize the panel, and then add graphic elements to the full panel, those elements outside of the default 400 × 300 pixel range are not shown when the panel is printed. To print all the elements on a maximized panel, modify the **Width** and **Height** of the panel to match the full-screen dimension of the panel.

You can modify an existing control panel by toggling into edit mode and right-mouse clicking on its title bar. You can also modify a panel with the **Object»Modify…** menu command just like any other object.

Screen Resolution and Lookout*Direct* Graphics

Lookout*Direct* graphics and control panels appear different, depending on the PC you are using and the resolution of your screen driver. When you position a graphic (or any other display element) onto a control panel, Lookout*Direct* identifies the position you selected by recording the specific pixel position of the graphic. (A pixel is the smallest possible dot on the screen.) Lookout*Direct* actually counts the number of pixels that the graphic is from the upper left-hand corner of the screen. When you subsequently recall a panel, Lookout*Direct* knows the exact location to place the graphic.

The reason to bring this up is because different computer screen drivers have different screen resolutions. VGA screens are 640 × 480 pixels. Super VGA screens typically range from 800 × 600 pixels to 1024 × 768 pixels. A panel created at 640 × 480 pixel resolution does not fill the screen of a 1024 × 768 super VGA monitor. A panel created at 1024 × 768 pixel resolution will overflow the screen of a 640 × 480 VGA monitor.

It is best to create your panels using the display driver resolution of the computer on which you intend to run Lookout*Direct*. If you are creating panels for use on multiple computers, consider developing panels using the display driver resolution of the most common resolution monitor (if you have a dozen Super VGA computers and one VGA computer, develop your panels in Super VGA, not VGA). You will then have to modify the panels slightly to fit on the less common resolution computer(s).

You can usually change the resolution of your screen from VGA to Super VGA by changing System Settings in Windows Setup. Refer to your *Microsoft Windows* manual for more information.

Panel Data Members

Table 2-38. Panel Data Members

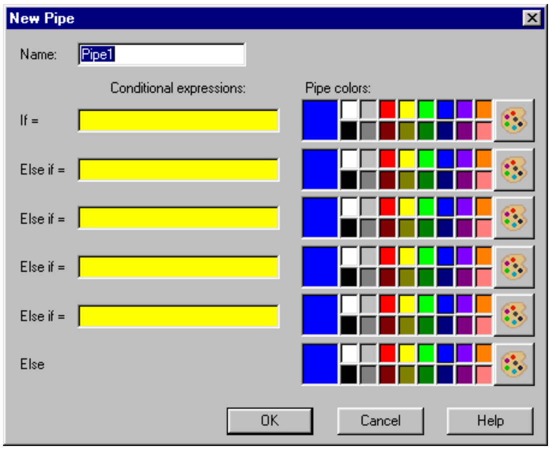
Data Members	Type	Read	Write	Description
<CTRL-F1> – <CTRL-F24>	logical	yes	no	Each of these 24 data members represent a function key, <F1> – <F24>—when pressed in conjunction with the <CTRL> key. Returns TRUE when the panel is active and its associated function key is pressed in conjunction with the <CTRL> key.
<F1> – <F24>	logical	yes	no	Each of these 24 data members represent a function key, <F1> – <F24>. Returns TRUE when the panel is active and its associated function key is pressed.
<SHIFT-F1> through <SHIFT-F24>	logical	yes	no	Each of these 24 data members represent a function key, <F1> – <F24>—when pressed in conjunction with the <SHIFT> key. Returns TRUE when the panel is active and its associated function key is pressed in conjunction with the <SHIFT> key.
activate	logical	no	yes	Upon transition from FALSE to TRUE, calls control panel to focus or pop up.
active	logical	yes	no	Returns TRUE when the panel is the currently selected panel (i.e., it is active).
maximize	logical	no	yes	Upon transition from FALSE to TRUE, maximizes control panel, replacing existing maximized control panel.

Table 2-38. Panel Data Members (Continued)

Data Members	Type	Read	Write	Description
minimize	logical	no	yes	Upon transition from FALSE to TRUE, minimizes control panel to icon state.
print	logical	no	yes	Upon transition from FALSE to TRUE, sends the control panel to the Windows Print Manager.

Pipe

Pipe displays different color rectangles (pipes) on a control panel as defined by the values of **Conditional expressions**. Pipe determines which color rectangle to display based on the order and current status of your **Conditional expressions**. If several **Conditional expressions** are TRUE at once, Pipe displays the color associated with the first TRUE expression. **Conditional expressions** must result in logical values.



Pipe Data Members

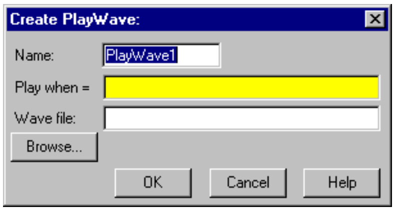
Table 2-39. Pipe Data Members

Data Members	Type	Read	Write	Description
none	—	—	—	Pipe does not have data members.

Comments You can easily create a complex piping network scheme (including changing colors) with a single Pipe object. Display the object on a control panel and copy the pipe display with the shift-drag method to create additional pipes with the same parameters. You can then move, resize, and group the pipes as you choose.

Playwave

Playwave connects Microsoft standard wave form files (`.wav`) to events in Lookout*Direct*. Playwave plays the audio file specified by **Wave file** when **Play when** transitions from off to on. **Play when** is a logical expression and might range from a simple pushbutton, to a digital input from a PLC, to an alarm generated in Lookout*Direct*. You can also create your own custom audio files with various software products. Therefore, you can connect individual alarms to custom wave files to be played each time an alarm goes TRUE.


Create PlayWave:

Name: PlayWave1

Play when =

Wave file:

Playwave Data Members

Table 2-40. Playwave Data Members

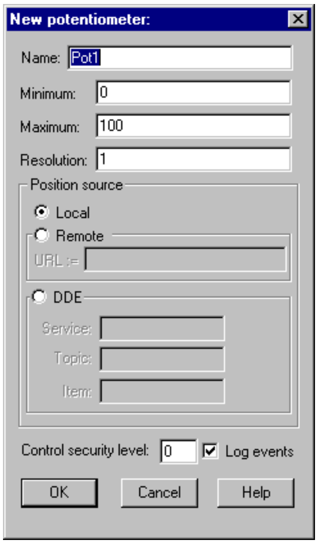
Data Members	Type	Read	Write	Description
none	—	—	—	Playwave does not have any data members

Comments Many computers do not come equipped with quality speakers built in. If this is the case, your wave files may sound distorted or may even be inaudible. If you want to take advantage of the Playwave feature, you may need to buy additional hardware, in particular a Microsoft Windows compatible sound board (with Windows driver) and external speakers.

Pot

Pot is a potentiometer that you use to change numeric setpoint values. You can display Pots on a control panel as a knob, vertical slider, horizontal slider, increment/decrement pushbuttons, or digital entry. You can also use Pots as multiple-position switches.

If you change the background color of a panel and add a Pot object displayed as a slider, its color is always gray. To change the background color of a Pot to match your panel, select the Pot object, then pick **Change»Background Color** from the menu.



New potentiometer:

Name: Pot1

Minimum: 0

Maximum: 100

Resolution: 1

Position source

[✓ Local] Remote URL := DDE Service: Topic: Item:

Control security level: 0 [✓ Log events]

Minimum is the lowest value signal the pot will generate.

Maximum is the highest value signal the pot will generate.

Resolution is the smallest increment of change, or detent spacing the Pot supports.

Position source determines where the value of the Pot resides. **Local** indicates the value of the Pot lies within the object itself—on the control panel.

Remote Pots get their values from a remote source, often the register on a controller they are connected to. Adjusting the Pot changes the value in the register, and changing the value in the register adjusts the Pot. In effect, the Pot is tracking a remote value. This is especially useful when you want to prevent Lookout*Direct* from changing the value of setpoints or registers upon initial startup, or reconnection of lost communication.

The **Remote** option calls for a URL to locate the data member you want to connect to. The URL field is green, and you cannot use a complex expression as a URL. If you need to use one RadioButton for several purposes, you can use a Symbolic Link to make a more complex connection than that possible with a URL.

You can right-click in the **URL** field and use the **URL Editor** dialog box to assemble the URL, in the same way you use the Lookout*Direct* expression editor.

A remote position source connection is completely reciprocal. A change in your Lookout*Direct* control changes the data member that control is remoted to. Any change in that data member also changes the control. It is not necessary, and is incorrect, to use the **Edit Connections** dialog box to connect a control object to its controlled data member.

Because the remote connection is reciprocal, you can only make such a connection to a data member that is either writable, or readable and writable.

When a process with remoted controls first opens, those controls take their initial values by following the URL to read the data members they are remoted to. The control will be covered by a red X to indicate that the remote connection is not functioning.

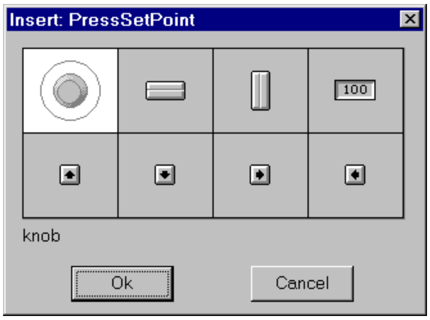
Note You should use **Remote** to connect a control in a client process to a data member in a server process. Connections inside a single process can be made using **Object»Edit Connections**.

Because complex expressions are read-only values, you cannot remote directly to them. For the same reason, you cannot remote one control to another control's `(intrinsic)` data member (though you can remote a control to another control's value data member).

Much like Remote Pots, **DDE** (Dynamic Data Exchange) Pots get their values from a remote source. This could be a cell in a spreadsheet, another DDE aware application, or a second copy of Lookout*Direct* running on the network. The last DDE parameters used on any object automatically become the default values for any new DDE object.

Control security level specifies the minimum security level operators must have to gain access to this individual object, and thus control it.

The **Log events** option creates a permanent audit trail for the object—who did what and when. All adjustments of the Pot are logged to disk, including the time of the adjustment, the operator account name, and what adjustment was made.



Note You can modify the background color on vertical and horizontal sliders with the **Change»Background color…** menu command. You can modify the font and font color of digital Pots using Change commands.

Pot Data Members

Table 2-41. Pot Data Members

Data Member	Type	Read	Write	Description
(implicit)	numeric	yes	no	Current value
decrement	logical	no	yes	When this data member value transitions from FALSE to TRUE, the implicit value of the Pot object decreases by the Pot **Resolution** amount.
enable	logical	no	yes	If TRUE (the default), enables DDE. If FALSE, disables DDE. The default value is on. This input is ignored for non-DDE TextEntry objects.

Table 2-41. Pot Data Members (Continued)

Data Member	Type	Read	Write	Description
enterValue	logical	no	yes	Under specific circumstances, when this value transitions from FALSE to TRUE, pops up a **Enter new value** dialog box for an operator to use in entering a value for the Pot. See the note following the table for more detailed information. The enterValue data member is designed for use under unusual circumstances, in particular when pointing devices are not available on a computer running Lookout*Direct*. Because of its unusual operation, this data member should not be used unless it is necessary for hardware reasons.
increment	logical	no	yes	When this data member value transitions from FALSE to TRUE, the implicit value of the pot object increases by the **Resolution** amount.
reset	logical	no	yes	While this value equals TRUE, the control will be set to the value in `resetvalue`.
resetvalue	numeric	no	yes	Sets the value a control will take when the reset data member transitions from FALSE to TRUE.
value	numeric	yes	yes	The current value of the control. If you have remoted this control, then `value` is the current value of the position source.
visible	logical	no	yes	When FALSE, the Pot object cannot be seen on the display panel. When TRUE, the Pot can be seen and controlled.

Note When the **`enterValue`** input transitions from **`FALSE`** to **`TRUE`**, and if the Pot is visible, if Lookout*Direct* is not in edit mode, and if the Pot has at least one digital display, the **Enter new value** dialog box pops up so an operator can input a value, just as if the operator had clicked on the digital display.

The numeric format and position used for the dialog box are based on the digital display for a Pot. Even if the panel containing the Pot digital display is inactive, the **Enter new value** dialog box will pop up. You can prevent this by predicating the **`enterValue`** input on the panel's **`active`** data member.

Comments Potentiometers are one of the most common control objects used in process controls. Using Pots, a plant operator can make setpoint changes with the mouse. Pots also work well as H-O-A switches. To create an HOA switch with a Pot, specify the minimum as 1, the maximum as 3, and the resolution as 1.

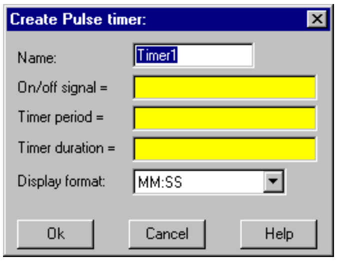
The increment and decrement data members enable quick connection of Pot objects to $Keyboard and Panel function keys, and screen Pushbuttons. These are often used to control Pot objects when Lookout*Direct* is running on an industrial PC platform that has restricted or no mouse functionality.

Pulse

Pulse is a timer that generates a periodic pulse of a specified duration. When **On/off signal** transitions to ON, the output signal turns on for the pulse duration time and then turns off for the remainder of the period. The output signal immediately turns off when the **On/Off signal** goes low.

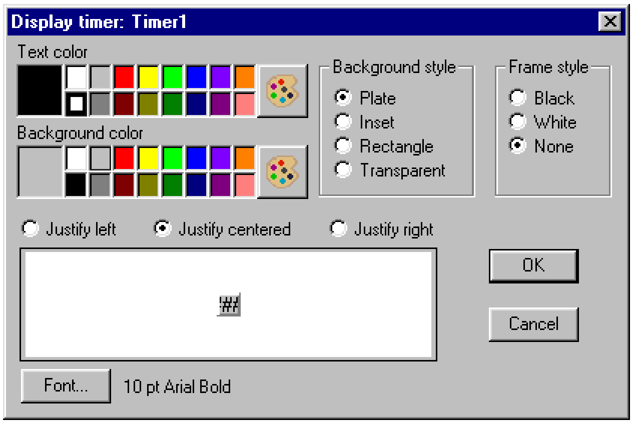
Timer period is the time interval for the full pulse cycle, and **Timer duration** is the width of each pulse. These parameters can range from 0.0 seconds to several years, with an effective resolution of 0.1 seconds over the entire range. **Timer duration** should always be less than **Timer period**.

The object is represented on a control panel by showing the time remaining before the output changes state. It is depicted in the format defined by the **Display format** parameter. It is updated approximately once per second. If the **On/Off signal** is FALSE, it shows `OFF`.


Create Pulse timer:

Name: Timer1
On/off signal =
Timer period =
Timer duration =
Display format: MM:SS

The **On/off signal** is a logical expression while **Timer period** and **Timer duration** are numeric expressions. Normally, these are simple time constants such as 0:20 (twenty seconds). See *Numeric Data Members* in Chapter 2, *How* Lookout*Direct Works*, of the *Getting Started with* Lookout*Direct* manual for information on entering time constants.



Display timer: Timer1

Text color

Background color

Background style: [✓ Plate] Inset Rectangle Transparent

Frame style: Black White [✓ None]

Justify left [✓ Justify centered] Justify right

Font... 10 pt Arial Bold

OK Cancel

Pulse Data Members

Table 2-42. Pulse Data Members

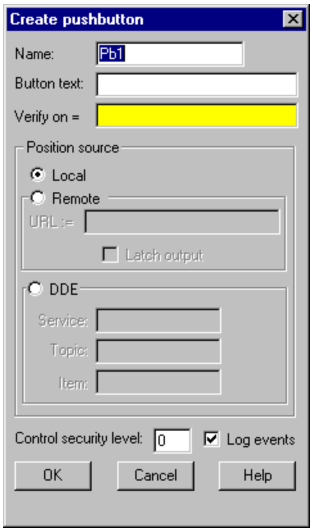
Data Members	Type	Read	Write	Description
(implicit)	logical	yes	no	Logical timer value

Comments Pulse can be used to periodically open a valve for a specified time duration. It can also act as a flasher to turn text and graphic signals on and off for display purposes.

Related Objects *DelayOff*, *DelayOn*, *Interval*, *OneShot*, *TextEntry*

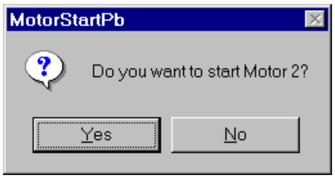
Pushbutton

Pushbutton generates a logical signal for receipt by other objects. A pushbutton changes state when you position the cursor over it and press the mouse button, trackball, touchscreen, or space bar. The pushbutton remains depressed and the output signal remains high until you release the button. If a **Verify on** message is defined, the operator must first acknowledge the message, then the output signal goes high, *but only momentarily*.



Button text displays the specified text on the pushbutton.

Use **Verify on** to create a dynamic text expression to be displayed in a message dialog box. See Chapter 6, *Security*, in the Lookout*Direct Developer's Manual* for more information on security.


MotorStartPb

Do you want to start Motor 2?

Position source determines where the value of the Pushbutton resides. **Local** indicates the value of the Pushbutton lies within the Pushbutton itself—on the control panel. If the pushbutton is not depressed its signal is OFF, if depressed its signal is ON.

Remote Pushbuttons get their values from a remote source, often the register in a controller they are connected to. Depressing the pushbutton changes the status of the register, and changing the status of the register depresses the pushbutton.

The **Remote** option calls for a URL to locate the data member you want to connect to. The URL field is green, and you cannot use a complex expression as a URL. If you need to use one RadioButton for several purposes, you can use a Symbolic Link to make a more complex connection than that possible with a URL.

You can right-click in the **URL** field and use the **URL Editor** dialog box to assemble the URL, in the same way you use the Lookout*Direct* expression editor.

A remote position source connection is completely reciprocal. A change in your Lookout*Direct* control changes the data member that control is remoted to. Any change in that data member also changes the control. It is not necessary, and is incorrect, to use the **Edit Connections** dialog box to connect a control object to its controlled data member.

Because the remote connection is reciprocal, you can only make such a connection to a data member that is either writable, or readable and writable.

When a process with remoted controls first opens, those controls take their initial values by following the URL to read the data members they are remoted to. The control will be covered by a red X to indicate that the remote connection is not functioning.

Note You should use **Remote** to connect a control in a client process to a data member in a server process. Connections inside a single process can be made using **Object»Edit Connections**.

Because complex expressions are read-only values, you cannot remote directly to them. For the same reason, you cannot remote one control to another control's `(intrinsic)` data member (though you can remote a control to another control's value data member).

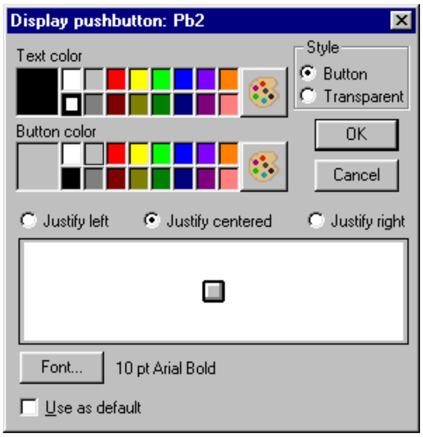
When you select the **Remote** option, you can choose whether or not the Pushbutton latches its output. The **Latch output** check box configures Lookout*Direct* for controlling a latching-relay.

When a user clicks on a Pushbutton that has latching selected, the pushbutton remains depressed, sending an ON signal (TRUE or high) until the Remote Position signal turns ON. Assume for example that an operator clicks on `MotorStartPb`, configured above. The pushbutton remains pushed in, sending a TRUE signal, until PLC.C101 goes TRUE. As soon as PLC.C101 goes TRUE, the pushbutton releases.

Much like Remote Pushbuttons, **DDE** (Dynamic Data Exchange) Pushbuttons get their values from a remote source. This could be a cell in a spreadsheet, another DDE aware application, or a second copy of Lookout*Direct* running on the network. See Chapter 5, *Dynamic Data Exchange,* in the Lookout*Direct Developer's Manual* for information on **Service**, **Topic**, and **Item** parameters.

Control security level specifies the minimum security level operators must have to gain access to this individual object, and thus control it. See Chapter 6, *Security*, in the Lookout*Direct Developer's Manual* for more information on security.

The **Log events** option creates a permanent audit trail for the object—who did what and when. Any depression of the Pushbutton is recorded to disk, including the time the button was depressed, and the operator's account name. See Chapter 7, *Logging Data and Events*, in the Lookout*Direct Developer's Manual* for more information on logging events.



Style: [✓ Button] Transparent

Justify left [✓ Justify centered] Justify right

10 pt Arial Bold

Pushbutton Data Members

Table 2-43. Pushbutton Data Members

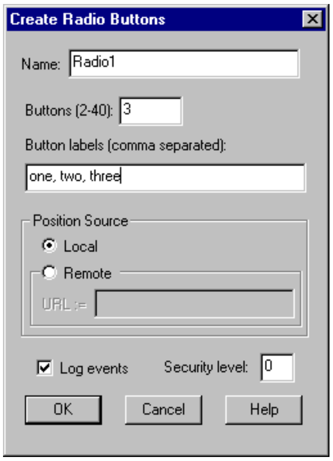
Data Members	Type	Read	Write	Description
(implicit)	logical	yes	no	Value of object (TRUE when button is depressed)
enable	logical	no	yes	If TRUE (the default), enables DDE. If FALSE, disables DDE. The default value is on. This input is ignored for non-DDE TextEntry objects.
reset	logical	no	yes	While this value equals TRUE, the control will be set to the value in `resetvalue`.
resetvalue	numeric	no	yes	Sets the value a control will take when the reset data member transitions from FALSE to TRUE.

Table 2-43. Pushbutton Data Members (Continued)

Data Members	Type	Read	Write	Description
value	numeric	yes	yes	The current value of the control. If you have remoted this control, then `value` is the current value of the position source.
visible	logical	no	yes	When FALSE, the Pushbutton cannot be seen on the display panel. When TRUE, the button can be seen and controlled.

RadioButton

The RadioButton object creates a set of radio buttons on your panel. You can have from 2 to 40 buttons in a set. Only one button at a time can be activated in each radio button group.



Name: Radio1

Buttons (2-40): 3

Button labels (comma separated): one, two, three

Position Source

[✓ Local] Remote

URL :=

[✓ Log events] Security level: 0

Set the **Buttons (2-40)** in each set. You can have as many as 40 buttons in each group, but you must have at least 2.

Position source determines where the value of the RadioButton resides. **Local** indicates the value of the RadioButton lies within the object itself—on the control panel.

The **Remote** option tells Lookout*Direct* to initialize the RadioButton value from a remote source. Adjusting the RadioButton changes the value in the register, and changing the value in the register adjusts the RadioButton. In effect, the RadioButton is tracking a remote value. This is especially useful when you want to prevent Lookout*Direct* from changing the value of setpoints or registers upon initial startup, or reconnection of lost communication.

The **Remote** option calls for a URL to locate the data member you want to connect to. The URL field is green, and you cannot use a complex expression as a URL. If you need to use one RadioButton for several purposes, you can use a Symbolic Link to make a more complex connection than that possible with a URL.

You can right-click in the **URL** field and use the **URL Editor** dialog box to assemble the URL, in the same way you use the Lookout*Direct* expression editor.

A remote position source connection is completely reciprocal. A change in your Lookout*Direct* control changes the data member that control is remoted to. Any change in that data member also changes the control. It is not necessary, and is incorrect, to use the **Edit Connections** dialog box to connect a control object to its controlled data member.

Because the remote connection is reciprocal, you can only make such a connection to a data member that is either writable, or readable and writable.

When a process with remoted controls first opens, those controls take their initial values by following the URL to read the data members they are remoted to. The control will be covered by a red X to indicate that the remote connection is not functioning.

Note You should use **Remote** to connect a control in a client process to a data member in a server process. Connections inside a single process can be made using **Object»Edit Connections**.

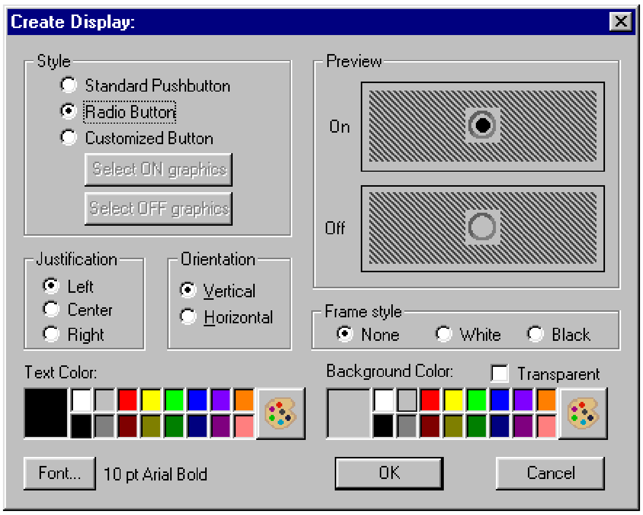
Because complex expressions are read-only values, you cannot remote directly to them. For the same reason, you cannot remote one control to another control's `(intrinsic)` data member (though you can remote a control to another control's value data member).

Note You cannot break a group of radio buttons into multiple rows.

Enter any text for the buttons in the **Button labels** field. Separate each button label with a comma. If you need to include a comma or a backslash in any button text, precede that character with a backslash(\). If you want to leave a button blank, you can enter two commas without any text or numbers between the commas. You do not have to enter a label for every button. Lookout*Direct* will leave each button after your last label entry blank. If you enter more labels than you have set buttons, your labels will be preserved but not displayed.

To log changes in button state, check the **Log Events** checkbox.

Security level sets the minimum security level an operator must have to change the radio buttons.



Create Display:

Style: Standard Pushbutton [✓ Radio Button] Customized Button

Select ON graphics

Select OFF graphics

Preview: On Off

Justification: [✓ Left] Center Right

Orientation: [✓ Vertical] Horizontal

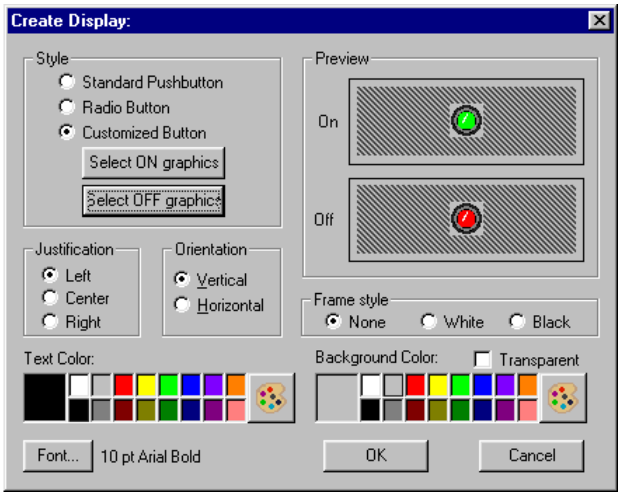
Frame style: [✓ None] White Black

Text Color:

Background Color: Transparent

Font... 10 pt Arial Bold

OK Cancel



Create Display:

Style: Standard Pushbutton Radio Button [✓ Customized Button]

Select ON graphics

Select OFF graphics

Preview: On Off

Justification: [✓ Left] Center Right

Orientation: [✓ Vertical] Horizontal

Frame style: [✓ None] White Black

Text Color:

Background Color: Transparent

Font... 10 pt Arial Bold

OK Cancel

You can use a standard Lookout*Direct* pushbutton, standardized radio buttons, or custom graphics for your radio button groups.

Notice that you cannot enter text in the **Create Display** dialog box. You must enter any text you intend to use in the **RadioButton Definition Parameters** dialog box. You can change font and text size in the **Create**

Display dialog box. The first text label you entered for your radio button is displayed in the **Preview** field so you see the effect of font changes.

The default display uses a standard **Radio Button** display. You can adjust text and background color for any of your display choices.

Selecting **Standard Pushbutton** displays standard on/off buttons in your radio button array.

Select **Customized Button** for a free range of choices from the Lookout*Direct* graphics library, or create your own ON/OFF indicators for a radio button array. See the *Creating Custom Graphics* section of Chapter 2, *Graphics*, in the Lookout*Direct Developer's Manual* for detailed information on creating your own graphics for use on a Lookout*Direct* control panel.

Set the **Orientation** of the radio button array to horizontal or vertical by checking the appropriate checkbox. Set label text **Justification** and button **Frame style** in the appropriate fields.

Related Objects *L3Pot*, *L3Pushbutton*, *L3Switch*, *Pot*, *Pushbutton*, *Switch*

RadioButton Data Members

Table 2-44. RadioButton Data Members

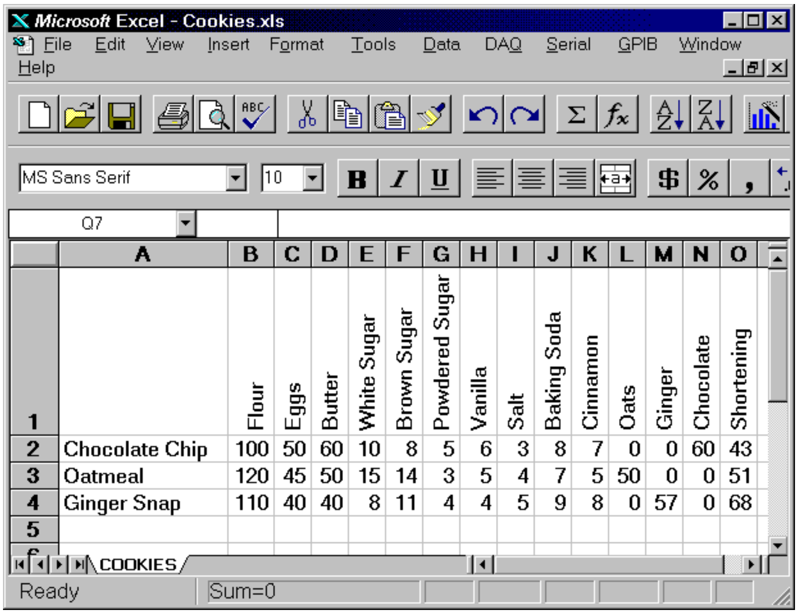
Data Member	Type	Read	Write	Description
1-40	logical	yes	no	Reports ON/OFF status of each button in a radio button set.
current	numeric	yes	no	Reports which radio button is active in a set.
(implicit)	numeric	yes	yes	Radiobutton value.
value	numeric	yes	yes	Number of the currectly active radiobutton.
visible	logical	yes	yes	Controls visibility of a radio button set. Default=TRUE.

Recipe

Recipe objects are an efficient means of importing large arrays of data (namely recipes and their ingredients) into Lookout*Direct* using an Excel (`.xls`) spreadsheet. Once created and implemented, the operator can easily and quickly change the current recipe with the click of the mouse, thus selecting a new set of ingredients.

The best way to describe how the Recipe class works is to step through a typical example, in this case involving cookie manufacture.

There are two steps to creating and implementing a recipe object. First, you define your recipes with their respective ingredients in a spreadsheet program such as Excel (anything that creates an `.xls` file will work—including Lotus 123). You can define up to 1,000 recipes in a single `.xls` file. Each recipe can have up to 255 ingredients. Three cookie recipes are defined in this spreadsheet.


Microsoft Excel - Cookies.xls
File Edit View Insert Format Tools Data DAQ Serial GPIB Window Help
MS Sans Serif
10
Q7
COOKIES
Ready
Sum=0

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1		Flour	Eggs	Butter	White Sugar	Brown Sugar	Powdered Sugar	Vanilla	Salt	Baking Soda	Cinnamon	Oats	Ginger	Chocolate	Shortening
2	Chocolate Chip	100	50	60	10	8	5	6	3	8	7	0	0	60	43
3	Oatmeal	120	45	50	15	14	3	5	4	7	5	50	0	0	51
4	Ginger Snap	110	40	40	8	11	4	4	5	9	8	0	57	0	68
5															

The first row of the spreadsheet is reserved for ingredient names. They begin in column B. These ingredient names later become alias data members of the Recipe object. Therefore, ingredient names must be unique. They cannot have the same name as a native data member (see the Recipe Data Member table for data member names). Also, you cannot name an ingredient `missing`; this is a reserved word. Valid characters in an ingredient name include A – Z, 0 – 9, the dollar sign ($), and a period (.). If you enter `Hi_@#!!There` as an ingredient name, Lookout*Direct* names the alias `HiThere`. Alias names are case sensitive.

Beginning in Row 2, Column A lists the names of the various recipes. Recipes follow the same naming convention as ingredients. Each recipe is followed by its unique ingredient values.

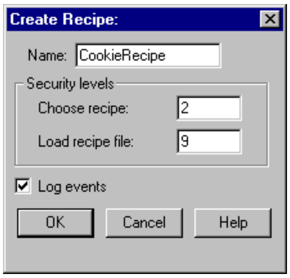
Ingredient values can represent process inputs, parameters, and outputs. Process inputs typically represent raw materials and other inputs consumed in the batch process. Examples include the number of eggs consumed, amount of flour used, amount of energy consumed, possibly even work hours required or amount of traceable fixed costs consumed.

Another type of ingredient value is a process parameter. Process parameters identify operational settings such as furnace cooling time, an air pressure setpoint, or a Low pH alarm limit. Process parameters might also include identifications of specific equipment to be used during the batch process.

The third type of ingredient value is a process output. Such an ingredient value might represent the number of finished cookies expected from the batch, amount of byproduct expected, or a cost variance calculation based on the selected recipe.

Ingredient value quantities may be specified as constants or as equations based on other formula parameters such as batch size.

The second part of defining a recipe involves defining a recipe object in Lookout*Direct*.


Create Recipe:

Name: CookieRecipe

Security levels

Choose recipe: 2

Load recipe file: 9

☑ Log events

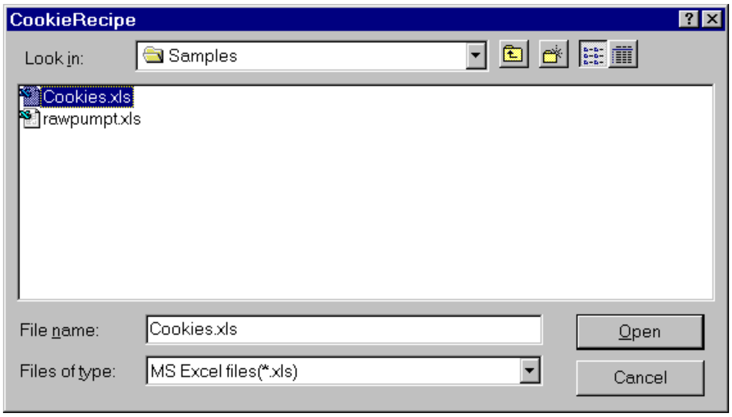
The first recipe dialog box defines security and event data logging.

Choose recipe security level specifies the minimum security level an operator must have to be able to select a recipe from all the recipes listed in the currently selected spreadsheet file.

Load recipe file security level specifies the minimum security level an operator must have to be able to select a different spreadsheet file.

The **Log events** option creates a permanent audit trail for the object—who did what and when. Any selection of a different recipe or recipe file is logged to disk, including the time the action occurred and the operator's account name. See Chapter 7, *Logging Data and Events*, in the Lookout*Direct Developer's Manual* for more information on logging events.

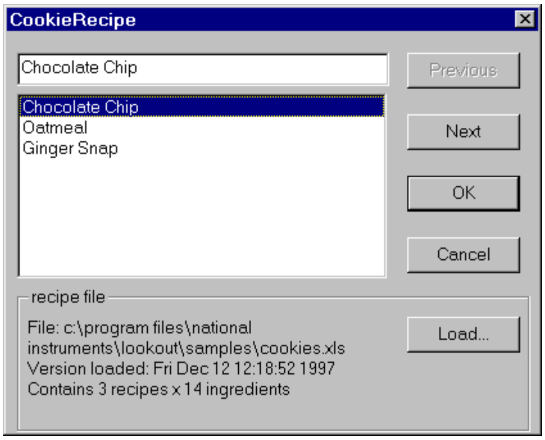
After defining security and event data logging, Lookout*Direct* presents you with a file selection dialog box.



Cookies.xls
rawpumpt.xls
File name: Cookies.xls
Files of type: MS Excel files(*.xls)

Select the `cookies.xls` spreadsheet file because it has the three batch recipes in it.

Once a file is selected, Lookout*Direct* presents a list of recipes.



Chocolate Chip

Chocolate Chip
Oatmeal
Ginger Snap

recipe file

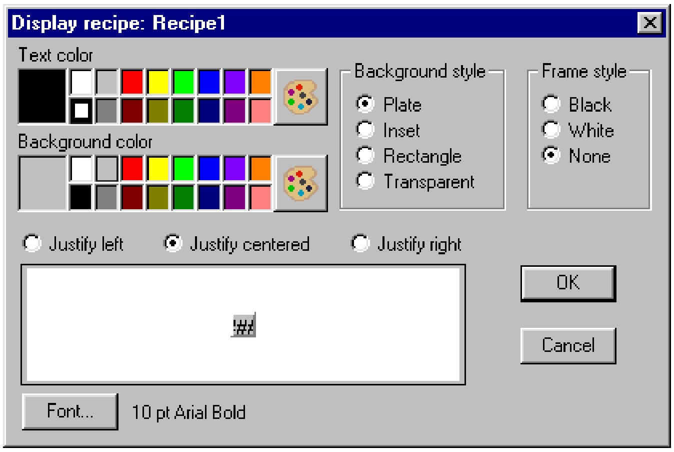
File: c:\program files\national instruments\lookout\samples\cookies.xls
Version loaded: Fri Dec 12 12:18:52 1997
Contains 3 recipes x 14 ingredients

As you can see, the recipe names come from column A of the spreadsheet. You can use the **Previous** and **Next** buttons to identify a recipe from among the list, or type the name in the data entry field above the list. (This same dialog box appears later when an operator clicks on the pushbutton representing this object.) Click on **OK** to choose the recipe you want to use. Select the recipe for oatmeal cookies.

The recipe file **Load** button invokes the file list dialog box, described previously. Click on this button to select a new `.xls` file.

Note If the recipe is changed in the spreadsheet, the change is noted in the recipe file dialog box—but the values currently resident in the object data members remain intact. The operator must load the spreadsheet again to update the copy of the recipe file in Lookout*Direct*. If you select a new `.xls` file to load but click on the Cancel button, it does *not* update! You must select **OK** for the recipe to actually be loaded.

After loading the spreadsheet, Lookout*Direct* presents the display parameters box.


Display recipe: Recipe1

Text color

Background color

Background style: [✓ Plate] Inset Rectangle Transparent

Frame style: Black White [✓ None]

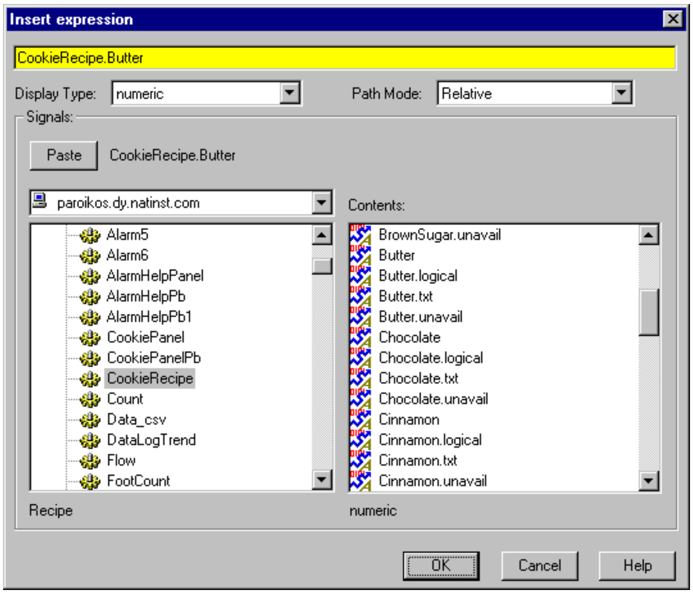
Justify left [✓ Justify centered] Justify right

10 pt Arial Bold

After you choose the object display parameters, you can paste it into the panel.

When you select a new recipe, Lookout*Direct* writes the ingredient values for the selected recipe into the corresponding data members of the object.

The actual number of data members that a recipe object has is based on the number of ingredients within it. This is best demonstrated by looking at the Insert Expression dialog box.



CookieRecipe.Butter

Display Type: numeric

Path Mode: Relative

CookieRecipe.Butter

paroikos.dy.natinst.com

Alarm5
Alarm6
AlarmHelpPanel
AlarmHelpPb
AlarmHelpPb1
CookiePanel
CookiePanelPb
CookieRecipe
Count
Data_csv
DataLogTrend
Flow
FootCount

BrownSugar.unavail
Butter
Butter.logical
Butter.txt
Butter.unavail
Chocolate
Chocolate.logical
Chocolate.txt
Chocolate.unavail
Cinnamon
Cinnamon.logical
Cinnamon.txt
Cinnamon.unavail

Recipe

numeric

Notice that there are four data members for each defined ingredient. Actual data member names vary from object to object, depending upon your recipe ingredients. However, the four readable data member types for each ingredient are consistent.

Recipe Data Members

Table 2-45. Recipe Data Members

Data Member	Type	Read	Write	Description
(implicit)	text	yes	no	Name of currently selected recipe
B – IV	numeric	yes	no	Each letter, B through IV, represents a column in the spreadsheet. The value of the data member is the numeric amount of the ingredient for the currently selected recipe.

Table 2-45. Recipe Data Members (Continued)

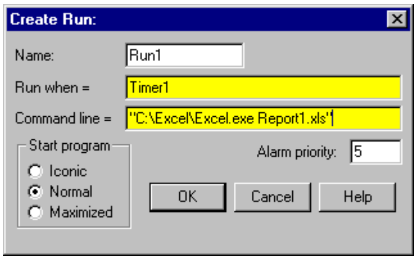
Data Member	Type	Read	Write	Description
B.logical through IV.logical	logical	yes	no	Each letter, B through IV represents a column in the spreadsheet. Returns TRUE (ON) if the amount of the ingredient in the spreadsheet cell for the selected recipe is greater than zero. Returns FALSE if the specified amount for the ingredient is zero.
B.txt – IV.txt	text	yes	no	Each letter, B through IV represents a column in the spreadsheet. The value of the data member is the textual amount of the ingredient for the currently selected recipe.
B.unavail through IV.unavail	logical	yes	no	Each letter, B through IV represents a column in the spreadsheet. Returns TRUE if the spreadsheet cell is empty. Returns FALSE if the cell contains data.
pick1 through pick1000	logical	no	yes	Upon transition from FALSE to TRUE, chooses the respective recipe within the spreadsheet. When used with pushbutton objects, these data members can eliminate the need for operators to use the recipe list dialog box.

Comments The recipe object reads a block of continuous columns. Therefore, the ingredient names should be a contiguous list in Row 1. If a recipe does not use a particular ingredient, just leave the respective cell blank.

When Lookout*Direct* encounters a blank cell in Column A, it ignores the entire row. Thus, you can easily annotate your recipes by leaving a cell in Column A blank and adding text to the cell in Column B of the same row.

Run

You can use Run objects to start an external program file from within Lookout*Direct*. When the result of the **Run when** logical expression goes TRUE, the object executes the **Command line**.



Name: Run1
Run when = Timer1
Command line = "C:\Excel\Excel.exe Report1.xls"
Alarm priority: 5
Iconic
[✓ Normal]
Maximized

In this example, Lookout*Direct* runs an Excel macro called `REPORT1.XLM` when the logical value returned by `Timer1` goes TRUE. `Timer1` is a TimeofDay object that triggers the report to run every day at 8:00 a.m.

The **Command line** text expression must be enclosed in quotation marks as shown. Notice that the example includes the full path name of the executable file. Ensure that your command line meets DOS syntax requirements. Because this is an expression data field, the command could be the result of a text expression.

Passing arguments in the Run Object in Lookout*Direct* requires proper use of double quotes depending on how many arguments you are passing and whether or not those arguments have spaces in the path.

If your argument has no spaces in the path, you need only insert double quotes before and after the argument.

If your argument has spaces in the path, you must insert two double quotes at the beginning and the end of that argument to define it as a single argument. These two double quotes are in addition to the double quotes you must use in passing any argument.

For example, when passing a single argument the following examples demonstrate the correct use of double quotes (spaces are exaggerated for effect):

```
"""c:\my excel\autoexec.xls"""
"c:\excel\excel.exe"
```

When passing two or more arguments, you follow the same rules for each argument, as illustrated in the following examples:

```
"""c:\program  files\msoffice\excel\excel.exe"" c:\autoexec.xls"
"""c:\program  files\excel\excel.exe"" ""c:\my excel\autoexec.xls"""
"c:\excel\excel.exe c:\working\autoexec.xls"
```

You can specify how an application presents itself when you activate it with the **Start program** selections. If you select **Normal**, the application window appears in front of the open Lookout*Direct* window when it is activated. If you want to reduce the application to an icon each time you start it, select **Iconic**. If you select **Maximized**, the application window replaces the Lookout*Direct* window on the screen. (Lookout*Direct* is still running; you just cannot see it. Press <Alt+Tab> to switch between applications.)

Table 2-46. Run Data Members

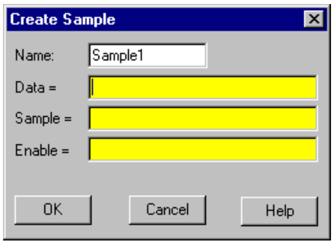
Data Member	Type	Read	Write	Description
none	—	—	—	Run does not have any data members

Comments If the application does not automatically shut down, multiple instances of the program may be running because of previous starts. Over time, this can snowball to the point where Windows performance is severely hampered.

If you want to execute DOS commands from within Lookout*Direct*, put the commands in a DOS batch file (`.bat`) and then identify the batch file in the Command Line.

Sample

The Sample object samples and holds data. Any time the **Sample** expression transitions from OFF to ON and the **Enable** expression is TRUE, the Sample object samples and stores a **Data** expression. Sample maintains an array of up to 35 previous samples. If **Enable** is left blank it is assumed to be TRUE. **Data** is a numeric expression while **Sample** and **Enable** are logical.



Note Sample does not have a display parameters dialog box. You can display the result of a Sample output signal by using its data member in an expression.

Sample Data Members

Table 2-47. Sample Data Members

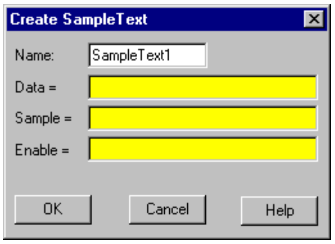
Data Member	Type	Read	Write	Description
(implicit)	numeric	yes	no	Current **Data** value—tracks **Data** input value.
1 – 35	numeric	yes	no	Previous samples. Signal 1 is the most recent sample since **Sample** went high. If you display Sample, you display the current and active value for the object—that is, the (implicit) value. If you display Sample.1, you display the least complete value.
DataReset	logical	no	yes	Upon transition from FALSE to TRUE, resets to zero all data members—including the current value and all previous samples.

Comments The **Reset** expression can be a regular pulse interval created by a TimeOf*xxxx* timer. For example, if you want to sample the temperature every hour of the day, use the output signal from a TimeOfHour timer in the **Reset** expression to sample the temperature at the beginning of each hour.

Related Objects *Average*, *Maximum*, *Minimum*, *SampleText*

SampleText

SampleText samples and stores the result of the **Data** expression any time the **Sample** expression transitions from OFF to ON and the **Enable** expression is TRUE. SampleText maintains an array of up to 35 previous samples. If **Enable** is left blank it is assumed to be TRUE.



Data is a text expression while **Sample** and **Enable** are logical expressions.

Note SampleText does not have a display parameters dialog box. You can display the result of a Sample object output signal by using its data member in an expression.

SampleText Data Members

Table 2-48. SampleText Data Members

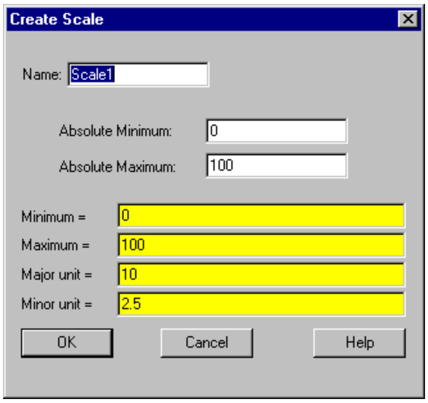
Data Member	Type	Read	Write	Description
(implicit)	text	yes	no	Current **Data** value. Tracks **Data** input value.
1 – 35	text	yes	no	Previous samples. Signal 1 is the most recent sample since **Sample** went high.
DataReset	logical	no	yes	Upon transition from FALSE to TRUE, resets all data members—including the current value and all previous samples.

Related Objects *Sample*, *L3TextEntry*, *TextEntry*

Scale

You can use the Scale object to create dynamic scales—that is, scales whose ranges and divisions can change based on numeric parameter expressions.

Note If you want to create a simple scale that does not change dynamically (which is normally the case), use the **Insert»Scale** command.



Name: Scale1

Absolute Minimum: 0

Absolute Maximum: 100

Minimum = 0

Maximum = 100

Major unit = 10

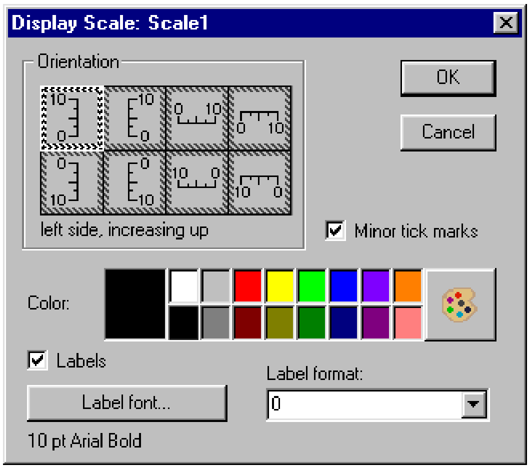
Minor unit = 2.5

Absolute Minimum and **Absolute Maximum** are numeric constants. They define the fullest possible range that the scale can show. These values act as clamps, restricting **Minimum** and **Maximum**.

Minimum and **Maximum** are numeric expressions you can use to change the minimum and maximum values on the scale. In the preceding example, the highest value of the scale (**Maximum**) is 400 if `Pot1` is less than 400, 1600 if `Pot1` is greater than 1600 (because of the **Absolute Maximum**), or equal to the value of Pot1.

Major unit specifies the number of units between major tick marks. **Minor unit** specifies the number of units between minor tick marks.

When you click on **OK**, the Display Scale dialog box appears.


Display Scale: Scale1

Orientation

left side, increasing up

Minor tick marks: ✓

Color:

Labels: ✓

Label format: 0

10 pt Arial Bold

Specify **Orientation**, **Color**, **Label format**, and **Label font** as you choose.

You can remove minor tick marks by deselecting the **Minor tick marks** check box and you can remove label numbers from your scale altogether by deselecting the **Labels** check box. (Only major units have numeric labels.)

Scale Data Members

Table 2-49. Scale Data Members

Data Member	Type	Read	Write	Description
visible	logical	no	yes	When TRUE, the Scale becomes visible on the control panel. When FALSE, it is invisible. The default value is TRUE.

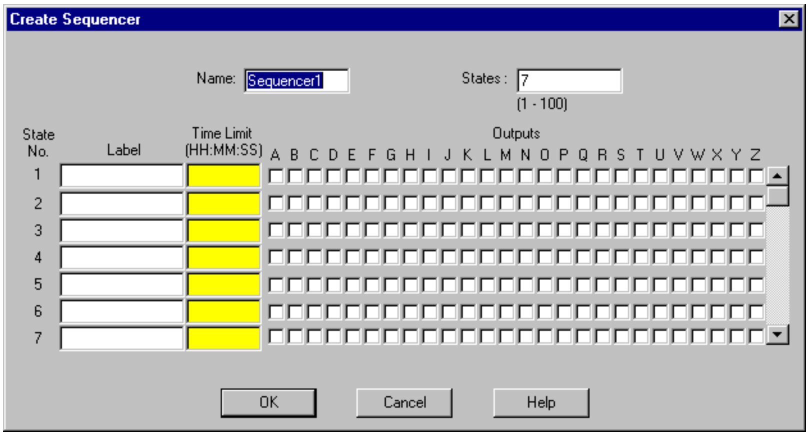
Comments Many people use this object class in conjunction with HyperTrends that are configured for a variable Y axis. They configure the **Minimum** and **Maximum** parameters of the Scale object to follow the same values as the **Max** and **Min** data members of the HyperTrend Object.

Sequencer

The Sequencer object is a method for cycling through a collection of up to 100 differently configured ON/OFF states for your process.

Each Sequencer state has 26 logical outputs. Outputs left blank are considered OFF.

You set each output to ON or OFF for each state. You can also create jumps to skip from one state to another, or activate immediate jumps to a designated state.



Name: Sequencer1

States : 7

(1 - 100)

The **States** field activates the states you want in your sequence loop. If you set **States** to `5`, the sequence object will pass through states 1 through 5 and then return to state 1 to repeat the cycle.

Notice that unused states can still be configured. In this way you can preconfigure special states, create subroutines, and so on. See the *Programming the Sequencer* section for further information on using this object.

Use **Label** to label each state.

The **Time Limit** parameter determines how long the Sequencer holds each state. If you leave this parameter blank, the Sequencer halts on that state until a `Goto` or `Jump` is activated, or the **Time Limit** parameter is changed.

Note When you set the Time Limit expression to reference a Lookout*Direct* control, you must make sure the output of that control is either in HH:MM:SS format, or in days.

Outputs are the ON/OFF settings for each state.

Programming the Sequencer

Left unmodified, the Sequencer cycles through the states selected in the **States** field of the **Sequencer parameter configuration** dialog box, beginning with state 1. If you enter `4` in the **States** field, the Sequencer will cycle through states 1—4 continuously, spending the amount of time in each state set by the **Time limit**.

Use the `Goto` data members to jump to a given state of the Sequencer immediately. Use the `Jump` data member to skip automatically from one state to a target state.

There is a tiny lag in state transition when you use the `Jump` data member. For instance, if you have a sequence cycling through states 1—8, and under some circumstances you want to skip states 5 and 6, moving directly from state 4 to state 7, set the `jump5.7` data member to `TRUE`. When the Sequencer reaches the end of the state 4 **Time limit**, it switches to state 5, and then immediately jumps to state 7. State 5 will be active for a brief period (about 10 ms), however, which you should take into account in designing your sequences.

You can use sequential jumps if you choose. When you activate a jump from state 1 to state 5, for example, and also a jump from state 5 to state 9, the Sequencer skips from state 1 to state 9 with a 10 ms delay at state 5.

If you use a `Jump` or `Goto` data member to activate a state outside the number you selected in your **States** field, the Sequencer will continue to cycle through any states following the target state, until it either reaches a state with no set **Time limit**, or state 100.

If the Sequencer reaches a state with no set **Time limit**, it remains in that state until a `Goto` or `Jump` is activated, or until the **Time Limit** parameter is changed.

If the Sequencer reaches state 100, and if state 100 has a **Time Limit** set, the Sequencer cycles to state 1 at the end of that time, resuming its cycle inside the states defined by the **States** parameter.

If you use a `Goto` or `Jump` data member to activate a state outside the ordinary cycle of a Sequencer object, you must use the `Jump` or `Goto` data members to return the sequence to its automatic cycle.

Sequencer Data Members

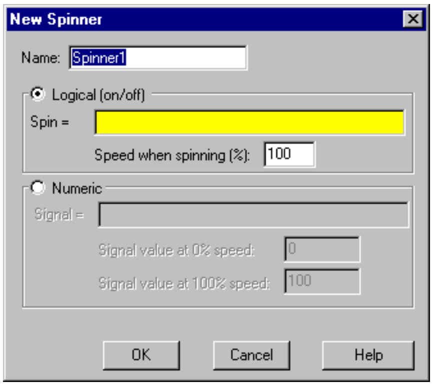
See the *Programming the Sequencer* section for detailed information on using Sequencer data members.

Table 2-50. Sequencer Data Members

Data Member	Type	Read	Write	Description
A – Z	logical	yes	no	Sequencer outputs
Goto1 – Goto100	logical	no	yes	When activated, forces Sequencer to go to the indicated state
Jump1.1 – Jump100.100	logical	no	yes	When activated, jumps from the state indicated by the first number to the state indicated by the second number
StateName	text	yes	no	Reports the currently active state name (**Label**)
StateNumber	text	yes	no	Reports the sequence number (**State No.**) of the current state
Time	numeric	yes	no	Reports the current length of time the Sequencer has been in the current state
TimeLimit	numeric	yes	no	Reports the length of time set for the Sequencer to hold the current state

Spinner

Spinner is a small, rotating disk. Its rotation speed can be variable, to represent the magnitude of a numeric **Signal**, or its rotation can be turned on or off based on the logical signal, **Spin**.



Name: Spinner1

[✓ Logical (on/off)]

Spin =

Speed when spinning (%): 100

Numeric

Signal =

Signal value at 0% speed: 0

Signal value at 100% speed: 100

Logical (on/off) and **Numeric** choose whether the spinner responds to a logical signal or a numeric signal. Choose **Logical** if you want to be able to turn the spinner on and off. Choose **Numeric** if you want the speed and direction of the spinner to change depending on a numeric variable.

Spin is a logical expression. When the result of the logical expression is TRUE, the spinner rotates at the rate defined by the **Speed when spinning (%)** field. **Speed when spinning (%)** is a numeric constant, ranging from –100 to 100.

Connecting the spinner to a positive value rotates the spinner in a counterclockwise direction. A negative value rotates the spinner in a clockwise direction.

Signal is a numeric expression. The result of this expression dictates the spin speed based on the linear range defined by **Signal value at 0% speed** and **Signal value at 100% speed**.

Table 2-51. Spinner Data Members

Data Members	Type	Read	Write	Description
none	—	—	—	Spinner does not have any data members

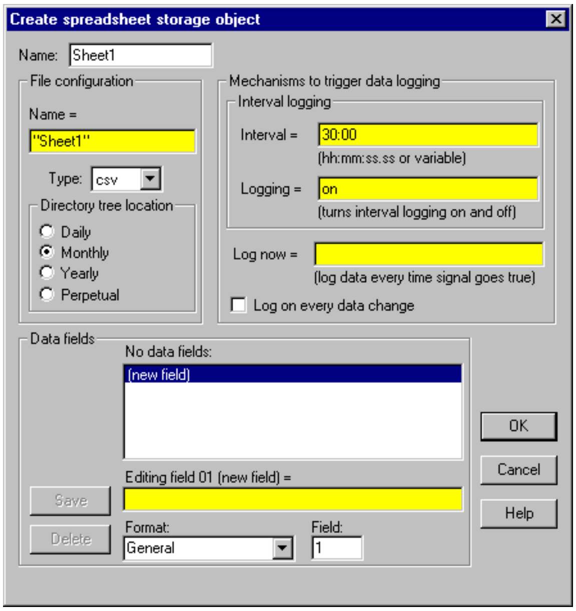
Comments Spinners are typically used to represent flow through a line or to show a motor running.

Spreadsheet

Spreadsheet permanently stores data to disk in spreadsheet files. You can log data on even and uneven intervals, when a data value changes, when an event occurs, or when any one of these things happen. Hence, you can implement complex logging criteria to meet almost any data storage need.

After each log, a new row is automatically added to the spreadsheet file. Lookout*Direct* can log a new row of data approximately 10 times per second; however, the time stamps associated with each row are rounded to the nearest second.

Each spreadsheet file may store any number of data signals. Each data signal is assigned a spreadsheet column, beginning with column number two. The first column contains the date and time. The first row contains the expressions associated with the data in each column. You may create any number of Spreadsheet objects for a given process.


Create spreadsheet storage object

Name: Sheet1

File configuration

Name = "Sheet1"

Type: csv

Directory tree location: ( ) Daily [✓ Monthly] ( ) Yearly ( ) Perpetual

Mechanisms to trigger data logging

Interval logging

Interval = 30:00 (hh:mm:ss.ss or variable)

Logging = on (turns interval logging on and off)

Log now = (log data every time signal goes true)

☐ Log on every data change

Data fields

No data fields:

(new field)

Editing field 01 (new field) =

Format: General

Field: 1

Name is the filename used to create a spreadsheet file. Lookout*Direct* assigns a DOS filename to each spreadsheet file by adding the **Type** extension to the **Name**. Currently, Lookout*Direct* supports only one **Type**: comma separated value format (`.csv`). Most database and spreadsheet programs including Microsoft Excel directly read the `.csv` file format.

Because the **Name** parameter is a text expression field, you can create new `.csv` files with unique names dynamically. This is especially useful for recording batch processing data. The definition dialog box Figure is configured so that an operator can enter a batch name using a TextEntry object before the batch is started. The text expression appends the filename to the specified path, `C:\BATLOG\`. So if the operator enters a file name like `BATCH71`, then the full path name would be `C:\BATLOG\BATCH71.CSV`. When the `BatchRun` logical signal goes TRUE, Lookout*Direct* creates the new `.csv` file and begins writing to it. When `BatchRun` goes FALSE, logging ends, leaving a comprehensive log of all data associated with the batch.

This example forces Lookout*Direct* to store the `.csv` file in a particular directory because it specifies a full path name. If you enter a relative pathname like `"\BATLOG\"&TextEntry1`, the file is located in that subdirectory of the identified *Direct***ory tree location**. So, for example, the full path name of the file might be `C:\LOOKOUT\1995\SEP\BATLOG\BATCH71.CSV`.

If you enter just a filename such as `"DATA"`, the file location is based on the Lookout*Direct* directory. For example, the full path name of the file might be `C:\LOOKOUT\1995\SEP\DATA.CSV`.

If you select **Daily**, Lookout*Direct* creates a new file and subdirectory every day in which to store the data. If you select **Monthly**, Lookout*Direct* creates a new file and subdirectory every month in which to store the data. If you select **Yearly**, Lookout*Direct* creates a new file and subdirectory every year. **Perpetual** files are stored in the root directory as specified by your **Data files location** parameter.

The following examples are the DOS filenames and directory trees created by Lookout*Direct* for a spreadsheet file named, `DATA`.

Daily	**Yearly**
`c:\lookout\1993\sep\09\data.csv`	`c:\lookout\1993\data.csv`
`\sep\10\data.csv`	`\1994\data.csv`
`\sep\11\data.csv`	`\1995\data.csv`
Monthly	**Perpetual**
`c:\lookout\1993\sep\data.csv`	`c:\lookout\data.csv`
`\oct\data.csv`	
`\nov\data.csv`	

The **Mechanisms to trigger data logging** are a set of tools used to create a simple or complex logging scheme, as desired. Use these parameters to log data based on a timer, event, or any combination of the two. When the spreadsheet is triggered, all data in the Data fields is logged to disk.

Interval is a numeric expression used to create a Pulse timer with a pulse period of the specified time period and a pulse duration of zero. Normally this is a time formatted constant value such as 15:00 (fifteen minutes), for example.

Logging is a logical expression that turns the **Interval** parameter on and off. It could be a switch on a control panel, a logical input from an external device, or a more complex expression. Normally this is a constant value, `ON` or `OFF`.

Log now is a logical expression. When **Log now** transitions from OFF to ON, Lookout*Direct* logs the data. A transition from ON to OFF has no effect. This expression could be a pushbutton on a control panel, a logical signal from a device, or a more complex expression.

The **Log on every data change** option should be used with care. When turned on, it triggers the logging of data any time any one of the data fields experiences a change. This is normally used to log the starting and stopping of pumps, opening and closing of valves, or other similar events. If your data fields contain even a single analog value that changes often, you could end up triggering the logger thousands of times. Or if they contain a logical value that changes frequently, you could have the same problem.

The **Data fields** window lists all expressions that have been entered for logging in the order of their field number.

The **Save** button saves your new or modified expression in the **Data fields** window along with a new field number if any. Normally, **Data fields** contain simple expressions like `PLC1.Tanklevel`.

The **Delete** button deletes the currently selected expression from the data fields list.

The **Format** option specifies the numeric format assigned to the currently selected numeric expression when it is logged to disk. This has no effect on logical or text expressions.

Field indicates the number of the currently selected data field.

Note Field numbers should not be modified after data has been stored or the data will not appear under correct headers until a new file is created.

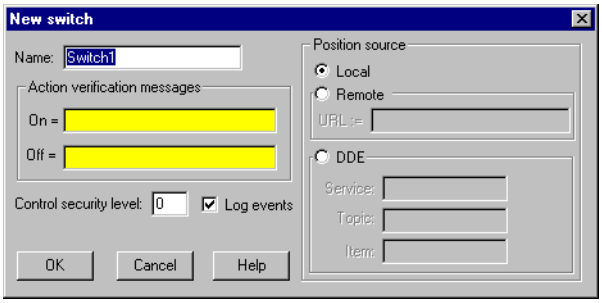
Spreadsheet Data Members

Table 2-52. Spreadsheet Data Members

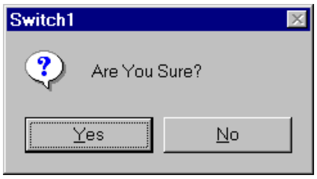
Data Members	Type	Read	Write	Description
logged	logical	yes	no	Spreadsheet file update pulse. The Spreadsheet object generates this logical pulse with a pulse duration of zero after each successful log.

Switch

Switch generates a logical signal for receipt by other objects. Switches change state when you click on them with a mouse button, trackball, touchscreen, or space bar on your keyboard.



Use **Action verification messages** to create dynamic text expressions to be displayed in message dialog boxes. See Chapter 6, *Security*, in the Lookout*Direct Developer's Manual* for more information on security.



Position source determines where the value of the Switch resides. **Local** indicates the value of the Switch lies within the object itself—on the control panel. If the switch is up the signal is ON, if down the signal is OFF.

Remote Switches get their values from a remote source, often the register on a controller they are connected to. Flipping the Switch changes the status of the register, and changing the status of the register flips the switch.

The **Remote** option is especially useful when you want to prevent Lookout*Direct* from changing the value of setpoints or registers upon initial startup, or reconnection of lost communication.

The **Remote** option calls for a URL to locate the data member you want to connect to. The URL field is green, and you cannot use a complex expression as a URL. If you need to use one RadioButton for several purposes, you can use a Symbolic Link to make a more complex connection than that possible with a URL.

You can right-click in the **URL** field and use the **URL Editor** dialog box to assemble the URL, in the same way you use the Lookout*Direct* expression editor.

A remote position source connection is completely reciprocal. A change in your Lookout*Direct* control changes the data member that control is remoted to. Any change in that data member also changes the control. It is not necessary, and is incorrect, to use the **Edit Connections** dialog box to connect a control object to its controlled data member.

Because the remote connection is reciprocal, you can only make such a connection to a data member that is either writable, or readable and writable.

When a process with remoted controls first opens, those controls take their initial values by following the URL to read the data members they are remoted to. The control will be covered by a red X to indicate that the remote connection is not functioning.

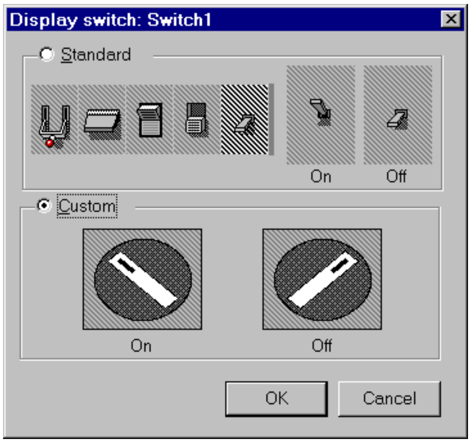
Note You should use **Remote** to connect a control in a client process to a data member in a server process. Connections inside a single process can be made using **Object»Edit Connections**.

Because complex expressions are read-only values, you cannot remote directly to them. For the same reason, you cannot remote one control to another control's `(intrinsic)` data member (though you can remote a control to another control's value data member).

Much like Remote Switches, **DDE** (Dynamic Data Exchange) Switches get their values from a remote source. This could be a cell in a spreadsheet, another DDE aware application, or a second copy of Lookout*Direct* running on the network. See Chapter 5, *Dynamic Data Exchange*, in the Lookout*Direct Developer's Manual* for more information on **Service**, **Topic**, and **Item** parameters.

Control security level specifies the minimum security level operators must have to gain access to this individual object, and thus control it.

The **Log events** option creates a permanent audit trail for the object—who did what and when. All adjustments of the Switch are logged to disk, including the time the Switch was flipped, the operator's account name, and the direction the Switch was flipped. See Chapter 7, *Logging Data and Events*, in the Lookout*Direct Developer's Manual* for more information on event logging.



You can replace the standard switch types with custom graphic symbols. If you decide to use custom graphics, you must specify both symbol parameters, **On** and **Off**. See Chapter 2, *Graphics*, in the Lookout*Direct Developer's Manual* for more information on creating custom graphic symbols and the use of transparent pixels.

Switch Data Members

Table 2-53. Switch Data Members

Data Members	Type	Read	Write	Description
(implicit)	logical	yes	no	Switch Position
enable	logical	no	yes	If TRUE (the default), enables DDE. If FALSE, disables DDE. The default value is ON. This input is ignored for non-DDE TextEntry objects.
reset	logical	no	yes	While this value equals TRUE, the control will be set to the value in `resetvalue`.
resetvalue	numeric	no	yes	Sets the value a control will take when the reset data member transitions from FALSE to TRUE.

Table 2-53. Switch Data Members (Continued)

Data Members	Type	Read	Write	Description
value	numeric	yes	yes	The current value of the control. If you have remoted this control, then `value` is the current value of the position source.
visible	logical	no	yes	When FALSE, the switch object cannot be seen on the display panel. When TRUE, the Switch can be seen and controlled.

Comments If a switch with more than two positions is needed, use a Pot object instead.

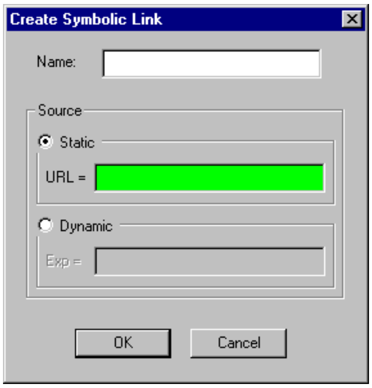
Related Objects *Pushbutton, Pot*

Symbolic Links

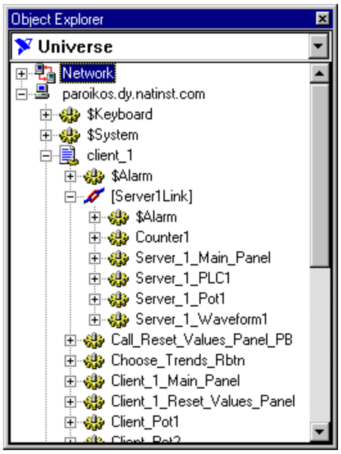
A Symbolic Link is a Lookout*Direct* object you use to make certain kinds of remote connections easier and more efficient. This object can also be used to manage failover redundancy in Lookout*Direct* 4. (Redundancy is not implemented in the Lookout*Direct* 4 Preview.)

The Symbolic Link serves as a flexible intermediary between separate processes whether they are running on one computer or on different computers.

Create a Symbolic Link using the Lookout*Direct* object browser. Right-click on the process or folder into which you want to insert the new Symbolic Link. The following dialog box appears.



The Symbolic Link can represent either a static or a dynamic source. The **Static** source is a URL pointing to a computer, process, folder, or object running in some instance of Lookout*Direct* on your network. A typical Symbolic Link set to a process appears in the following illustration.



As you can see, all the objects in the `Server_1` process are represented in the Symbolic Link `[Link_to_Server1]`. You can drag and drop any of the objects or data members onto a panel in the process containing the Symbolic Link, where they will appear as expressions.

The **Dynamic** source must always be an expression that evaluates as a text string. When you select this option, you can use text strings and text variables to prepare the Symbolic Link to be used by a control for remote connections that cannot be made directly.

For example, you cannot use a complex expression in a Pot control remote source URL. You can, however, construct a complex expression as the dynamic source in a Symbolic Link, and then set the URL to connect to that Symbolic Link.

For instance, the following expression evaluates as two different URLs depending on the position of `Switch1` (line breaks inserted for clarity).

```
tif(Switch1,
"\\.\server_1\Server_1_Waveform1.sinewave",
"\\.\Server2\Server2_Waveform.sinewave")
```

If you connect a HyperTrend item to the Symbolic Link containing this dynamic source, changing the switch changes which server provides the wave form being plotted on the HyperTrend graph.

As another example, because Lookout*Direct* data is now polymorphic, you can construct strings using both text and numeric inputs.

For example, if you create Pot1 with a **minimum** of `0`, a **maximum** of `9`, and an **interval** of `1`, you can use the expression

```
"Modbus1.4001" & Pot1
```

as the entry for the **Dynamic** option in a Symbolic Link.

You can then use the Symbolic Link to connect a control to Modbus data members `40010-40019`, depending on the setting of Pot1.

While you could not directly remote your control to that range of Modbus data members, you can make a remote connection from that control to the Symbolic Link using that dynamic expression.

If you connect the **Dynamic** expression to a data table, you have a nearly unlimited ability to have one object control a large number of data members, either through a cursor control or a radio button control.

$System

$System is a global object. It makes global Lookout*Direct* data such as the currently logged in user name and security level available for use in your process. You can use $System data members just like other object data members.

The **seclevel** data member is always an integer value between 1 and 10. This number represents the Lookout*Direct* security level of the user currently logged in. For more information about Lookout*Direct* security levels, see Chapter 6, *Security*, in the Lookout*Direct Developer's Manual*.

The **time** data member represents the current date and time of the system. Like all time values in Lookout*Direct*, this is a floating point number in which the integer represents the date and the fraction represents the time of day. You can use the various Lookout*Direct* date and time numeric formats to view this value in the most convenient format. This data member updates itself every minute, on the minute. It also updates itself immediately after it is created or when its process is opened.

The **username** data member is the account name of the user currently logged in. For more information about Lookout*Direct* security accounts, see Chapter 6, *Security*, in the Lookout*Direct Developer's Manual*.

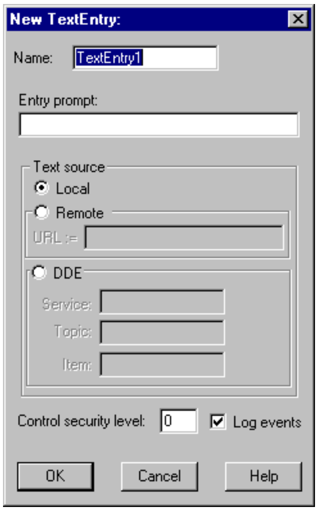
$System Data Members

Table 2-54. $System Data Members

Data Member	Type	Read	Write	Description
NetworkStatus	text	yes	no	Reports the status of the last network transaction of your computer. You may need to use this data member in conjunction with a Sample object to keep track of high levels of network activity with many I/O points.
seclevel	numeric	yes	no	Security level of the user currently logged in
time	numeric	yes	no	Current operating system time
username	text	yes	no	Name of the user currently logged in

TextEntry

With TextEntry you can manually enter textual notes with the keyboard. These notes may contain any combination of numeric and alphanumeric characters; however, the result of your entry is converted to a text value. Just like any other text expression in Lookout*Direct*, your note can be logged to disk, connected to other data members that accept text signals, and so on. The note is saved and displayed as a single line entry—you cannot embed carriage returns into the message.


New TextEntry:
Name: TextEntry1
Entry prompt:
Text source
[✓ Local]
Remote
URL :=
DDE
Service:
Topic:
Item:
Control security level: 0
[✓ Log events]

Entry prompt is the text that appears at the top of the text entry dialog box when an operator selects the text entry pushbutton.

Text source determines where the user-entered text resides. **Local** indicates the user-entered text lies within the object itself—on the control panel.

Remote indicates that the user-entered text resides in a remote source, such as a text expression or another TextEntry object.

The **Remote** option calls for a URL to locate the data member you want to connect to. The URL field is green, and you cannot use a complex expression as a URL. If you need to use one RadioButton for several purposes, you can use a Symbolic Link to make a more complex connection than that possible with a URL.

You can right-click in the **URL** field and use the **URL Editor** dialog box to assemble the URL, in the same way you use the Lookout*Direct* expression editor.

A remote position source connection is completely reciprocal. A change in your Lookout*Direct* control changes the data member that control is remoted to. Any change in that data member also changes the control. It is not necessary, and is incorrect, to use the **Edit Connections** dialog box to connect a control object to its controlled data member.

Because the remote connection is reciprocal, you can only make such a connection to a data member that is either writable, or readable and writable.

When a process with remoted controls first opens, those controls take their initial values by following the URL to read the data members they are remoted to. The control will be covered by a red X to indicate that the remote connection is not functioning.

Note You should use **Remote** to connect a control in a client process to a data member in a server process. Connections inside a single process can be made using **Object»Edit Connections**.

Because complex expressions are read-only values, you cannot remote directly to them. For the same reason, you cannot remote one control to another control's `(intrinsic)` data member (though you can remote a control to another control's value data member).

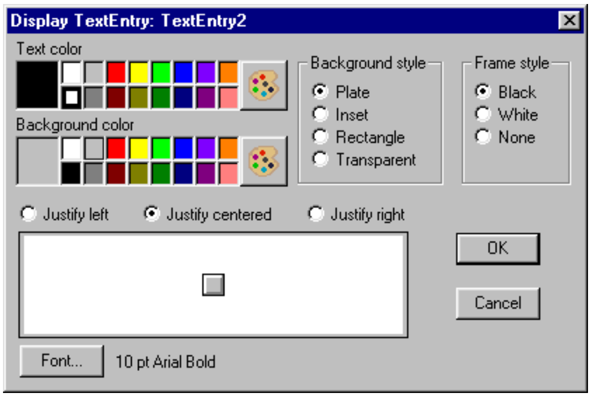
Much like **Remote** TextEntry objects, **DDE** TextEntry objects get their values from a remote source. This is the option you use to tie the text to a cell in a spreadsheet, a database lookup table, or any DDE aware application—including a second copy of Lookout*Direct* running on the network. See Chapter 5, *Dynamic Data Exchange*, in the Lookout*Direct Developer's Manual* for more detailed information on **Service**, **Topic** and **Item**.

Note The last DDE parameters used on any object automatically become the default values for any new DDE object.

Control security level specifies the minimum security level operators must have to gain access to this individual object, and thus control it.

The **Log events** option creates a permanent audit trail for the object—who did what and when. When selected, all text entries in this object are logged to disk. Each entry includes the time of the entry, the operator's account name, and what entry was made. See Chapter 7, *Logging Data and Events*, in the Lookout*Direct Developer's Manual* for more information on event logging.

Lookout*Direct* presents the following display parameters dialog box after you define the object. It lets you define the text font and presentation style.



Background style: [✓ Plate] Inset Rectangle Transparent

Frame style: [✓ Black] White None

Justify left [✓ Justify centered] Justify right

10 pt Arial Bold

TextEntry Data Members

Table 2-55. TextEntry Data Members

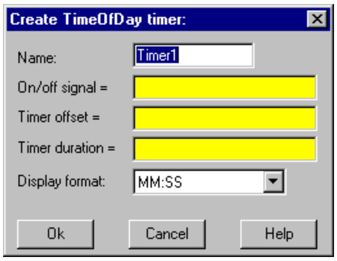
Data Members	Type	Read	Write	Description
(implicit)	text	yes	no	Current, user-entered text
enable	logical	no	yes	If TRUE (the default), enables DDE. If FALSE, disables DDE. The default value is ON. This input is ignored for non-DDE TextEntry objects.
reset	logical	no	yes	While this value equals TRUE, the control will be set to the value in `resetvalue`.

Table 2-55. TextEntry Data Members

resetvalue	numeric	no	yes	Sets the value a control will take when the reset data member transitions from FALSE to TRUE.
value	numeric	yes	yes	The current value of the control. If you have remoted this control, then `value` is the current value of the position source.

TimeOf*xxxx*

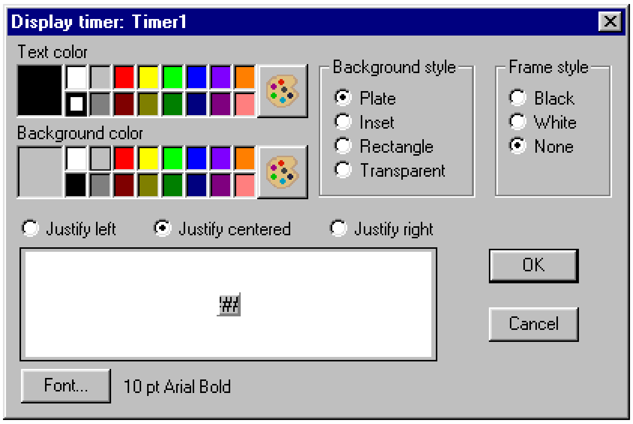
TimeOf*xxxx* are timers that generate a periodic pulse of a specified duration. The timers are turned on and off by **On/off signal**. The time period is defined by the type of timer used—a TimeOfMinute timer has a one-minute period, a TimeOfYear timer has a one-year time period, and so on. The output of these timers goes high after the specified **Timer offset** has elapsed in the current period and remains high for the specified **Timer duration**.



The **Timer offset** and **Timer duration** can range from 0.0 seconds to a year, and the effective resolution is 0.01 seconds over the entire range. The **Timer offset** plus the **Timer duration** should always be less than or equal to the time period.

The object display shows the time remaining before the output changes state and is updated approximately once per second. It is shown in the selected **Display format**. If the **On/off signal** is OFF, the display shows `OFF`.

The **On/off signal** is a logical expression while **Timer offset** and **Timer duration** are numeric expressions. Normally, these are simple time constants such as 6:10:20 (six hours:ten minutes:twenty seconds). See *Numeric Data Members* in Chapter 2, *How* Lookout*Direct Works*, in the *Getting Started with* Lookout*Direct* manual for more information on entering time constants.



Timeof*xxxx* Data Members

Table 2-56. TimeOf*xxxx* Data Members

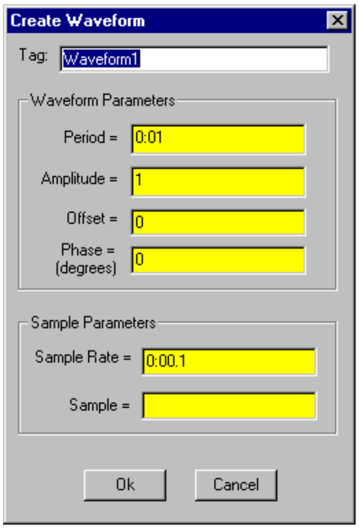
Data Members	Type	Read	Write	Description
(implicit)	logical	yes	no	Logical timer value

Comments TimeOf*xxxx* can be used in place of Pulse objects when the pulse needs to be synchronized with the clock—if a pump should only be allowed to run between the hours of 8:00 and 17:00 each day, the TimeOfDay timer should be used.

Related Objects *DelayOff*, *DelayOn*, *Interval*, *OneShot*, *Pot*

Waveform

The Waveform object generates cosine, sine, square, sawtooth, triangle, and random waveforms.



Tag: Waveform1

Waveform Parameters

Period = 0:01

Amplitude = 1

Offset = 0

Phase = (degrees) 0

Sample Parameters

Sample Rate = 0:00.1

Sample =

The Waveform object produces output by sampling the desired waveform at the specified **Sample Rate**. The **Period** (in days), **Amplitude**, **Offset** (level shift), and **Phase** (in degrees) of the generated waveforms can be set to any numerical expression. A single Waveform object can be used to generate multiple waveforms of varying relative phases, all with the same **Period**, **Amplitude**, **Offset** and absolute **Phase**.

Lookout*Direct* samples a waveform when the logical expression **Sample** transitions from FALSE to TRUE. This can be a simple expression like the signal from a pushbutton, or it can be a complex algorithm.

Sample Rate is a numeric expression that determines how often to sample the waveform. Lookout*Direct* converts the numeric value of **Sample Rate** into a time signal that represents days and fractions of a day. The Waveform object then samples the waveforms at the specified time interval. Normally, this will be a simple time constant such as 0:01 (one second).

When the **Period** of the waveform is changed, the waveform must be phase shifted so that there is a smooth transition to the new frequency. This is handled internally by the Waveform object and does not effect the **Phase** parameter.

As a result, multiple waveform objects will not be in phase with each other if one or more have had their **Periods** changed. To reset a waveform so that it will again be in phase with other waveforms, use the **Reset** connection. See *Waveform Comments* for a more detailed discussion of phase.

Each waveform output (except random) has 361 separate data members for generating waveforms of different relative phase shifts. For example, cosine0 (or just cosine) is a cosine wave of 0-degree relative phase shift, cosine90 is a cosine wave with +90 degrees relative phase shift, and cosine_90 is a cosine wave with –90 degrees relative phase shift.

Waveform Data Members

Table 2-57. Waveform Data Members

Data Members	Type	Read	Write	Description
cosine_180 — cosine180	numeric	yes	no	Cosine waveform output.
random	numeric	yes	no	Random waveform output.
Reset	logical	no	yes	Resets the phase shift to zero when transitioned from OFF to ON. (See comments on phase in Waveform Comments.)
Sample	logical	no	yes	When this transitions from false to true, the waveform is sampled.
SampleRate	numeric	no	yes	Specifies the rate at which the waveform will be automatically sampled.
saw_180 — saw180	numeric	yes	no	Sawtooth waveform output.
sine_180 — sine180	numeric	yes	no	Sine waveform output.
square_180 — square180	numeric	yes	no	Square waveform output.
triangle_180 — triangle180	numeric	yes	no	Triangle waveform output.

Waveform Comments

A waveform is a function of time whose values repeat every period. The total phase shift of the waveform determines where, in its cycle, the waveform starts at time t = 0 (midnight on the morning of the January 1, 1900 for Lookout*Direct*). Two waveforms that start at the same place in their cycle at t = 0 (that is, same total phase shift) are said to be “in phase” with each other.

For a waveform generated by a Waveform object, the total phase shift is equal to the absolute phase shift as specified by the **Phase** parameter, and by the relative phase shift specified by the selection of a particular data member (for example, cosine 90). Because the phase is defined in terms of absolute time, two waveform objects with the same **Period** and **Phase** will generate waveforms that are in phase with each other.

However, if the **Period** of one of the waveforms is variable (for example, if it is connected to a Pot object) and changes, the absolute phase of the waveform will be changed. This additional phase shift is handled internally by the Waveform object, and is only noticeable by the fact that it can produce an undesirable phase shift between two Waveform objects that have the same **Period**. For this reason, you may want to use the **Reset** data member to reset this internal phase shift.

Note The **Phase** parameter is in degrees. A **Phase** of 180 degrees will shift the waveforms one half period ahead. For example if the **Period** is 1 day and the **Phase** is 180 degrees, then the shift will be one-half day.

$$\frac{\textbf{Phase}}{360^\circ} \times \textbf{Period} = \frac{180^\circ}{360^\circ} \times 1\,day = \frac{1}{2}day$$