
Logging Data and Events

This chapter describes three *LookoutDirect* methods for logging real-time system data to disk—Spreadsheet Logger, Citadel Historical Database, and Event Logger—and report generation.

The Spreadsheet Logger creates standard ASCII text files in comma separated value (.CSV) file format. You can open and edit these files with common spreadsheet and database programs. The Citadel Historical Database creates a historical database that *LookoutDirect* HyperTrend objects access in real time. You can retrieve this data using Structured Query Language (SQL). The Event Logger creates a chronological audit trail of who did what and when.

You might implement all three methods on a single system. They are *not* mutually exclusive.

Refer to Chapter 9, *Alarms and Events*, for more information on the Alarm Logger, which logs alarms to disk.



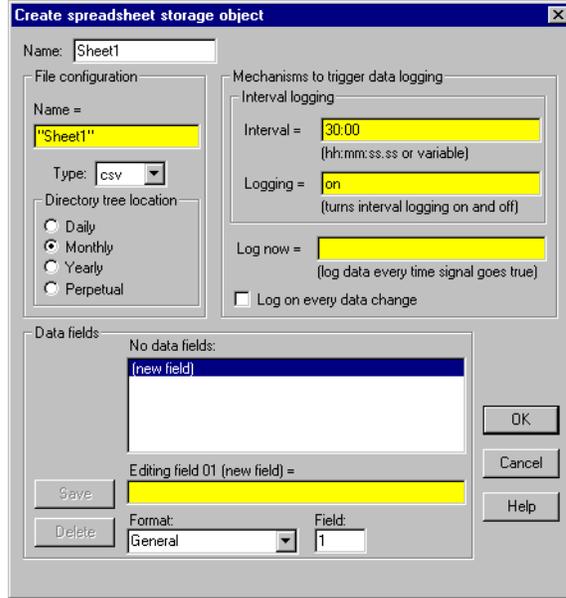
Note When your operating system switches in or out of Daylight Savings time, *LookoutDirect* corrects for the change relative to universal time so that there is no data discontinuity or loss in the Citadel database.

Spreadsheet Logger

When you want to create permanent ASCII files that you can later open with software packages such as Excel, Lotus, and Foxpro, use a Spreadsheet object to store real-time system data to disk.

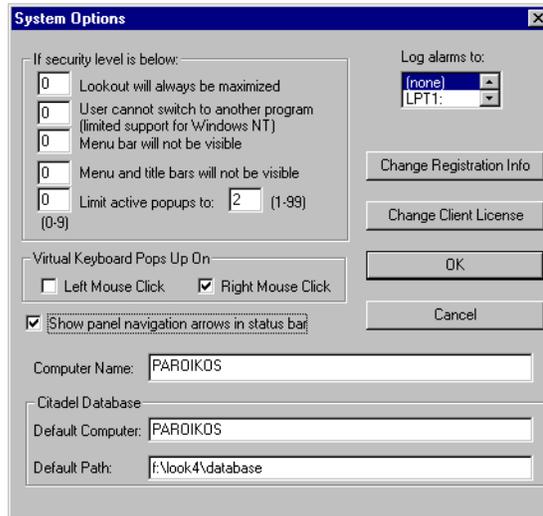
You can generate more than one spreadsheet for a single process if you use multiple Spreadsheet objects in one process file (a .LKP file). You can have different spreadsheet files in different subdirectories and each might have different data stored using different logging criteria. For more information on the Spreadsheet object, refer to the *Spreadsheet Logger* description in the online PDF *Object Reference Manual* or online help.

The following illustration shows the create object dialog box that you use to configure a spreadsheet object.



Data Location

LookoutDirect stores spreadsheet files in subdirectories specified by the **Citadel Database** section of the **System Options** dialog box illustrated below.



CSV Files

All LookoutDirect spreadsheet files use the comma-separated value (.CSV) format. A .CSV file contains text separated by commas. Each line of the file represents a row of spreadsheet data. The first row lists signal names and describes the data stored in each column of the file. The first column of the spreadsheet file specifies the date and time data in each row was logged. The following illustration shows a Lookout .CSV file opened by Excel.

The screenshot shows the Microsoft Excel interface with a spreadsheet titled 'Data.csv'. The spreadsheet has five columns: A (Time), B (Pressure), C (TankLevel), D (ReliefValve), and E (Temperature). The data rows are as follows:

	A	B	C	D	E
1	Time	Pressure	TankLevel	ReliefValve	Temperature
2	9/29/97 15:44	46	11	0	78
3	9/29/97 15:45	37.64	31.37	0	76
4	9/29/97 15:45	30.63	50.92	0	77
5	9/29/97 15:45	23.99	58.3	0	78
6	9/29/97 15:45	19.19	64.94	1	79
7	9/29/97 15:45	15.5	55.35	0	78

You can view and edit spreadsheet files using a standard word processing program, but spreadsheet programs such as Microsoft Excel provide a more intuitive interface for viewing or editing data and printing custom reports.

File and Disk Errors

If *LookoutDirect* cannot find the data directory or spreadsheet files or cannot log data to disk, it generates a priority eight alarm with a descriptive error message. For example, if your default data location was on `c:\lookout\database`, and *LookoutDirect* was to encounter a full disk while writing to a file named `data.CSV`, the alarm text would read `(Disk is full) "c:\lookout\database\data.csv"`.

When you correct the problem that caused the alarm, the alarm automatically resets.

Concurrent File Access

When logging data, *LookoutDirect* opens the file long enough to add a new row of data and then closes the file. *LookoutDirect* can log approximately ten new rows of data per second. (The time stamps associated with each row are rounded to the nearest second.) Because *LookoutDirect* runs under the Windows multitasking environment, you can open the spreadsheet or database while *LookoutDirect* is running. If you have the data file open in a spreadsheet program such as Excel, *LookoutDirect* cannot add new rows of data to the file. If *LookoutDirect* does not have write access to the file, it generates an alarm explaining the problem.

```
Error writing spreadsheet file: Permission denied  
[c:\lookout\database\data.csv]
```

If *LookoutDirect* cannot log data to the spreadsheet file, it creates a temporary buffer in memory to which it logs all the spreadsheet data. When you close the spreadsheet file, *LookoutDirect* updates it and resets the alarm.

Information Overload

If you create a Spreadsheet object that logs fifty data fields (object data members and/or expressions) at five-minute intervals, you generate 14,400 data points per day, or 432,000 data points per month. It can be difficult to determine which data are critical information.



Note Carefully consider the importance of each data point and the time interval between data points to avoid information overload for both you and your spreadsheet program.

If you have logged more than 16,384 rows of data, the current version of Excel cannot load the entire spreadsheet file. Spreadsheets created with one-minute intervals generate 44,641 rows of data if the directory tree location is set to **Monthly**. Spreadsheets created with two-minute intervals generate 22,321 rows of data if the directory tree location is set to **Monthly**. To decrease the number of data rows, try changing the directory tree location to **Daily**, which generates only 1,440 rows of data per day at one-minute logging intervals. You can also use a text editor to divide the larger file into smaller files with fewer data rows.

Besides limiting rows to 16,384, Excel limits spreadsheets to 256 columns of data. One column is reserved for the date and time.

Citadel Historical Database

When you need to view historical information using *LookoutDirect* HyperTrend objects or access historical data using Structured Query Language (SQL), use the Citadel Historical Database to store real-time numeric and logical data in a compressed format.

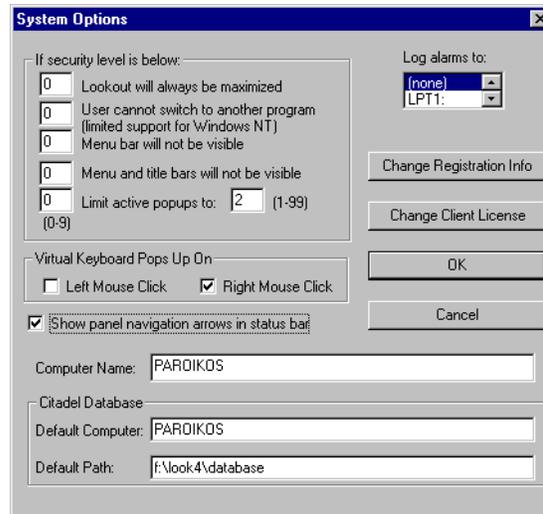
LookoutDirect logs data only when the value of a point changes, *not* at a timed interval. The logged data accurately reflects the actual behavior of the point being logged because the same value of a point is not recorded over and over. With Citadel, disk usage is exactly proportional to the amount of information recorded.

After the data is stored to disk, you can view it with a HyperTrend object in *LookoutDirect* or with SQL. HyperTrend objects serve as windows into your database. SQL, an industry-standard language supported by most database packages, enables other applications to directly retrieve data from Citadel.

Because Citadel uses Universal Coordinated Time (UCT) to time stamp the data, you do not need to compensate for data logged in different time zones. The HyperTrend object automatically converts from universal to local time before displaying a data history.

Default Data Location

The **Citadel Database** fields in the **System Options** dialog box specify the root directory under which all data logging is stored, including the database. Ordinarily, Citadel creates a special `database` subdirectory in the *LookoutDirect* directory. This subdirectory holds your historical database files.

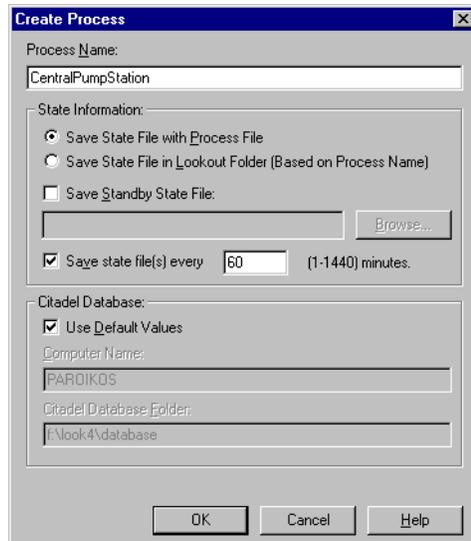


If you move or rename the subdirectory or files, you will be unable to access your data. If you change the default directory, the change does not take effect until you stop and restart *LookoutDirect*. This also interrupts data continuity, and you have to do separate SQL queries to both databases.

Unlike spreadsheet files, only one historical database per *LookoutDirect* process exists. If you want to develop multiple processes where each process file has its own unique historical database on a single computer, specify a different location for each process database, as explained in the *Process Data Location* section of this chapter.

Process Data Location

When you create a process in *LookoutDirect*, you have an opportunity to set the default data location for that process in the **Create Process** dialog box.



When this dialog box first appears, the **Use default values** checkbox is selected. This option directs *LookoutDirect* to log data from this process to the default location set in the **System Options** dialog box for the copy of *LookoutDirect* running the process. In this way, you can create a process that logs to the default data location of any copy of *LookoutDirect* running on any computer you move the process to.

You can also direct data to a location on a remote computer, as long as that computer is running the *LookoutDirect* Citadel service. Deselect the **Use default values** option and enter the computer and path you want data logged to.

Although you can direct data from different processes to different database directories, proliferating a variety of databases with large numbers of processes running in one instance of *LookoutDirect* can degrade performance, depending on the number of data points being logged.

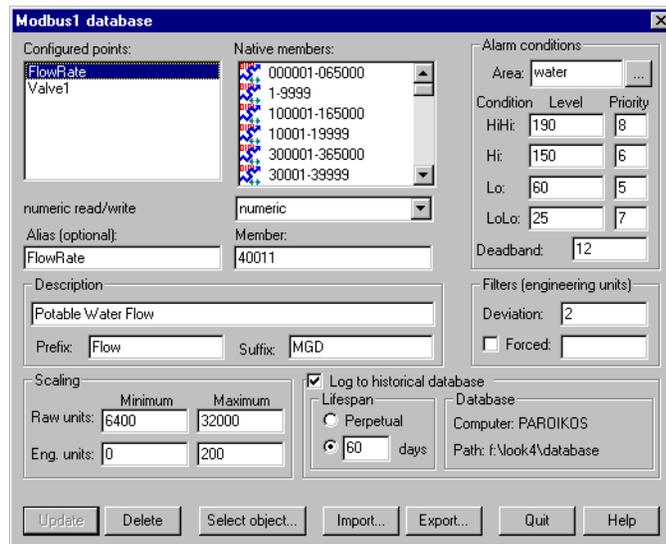
Creating a Historical Database

Citadel stores historical information using traces. Trace refers to the line of continuity for a specific data member name or point. A trace connects all the historical values for a given point, which displays as a continuous line in a HyperTrend object. If *LookoutDirect* is unexpectedly interrupted or a data member is temporarily modified to *not* log to disk, a trace can be broken. If the trace is broken, the HyperTrend plots the trace as a continuous line with void sections to represent gaps in the data. You cannot remove individual

traces from the database, but you can add new traces to the database by configuring a new point.

You can log any numeric or logical data member of any object to the historical database. Use the following procedure to add a trace to the Citadel database:

1. Select **Object»Edit Database** and an object that contains data you want to log. A dialog box similar to the following appears.



2. Identify the value you want to log in the **Member** data field. If the value was previously configured, select it from the **Configured points** list.
3. Check the **Log to historical database** checkbox and choose an appropriate **Lifespan**. See *Logging Criteria* for an explanation of time span settings.
4. Enter a value in the **Deviation** field. See *Logging Criteria* for an explanation of **Deviation** settings.
5. Click on the **Save** or **Update** button. (If you are modifying an existing configured point, the button automatically changes to **Update**.)
6. Configure all the object data members that you want logged to the Citadel database.
7. Click on the **Select object** button and select the next object containing data you want to log.
8. Repeat steps 2 through 6 until you have created the traces that you need.
9. Click on **Quit**.

Logging Criteria

To create a new trace in the Citadel historical database, *LookoutDirect* needs the following information: data member name (**Alias**), **Deviation**, and **Lifespan**.

- **Data member name (Alias)**—*LookoutDirect* must name each trace in the historical database for archiving and retrieval purposes. If **Alias** is not specified, *LookoutDirect* uses the native data member name as displayed in the **Member** field. If an alias is assigned to the native data member, *LookoutDirect* uses the **Alias** name instead. The name used for the trace is the same name saved to the **Configured points** list box.
- **Deviation**—If an analog value surpasses or equals the **Deviation** setting, *LookoutDirect* saves a new value to disk in the database. If you implement **Scaling** parameters, *LookoutDirect* compares the **Deviation** setting to changes in the **Eng. units** values to determine when to log a new point. If you leave the **Scaling** parameters blank, *LookoutDirect* compares the **Deviation** setting to the raw (unscaled) signal. The **Deviation** parameter is not available on logical signals because *LookoutDirect* logs all state transitions of logical values to disk.
- **Lifespan**—*LookoutDirect* needs to know how long you want to maintain this trace of data in the historical database. *LookoutDirect* maintains the data for *at least* the time span specified in the **Log to historical database** parameters.

LookoutDirect does not discard old data immediately. Disk space containing old data is reused when new data is logged.

Alarm Information Overload

Because *LookoutDirect* creates and maintains the historical database in 1 MB chunks, you must have a least 1 MB of available disk space to begin logging data. When the first 1 MB file fills up with data, *LookoutDirect* creates a second 1 MB file in the same directory. When the second fills up, *LookoutDirect* continues to create 1 MB files until all traces can be maintained on disk for the time spans specified in the **Log to historical database lifespan** data field. *LookoutDirect* monitors the status of your hard drive and generates an alarm when your disk falls below 500 KB of available space.

Use discretion when determining **Deviation** settings on each trace of data. If **Deviation** is not specified, *any* change of an analog value results in a new point being logged to disk, and you might generate too much data. If the **Deviation** setting is too large, very little information might be saved to disk.

Event Logger

When you want to create a chronological schedule of events or an audit trail, log LookoutDirect events. You can log all events: operator commands, Event objects, and all global events (running LookoutDirect, closing LookoutDirect, opening a process file, closing a process file, entering edit mode, exiting edit mode, and logging on and off).

LookoutDirect system events, such as logging on and logging off, or entering and exiting edit mode, are automatically logged as events by LookoutDirect. Other events, such as adjusting the value of a Pot object, are only logged if you select the **Log events** option when you create or modify the object.

When LookoutDirect logs an event, it also logs the account name (the operator), date and time of the event, name of the object adjusted, and the previous and subsequent settings of the object. Because all of this information is logged, you create an exhaustive audit trail for that specific workstation.

Use the Event object class to define and log your own event messages based on a user-defined trigger. For additional information, refer to the *Event* object class in the online help or the PDF *LookoutDirect Object Reference Manual*.

Event Data Location

LookoutDirect stores event files in the same Citadel database that holds LookoutDirect alarms and LookoutDirect data for any LookoutDirect process.

To view events in real time, select the **Show Events** or the **Show Alarms & Events** option in the **Alarm Filters** dialog box. Print events the same way you print alarms, using the appropriate alarm filter settings.

Event Information Overload

The event logger can store information on an individual object instance for Switches, Pots, and Pushbuttons. Every time you flip a Switch, adjust a Pot, or depress a Pushbutton, LookoutDirect logs the event to disk. If you enable the Event Logger for all instances of these object classes, you might collect more data than you need.

By selectively enabling the Event Logger on critical Switches, Pots, and Pushbuttons, you cut down on the amount of information logged to the event file. For example, you might place a dozen Switches on a control panel, but only one of those twelve requires data logging. Rather than log events for all 12 Switches, enable the Event Logger only on that single switch.

Report Generation

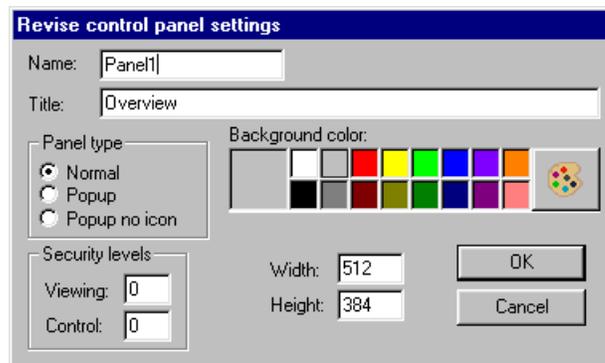
Control Panel Reports

Panel objects have a special data member named `print`. When `print` changes from `FALSE` to `TRUE`, *LookoutDirect* copies a picture of the control panel and sends that copy to your printer using the Windows Print Manager. You could use this to record the status of a particular panel at a particular time. For more information, refer to the *Panel* description in the online PDF *Object Reference Manual* or the online help.

To configure your custom report, design a control panel and connect a logical trigger signal to the panel. You can connect any logical expression to the `print` member. The control panel does not have to be visible to be printed. Therefore, an operator can view one screen (panel) while printing another screen. For more information about making connections, refer to the *LookoutDirect Getting Started Guide*.

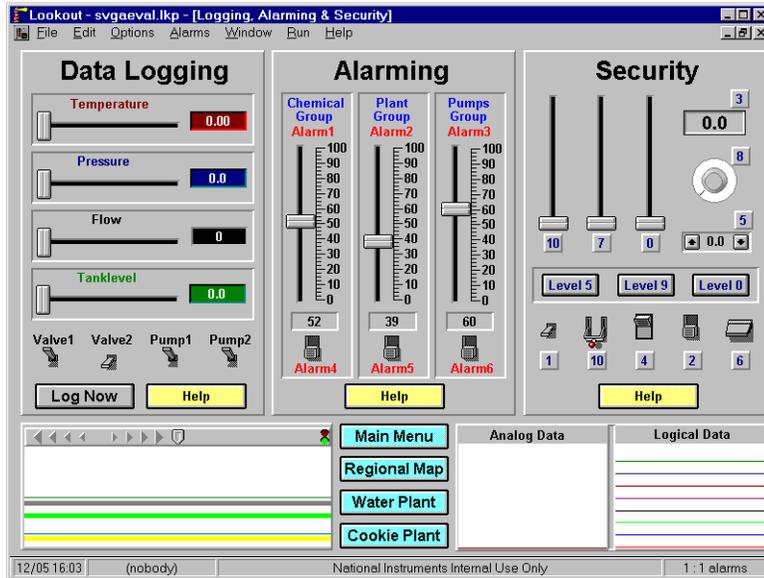
LookoutDirect determines the printed panel size based on dimensions entered in the **Revise control panel settings** dialog box. There are several ways to access this dialog box. First, make sure you are in edit mode. Then, do one of the following:

- Right-click on a panel title bar.
- Right-click on a panel in the **Object Explorer** and select **Properties**.
- Select **Object»Modify**, then select a panel from the list.

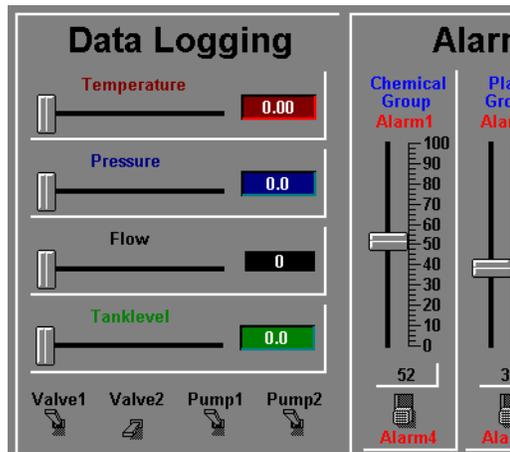


When **Panel type** is set to **Normal**, *LookoutDirect* assumes that the panel is maximized. Even though your control panel might be maximized, *LookoutDirect* prints only the area defined by your Panel object **Width** and

Height settings. For example, you might have a panel that looks like the following when maximized.



The panel shown above has a specified **Height** of 300 pixels and a **Width** of 400 pixels. At a video resolution of 800 × 600, the printed panel would look something like the following figure.



Modify the **Height** and **Width** dimensions of your Panel object to match your screen resolution. This problem applies only to **Normal** style panels. **Popup**

and **Popup no icon** style panels print according to the WYSIWYG principle (What You See Is What You Get).

Third-Party Reports

You can generate reports using *LookoutDirect* and a third-party spreadsheet program. Current spreadsheet software provides extensive macro command capabilities you can use to quickly generate reports from *LookoutDirect*. You can write Excel macros that prompt you for the report date, automatically open the correct spreadsheet file(s), extract the data, and print reports with combinations of numeric tables and graphs. You can launch these macros from *LookoutDirect* or automatically invoke them using predefined timers.

