

TORO

Count on it.

Sentinel™

Central Software User's Guide

Sentinel - 5.2.5 - Sample Golf Course

File Setup Utility / Diagnostics Group Operations Weather Flow Window

Unit Rain Graph Floptize Alarms Send Auto Send ET Exit

Unit Operations: Master Control Panel

Unit 001 created 8/8/2001 5:18:11 PM | blusky1.jpg

Outputs

- AUTO
- MANUAL
- PUMP

Receive

Send

Expected Flow:

0

Actual Flow:

Locations

Arrange

Locked

Un-Lock

Reports

Stn On Times Run Times Water Use Flow Graph ET Rain Print Close

UNIT 001

- alarm
- rain
- normal

Programming

- Special Data
- Time/Date
- Schedules
- Programs
- Zone Data
- Data Ret.

Status

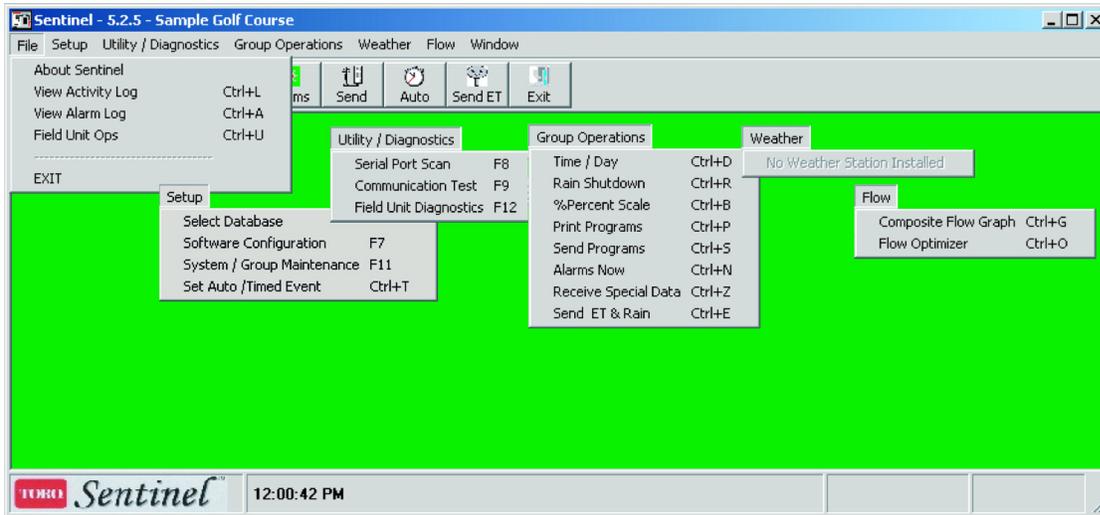
- Alarms
- Stn Days Off
- Programs

TORO Sentinel™ 1:50:52 PM

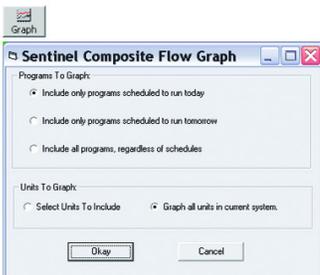
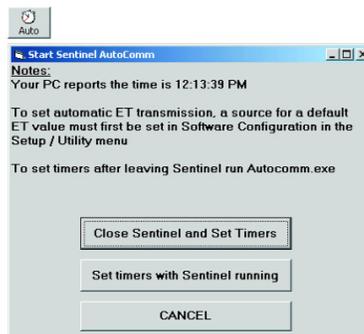
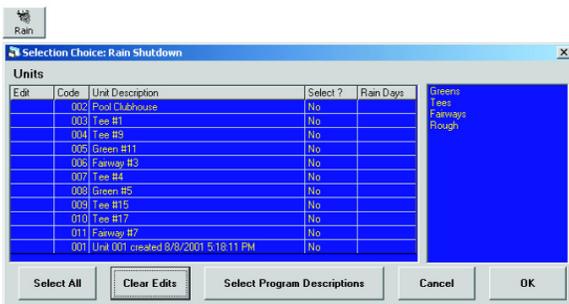
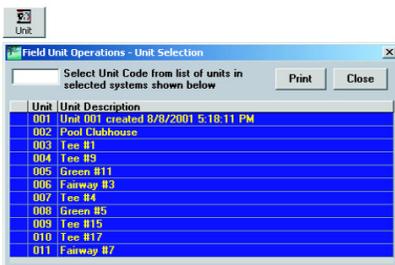
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Quick Reference



The six Sentinel main menus are displayed above. Listed with most of the menu items are a hot key (shortcuts) by which the Sentinel feature can be quickly accessed using keystrokes. The **Window** menu lists the shortcut to each opened utility window. Below the main menu is an icon tool bar which can be used to access the same Sentinel features from the main menu with a click of the mouse.



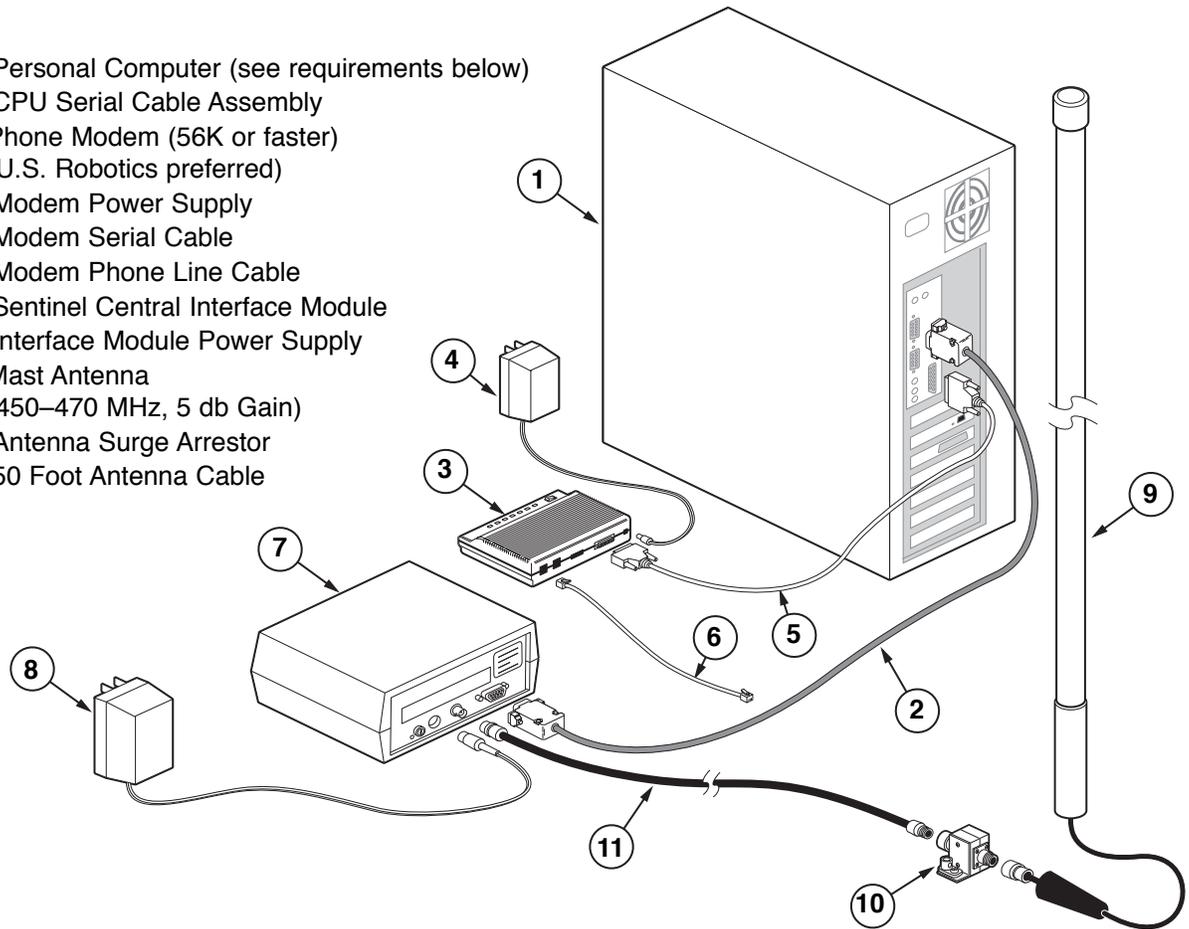
Chapter 1 : General Overview

User FCC-Licensing Responsibilities

The radios in this product communicate on frequencies under the control of the Federal Communications Commission (FCC). The user must apply for and be granted a frequency license which is site specific. All costs associated with obtaining and maintaining the license are the responsibility of the user and not The Toro Company.

System Hardware and Components

- 1 Personal Computer (see requirements below)
- 2 CPU Serial Cable Assembly
- 3 Phone Modem (56K or faster)
(U.S. Robotics preferred)
- 4 Modem Power Supply
- 5 Modem Serial Cable
- 6 Modem Phone Line Cable
- 7 Sentinel Central Interface Module
- 8 Interface Module Power Supply
- 9 Mast Antenna
(450–470 MHz, 5 db Gain)
- 10 Antenna Surge Arrestor
- 11 50 Foot Antenna Cable



System PC Requirements

Ensure that the PC on which you intend to install the Sentinel software meets the requirements outlined below. Install the Sentinel software to your central computer according to the instructions in **Chapter 2**. After successfully installing the Sentinel software, you must configure the software and create a system of field units corresponding to your actual Sentinel field controllers. See **Chapter 3** for guidance. Once a system is created, you may then program each field unit as described in **Chapters 4–7**.

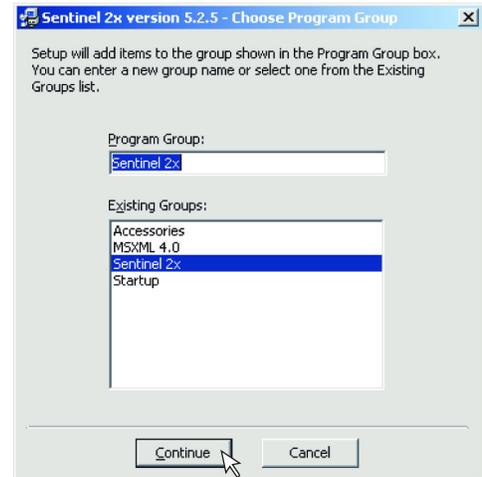
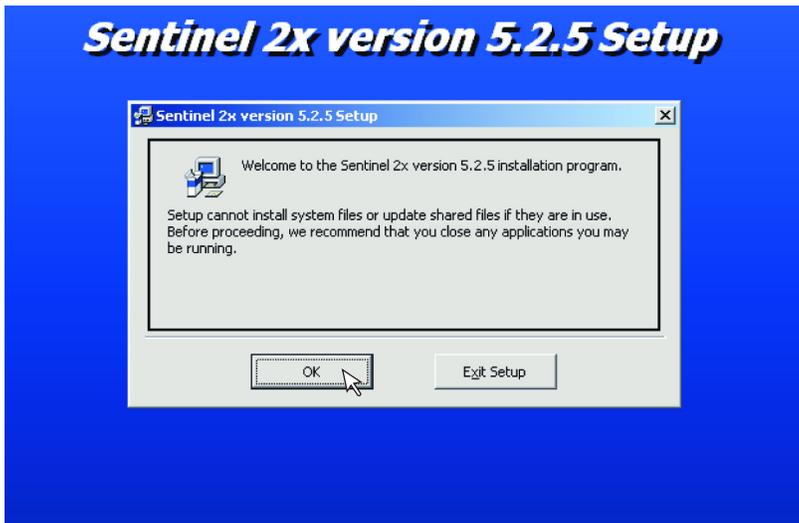
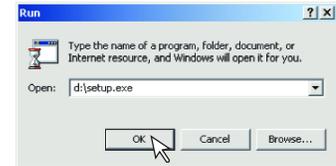
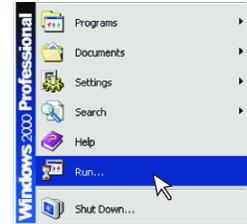
The following hardware and software are required to run Toro's Sentinel central software:

- Microsoft Windows 95, ME, XP or 2000
- Pentium–Pentium IV or 100% Compatible Processor, 1Ghz or Faster
- 2X or faster CD-ROM
- At least one RS232 serial communications port dedicated to the system.
- SVGA 600 x 800 or higher resolution video adapter and compatible monitor.
- Minimum of 32 MB RAM.
- Minimum of 540 MB HD (min 30 MB free space).

Chapter 2 : Software Installation

Note: Throughout this manual, the terms **folder** and **directory** are interchangeable.

Insert the Sentinel CD in your CD-ROM drive. If Windows is configured to detect new CDs, the Sentinel setup program will start automatically. Otherwise, open the Windows **Start** menu (located at the lower left corner of the screen) and select **Run**. In the Run dialog box, type **X:\Setup.exe**, where **X** is the letter of the CD-ROM drive, usually D: or E:. Press **ENTER** or click **OK** to start the Sentinel setup program. The setup program will allow you to specify the directory and program group in which to install Sentinel. Click **Change Directory** with the mouse to specify a different directory. The default directory (folder) is **C:\Program Files\Sentinel** and the default program group is **Sentinel 2X**. If upgrading from a previous software version, modify the folder and group name (example: Sentinel 520) to preserve the old installation and avoid confusion. After installation is complete, simply close the setup program by clicking the **X** in the upper right corner of the window with your mouse.



Chapter 3 : Getting Started

Software Configuration

Windows: Adjust Windows **Display Properties** to ensure complete visibility of the Sentinel screen. Close all programs, and with your pointer aimed in the middle of the screen (not over any icon), click the right mouse button. A menu window will launch. Click **Properties** from the menu. The **Display Properties** utility window will open. Select the **Settings** tab and set the **Screen area** to 800 by 600 or greater. A lower setting will prevent viewing each Sentinel window in full view. A color setting of more than 256 colors, such as 16-bit or 24-bit is also recommended. This is not required for normal operation of Sentinel but for satisfactory viewing of pictures you may insert for each field unit's screen display. Lower settings (16 or 256 colors) may improve the speed performance for slower computers.

Sentinel: To configure Sentinel, start the software by double clicking on the folder icon from the desktop. Double click on the Sentinel icon inside the folder. Do not click any other Sentinel icons before Sentinel is completely configured. The other Sentinel modules (**AutoComm**, **Flow Graph** and **Flow Optimizer**) will not function properly if launched before the Sentinel software is configured.

Sentinel can also be started by clicking the **Start** button, then **Programs**, then **Sentinel folder**, and finally **Sentinel**. This is just another option of launching the Sentinel central program.

During the window launch, an opening window will briefly display the logo and software version number. In this window, you will also see one of these four letter acronyms that designates the software editions:

- **BSCM** - Basic Software Control Module
- **ETCM** - ET Control Module - Central Software plus ET Support
- **OFCM** - Optimal Flow Control Module - Central Software plus Flow Optimization
- **AFCM** - All Feature Control Module - Complete Software Package with ET Support and Flow Optimization.

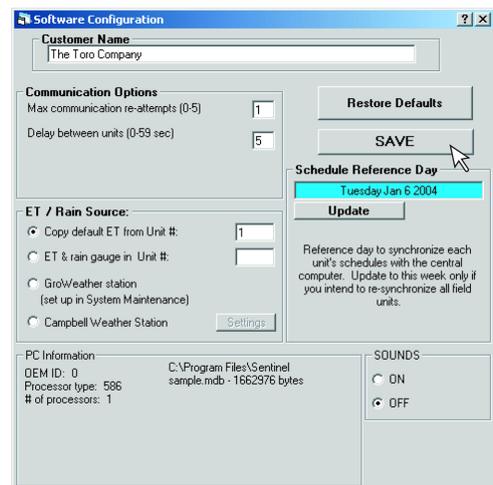
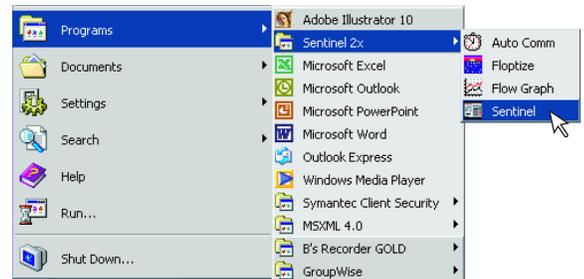
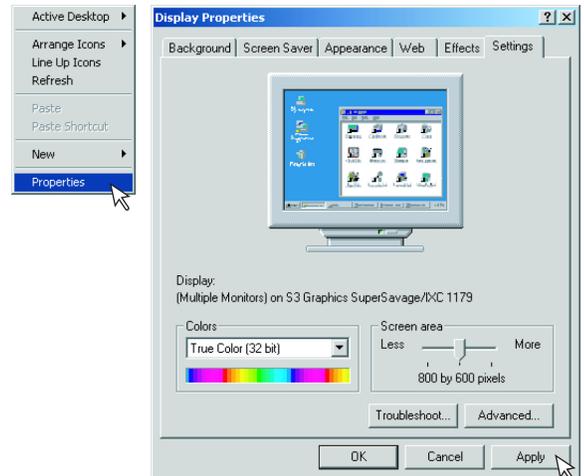
After starting Sentinel for the first time, the **Software Configuration** will open. This utility window will automatically open the very first time Sentinel is launched or when a new database is created. Sentinel uses the default file name **Sentinel.mdb** to create a main database. To access this window, select **Software Configuration** from the **Setup / Utility** menu. See **Chapter 16** for additional information.

You can enter the name of your organization in the white box at the top of this window.

NOTE: Throughout this manual, the Sentinel Field Satellite controller is referred to as **Unit** or **Field Unit**.

If you intend to irrigate based on ET (Evapotranspiration), you must select the source for ET and rain information before proceeding with the setup. If you select the first **ET/Rain Source** option, the daily ET value will be read from the Sentinel database for the specified unit. If you are not using ET based irrigation, the unit code entered here will not matter. Sentinel will never use the information. See **Chapter 10** for more details on ET function.

The **Schedule Reference Day** defaults to the date when the Sentinel software is first installed. Sentinel will use this date to mark the first week of the six-week schedule cycle. The software will calculate the schedules of all field units, even if they are programmed on different days, in relation to this date. You should never have to change this information.



Serial Port Scan

With the **Serial Port Scan** window selected in the **Utility / Diagnostics** menu, you can view what devices are connected to the central computer RS-232 serial communications ports (COM 1 through COM 4). **Scan All Ports** will automatically check each serial port one at a time. You can also scan each port individually. A **GroWeather** station will register as an **Unknown**.

Communication Test and **Field Unit Diagnostics** are covered in **Chapter 16**.



System / Group Maintenance

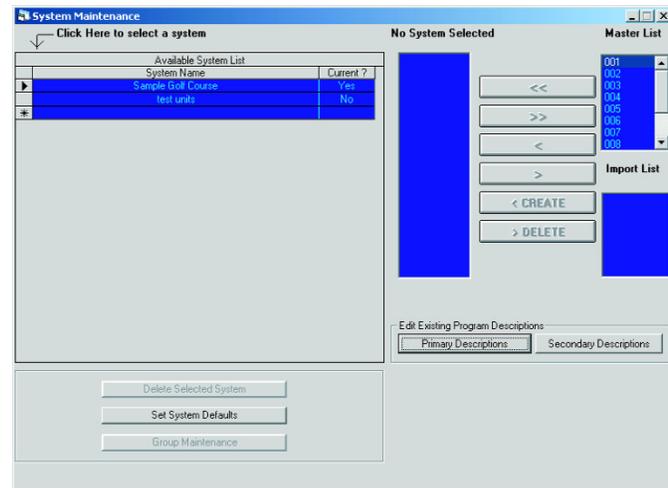
After configuring Sentinel, select **System/Group Maintenance** from the **Setup/Utility** menu.

Creating a system with a Weather station

Only do this step if you have a Weather station. If you are not using a weather station, skip to the **Creating A System of Field Units** section of this chapter. If you will be using a weather station, click **Add Weather Station**. Please note that this button will only appear if the **GroWeather** station was selected as the **ET/Rain Source** in the Software Configuration window.

Select the directory containing your **GroWeatherLink** software from the top file list. This directory contains a subdirectory for each GroWeather station displayed in the lower list. Select the station from the lower list, then click **OK**.

This will create a system where you can choose which Sentinel field units to include. When automatic ET transmission is finished, all of the field units that are added to the system will receive the ET and rain values recorded by the Weather station. If you have more than one Weather station, you must create a separate system for each one, then add all field units that will use its ET values.



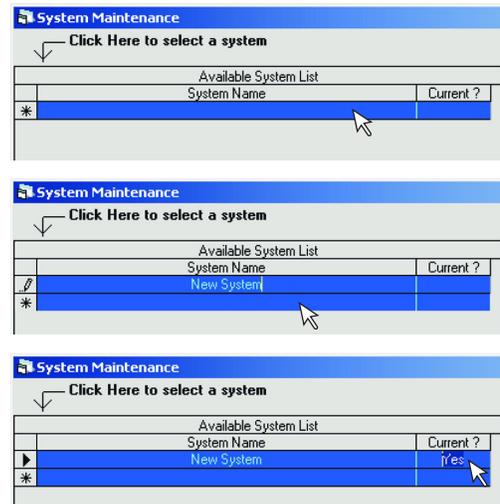
Creating a System of Field Units

Before you can program the Sentinel field units, you must create and name a system that will contain them. Type the name of your choice at the top empty **System Name** box in the **System Maintenance** window.

Click the blank space below the name you just created. This will prompt the system to generate a **No** in the **Current?** column. To select a system to be the current system, click on the **No** in the **Current?** column to toggle **No** to **Yes**. With **Yes** selected on the newly created system, programming of field units is enabled for this system. You may wish to create additional systems of units. This is useful, for example, if you plan to use the Sentinel **Flow Optimizer**. The **Flow Optimizer** function will optimize all programs in the current system. You can then make another system current and optimize it independently. If you don't have a specific need for multiple systems, create only one system to keep it simple. See **Chapter 15** for more in depth details regarding the **Flow Optimizer**.

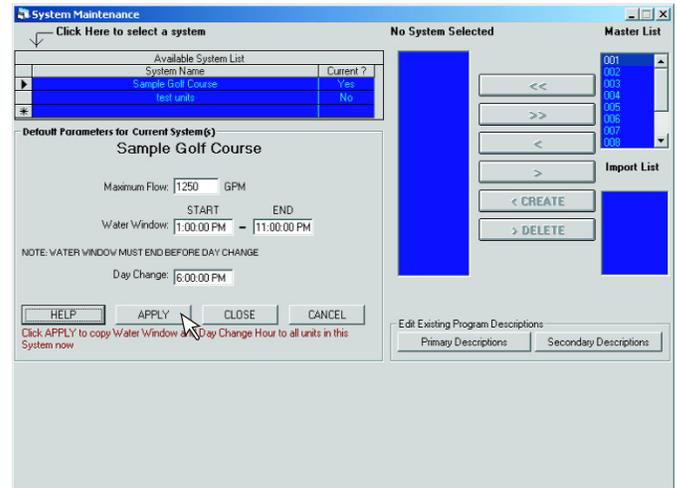
In order to create, add, or remove existing field units to a system, the system must be selected. Click the square box to the left of the **System Name** to select it. The triangular arrow point indicates which system is selected.

Once you have the system named and selected, the next step is to specify the field units within the system. Click the **Create** button located in the middle of the **System Maintenance** window. This will display a window to enter a field unit code. Enter the **3-digit unit code** programmed in the actual field unit that you want to add to the system. Repeat this process for each unit you want to include in the system. Sentinel will create a record in the system database for each field unit listed.



System Defaults

Once all the field units are listed in the system, you can set certain parameters that will apply to all of them. Click the **Set System Defaults** button within the **System Maintenance** window. The **Default Parameters** section will activate. Within its corresponding text fields, you can enter the **Maximum Flow** for the entire system. The same can be done for **Water Window Start** and **Water Window End** time, as well as **Day Change** hour. The **Day Change** hour must be outside the water window, unless the water window's start and end are identical, then the day change hour must be the same time as well. You must enter values here and click the **Apply** button if you intend to use the **Sentinel Flow Optimizer** to optimize the system. If you don't plan to use the **Flow Optimizer**, you can set a different **Water Window** and **Day Change** hours for each individual unit as described in **Programming Field Units**.



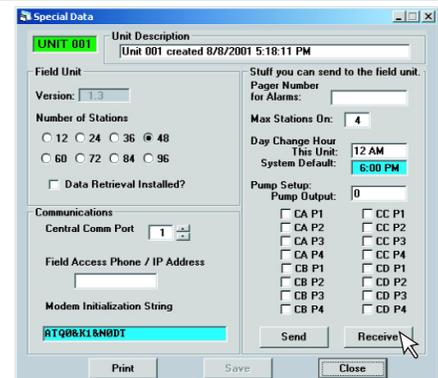
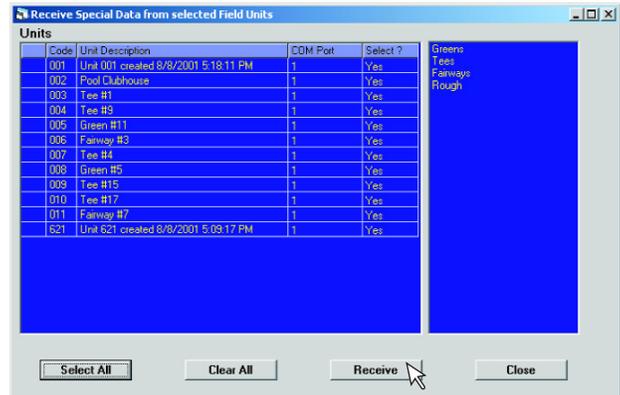
Proceed to **Chapter 4: Programming Field Units** to configure and program them individually.

Chapter 4 : Programming Field Units - Configuring Field Units

Receiving Special Data from Field Units

The **Special Data** should be received first from each unit before any other communication to the field unit takes place. Sentinel provides a utility window to select a field unit or a group of field units to upload the **Special Data** from. The **Receive Special Data** selection is located under the **Group Operations** menu listing. The example window shown at the right lists all units in the current system and indicates the **Comm Port** that each unit is assigned to.

By default, all units are selected when **Receive Special Data** window opens. You can deselect any unit by toggling the **Yes** to **No** under the **Select?** column. The **Clear All** button can be used to deselect all or **Select All** to choose all field units. If group(s) of field units have been set under **System / Group Maintenance**, the group name(s) will be available for selection from the list labeled **Group(s)** at the right side of the window. When the selection process is complete, click **Receive** and Sentinel will read the **Special Data** from all selected field units one at a time.



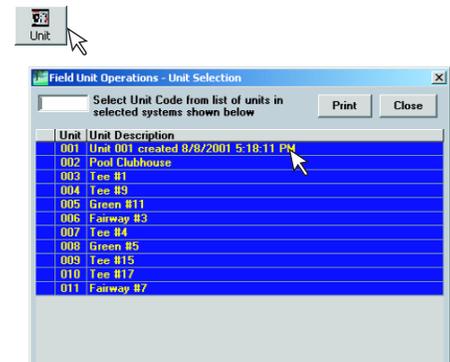
Configuring Individual Field Units

Once you have listed the field units in the current system, you can program them individually. To select a field unit to program, click the **Unit** icon in the upper left corner of the main screen or select **Field Unit Ops** from the **File** drop-down menu or hold down the **CTRL** key and press **U**. (Many menu items can be selected with hot keys. See the illustration in the **Quick Reference** section.) This will open the **Unit Selection** window which displays the list of all units in the current system.

A **Print** button is provided if you wish to print this list. It will use the Windows default printer. Select the first unit you want to program or type the 3-digit code in the text box above the list. Unit **001** is used as an example in the picture.

NOTE: The unit description initially states the time & date the unit was created in **System Maintenance**. Changing the description is covered in the next section.

When a specific unit is clicked, the **Master Control Panel** will open.



Master Control Panel

The **Master Control Panel** groups together all of the tools necessary to configure and program a specific field unit, check the status and view the reports. All windows shown in the following sections of this chapter are accessed here.

Displaying a Picture in the Master Control Panel

You can display an image of the actual field unit or associated landscape unique to the selected unit. Sentinel can display two different picture formats, **BMP** and **JPEG**. For Sentinel to recognize the picture, the file must be in the appropriate format and have the proper extension, “.bmp” or “.jpg.” You can have more than one picture for a single field unit. The picture files must reside in the Sentinel folder in order to appear in the list box at the top of the **Master Control Panel**. To display the image file, scroll through the image list by clicking the small arrows at the right of the text box. When you see the desired file name, double-click it with the mouse and the image will replace the background.



Special Data

The first step in programming a field unit is receiving and setting the **Special Data**.

Receive Special Data must be performed first in order for Sentinel to record the field unit firmware version before proceeding to any other utility window. Sentinel will automatically configure other windows according to the received field unit software version for compatibility.

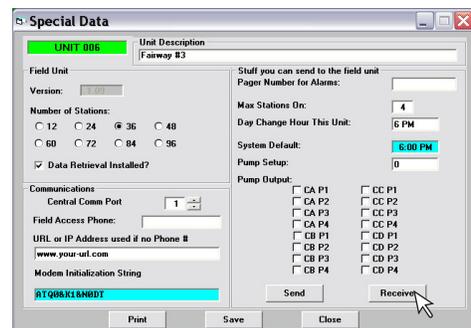
See **Receive Special Data** section in this chapter. If a Sentinel Radio module is installed, the group operation utility can be used to receive the field unit special data from several field units at once.

Click the **Special Data** button from the **Master Control Panel**. This will open the **Special Data** window which contains the settings for a number of stations, firmware version, Data Retrieval option, Central Comm Port, Field Access Phone number, Pager Number for Alarms, maximum number of station that are active simultaneously, Day Change Hour (if different from the system default set in System Maintenance), and Pump Setup.

NOTE: The unit code in the upper left corner has a green background. This is typical of all unit-specific windows in the Sentinel software which will either be located in the upper left or upper right corner of the window. This little box will turn red if an alarm condition is detected from the field unit during a communication. It will turn yellow if the unit is currently shut down for a Rain Day.

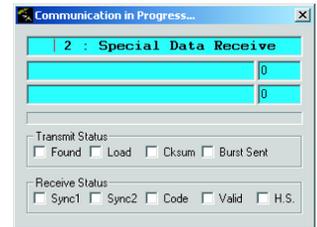
The **Unit Description** can be modified in the **Special Data** window. You can enter any text you desire in the description text box at the top, up to 50 characters in length. This unit description will appear, along with the unit code, in the other Sentinel screens, including the **Unit Selection** window shown at the start of this chapter.

NOTE: Do not change the **Day Change Hour** here (Special Data window) if you intend to use the flow optimizer, which requires the same setting for all units in the current system. You can change the default settings in **System/Group Maintenance**.



The most important item of **Special Data** is the **Comm Port**. If you are not sure which port Sentinel uses to communicate with a field unit, you can run the **Serial Port Scan** from the **Utility/Diagnostics** menu. This function can detect a Sentinel field unit, Sentinel modem, or phone modem on any of the central computer serial ports. See **Chapter 16** for more details.

After selecting the correct **Comm Port**, you can click the **Receive** button to verify the field unit version and number of stations from the unit itself. During communication with the field unit, a status window labeled **Communication in Progress** will briefly appear. This window, referred to as the **Comm Progress** window, indicates progress as communication is established and while data is being transmitted or received. This window will appear every time the **Send** or **Receive** button is clicked from any Sentinel screen. It can also be used to monitor if a break or an error in communication occurs. The top blue box will indicate the type of communication in progress, in this case **Special Data Receive**. It will turn green when the operation is successfully completed or it will turn red if an error occurred during transmission. The blue boxes below the window displays the data being sent or received. The check boxes at the bottom half of the window are successively checked to indicate completion of each step during the communication process.

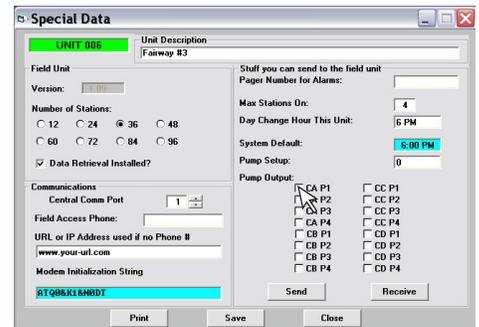


After the data transfer is completed, Sentinel will display the received field unit version, unit code, number of stations, pager number, day change hour and pump setup.

If you are using a phone modem to communicate with the field units at a remote site, enter the field unit phone number under **Field Access Phone**. If you are using the internet to communicate with the field unit, enter the URL or IP address under **URL or IP Address used if no Phone#**. If you will use the paging feature, enter the pager number in the box labeled **Pager Number** for Alarms. With a pager number entered, Sentinel is able to send a page notification whenever an alarm is activated.

Pump Setup

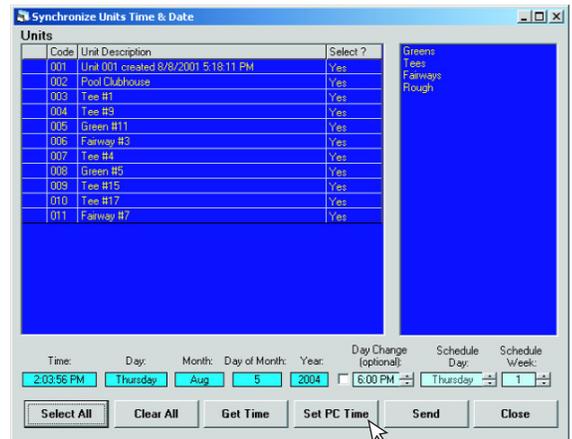
In the **Special Data** window, you can assign any station to a pump. Type the station number in the box labeled **Pump Output**. Each unit has four clusters of four programs for a total of 16 programs which are discussed in detail in **Chapter 5**. Check all programs that need the pump activated. If you do not wish a program to start the pump, leave the box unchecked.



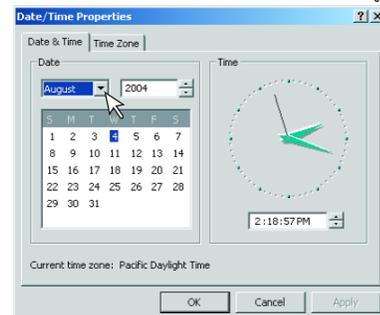
Synchronizing Time and Data in Field Units

After **Special Data** is received from each unit, the time and date can be synchronized in one group operation. From the **Group Operations** menu, select **Time/Day**. The new window will list all units in the current system that can be synchronized.

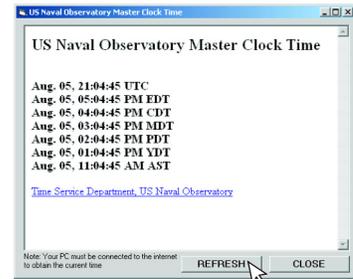
By default, all units are selected but you can deselect each unit by clicking on the box under the **Select?** column which toggles the selection from **Yes** to **No**. If groups of units have been set in **System / Group Maintenance**, the group names will be available for selection under the **Group(s)** column at the right side of the window. **Select All** and **Clear All** buttons are also provided at the bottom of the window.



The first five text boxes along the bottom of the window displays the **Time, Day of the Week, Month, Day of Month** and **Year**. These are the values that will be sent to the selected field units. These values are based on the time and date information set in the PC. If the values are not accurate, you can adjust the settings by clicking the **Set PC Time** button. This will launch the PC Date and Time Properties window.



If the PC has an internet connection, the current time and date information can be checked by clicking the **Get Time** button. A browser window will launch which will display the current time and date (in several time zones) retrieved from the **US Naval Observatory** website. To update the displayed information on the browser, click the **Refresh** button. The PC must be connected to the internet for this function to work. Use the given information to update the time and date of the PC and the field units.



The **Day Change Hour** is optional because you may wish to have different **Day Change** Hours for each individual unit. It will not be sent to the selected units unless the check box under **Day Change** is activated. Activating the check box will instruct Sentinel to send the **Day Change** Hour information. You can change the **Day Change** hour by scrolling through the desired Hour using the Up and Down arrows next to the text box.

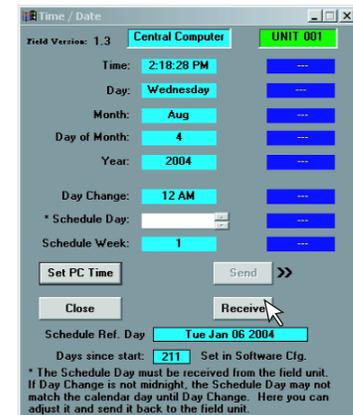
After completing the information update, click the **Send** button. Sentinel will then transmit the displayed information to each of the selected field units.

NOTE: Closing the **Synchronize Units Time & Date** window without clicking **Send** will not update the field unit information.

Time / Date - Master Control Panel

After configuring **Special Data**, you should click **Time/Date** button in the Master Control panel to open the **Time / Date** screen. The time and date set in your PC will automatically display under Central Computer. The displayed time is synchronized with the computer's clock. Clicking the **Set PC Time** button will enable you to set the computer's time.

Click the **Receive** button to read the time and date from the field unit to check its accuracy. To send the correct time and date to the field unit, click the **Send** button. **Send** is only enabled after **Receive** is processed. The data in the left column is sent to the field unit, then received back from the field unit and displayed at the right column for verification. The **Communication Progress** window will appear during the data transfer, as for all communications between the Central and a field unit.

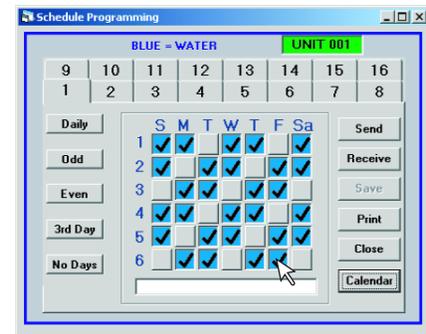


The **Schedule Reference Day** is simply the date the software was first configured on your central computer. The date can be updated at the **Software Configuration** screen. By using this date as its reference, Sentinel ensures all schedules are on the same schedule week.

Schedule Programming

You can define 16 different schedules for a field unit. All 16 schedules are available to any of the field units 16 programs. You can type a description for each schedule in the bottom text field. To switch the view to a different schedule, click the desired tab (1, 2, 3, etc.) at the top. Each schedule is six weeks long. Sentinel uses the **Reference Date** to automatically determine the current week of each schedule.

To select a day for irrigation, click the box corresponding to the day and week. Days selected for irrigation (**Run Days**) are blue with a check mark. To deactivate a day, so no program will run that day, click it to change it back from blue to the background color. Buttons on the left of the calendar will fill simple patterns; **Daily**, **Odd** days, **Even** days, every **3rd Day** or **No Days**. You can also click on the day letter above the column to select the entire column or click the week number at the left to select an entire week. Double clicking on the same letter or number will deselect that column or row. The **Send** button will transmit the schedules to the field unit, which stores all **Run Days** for each schedule. The **Receive** button will retrieve all 16 schedules (four for older field units) from the field unit. Sentinel will not save the received schedule to the database until the **Save** button is clicked.



NOTE: For older field units with an earlier software version which only support four schedules, the **Scheduling Program** window will only display four available schedules. This is determined by the field unit firmware version received in **Special Data**.

The **Print** button will print an image of the selected schedule on your default printer.

The **Calendar** button displays a schedule outlook for the current month with the selected schedule plotted. You may notice on your screen that the first schedule week is not necessarily the first week of the month on the calendar. This is because the schedules are six weeks long, so the first week may occur at different positions on the calendar, depending on the month. This relationship is determined by the **Reference Day**.

From the **Calendar** screen, you can view the irrigation schedule of any month with any or all of the 16 schedule patterns. **Run Days** (days selected for irrigation) are indicated with a blue box under the calendar day. Days without any blue box designated to them are disabled for irrigation.

You can also add your own labels to the days. To do so, click the **Edit Notes** button. This will allow you to enter a 30-character description, such as a holiday name, in the yellow space at the bottom of each day. (Only about 11 characters will show.) You can pick the **Lock Notes** button to freeze these labels temporarily, but **SAVE** must be clicked to assign them to the date. When saved, the labels will always appear on the assigned calendar date on all schedules of all field units. Once saved, the notes will appear against a green background.

Except for the notes below each day, nothing else you do on this screen can be saved or affect the schedules of the programs. This screen is for viewing the schedules in relation to the calendar format.

You will see how these schedules are assigned to the programs in **Chapter 5**.

NOTE: Receive **Special Data** must be performed first before setting **Schedules**. If it is not, field units with 16-schedule capability are assumed to have only four-schedule capability by default.



Chapter 5 : Programming Field Units - Auto Programming

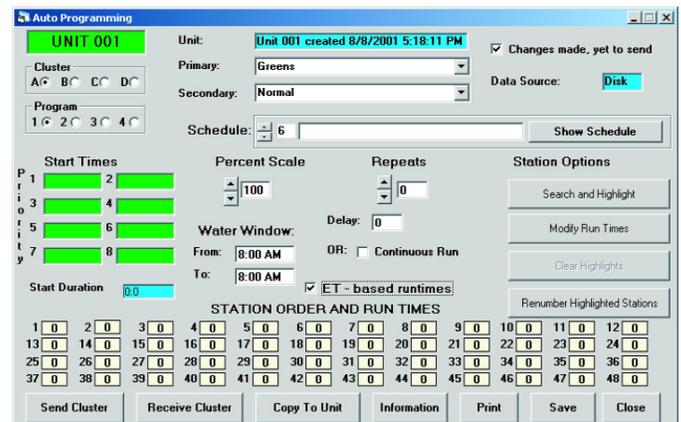
Auto Programming

The **Auto Programming** window (under **Master Control Panel / Programs**) is the hub of the entire Sentinel system. This is where you can control the automation of starting, running, stopping and repeating all stations of each field unit. Each field unit can have 16 programs. Each program can use any of the 16 custom schedules defined in Schedule Programming. The 16 programs are divided into four clusters, **A** through **D** and each cluster having programs 1 through 4. Every parameter on the current selected program must be configured and saved before proceeding to the next program. You can pick a different cluster and program by clicking the desired letter and number in the upper left corner of the window. A cluster of four programs can be transmitted to the field unit at one time or after all programs are saved, you can send all 16 programs to the field unit at once with the **Automatic Communications** function described in **Chapter 11**.

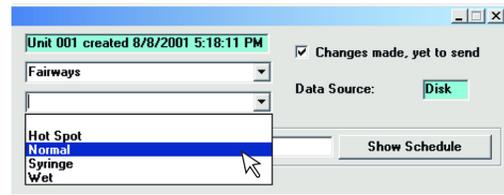
NOTE: If planning to use the **Flow Optimization** feature (**Floptize**), only six programs can be used due to the field unit's maximum simultaneous operation of six stations. Refer to the section **Start Times** and the **Flow Optimizing Parameters** for more information.

The schedule will determine the days the program will run. The field unit will not run a program on a day that is not selected in the assigned schedule. To assign a schedule to the program currently selected, toggle the up/down arrow at the left side of the schedule number. The schedule description is displayed at the right side of the number. You can show and hide the entire schedule for reference by clicking the **Show Schedule** button. The button changes to **Hide Schedule** when the schedule window is activated.

You can assign the **Primary** and **Secondary** descriptions for each program at the top center of the **Auto Programming** window (beneath the **Unit** description). Use a description that pertains to the program selected. Once a description is typed and saved, that description is available as a selection for other programs to use. When you select a different program and click the down-arrow at the right side of one of the description boxes, a list of all descriptions that have been saved will be displayed for selection.



Try to choose phrases for the **Primary** descriptions that describes large categories of programs, such as types of landscapes or locations. Use the Secondary Descriptions for a different kind of breakdown such as methods. In the picture above, the primary description groups programs by landscape, while the secondary describes methods. Thus all programs for **Normal** irrigation of **Fairways** are quickly selected by these descriptions. Unfortunately, once a description is entered and saved, you can not delete it from the list due to the relational nature of the Sentinel database. However, you can always add new descriptions if you need more selection.

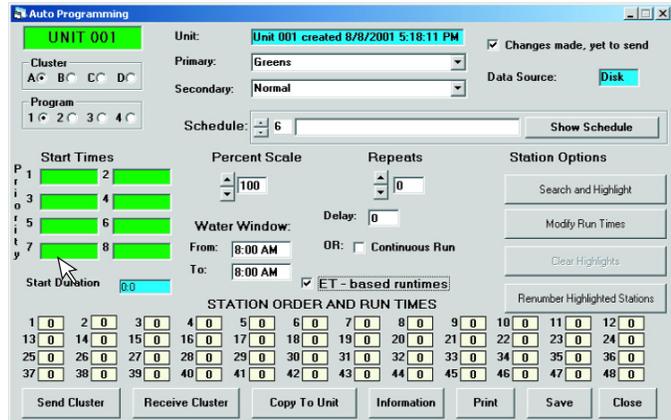


To the right of the descriptions, you will see two indicators, **Data Source** and **Changes made, yet to send**. When you open the **Auto Programming** window, programs are read from the Sentinel database from the PC hard drive, thus the **Data Source** reads **Disk**. After you receive data from the field unit, the **Data Source** will change from **Disk** to **Field**. This indicator enables you to determine where the displayed program data originated.

When any parameter on the **Auto Programming** screen is altered, a checkmark will appear in the check box next to **Changes made, yet to send**. It will remain checked until you send the updated program to the field unit (either from this window or with **Automatic Communications** described in **Chapter 11**) or manually clear it by clicking the checkmark with the mouse. This is a reminder that changes have been made but have not been sent to the field units.

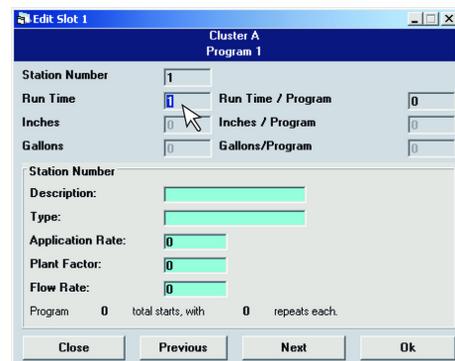
Program Slots

Referring to the **STATION ORDER AND RUN TIMES** section of the **Auto Programming** window (accessed by clicking **Programs** in the **Master Control Panel**), note that there are 48 slots represented by boxes with numbers inside and next to them. These slots represents the run time slices that form a program. The number inside each box is its own station run time in minutes. It is important to understand that the number next to each box is not the slot number but the station number or valve number that is assigned to that slot. The station number or valve number refers to the field terminals that the field unit controls. Initially there is a one-to-one correspondence, station 1 is assigned to slot one, station 2 is assigned to slot two and so forth. You can change this and assign any station to any slot and even assign the same station to a number of different slots. When you first start using Sentinel, all of the run times in the boxes are zero and all the stations are listed in order alongside the slots. The slots determines the succession of stations that will run in the given program.



To change a run time and/or assign a station, click on the box. The **Edit Slot** window will open. You can change the **Station Number** and enter the **Run Time** in minutes at the corresponding box. The other activated text boxes in the **Edit Slot** window will depend on the station information entered in the **Zone Data** screen. This is explained in **Chapter 6** in greater detail.

For now, we will only deal with the **Run Time** entered in minutes. As an example, suppose we change the station number 6 to 1, and enter a run time of 1 minute. Save this change by clicking **OK**, then **Close**. The result is shown below. Now there are two slots with station 1.

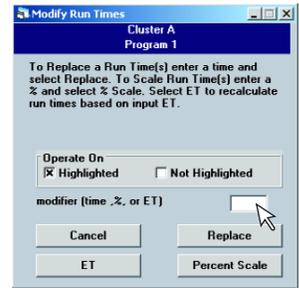


1	3	2	3	3	3	4	3	5	3	1	1	7	20	8	20	9	20	10	20	11	20	12	0
13	15	14	15	15	7	16	7	17	7	18	7	19	7	20	7	21	7	22	7	23	0	24	0
25	0	26	0	27	0	28	0	29	0	30	0	31	0	32	0	33	0	34	0	35	0	36	0

Now we'll see how a number of slots can be edited in rapid succession. Click slot box 7 with the mouse and an **Edit Slot** window will open. After proper changes are made in the **Edit Slot** window, click **OK** to save it. Instead of clicking **Close**, click **Previous** or **Next** to edit the slot to the left or right of the currently selected slot. As an example, we can start with slot 7. We assigned station 2 to slot 7 with 5 minutes run time, clicked **OK** and **Next** to move up to slot 8, changed it to 3, and so on.

We could proceed indefinitely and click **Close** after editing the last slot desired. There is an even faster way to edit a number of slots. You can change the run times of any number of slots simultaneously. To select a group of slots for editing, place the mouse cursor directly over the station number of the first desired slot. When clicked with the mouse, the station number will change to white to indicate that it is selected. You can repeat this for any slots. To select several at once, after clicking the first station number, hold down the **shift** key and move the mouse to the station number of the last desired slot. All of the slots in between both numbers will be selected and the corresponding station numbers will change to white.

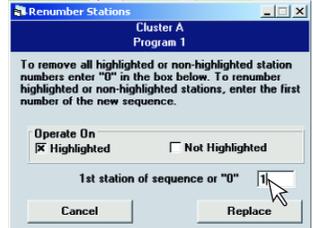
Now click the **Modify Run Times** button under **Station Operations** at the right side of the screen. The **Modify Run Times** window will open in front of the **Auto Programming** screen. It has several options, but for now, note that you can simply enter a time in minutes and hit the **Replace** button. All selected slots will have their run time changed simultaneously. The new run time will replace the old run time for all selected slots. You can also pick the **Percent Scale** button to reduce or increase run times of the selected stations by the same percentage. The **ET** option will be discussed in **Chapter 10**.



For example: Select slots **1** through **8** by holding the shift key while clicking **1** and **8**. If **3** is entered in the modifier text box, clicking the **Replace** button and **OK** will replace all the run times of slots **1** through **8** with **3** minutes.

STATION ORDER AND RUN TIMES																							
1	3	2	3	3	3	4	3	5	3	6	3	7	3	8	3	9	20	10	20	11	20	12	15
13	15	14	15	15	7	16	7	17	7	18	7	19	7	20	7	21	7	22	7	23	0	24	20
25	0	26	0	27	0	28	0	29	0	30	0	31	0	32	0	33	0	34	0	35	0	36	0

The **Renumber Highlighted Stations** command allows you to replace the selected station numbers with **0** or any station number sequence desired. Simply enter the first number in the sequence and the remaining stations will be numbered sequentially.



NOTE: It is not necessary to reset the station number to **0** to prevent the station from running if the station runtime is already set to **0**, which causes Sentinel to ignore the slot.

For example: Select stations 6 through 10 by holding the **shift** key while clicking on **6** and **10**. Click **Renumber Highlighted Stations** and enter **1**. Stations **6** through **10** will automatically be renumbered with **1** through **5**.

Modify the run times of the newly renumbered stations to 5 minutes.

STATION ORDER AND RUN TIMES																							
1	3	2	3	3	3	4	3	5	3	1	5	2	5	3	5	4	5	5	5	11	20	12	15
13	15	14	15	15	7	16	7	17	7	18	7	19	7	20	7	21	7	22	7	23	0	24	20
25	0	26	0	27	0	28	0	29	0	30	0	31	0	32	0	33	0	34	0	35	0	36	0

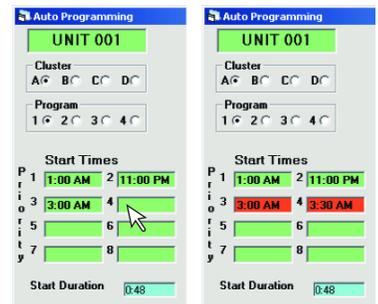
The **Search and Highlight** command is discussed at the end of **Chapter 6: Zone Data**, which explains the process of selecting stations by descriptions entered in the **Zone Data** screen.

Click **Clear Highlights** to deselect the five slots and change the station number color back from white to black. If this were transmitted to the field unit along with a **Start Time**, station 1 would run for 3 minutes, followed immediately by stations 2 through 5 for 3 minutes each, in order. It will be immediately followed by station 1 again for 5 minutes this time and then stations 2 through 5 for 5 minutes each. Though more stations are assigned to other slots, they are ignored since they have zero run times.

Start Times

You can assign up to eight start times to each program. The program will start at the earliest start time within the **Water Window**, and re-start at each additional start time. If the time between two different starts is less than the total duration of the program, the boxes will turn red to warn you that a conflict exists and the start time will be ignored.

IMPORTANT: Do not assign the starts such that more than the maximum number of programs will be scheduled to run simultaneously, as the controller firmware will only allow up to the maximum station number of outputs that are on at one time. Assigning the same start time to more than six programs will be displayed properly when you run a flow graph, but only the first six programs will run. Any remaining programs having the same start time will not run at all. (This is a hardware limitation.)



The order number of the **Start Times** is not important. In the first picture above (**Water Window** set at 8:00 AM to 8:00 AM), the first program will start at 11:00 PM because it is the earliest start time according to the **Water Window**. The program will start again at 1:00 AM and again at 3:00 AM. The **Priority** order number next to the text boxes do not apply here. These are used by the **Flow Optimizer** which is discussed in **Chapter 15**. If utilizing the **Flow Optimizer**, **ONE AND ONLY ONE** start time must be entered, but the value is not important because the Flow Optimizer will re-assign all start times. In this case, the **Priority** number is important. The order of the text field that the start time is entered determines its priority within the entire system for optimization.

Percent Scale

The **Percent Scale** next to the **Start Times** can adjust the percent scaling of the program **Run Times**. You can enter any value from **0** to **250** or adjust the value by clicking on the **up/down** arrows. 100 is normal, meaning 100 percent of the actual run time. A smaller value will reduce the run time of each slot to that percentage and a larger value will increase it. For example, 200 would double the run times. This factor applies to all slots for the selected program, and therefore to the total duration (**Start Duration**) of the program. The run times in the slots will remain unchanged on the screen because the percentage is applied in the field unit after it receives the program. However, the **Start Duration** is updated to reflect the percent scaling for an instant reference.

For example: With a percent scale of 200%, stations 1 through 5 assigned in slots 1 through 5 will run for 6 minutes each (200% of the 3 minutes entered in slots 1 through 5), then another 10 minutes each for stations 1 through 5 assigned in slots 6 through 10 (200% of the 5 minutes entered in slots 6 through 10), for a total of 80 minutes, or 1 hour and 20 minutes. This scaled-up total applies to all three start times.

Water Window

The **Water Window** is the period of time during each day when irrigation is allowed. The field unit will disable irrigation outside the water window time. In the picture above, the start and end of the **Water Window** are exactly the same, from **8:00 AM to 8:00 AM**, so irrigation is allowed for 24 hours each scheduled day. If the end of the **Water Window** was changed to **11:30 PM**, the program will never finish. Irrigation will cease at 11:30 PM, half an hour after the 11:00 PM **Start Time** and the program is still 50 minutes short of being completed.

If you are required to complete all irrigation within a certain daily period, you can set the water window to that length. If necessary, you can use **Percent Scaling** to adjust the duration of the program until it fits within the watering window.

Continuous Run

Continuous Run is a special case of the **Water Window**, in which all non-zero slots will continue to run from the beginning to the end of the **Water Window**. To work this way, the **Water Window** must end at least 1 minute short of a full day. The program will start at the beginning of the **Water Window** and repeat continuously until the end of the **Water Window**. The **Sentinel Flow Optimizer** cannot optimize programs using the continuous run option because it optimizes the system through re-assignment of start times. Therefore, **Continuous Run** programs are automatically excluded from optimization.

Repeats

The **Repeat** option will automatically repeat the program for the specified number of times. You can enter any value from **0** to **250**. Zero will let the program run once and never repeat, 1 will repeat it once, and so on. If repeating the program causes the total **Start Duration** to exceed the time between two **Start Times**, the **Start Times** will turn red to warn you. In the picture, percent scaling was already set at 200%, doubling the original **Start Duration** of 40 minutes to 80 minutes. The repeat again doubled the total to 2 hours and 40 minutes, exceeding the time between starts.

Delay

You can enter a **Delay** between repeats, in minutes, of any value from 0 to 255 (4 hours, 15 minutes). After the first time the program runs, the program will wait for the specified amount of delay time before repeating. The program will then run again and delay the same amount of time and so on.

The screenshot shows the 'Auto Programming' window for 'UNIT 001'. The 'Percent Scale' is set to 200. The 'Water Window' is set from 8:00 AM to 8:00 AM. The 'Start Times' are 1:00 AM, 11:00 PM, and 3:00 AM. The 'Start Duration' is 1:20. The 'Station Order and Run Times' table shows 48 stations with run times of 0 minutes.

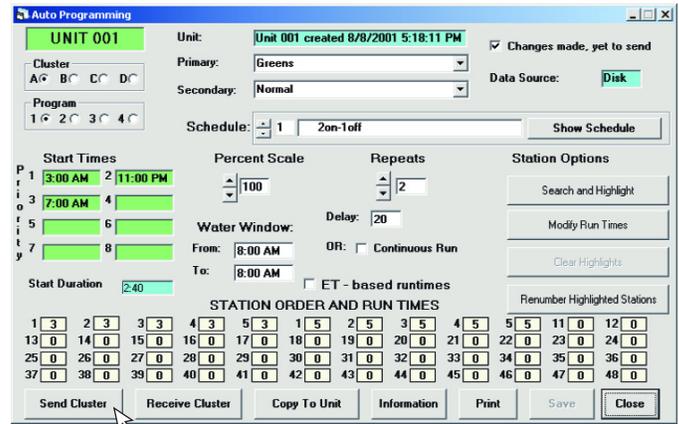
STATION ORDER AND RUN TIMES																																																																																															
1	3	2	3	3	3	4	3	5	3	1	5	2	5	3	5	4	5	5	5	11	0	12	0	13	0	14	0	15	0	16	0	17	0	18	0	19	0	20	0	21	0	22	0	23	0	24	0	25	0	26	0	27	0	28	0	29	0	30	0	31	0	32	0	33	0	34	0	35	0	36	0	37	0	38	0	39	0	40	0	41	0	42	0	43	0	44	0	45	0	46	0	47	0	48	0

The screenshot shows the 'Auto Programming' window for 'UNIT 001'. The 'Repeats' is set to 1. The 'Percent Scale' is set to 200. The 'Water Window' is set from 8:00 AM to 8:00 AM. The 'Start Times' are 1:00 AM, 11:00 PM, and 3:00 AM. The 'Start Duration' is 2:40. The 'Station Order and Run Times' table shows 48 stations with run times of 0 minutes.

STATION ORDER AND RUN TIMES																																																																																															
1	3	2	3	3	3	4	3	5	3	1	5	2	5	3	5	4	5	5	5	11	0	12	0	13	0	14	0	15	0	16	0	17	0	18	0	19	0	20	0	21	0	22	0	23	0	24	0	25	0	26	0	27	0	28	0	29	0	30	0	31	0	32	0	33	0	34	0	35	0	36	0	37	0	38	0	39	0	40	0	41	0	42	0	43	0	44	0	45	0	46	0	47	0	48	0

Program Transmission

In the example picture, we have adjusted the **Percent Scale** factor back to 100, added a 20-minute delay, and changed two of the **Start Times**, just enough to allow the program to complete its cycle between starts. Now we have a workable program but it will not run yet because the field unit is not aware of the program changes. Clicking the **Send Cluster** button will open the **Communication In Progress** window and transmit all programming data seen on the **Auto Programming** screen to the field unit, where it is stored in tables.



This includes everything you see on the **Auto Programming** screen with the exceptions of the unit and program descriptions. It includes the **Start Times**, **Schedule** assignment (the actual schedule must be sent from the Schedule window), **Percent Scale**, **Repeats**, **Delay**, **Water Window start and end**, **Continuous Run** option, **Station Order** (station/valve number assigned to each slot) and **Run Times** of all slots. Furthermore, note that the command is **Send Cluster**, which means the entire cluster of all four programs is sent at the same time. Not just the data you see on the current screen is sent, but all the data for the other three programs in the cluster are sent as well. In this case, all programs of cluster A from A 1 (shown), A 2, A 3, and A 4 are transmitted at the same time. This enables you to define four different programs, then send them all at the same time in one operation.

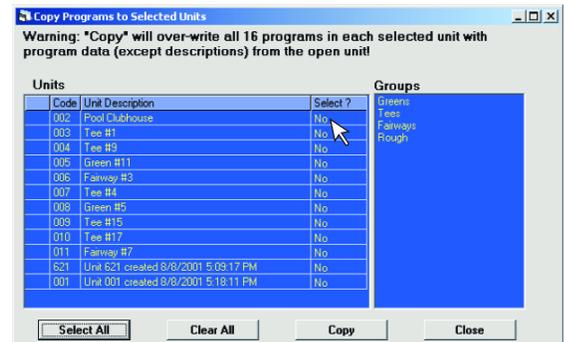
Once the data is saved in the field unit, it can operate on its own. In the example above, the program will begin at the next start time to occur after the unit receives the program (if it is a scheduled run day). Slot 1 will run station 1 for 3 minutes, slot 2 will run station 2 for 3 minutes, and so on, until slot 10 runs station 5 for 5 minutes. Slots 11 through 48 will be ignored because there are no run times. The program then executes the 20-minute delay, running no programs. After the delay, the first repeat begins the whole cycle again, followed by another delay and the second repeat. Then the unit will wait for the next Start Time, unless one of the other 15 programs takes over. Remember: Any program of any cluster can control any combination of all the field unit stations.

The **Receive Cluster** command is available for two reasons. You may wish to receive programs to verify that programs sent to the field unit were transmitted accurately. Also, if you have upgraded the Sentinel software, this is a handy way to retrieve the programs from field controllers and save them into the new database in the Central computer. Like the **Send Cluster** command, **Receive Cluster** will open the **Comm Progress** window, but instead of transmitting, it will receive all four programs of the selected cluster from the field unit, and replace what you see on the screen with the program received. The received data will replace the cluster (four programs) in the Central computer when you click the **Save** command.

Copy Programs to Field Units

Depending on the situation, similar programs might be needed in multiple field units. In this event, Sentinel provides a utility to copy all of the programs from the currently accessed field unit to all units selected in the database.

To copy the programs, click the **Copy to Unit** button from the **Auto Programming** window. A new utility window will open with a list of all field units in the current irrigation system. By default, no field unit is selected. Select one unit at a time by toggling **No** to **Yes** under the **Select?** column. **Select All** and **Clear All** buttons are also provided at the bottom of the window. If groups of field units are already setup in **System / Group Maintenance**, all units in a group may be selected by clicking the group name from the list under the **Group(s)** column at the right side of the window. After the selection process is complete, click **Copy** and Sentinel will copy all of the program data (run times, start times, etc.) from the currently accessed field unit to any units selected in the database. Be aware that the new data will overwrite all data previously stored in the database for all the selected field units. Once the program data is successfully copied into the selected field units, modifications can be made by opening the **Auto Programming** window for each unit individually. After programs are copied, they can be sent to the field units with the **Send Program Changes** command or with **AutoComm**, both described in Chapter 11.



NOTE: Copying programs to field units will copy the selected schedule number, start times, run time, percent scale, water window, repeats, delay, state of continuous run, ET check boxes and station order. It will **NOT** copy the **Primary** and the **Secondary** descriptions of the programs and it will **NOT** copy the **schedules** and any other data found in other utility windows of the **Master Control Panel** such as **Zone Data**.

Program Information

Clicking the **Information** button in the **Auto Programming** window will display a table that lists the start time for each slot within the selected program. The **Water Usage** column at the right side of the table gives the total gallons used by each station on a single run, not multiplied by the number of starts nor repeats. Thus, the totals at the bottom are for one cycle, one pass through the 48 slots. Water Usage is based on the run time for each slot and the expected flow entered for the corresponding station in the **Zone Data** screen.

The **Cycle Graph** displays a graph of one program cycle, as shown below.



Chapter 6 : Programming Field Units - Zone Data

Zone Data

The **Zone Data** screen allows you to set certain parameters to each individual station of the field unit. As with **Schedule Programming** and **Auto Programming**, the **Zone Data** screen is accessed from the **Master Control Panel** for any specific field unit selected from the **Unit Selection** screen.

Shown in the figure is a blank **Zone Data** screen before any data is entered. It provides, for each station in the unit, rows where you can enter the **Station Description**, **Type Description**, **Expected Flow** in gallons per minute, **Maximum Flow** to limit water consumption in gallons per minute, **Plant Factor**, **Application Rate** in inches per hour and station mapping information if a **Map To Universal** control unit is used (**Mapped Unit** and **Mapped Station**).

Stn	Select	Station Description	Type Description	Exp. Flow	Max. Flow	Plant Factor	App. Rate	Mapped Unit	Mapped Station
1				0	0	0%	0		0
2				0	0	0%	0		0
3				0	0	0%	0		0
4				0	0	0%	0		0
5				0	0	0%	0		0
6				0	0	0%	0		0
7				0	0	0%	0		0
8				0	0	0%	0		0
9				0	0	0%	0		0
10				0	0	0%	0		0

You can also map one or more stations to stations in one or more universal units, specifying which unit and station within that unit to assign to each station. In the last column, you can flag a station for your own purposes and the station will appear highlighted in the corresponding slot in the **Auto Programming** window.

To enter a **Station Description** or **Type Description**, click the corresponding text box underneath the title and within the correct station number row. This will open a data entry box where you can type any description up to 20 characters. Click **OK** to save the description and close the text box.

Similarly, to enter numerical data, click on the desired square and a data entry box will open. After typing a value, click **OK**. The range of values allowed for each of the parameters is shown in the table:

	Expected Flow	Maximum Flow	Plant Factor	Application Rate
Minimum	0	0	0%	0
Maximum	32,000	32,000	250%	100

NOTE: If the satellite station will be operating in conjunction with a **Map To Universal** control station, the total expected flow for both stations must be entered.

The **Expected Flow** and **Maximum Flow** are also limited by the system **Maximum Flow** that is set in the **System / Group Maintenance, System Defaults**. The maximum value allowed is the lesser of the value between this chart and the **System Maximum** value.

If the satellite station is used in conjunction with a **Map To Universal** control unit, enter the 3-digit unit code of the mapped unit in the **Mapped Unit** column. In the **Mapped Station** column, enter the corresponding station number being mapped to in the **Map To Universal** control unit.

NOTE: If you wish to operate only a **Map To Universal** station, simply assign that station to any satellite station which is not currently being used to operate an irrigation control valve. Enter the program assignment and run time information as you would for any other satellite station.

Sending, Receiving and Storing Zone Data

There is a notable difference between the description column and the other columns. The descriptions are only used in the Central software and are stored in the Central software database of your PC. They are not transmitted to or stored in the field unit. The **Expected** and **Maximum Flow**, **Plant Factor**, **Application Rate**, **Mapped Unit** and **Mapped Station** are all used by the field satellite unit as well as the central software, and are stored in both places. If the **Send** command is clicked, these values are transmitted to the field unit, where they will overwrite any previous **Zone data**. Likewise, if the **Receive** command is clicked, the **Zone Data** from the field unit is transmitted to the Central computer, where it overwrites the six columns in the Central software database (not affecting the descriptions).

NOTE: The last column in which you can flag a station for your own purposes is treated like the descriptions. They will not be transmitted nor stored in the field unit.

After entering the **Zone Data**, clicking the **Save** command will store it in the Central computer's database but not in the field unit. Only when you click **Send** will the new data be saved in the field unit.

ET Based Watering

The field unit will calculate run times for each station based on the **Application Rates** and **ET** (evapotranspiration) value that reside in the unit. In order for this function to work properly, the **ET Based Watering** check box must be selected in the **Auto Programming / Program** window. Only stations with non-zero application rates will have their run time adjusted based on **ET**. The **Zero App Rates** command is provided so you can quickly reset all **Application Rates** to **0** before transmitting the **Zone Data** to the field unit. **ET** based watering is explained in **Chapter 10**.

The pictures below illustrate how you can enter a value once and have it applied to several different stations. This will work for any column - descriptions as well as numerical data.

Stn	Select	Station Description	Type Description	Exp. Flow	Max. Flow	Plant Factor
1		Left side entryway	Turf/570-4P	63	70	100
2		Right side entryway	Turf/570-4P	58	64	100
3		Entrance plaza	Turf/570-4P	79	88	100
4	→	Lakeside North	Turf/2001	144	159	100
5	→	Lakeside South	Turf/2001	122	134	100
6	→	River bank West	Turf/2001	166	180	100
7	→	River bank East	Turf/2001	166	180	100
8	→	Common Green	Turf/2001	122	134	100
9		Concession area - L	Turf/570-4P	79	88	100
10		Concession area - R	Turf/570-4P	63	70	100
11		Play field perimeter	Turf/2001	122	134	100
12		Play field North	Turf/2001	166	180	100
13		Play field South	Turf/2001	122	134	100
14		Entrance planters	Ornamentals/570-12P	28	37	100
15		Concession planters	Ornamentals/570-12P	28	37	100
16		Slopes Northside	Ground cover/340	48	53	100
17		Slopes Southside	Ground cover/340	56	62	100
18		Slopes center berm	Ground cover/340	40	45	100
19		Entryway island	Shrubs/514	60	66	100

Zone Data - Selecting Multiple Rows (Stations) to Enter a Common Value

Click a row under **Select**. Click additional desired rows. Click the column to change under any selected row. Enter the new value. The value is automatically entered in each selected row. Click **Clear Selects** before selecting different stations for another value.

Once you have entered all the data and descriptions for all stations, it makes selection in the **Auto Programming** screen easier.

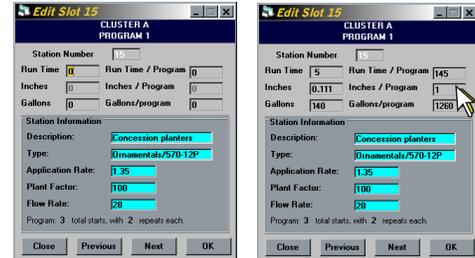
While in the **Auto Programming** screen for the same unit, clicking the **Search & Highlight** button under **Station Options** opens a data entry box with a list of available descriptions. Picking a description from the box will highlight all station numbers assigned to slots that contain that description. In the picture below, the **Turf/2001** type description was picked. As you can see in the Zone Data screen above, this matches stations 4–8 and 11–13. Stations 6, 7 and 8 are not seen in the Auto Programming screen because they are not assigned to any slots in the selected program. Stations 4, 5, 11, 12 and 13 will be highlighted, so clicking the **Modify Run Times** command provides simultaneous editing of all highlighted stations.

In the series of example pictures to the right, **Application Rates** were entered in the **Zone Data** screen for some stations. This demonstrates the full potential of the **Edit Slot** window introduced in **Chapter 5**.

Now you can see the description and zone data for the selected station as you enter the run time. Moreover, you can enter any one of the top six variables, and Sentinel will automatically calculate the other five.

Stn	Select	Station Description	Type Description	Exp. Flow	Max. Flow	Plant Factor	App. Rate	Mapped Unit	Mapped Station
3		Entrance plaza	Turf/570-4P	79	86	100	1.72	0	0
4	---	Lakeside North	Turf/2001	120	159	100	0.35	0	0
5	---	Lakeside South	Turf/2001	120	134	100	0.35	0	0
6	---	River bank West	Turf/2001	120	100	100	0.35	0	0
7	---	River bank East	Turf/2001	120	100	100	0.35	0	0
8	---	Common Green	Turf/2001	120	134	100	0.35	0	0
9		Concession area - L	Turf/570-4P	79	86	100	1.72	0	0
10		Concession area - R	Turf/570-4P	63	70	100	1.72	0	0
11		Play field perimeter	Turf/2001	122	134	100	0.35	0	0
12		Play field North	Turf/2001	166	180	100	0.35	0	0
13		Play field South	Turf/2001	122	134	100	0.35	0	0
14		Entrance planters	Ornamentals/570-12P	28	37	100	1.35	0	0
15		Concession planters	Ornamentals/570-12P	28	37	100	1.35	0	0
16		Slopes Northside	Ground cover/340	48	53	100	0.75	0	0
17		Slopes Southside	Ground cover/340	48	53	100	0.75	0	0

In the **Inches / Program** text field, 1 (inch) was entered and the software automatically calculated the **Run Time** and total **Gallons** of water. The three boxes in the top right corner account for additional starts and repeats of the same program, so they register the total values for a day. The three boxes to the left only apply to one start with no repeats. A total run time for the day could be entered in the top right box and it would be divided by the total start times and repeats to obtain the **Run Time** for the slot in the box to the left. The other variables are similarly related.



Chapter 7 : Programming Field Units - Data Retrieval

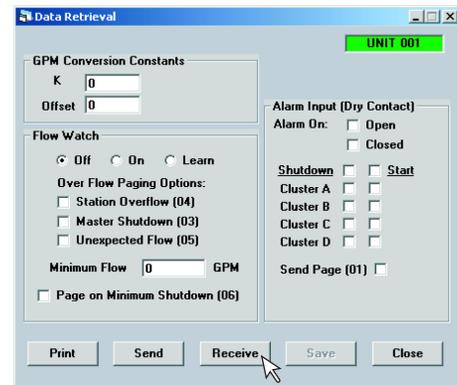
Data Retrieval

The **Data Ret.** (Retrieval) screen, accessed from the **Master Control Panel**, is only used for units with a flow meter or alarm attached to the field unit. The screen is not available if **Data Retrieval Installed?** is not checked in the **Special Data** screen.

On this screen, you can enter and transmit the conversion constants for a flow meter to the field unit. **K** is the multiplier to convert clicks per second in a flow meter to gallons per minute. The **Offset** is added for adjustment.

If you have a phone modem connected to the field unit's serial port, you can use the Sentinel pager option. Turn on **Flow Watch** and specify the paging for any of the four alarms on the screen. **Station Overflow** occurs when the flow in a station exceeds the maximum specified in **Zone Data**. **Master Shutdown** occurs after three **Station Overflow** events. **Unexpected Flow** occurs when a station is off but the flow meter detects a flow. **Minimum Shutdown** occurs when the flow in any running station is less than the value specified in the **Minimum Flow** box.

The **Alarm Input** is for your own custom alarm. Select **Open** if your dry contact switch is normally closed and vice versa. You can choose **Shutdown** and specify one or more **Clusters of Programs** to shut down if an alarm occurs. You can also choose **Start** and specify one or more **Clusters of Programs** to start if alarm occurs. Moreover, you can check the **Send Page** option if you have a phone modem connected to the field unit's serial port. With this option enabled, Sentinel will send an alarm page to the specified pager in **Special Data** whenever an alarm is activated.



Chapter 8 : Field Unit Status

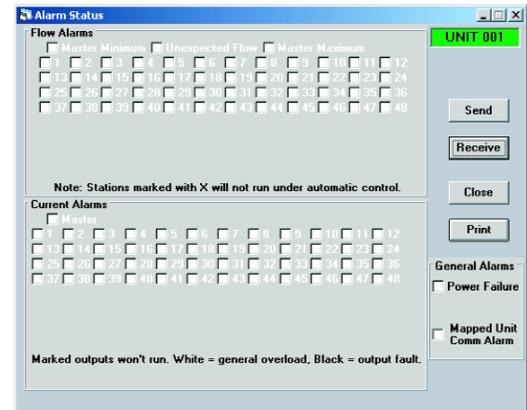
Four status screens can be opened from the **Master Control Panel** for any field unit. These are the **Alarm Status**, **Output Status**, **Program Status**, and **Station Days Off**.

NOTE: The **Output Status** window will launch when **Send** is clicked on the **Master Control Panel**.

Alarm Status

Similar to the unit code label in each window of the **Master Control Panel**, the **Alarms** button will be color-coded with green, yellow or red, depending on the alarm status received. If an alarm was received during any communication from any of these screens, it will turn red. Yellow indicates shutdown for a **Rain** day. Green is the normal state.

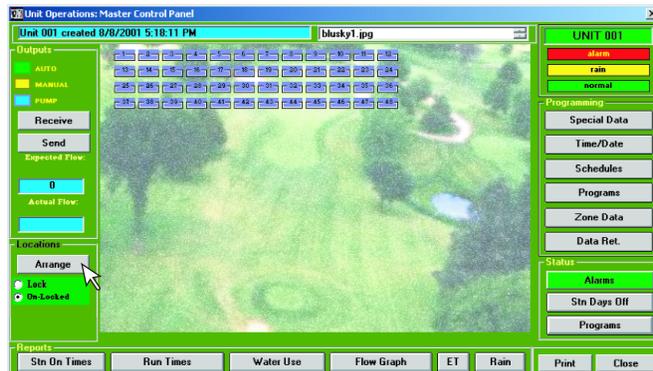
If the **Receive** button is clicked, Sentinel will read the states of the **Flow**, **Current**, **Power Failure**, **Missed Start** and **Mapped Unit Comm Alarms** for every station of the unit including the master valve. Any alarm will result in an **X** in the corresponding box on the screen. The **Power Failure Alarm** is received every time the field unit loses power, which may include the initial set up of the entire system. In the event of a power failure, the field unit records the time the power failed and the time it was restored.



Clearing Alarms

To clear the alarms in the field unit, click each checked box to remove the **X**, then click the **Send** button. The red labels will not revert to green until the **Master Control Panel** is re-opened.

Output Status



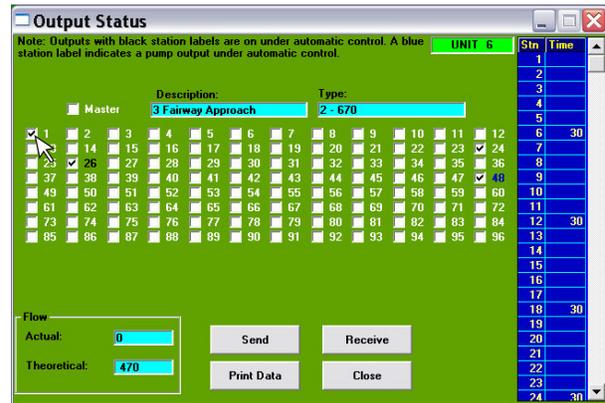
The status of each field unit output station is represented graphically on the **Master Control Panel**. Each station is represented by a small numbered, blue text box. It is initially located in the upper left corner. These symbols or icons can be arranged automatically by clicking **Unlock** and **Arrange**. If you have displayed a picture or map on the Master Control Panel as described in **Chapter 4**, you can arrange the icons within the image to represent their actual locations in the field. Select **Lock** to save the positions of the icons.

NOTE: You might only see one icon during the initial view before arranging the icons. This is because the icons are stacked on top of each other as a default arrangement. Clicking **Un-Lock** and **Arrange** will organize all the icons in rows and columns for full view.

To relocate the icon, you must first select **Un-Lock**. Click on the icon and then click at the desired spot where the icon should be positioned. Dragging the icon will not work. Proceed to locate all of the icons as necessary. When finished, select **Lock** to save the icon positions.

Double clicking a station number will select it for manual activation, and it will blink yellow to confirm selection. Double clicking the station again will deselect it. Program activated stations will blink green and cannot be deactivated from this window.

The **Output Status** screen (accessed when the **Send** button from the **Master Control Panel** is clicked) is used both to view the status of each output, which stations are on and which are off, and to manually turn stations on or off. A station that a program started is under automatic control and cannot be turned-off here. The sum of the **Actual Flow** and **Theoretical Flow** (Expected Flow from **Zone Data**) for the selected stations are shown at the bottom. The **Station Description** and **Type Description** (also from **Zone Data**) are shown, at the top of the window, for the last station selected. In the example picture, the Actual Flow is absent because this field unit does not have a flow meter to measure it. The picture illustrates three different possible indications of a station's status. Station **26** was started by an automatic program. This is indicated by the black colored number. Stations **1** and **24** were started manually from this screen. This is indicated by the white colored numbers. To turn-on a station this way, enter the run time in the column at the right side of the screen next to the station number, then click the **Send** command to start it. Station 48, indicated by the blue colored number, controls a pump under automatic program.



Receiving Output Status

Click **Receive** on the **Master Control Panel** to quickly receive the status of each station from the field unit. Icons of stations running under manual control will blink yellow. Those started by an automatic program will blink green. The yellow-blinking icons will stop blinking when the remaining runtime has expired. However, the green-blinking icons will continue to blink until data is received from the field controller again to verify a changed state of the stations under automatic control.

Sending Manual Output State

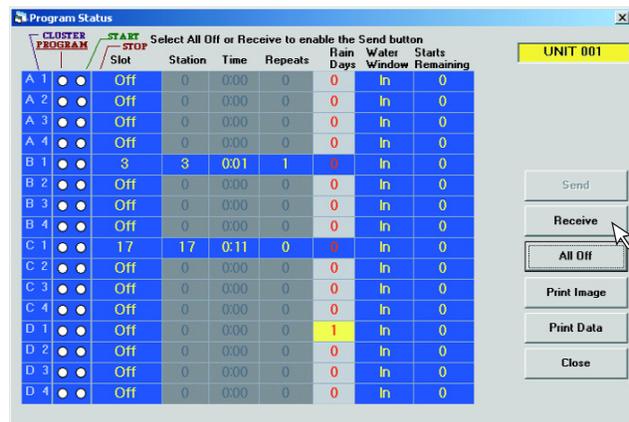
There are two ways to manually turn on or off stations from the central computer. From the **Master Control Panel**, you can double click any of the icons to activate or deactivate the stations. Clicking the **Send** button will open the **Output Status** window which verifies the selected states and allows you to set the time remaining (in minutes) for each station before sending the data. Stations will not turn on manually in the field unit until you click **Send** in the **Output Status** window.

Another procedure is to check the box next to the station numbers in the **Output Status** window to set on or off state. Runtime can be set at the right side of the utility window. **Send** must be clicked before the states will change in the field unit.

Program Status

After the **Program Status** is received from a field unit, the screen can indicate which programs are running, which slot is currently executing within each running program, which stations are assigned to the executing slots, the remaining run time for these slots, repeats and starts remaining for the running programs, rain days remaining if a program is shut down, and whether the program is running within its assigned watering window.

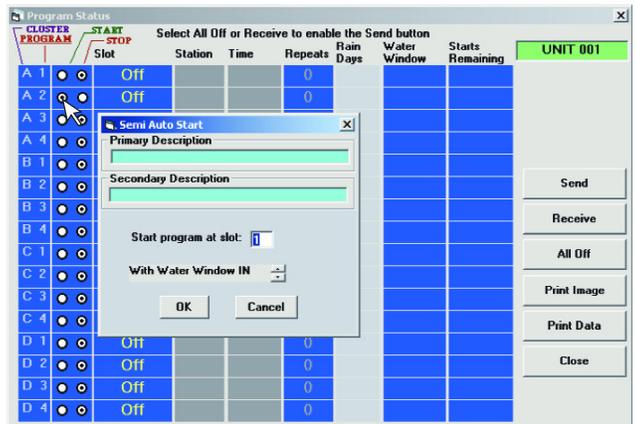
In the example, the unit code background turned yellow after the **Receive** command was executed, indicating that one or more programs was shut down for one or more rain days (just as it would turn red to indicate an alarm). The yellow box under the Rain Days column indicates that **Cluster D, Program 1** (D 1) is the only program shut down for 1 day. It also indicates that **Cluster B, Program 1** (B 1) is running slot 3, which is assigned station 3 and has 1 minute of run time remaining and 1 repeat remaining. Also, **Cluster C, Program 1** (C 1) has 11 minutes of run time remaining on slot 17, which is running station 17. Both programs are running within their assigned **Water Window**.



Semi-Auto Start

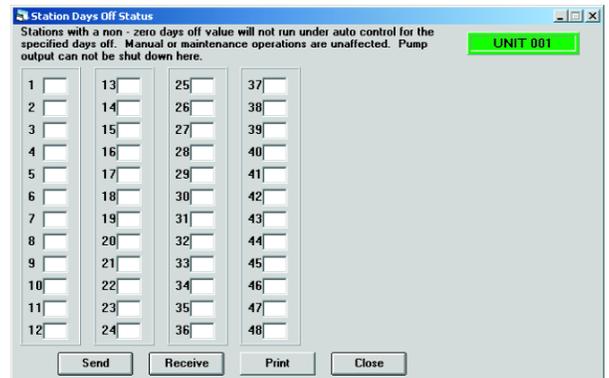
You can also start any programs as shown in the picture. When you click on the **Start** option next to a program, (A 2 in the example picture) the **Semi Auto Start** data entry box opens where you can specify which slot to begin the cycle and whether the **Water Window** is **In** or **Out**. This is known as a **Semi Auto Start**. You can select any number of programs to start, then click **Send** to transmit to the field unit. To stop a running program, select the **Stop** option next to the Program, then click **Send**. Click the **Print Image** button to print the program status window and the **Print Data** button to print the information in tabular format.

The **All Off** command will simultaneously select **Stop** for every program. You can then click **Send** to immediately shut off all programs at once.



Station Days Off

From the **Master Control Panel**, you can specify stations within a field unit to shut off for a specified number of days. Click the **Stn Days Off** button to display the **Station Days Off Status** window. Simply enter the desired number of days off in the text box next to the station number. Click the **Send** command button to transmit the information to the field unit. Click the **Receive** command button to verify which stations are already off in the field unit.



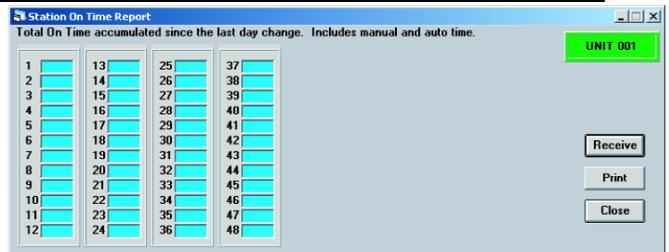
Chapter 9 : Field Unit Reports

Station On Times Report

Click on the **Stn On Times** command to display the **Station On Time Report**. From this screen, click the **Receive** command to read the current data from the field unit. The total time in **Hours** and **Minutes** that each station operated since the last Day Change time will be displayed.

These figures are not stored in the central database. That is the reason why no **Save** command is provided in the window.

The data represents the actual values accumulated in the field unit which can change while a program is running.

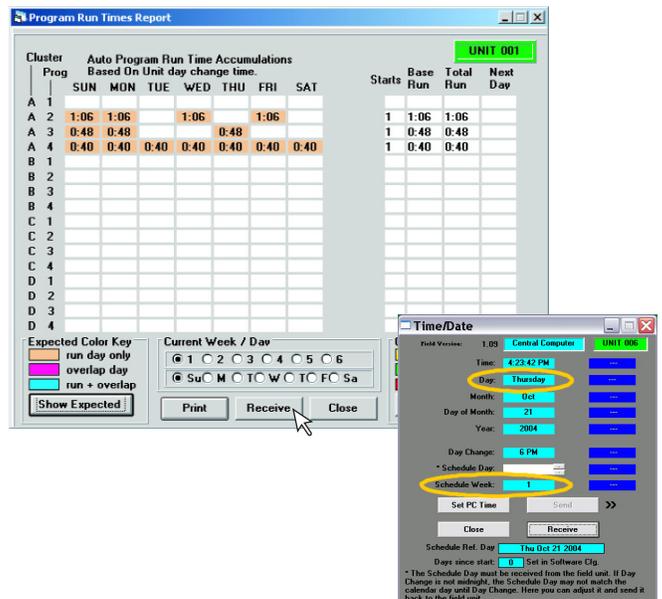


Program Run Times Report

The **Program Run Times Report** displays the total expected run time for each of the field unit's 16 programs during each day of any chosen week of the current 6-week schedule period. The actual run time can be received from the field unit for comparison.

NOTE: Before using this report, you should **Receive** each cluster of programs from the field unit in the **Auto Programming window**, **Schedule Programming window** and **Special Data window**. It is also advisable to **Receive** and **Send** the **Time / Date** to synchronize the field unit with the central computer. These steps will ensure agreement between the field unit and the central computer database in case a change in either component was forgotten.

Upon opening the **Program Run Times Report** window, you should select the current **Schedule Week** and **Day** of the schedules.



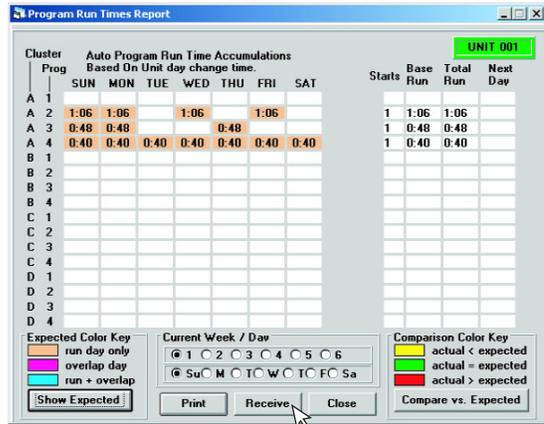
Next, click the **Show Expected** button to display the total of the run times programmed for each day of the current week. As shown in the picture, the total times for completed programs before the day change time are shown with a peach background. If a program runs past the day change time, that portion listed on the following day will have a light magenta background indicating the overlap. If a program is set on continuous run with a Water Window starting before and ending after the day change time, it is displayed as overlapping every day. If overlap from a previous day is added to run time scheduled for a given day, the background will be light blue.

To display a report of run times that actually occurred from the field unit, click the **Receive** command. Since all the data received is actual, it will appear with a white background.

On the right side of the screen, the **Base Run** is the total length of one cycle of the program, accounting for repeats. The **Total Run** is multiplied by the number of starts. **Next Day** lists that portion of run time remaining after the day change time, which continues to run into the next day.

After both expected run times and the report received from the field unit have been displayed, you can click the **Compare vs. Expected** button to compare them. Now you can quickly see if programs actually ran longer than expected, less than expected, or not at all. A green background indicates no difference in the programmed time and actual time of a program for a day. Yellow means a program ran for less time than expected. If it did not run at all, it is labeled **OFF** for that day. This could be due to rain shutdown or a manual stop at the field unit or from the **Program Status** screen. If the actual run was longer than the time programmed, the background is red. Such cases may occur if a program was manually started at the field unit, or if a program was shortened in the central computer without transmitting the change to the field unit which continues to run the previously stored longer time program. For this reason, receiving the programs is recommended before viewing the report.

As with any window with a **Print** button, clicking this button sends an image of the window to your default printer.



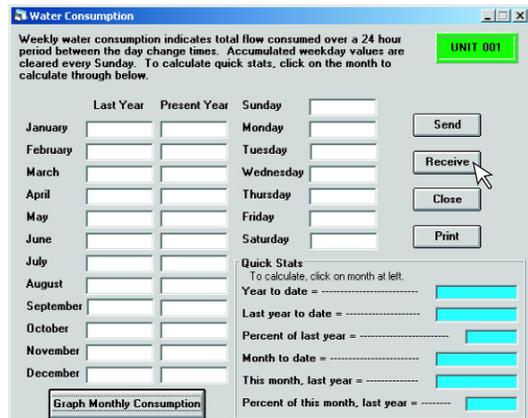
Water Consumption Report

NOTE: In order to utilize the **Water Consumption Report** feature, a functional flow meter must be connected to the field unit. In addition, the **Data Retrieval Installed?** option box must be checked in the **Special Data** window.

Clicking the **Water Consumption** button displays the **Water Consumption Report** which shows the total number of gallons consumed each day of the current week, as well as the total gallons consumed by the field unit each month of the previous year and each month of the current year. All of the data is stored in the field unit, so no save command is needed, but you must click the **Receive** command to retrieve it.

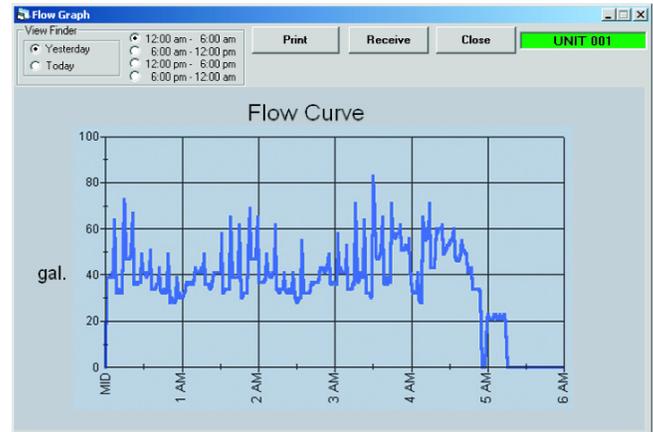
Clicking any month at the left of the screen immediately calculates the statistics shown under **Quick Stats**. These includes **Year to Date** totals in gallons consumed thus far from the beginning of the year to the month selected. **Last Year to Date** gives the total for the same month of the previous year for comparison. Percent of last year is a direct comparison of these two values. Month to date gives the total consumption for the month selected or consumption so far if the current month is selected. This month, last year is the corresponding value for the previous year for the selected month. Percent of this month, last year compares last year's data to the present year's data.

Click **Graph Monthly Consumption** to display a bar graph. The graph has blue bars for each month of the previous year, and green bars for each month so far this year. The height of the bars represents the total water consumption in gallons for each month. You can print the graph with your default printer.



Flow Graph

The **Flow Graph** Report requires a flow meter connected to the field unit. The screen is unavailable unless the **Data Retrieval** option is selected in **Special Data**. This report graphs the instantaneous number of gallons the field unit has consumed throughout any four hour period of the current or previous day. Clicking **Receive** will read the flow data for the entire day selected. Clicking **Yesterday** or **Today** will also instruct Sentinel to receive a full day's flow graph. Once **Today's** or **Yesterday's** data is received, any one of the four hour periods can be selected to display.



Rain Fall Report

The **Rain Fall Report** receives and displays daily and monthly rainfall data in inches recorded in the field unit if a rain gauge is connected. This report is similar in appearance to the **Water Consumption Report** and **ET Report**, with similar functionality of the **Quick Stats** and **Graph Monthly Rain**.

If your current system uses a **GroWeather Station**, the total rain amount for **Today** and **Yesterday** are displayed immediately upon opening the **Rain Report**. If the central computer is connected directly to a **Campbell Weather Station**, it will read these values from the weather station, which will take a few moments before opening the utility window, and a command button will be available to access the weather report.

Clicking the **Receive** command reads the daily and monthly rainfall values from the beginning of the previous year to the present day. You can also enter values on the screen and send data to the field unit. However, as a precaution against inadvertently overwriting data in the field unit, editing and sending data is temporarily disabled when this screen is opened until the **Receive** command is executed to display any data already in the field unit.

Once **Receive** has been executed, editing is allowed and the **Send** command is enabled.

Clicking **Graph Monthly Rain** produces a bar graph which you can print on your default printer.

If you have a **GroWeather Station** or a **Campbell Weather Station**, you can send the value for today's rainfall to the controller. Enter the number seen from the **Today** box under **Weather Station Rain** to the **Unit Rain Today** box. You can also copy and paste it in. Just drag your mouse across the number (with the button pressed) to highlight it, hold the **Ctrl** key and press the **C** key to copy; then click inside the Unit Rain Today box, hold the **Ctrl** key and press the **V** key to paste the number in. If you are irrigating based on ET, this number is used in the field units along with the daily ET values. **Chapters 10** and **11** show you how these numbers can be transmitted to all units automatically.

ET Report

The **ET Report** is similar in appearance to the **Rain Report** and is presented in detail in **Chapter 10**.

Chapter 10 : ET Based Watering

Evapotranspiration (ET) is the total discharge of water by direct evaporation from soil and rock surfaces, and transpiration from growing plants. Sentinel has extensive provisions for irrigation based on **ET**.

ET information can be obtained from one of four sources. The source must be specified in the **Software Configuration** screen as shown at the right. (Refer to **Chapter 3** for additional information.) **ET** data can be manually entered in a field unit or in the central database. An **ET** gauge and a rain gauge can be connected to a field unit, or periodic **ET** values in inches can be recorded by a **GroWeather** station or a **Campbell Weather Station**.

Manual Entry

If **ET** values are to be entered manually, the first option, **Copy default ET from Unit #** should be selected. Daily **ET** values must be entered in the field unit specified here, or entered in the **ET Report** screen for that unit and sent to that unit. Once the daily value is stored in the default unit, it is available for Sentinel to read from the database at the end of the day and transmit to all other units.

ET Gauge

If an **ET Gauge** is connected to a field unit, the second option should be selected. The unit code for that unit is entered here. That field unit will be polled to transmit **ET** to other units. If a rain gauge is also connected, daily rainfall measurements can be used in conjunction with **ET**.

GroWeather Station

If you have a **GroWeather Station**, select the third option under the **ET / Rain Source**. A **GroWeather Station** must be selected for the current system in the **System / Group Maintenance** screen, as shown in **Chapter 3**. The GroWeatherLink software must poll the weather station from your central computer, the same computer where Sentinel is installed. Sentinel will read and sum the **ET** values for the last available day from the GroWeatherLink database and transmit the last daily total to all field controllers in the current system.

Campbell Weather Station

If you have a **Campbell Weather Station**, select the 4th option under the **ET / Rain Source**. A settings window will open. Set the correct **Comm port** at which the **Campbell Weather Station** is connected. Do not change any other settings without instructions from Toro's technical support staff.

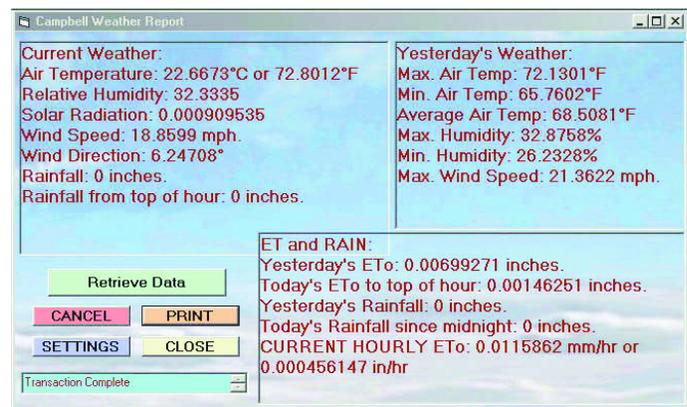
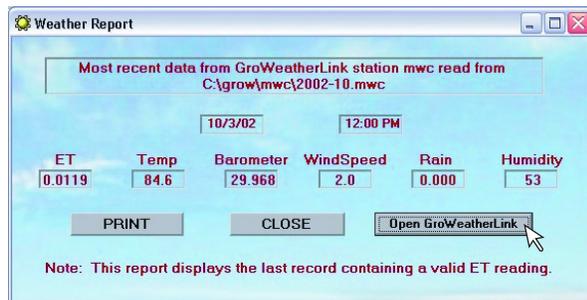
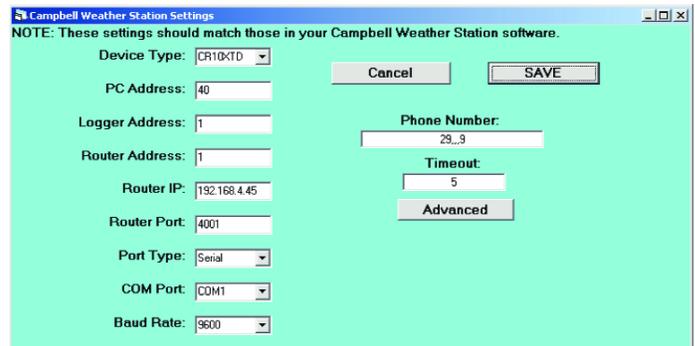
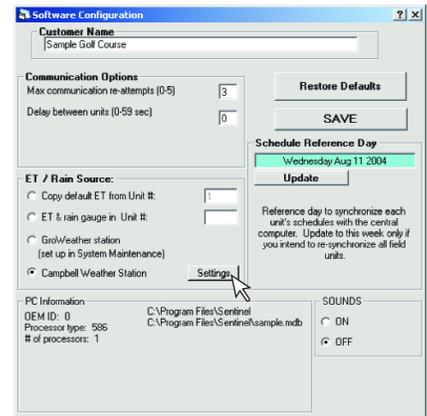
NOTE: During Sentinel 2X installation, the file named **PBD.INI** is also written within the sentinel files. This file contains the information for this settings window and if deleted, the window will not launch.

If selected, **Campbell Weather Station** will become the **ET** source for all field units. Sentinel will read the **ET** values for the last complete day directly from the **Campbell Weather Station** before sending it to the units.

Both GroWeather and Campbell Weather stations have updated weather reports which can be opened from the Sentinel menu.

The diagrams on page 24–25 shows how **ET** watering is automatically accomplished when using **Sentinel AutoComm** (described in **Chapter 11**) in conjunction with one of the **ET** sources above. In this case **ET** and rain data are recorded in one field unit with a rain gauge and **ET** gauge throughout the day. The total **ET** and rain values for the day are retrieved automatically from the field unit by the central computer at the time set in **Sentinel AutoComm**. Immediately after this, the same values are transmitted from the central computer to every unit in the current system. The time required to finish these transmissions

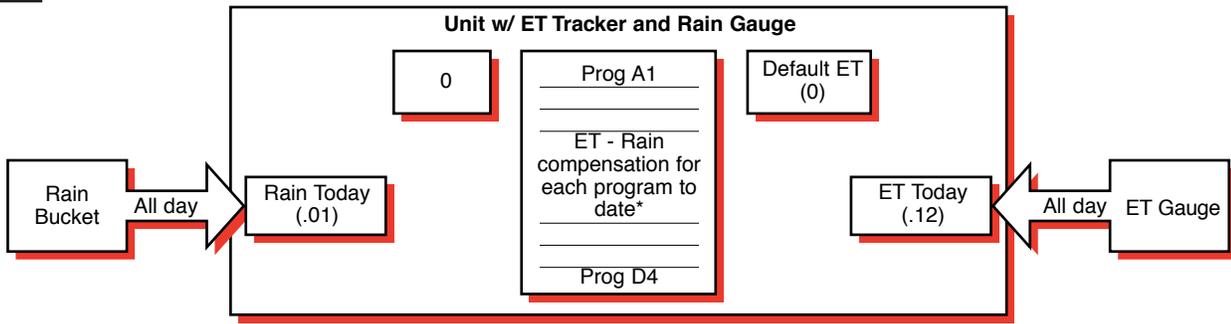
depends on the number of units in the system, and may exceed an hour for very large systems. At the day change in each field unit, the run time for each **ET** slot (for which the assigned station has an application rate set in **Zone Data**) is adjusted to compensate for the new **ET** and rain values. Toro recommends setting the **ET Send Time** about an hour before the day change. In the event of a communication failure, each unit's default **ET** and rain values are used.



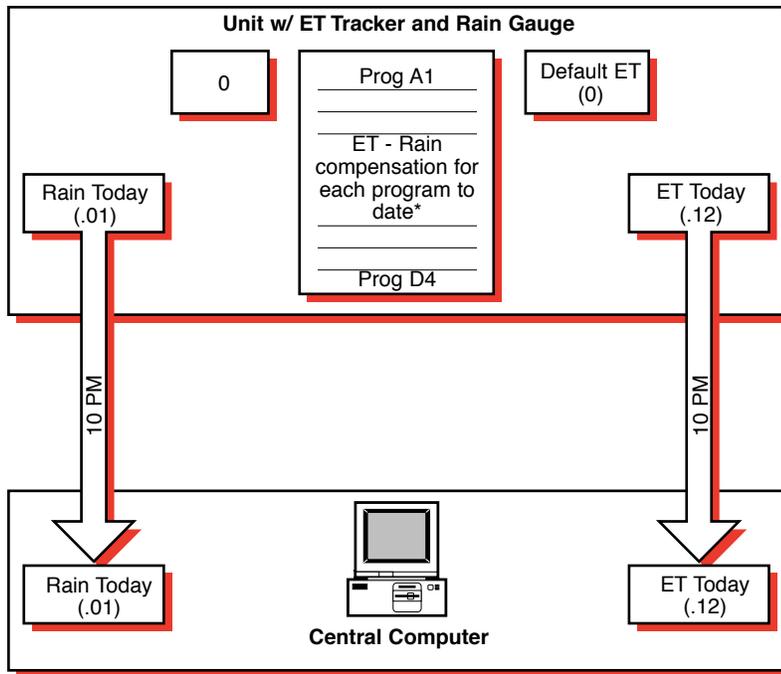
ET Based Watering w/ ET & Rain Gauge

(Example with ET send time at 10:00 PM and Day Change at 11:00 PM.)

1 All day - ET and Rain Accumulated in One Unit



2 10:00 PM - Transmissions at ET Send Time

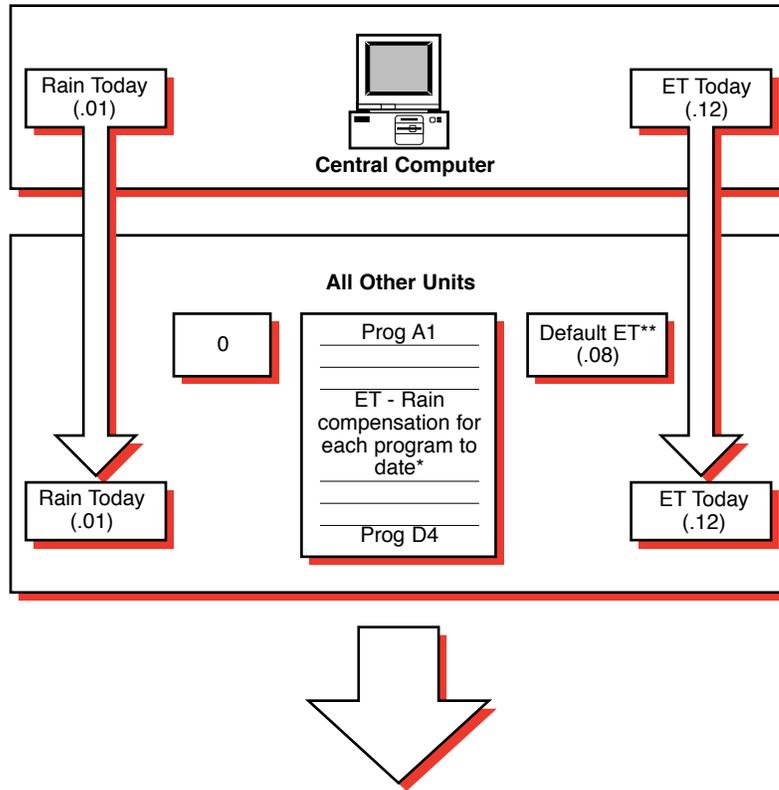


Notes:

- * This is the value used to water the next day.
- ** In the Unit with the tracker, the default is used to reset daily ET to 0. In all other units, you may choose any value.

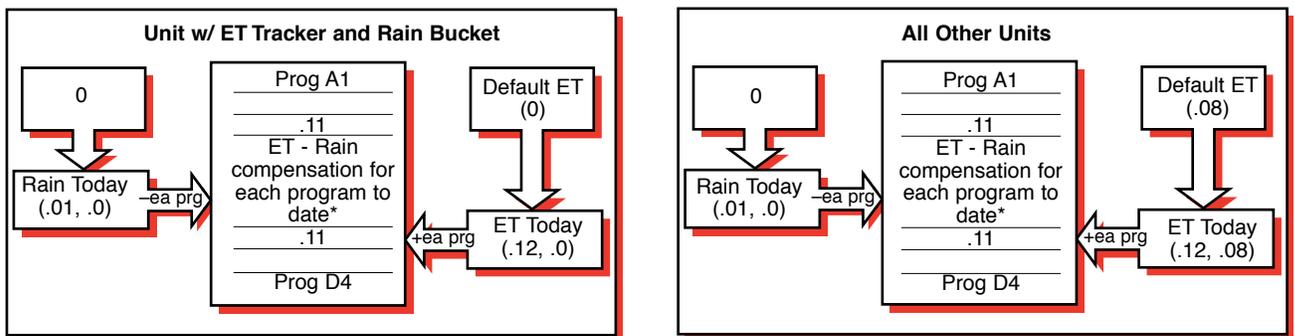
3

10:00 PM - 11:00 PM - Transmission between ET Send Time and Day Change

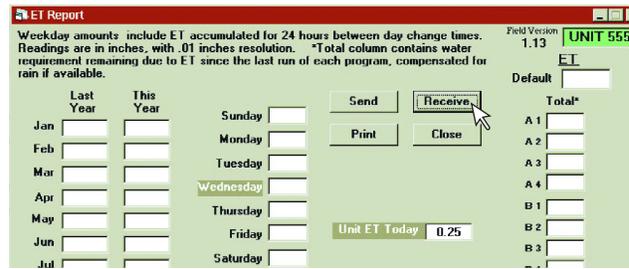


4

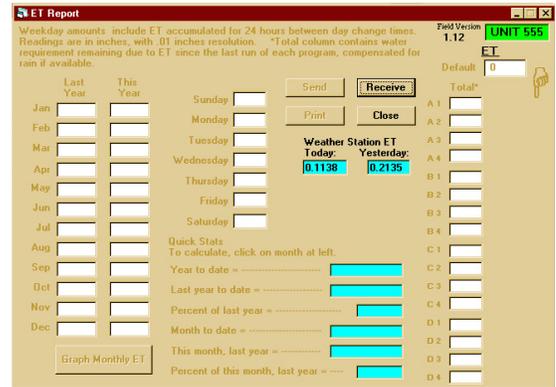
11:00 PM - Events in all Field Units at Day Change



If manual data entry is used (with the first ET source option selected in **Software Configuration**) instead of a gauge, everything works the same way except you must manually enter values for the day's **ET** and rain. Do this on the **ET Report** and **Rain Report** windows for unit specified in **Software Configuration**. The **ET Report** screen is accessed from the **Master Control Panel** for each individual unit. It is similar in appearance to the **Rain Report** window. You must execute the **Receive** command to read existing data in the field unit before the **Send** command is enabled. Enter the total ET for the day in the **Default ET** box and click the **Send** command or **Close** to ensure the value is saved before the **Transmit ET** time set in **AutoComm**. **AutoComm** will then read the default ET value for this unit from the database and send it, as the ET Today value, to all other units just as in part 3 of the diagram. In this case, zero (0) Rain Today is sent to each unit. A value for the day's total rain can be sent from the **Rain Report** screen.



If you are using a **GroWeather** or **Campbell Weather** station, Sentinel reads the **ET** values retrieved by the **GroWeatherLink** software directly from the **GroWeatherLink** data file in the central computer or directly from the **Campbell Weather Station**. It will also read the last complete day **ET** totals. This daily value is then sent to all units in the current system as the **ET Today** value in the diagram. The **ET Report** screen shown is the same screen as the example but appears slightly different because a weather station is used. When the **ET** report is opened, **ET** values for **Today** and **Yesterday** are immediately read from the **GroWeatherLink** database, or directly from the **Campbell Weather Station**, for this unit. When the **Receive** command is clicked, monthly and daily **ET** values, and the **ET Today** are read from the field units. Separate values are received for each program. After clicking the **Receive** command to retrieve current data from the field unit, you can easily copy the value for Today's or Yesterday's **ET** from the weather station to the **Unit ET Today** box and send it to the field unit. Highlight the number by dragging the mouse across it with the right button depressed, then press and hold the **Ctrl** key and press the **C** key (ctrl - c) to copy the value. Then click the **Unit ET Today** box with the mouse, press and hold the **Ctrl** key and press **V** (ctrl - v) to paste the value. Send the new value to the field unit by clicking the **Send** button.



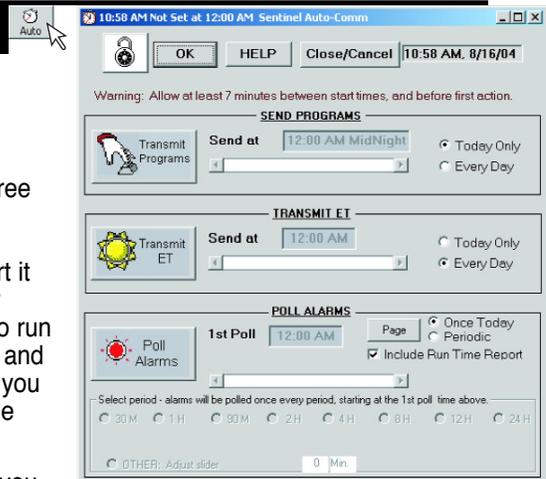
Chapter 11 will show you how to set **AutoComm** to automatically retrieve and send **ET** data.

Chapter 11 : Automatic Communications

Sentinel AutoComm

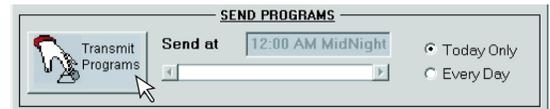
Sentinel has several automatic communication features to transfer data between the central and all field units without redundant operations by the user. The most powerful is the **AutoComm** which can be set to perform three different operations at pre-designated times. They are: polling alarms, transmitting ET data and transmitting changed programs. **AutoComm** is a stand-alone module that can run independently from Sentinel. You can start it from the Sentinel menu, with the **Ctrl-T** key combination, the **Auto** icon, or from the Windows start menu. It is recommended that you close Sentinel to run **AutoComm** to avoid conflicts between your manual operations in Sentinel and the **AutoComm** transmissions and database access. At the specified time you set **Autocomm** to launch, Sentinel and other Sentinel modules, such as the **Flow Optimizer**, will close automatically.

The **AutoComm** main screen has three large buttons to select the events you wish to set.



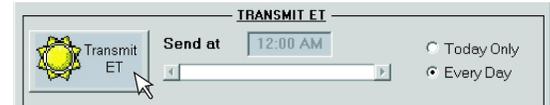
Transmit Programs

Clicking this button in the **AutoComm** window will cause **AutoComm** to check for any programs in the Sentinel database that have been changed but have not been sent to the field controllers. **AutoComm** will then transmit them to their designated field controllers at the specified time. Referring to **Chapter 5**, you will note that any changes to a program will cause a checkmark to flag the program until it is sent to the field unit. It is this checkmark that flags the program in the database so **AutoComm** will select the program and automatically transmit it to the field units. You can set the time by typing it at the **Send at** box or by clicking the scroll bar below it. You must leave **AutoComm** running in order for it to perform the automatic transmissions at the desired time. Clicking the **OK** button at the top will merely minimize the **AutoComm** window but will leave it running. (To exit **AutoComm**, click **CANCEL** or the **X** box at the top right corner of the window.) If you pick the **Every Day** option next to the time, the operation will repeat everyday at the same time for as long as **AutoComm** is left running.



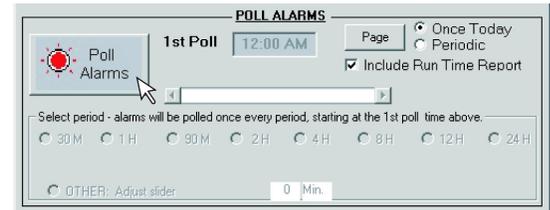
Transmit ET

This option will retrieve the **ET Today** and **Rain Today** values from the **ET** source specified in the **Software Configuration** screen. It will transmit these values to all units in the current system. Thus, if the source is an **ET** gauge (and Rain gauge) **AutoComm** will first receive the values from the unit specified in **Software Configuration**. If the source is a default ET value, **AutoComm** will first retrieve the default ET value for the unit specified in **Software Configuration** from the database. If the source is a **GroWeather** station, **AutoComm** will read and sum the values for the last complete day in the **GroWeatherLink** database located in the central computer. If the **ET** source is the **Campbell Weather Station**, the **ET** values of the last complete day will be directly read from the weather station. You can specify any time and select **Every Day** to repeat the operation daily, as long as **AutoComm** remains running.



Poll Alarms

This option will command **AutoComm** to read the alarm states from all field units in the current system at the specified time. Each unit is polled individually and the results are displayed on the screen and saved in a log file, **calarms.log**. Example results are shown in **Chapter 12**. As with the other two **AutoComm** options, a time can be typed into the box or set by the scroll bar. Additionally, alarms can be polled more than once per day at the period selected by clicking one of the option buttons or dragging the slider at the bottom to specify the time interval between polls.

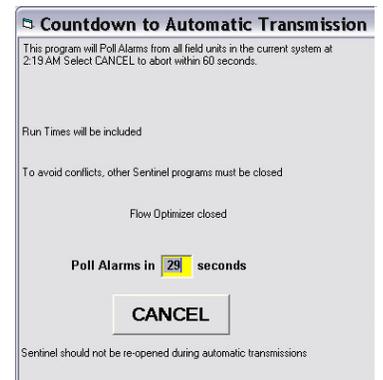


Once any or all of the three events are selected, **AutoComm** constantly checks the time until the first event is scheduled to occur. If an event is not selected (the large button is not green and the time appears very dim), the time set for it will be ignored and **AutoComm** will wait for the next scheduled event that is selected. The time required to complete a transmission depends on the number of field units in the system. **AutoComm** will not allow you to set times for different events closer than three minutes apart. Allow at least an additional minute per three field units and an additional two minutes for processing. For example, for a system of 30 field controllers, allow 12 minutes after polling alarms before sending the ET data, 10 minutes allotted for the 30 field units plus the 2-minute processing time. If the communication retry count in the Sentinel Software Configuration screen is greater than one, allow an additional 15 seconds for each try for each unit.

Since **AutoComm** must be left running and may be left unattended, password protection is provided to prevent inadvertent interference. Clicking the padlock icon opens a password input box. After you enter and confirm a password (up to 10 characters), **AutoComm** is locked and cannot be changed. It will run with the current settings, triggering events at the specified time, until the password is entered to unlock it (by clicking the padlock icon again and typing the password in the box), or until the computer is re-booted.

NOTE: It is recommended that you record your password for future reference. The system will not allow you to make changes without the correct password.

One minute before the first selected scheduled event, **AutoComm** displays the **Starting Auto** countdown and warning window in case Sentinel is being used. At the end of the 60-second countdown, a program called **AutoSentinel** takes over in the background, completing the scheduled event by transmitting data from the Sentinel database to the field units or polling the units and recording data to the database or log file. Meanwhile, **AutoComm** waits until it is time to trigger the next scheduled event. While **AutoComm** communication is active, it is recommended that Sentinel and the other modules (Flow Optimizer and Composite Flow Graph) remain closed, because manual communications or database operations may conflict with **AutoComm** and result in errors.



Send ET

Sentinel also provides a method of completing the **ET** transmissions to the field units without waiting for the preset time. From the **Special Operations** menu, select **Send today's ET & Rain** to all units. **ET** values and **Rain** values from the source specified in **Software Configuration** will be read and immediately sent to all units in the current system. This is exactly the same as scheduling **ET** transmissions in **AutoComm**, except the transmission begins immediately instead of being scheduled for later a time.

Clicking the **Send ET** button on the tool bar is a shortcut to the same immediate process.



Send Program Changes

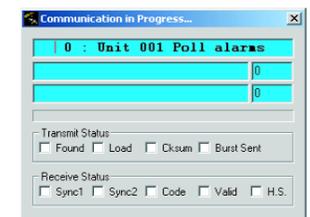
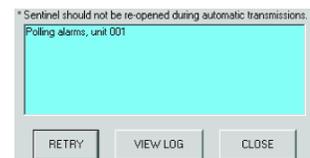
This command allows automatic transmission of all program changes to any number of field units. Anytime a field unit program is altered in the **Auto Programming** screen (**Chapter 5**), a box is checked on that screen and a flag is set in the database. When **Send Program Changes** is selected from the menu, or **Send** is clicked on the tool bar, a list of all clusters of programs that have been changed (but not sent) are displayed as shown. If you wish to send programs that were not flagged, click the **Yes** or **No** next to the unit to toggle or change the current status. You can toggle individual clusters of programs or all clusters for a unit. Programs in clusters marked **Yes** will be transmitted to the field unit when the **Send** button is clicked. To display all units, click the "f" next to **Unit Code**. All 16 schedules re also automatically sent to each selected unit.



Send program changes to field units.							
SEND		Select All	HELP	CLOSE			
<input type="checkbox"/> Show only units with changes		<input type="checkbox"/> Show all units in system(s)					
Clusters with changed programs to send. Schedules will also be sent.							
Unit Code	Unit Description	All Clusters	Cluster A	Cluster B	Cluster C	Cluster D	
001	Unit 001 created 8/9/2001 5:18:11	No	Yes	No	No	No	No
002	Pool Clubhouse	Yes	Yes	Yes	Yes	Yes	Yes
003	Tee #1	Yes	Yes	Yes	Yes	Yes	Yes
004	Tee #9	Yes	Yes	Yes	Yes	Yes	Yes
005	Green #11	Yes	Yes	Yes	Yes	Yes	Yes
006	Fairway #3	Yes	Yes	Yes	Yes	Yes	Yes
007	Tee #4	Yes	Yes	Yes	Yes	Yes	Yes
008	Green #5	Yes	Yes	Yes	Yes	Yes	Yes
009	Tee #15	Yes	Yes	Yes	Yes	Yes	Yes
010	Tee #17	No	Yes	Yes	Yes	Yes	No
011	Fairway #7	Yes	Yes	Yes	Yes	Yes	Yes

Chapter 12 : Polling Alarms

While you can set **AutoComm** to poll alarms periodically even when the system is unattended, you also have the ability to check the alarms immediately with the click of the mouse. Selecting **Alarms Now** from the Sentinel **Group Operations** menu or clicking on the **Alarms** icon in the tool bar will trigger the same actions as scheduling a **Poll Alarms** event in **AutoComm**. After choosing the command, **AutoComm** will start the process immediately. Alarms states are checked in each field unit in the current system. As each unit is polled, the **Communication In Progress** window is displayed and the results are listed as shown below. Results are entered in the log file (**calarms.log**) as the next unit is polled. Upon completion, the results are displayed in the **Alarms** window which contains a color-coded box for each field unit polled. If the communication process failed, this box is white. If any alarm was received from the unit, the box is red. If the unit is shutdown for a rain day, the box is yellow. If the communication succeeded and verified that no alarms were set, the box is green. This same window is displayed when alarms are polled automatically with **AutoComm**.



You can open the alarm log, **calarms.log**, by clicking the **View Alarm Log** command from the Sentinel File menu. This will launch the Windows **Notepad** program. If editing a log file, make sure to save it in the original text format. If the file is converted to a Word format, Sentinel will not be able to recognize the file.

Sample data from an Alarm Log file is shown below:

```
8/20/99 4:21:13 PM ==> Polling Alarms from 3 units.
8/20/99 4:21:25 PM ==> ! Alarm # 197 power failure in unit # 148
8/20/99 4:21:25 PM ==> Unit 148 Successful
8/20/99 4:21:37 PM ==> ! Alarm # 197 power failure in unit # 555
8/20/99 4:21:37 PM ==> Unit 555 Successful
8/20/99 4:21:49 PM ==> Unit 145 Successful
8/20/99 4:21:49 PM ==> - Alarms checked in 3 units, of 3 attempted
```

No alarms were detected in the third unit, 145.

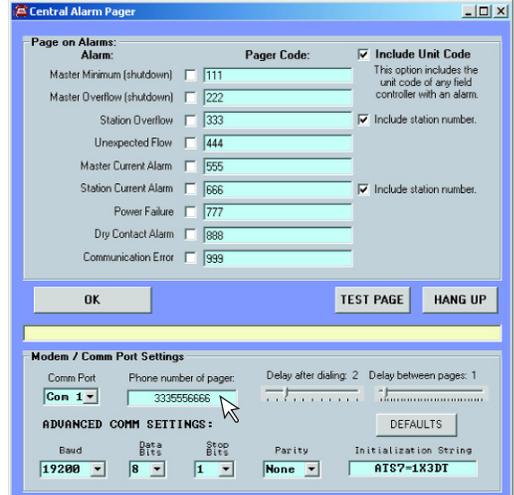
Run Times Report

If you select **Include Run Time Report** in the **AutoComm** window before polling alarms, you can also open the **Run Time** and **Deviation Report** by clicking the corresponding command buttons in the **Alarms** result window. The run time report includes a listing of data similar to that displayed in the **Run Time Report** accessed from the **Master Control Panel** in Sentinel. The **Deviations Only** report is a condensed version of the same data listing, excluding the programs that ran normally as programmed and expected, so that results with deviations can be printed efficiently. See **Appendix B** for specification and examples of these files.

You can launch Sentinel from the **Alarms Results** window in two ways. The square Sentinel button at the lower right corner is a quick shortcut. Additionally, clicking one of the color-coded field unit boxes will open Sentinel in a special mode. This will cause Sentinel to automatically open the **Alarm Status** window for that unit and retrieve the current alarm states of that unit.

Page Notification on Alarm Activation

You can set **AutoComm** to page you when it receives an alarm if you have a pager. After selecting **Poll Alarms** in **AutoComm**, click **Page** to open the utility window. You can enter a pager number and select the **Comm Port** and other settings for the PC modem you will use to call the pager. You can also adjust the delay after dialing and between pages, and specify the information included with the page. Click the check box next to the alarm type to include it in paging (if no boxes are checked, no paging will occur). You can enter any string (text message that the pager will accept) in the text box, next to the alarm, that you would like to include in the page message for that alarm. You can select **Include Unit Code** to include the 3-digit unit code with each page and you can also choose to include the station number for the **Overflow** and **Current** alarms.



Chapter 13 : Rain Shutdown

The **Rain Shutdown** module can be quickly accessed in three ways: by clicking on the **Rain** button in the tool bar, selecting **Rain Shutdown** from the **Group Operations** menu or by pressing the **CTRL + R** shortcut key combination. The **Selection Choice** window will appear first. This is where you can select field units for immediate shutdown or groups of field units from the group list on the right. Clicking a box under **Rain Days** will open the **Rain Days Entry** window. This is where you type the number of days the field units will be inactive, then click **OK**. You can also just pick the number of days from the selection. As an example, if **Pool Clubhouse** is selected with **2 Rain Days**, Pool Clubhouse field unit will be off for two days after the data is sent. Multiple units can be selected by clicking the edit box next to each desired unit. Changes made will apply to all selected units.

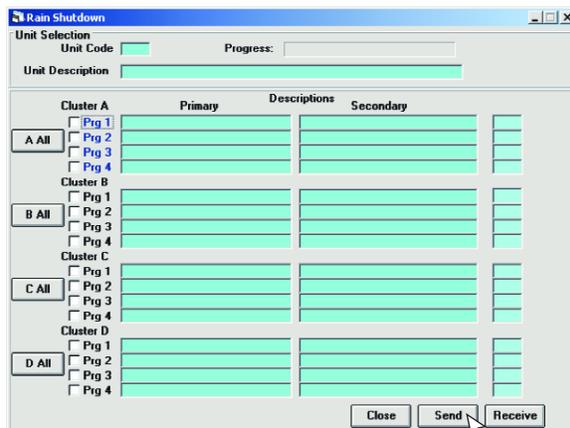
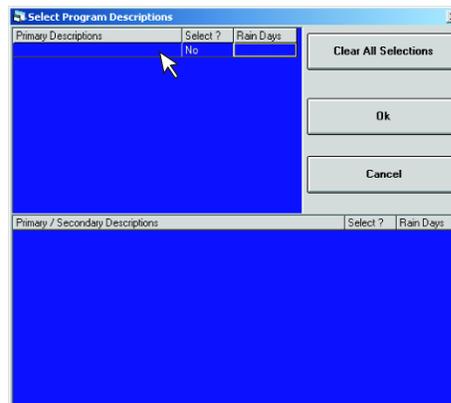
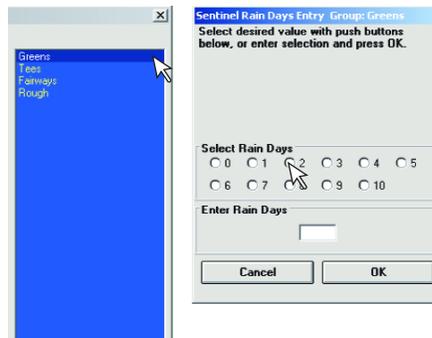
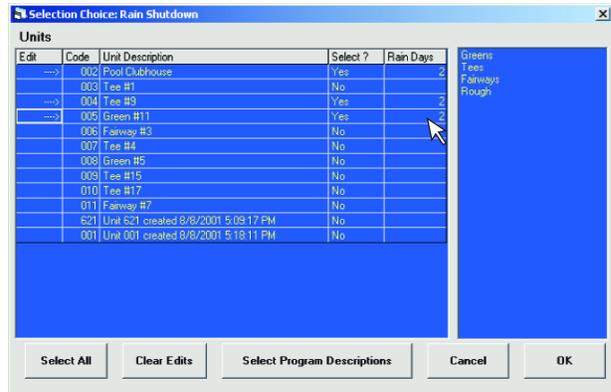
If a group of units is selected from the listing on the right (**greens** is selected in the example), all units associated with the group **greens** will be affected with the selected **Rain Days** setting. If **greens** is selected with two rain days, all units in the group **greens** will be off for two days after **Send** is executed.

Clicking **Select Program Description** allows you to narrow the selection by specifying the **Primary Description** as well as the **Secondary Description**. All programs within the selected units that fit both the primary and secondary descriptions are affected.

Example: Group **greens** is selected with **Primary Description** of **Turf** with two rain days. Two **Secondary Descriptions** were picked, **North Slope** and **South Slope**. Field units in the **greens** group with programs fitting the descriptions, **Turf** and **North Slope**, as well as programs with both **Turf** and **South Slope** descriptions will be shut down for two days.

After finalizing the unit selection for Rain Days, click **OK** on the **Selection Choice** window. The **Rain Shutdown** window will launch. It is initially blank. Click **Send** to save the **Rain Days** settings to the field units.

In the **Rain Shutdown** window, specific programs can be shut-down with the check boxes to the left of this window. Selecting programs here supercedes the selections from the **Selection Choice: Rain Shutdown** window and will apply it to all selected units. A default number of rain days can be entered which is used for any unit that was selected on the previous screen but for which no value was entered. The default number entered here supersedes any values entered by description. When you click **Send**, the program descriptions are filled in as each of the units you selected is successively transmitted. Each attempted transmission to a field unit as well as results are registered on the **Multi-Unit Comm Status** window.



Chapter 14 : System Flow Graph

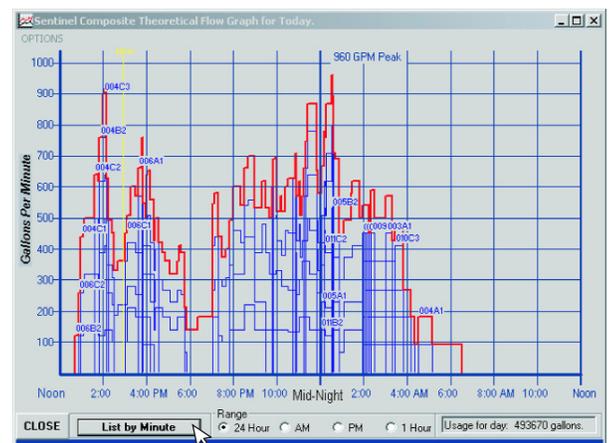
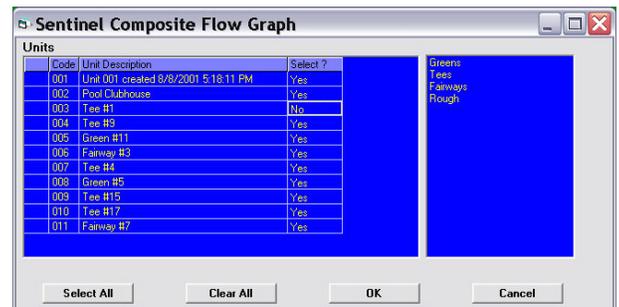
The **System Flow Graph** is an independent module that displays a graph of the total theoretical flow (in gallons per minute) of all programs for all field units in the current system(s) for one day. It can be opened from Sentinel from the **Flow** menu by selecting the **Composite Flow Graph** item or simply clicking the **Graph** button on the tool bar. Since the **System Flow Graph** module runs independently, it can also be started from the Windows **Start** menu. **System Flow Graph** can be launched even when Sentinel is not running. The **System Flow Graph** is sometimes referred to as the **Composite Flow Graph** because it integrates all the graphs of all programs in all units in the current system(s), representing the total flow of the entire system with a red line at the top of the graph. (If you prefer, a different color scheme can be selected in Options.) If more than one system has been selected as the Current system in the **System Maintenance** screen (discussed in Chapter 3), all programs from all units of all current systems are graphed and totaled.

When the **System Flow Graph** is opened from within the running Sentinel program, the user is prompted to select which day to graph, as all programs in the current system(s) may not be scheduled to run on any given day. Three choices are presented, as shown at right, **graph today**, **graph tomorrow**, or **all programs**, regardless of schedules. If the third option is selected, the resulting total graph is only valid for days on which all programs in the entire system are scheduled to run. If it is opened from Windows, the graph will default to the third choice and displays all programs.

After choosing which day to graph, units to graph can be selected by choosing either **Select Units To Include** or **Graph all units in current system**. If the first option is checked, a new window will open when **OK** is clicked, where any unit, units or groups of units can be selected. After making a selection of units, clicking **OK** on that window launches the **System Flow Graph** module, graphing all programs of the selected units.

When the graph is opened, it initially displays a full day. You can zoom in to display half a day by clicking the mouse in the left or right half of the graph. Then clicking the mouse within a one-hour segment of the graph will zoom in further to display that single hour. Clicking the mouse on the graph again will cause zooming of the vertical scale (gallons per minute) only. Click the right mouse button on the graph to zoom out again. You can also select the time scale with the options at the bottom of the screen, which has the same effect as zooming in or out with the mouse. When the time scale is one hour, you can shift the graph by one hour left or right with the scroll bar at the bottom of the graph. When the vertical scale is zoomed in, you can shift the graph up or down with the scroll bar at the right.

The graph for each program is derived from **Run Times**, **Start Times**, and **Repeats** entered in the **Auto Programming** screen (Chapter 5) and **Expected Flow** for each station entered in **Zone Data** (Chapter 6). Each blue line in the picture to the right represents the graph of one program, and consists of at least three line segments. The first segment is a vertical line rising at the start of the program to the height representing the expected flow for the station in the first slot. The second segment is a horizontal line from the top of the first segment to the right for the duration of the first slot run time plus run times of any contiguous slots with stations of the same expected flow. The last segment is a vertical line marking the end of the program. Stations with different expected flows will result in more line segments. Up to twenty program graphs are labeled with the unit code, cluster letter, and program number, as you can see in the picture. Each program graph is stacked on top of the one below, so that it's height represents a running total of the flow of all programs beneath it. The flow contribution of a single program is only the distance to the next program beneath it. The red line at the top represents the top program as well as the total of all flows of all programs in the current system(s). The box in the lower right corner of the window displays the total usage in gallons for the period displayed. It will automatically recalculate if a different time scale is selected.



Time	C	P	Station	Flow
--> 06:00 PM -- Day Change --				
06:00 PM	Unit 008	C 1	22	140 GPM
06:00 PM	Total:			140 GPM
06:01 PM	Unit 008	C 1	22	140 GPM
06:01 PM	Total:			140 GPM
06:02 PM	Unit 008	C 1	22	140 GPM
06:02 PM	Total:			140 GPM
06:03 PM	Unit 008	C 1	22	140 GPM
06:03 PM	Total:			140 GPM
06:04 PM	Unit 008	C 1	22	140 GPM
06:04 PM	Total:			140 GPM
06:05 PM	Unit 008	C 1	22	140 GPM
06:05 PM	Total:			140 GPM
06:06 PM	Unit 008	C 1	22	140 GPM
06:06 PM	Total:			140 GPM
06:07 PM	Unit 008	C 1	22	140 GPM
06:07 PM	Total:			140 GPM
06:08 PM	Unit 008	C 1	22	140 GPM
06:08 PM	Total:			140 GPM

The options menu allows you to print the graph as it is displayed, and to cycle through different color schemes and adjust the thickness of the lines (**focus offset** - thicker lines are easier to see but less accurate at lower resolution).

The **List by Minute** command displays a list of all the data used to generate the flow graph. This includes the total flow in each station that is running at each minute of the day, the unit, cluster, program running each station, and the total flow of all stations running at that minute. An example is shown. This list can be printed, but it may require an unwieldy number of pages if the system is large - hundreds if dozens of controllers run concurrently all day.

Chapter 15 : System Flow Optimizer

The **System Flow Optimizer** like the **System Flow Graph**, runs as an independent program from Sentinel. It can be opened from the Sentinel menu or tool bar (**Floptize**), or started independently from the Windows start menu. The flow optimizer begins by creating a flow graph of the current system identical to, and by the same method as, the **System Flow Graph**. The flow optimizer rearranges the **Start Times** of each program by a proprietary method called **Floptize** (short for flow optimize) to achieve a new operating order in which the maximum flow of the system is maintained for the shortest possible time. As seen in the picture below, the original flow graph appears first. Then a graph of the optimized system appears on top of it. Finally, a control panel window is displayed which enables you to adjust various parameters (see picture on page 33). When the optimizer is started, it initially graphs and optimizes only programs scheduled to run today. This can be adjusted as seen on the next page.



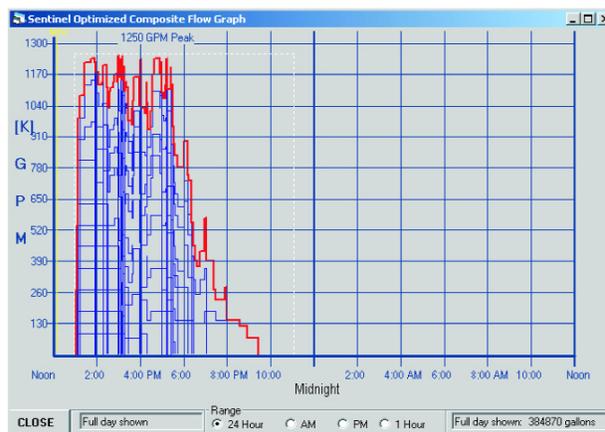
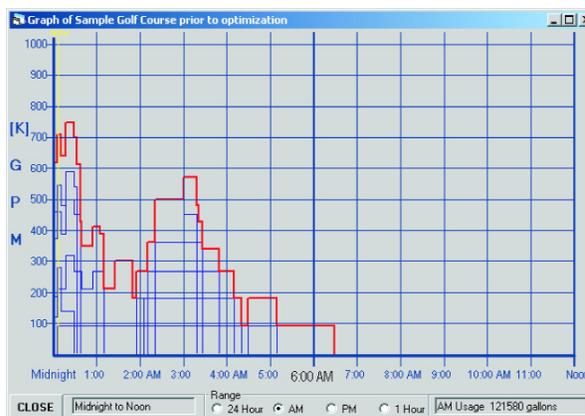
Flow Optimizing Parameters

With the **Flow Optimizing Parameters** control panel, you can pick tomorrow or any day of the 42-day (six-week) schedule period to optimize. You can also adjust the maximum flow of the system and the start and end of the Water Window (both originally set for the entire system in the System Maintenance screen).

IMPORTANT: Due to hardware limitations, only six programs or stations per unit can run concurrently. When using the **System Flow Optimizer**, do not use more than six programs in each unit. The flow graph will display all 16 programs, but will not indicate that all programs beyond the first six will not run.

The **Step Interval** is a time in minutes between the starts of the first tier of programs in the optimized system. With zero **Step Interval**, the first several programs (up to the maximum flow) would start at the same instant. The **Step Interval** allows adjustment of the start spacings up to five minutes apart. It only applies to the first several programs, those that would otherwise start at exactly the start of the **Water Window**.

Once you have made the desired adjustments on the control panel, click the **Floptize** command to re-optimize the system with the new settings. No matter how many times you adjust the parameters and **Floptize** the system, the optimized **Start Times** will not take effect (will not be saved in the Sentinel database) until you click the **APPLY** button. Only when the **APPLY** button is clicked does Sentinel save the new start times in the Sentinel database.



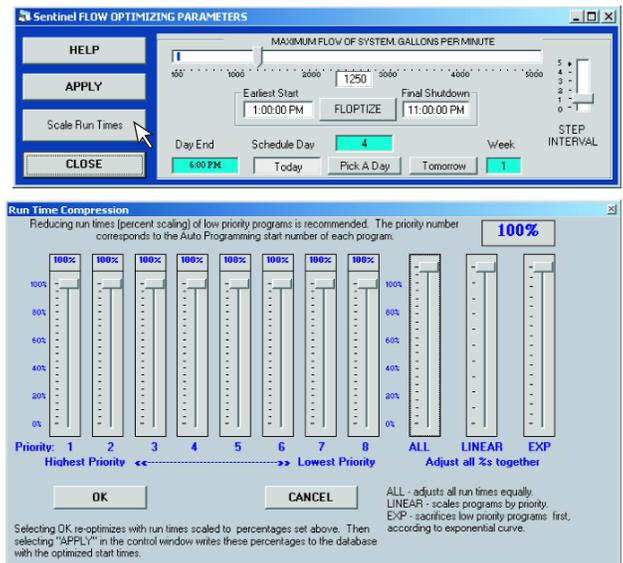
Priorities

The **Floptize** process will try to assign earlier **Start Times** to higher priority programs. There are eight priorities, **1** being the highest and **8** the lowest. As stated in **Chapter 5**, to use the **System Flow Optimizer**, you must only assign one **Start Time** to any one program. This is because the **Start Time** number determines the priority of the program.

Referring to the picture on page 9 in **Chapter 5**, note that each **Start Time** box is numbered with a priority number. If a **Start Time** is entered in the box labeled **1**, the program has the highest priority. **Floptize** will try to assign an earlier **Start Time** to that program than to a program with a time entered in the box labeled **2** or any higher number (lower priority). **Floptize** will also try to assign an earlier **Start Time** to a priority **2** program than to a priority **3** program, and so on. The crucial point is to only enter one **Start Time** for each program and that the actual time you enter is not as important as the sequence of the box in which you enter it.

If you find that your programs are too long to all run within the water window, you can pick **Scale Run Times** rather than adjusting the water window. This will open a window with eight different sliders to adjust run times of eight different groups of programs (grouped by priority). If you adjust the first slider down to 95%, the run time of each slot in every program with a priority of 1 will be scaled down to 95% of its original value. For example, if you adjust the lowest priority slider (priority 8) down to 60%, and a program had a start time entered in box 8 with a run time of 10 minutes, that run time would be decreased to 6 minutes.

Three additional sliders are provided to quickly adjust all programs. The slider labeled **ALL** will move the 8 main sliders equally. If you move it to 50%, all eight sliders will automatically move to 50%. If the second slider, labeled **LINEAR**, is adjusted, then the eight main sliders are automatically adjusted an amount proportional to their priority. The second priority will be reduced a little bit more than the first priority, and so on. This is a quick way to reduce the overall run time of the entire system without sacrificing the run times of the high priority programs as much as those of low priority programs. The last slider, labeled **EXP** (exponential), is similar but will adjust according to an exponential curve, sacrificing low priority programs much more than the linear slider. You can adjust these sliders all you want to see how they work. The scaled run times will not overwrite the original run times in the Sentinel database until the **APPLY** button is clicked.



Be aware of the following seven crucial points when using the **System Flow Optimizer**:

- **Assign only one Start Time per program.**
- **While each field unit can run only six programs concurrently, the number of programs included in the flow optimizer from different units is unlimited.**
- **Enter a Start Time in a higher numbered box to assign a lower priority to a program, and vice versa.**
- **Optimization will not take affect in Sentinel before the APPLY command is executed.**
- **Clicking the APPLY command will cause new Start Times to overwrite the old Start Times in the Sentinel database.**
- **If the water window or maximum flow are adjusted, clicking the APPLY command will change these values in the Sentinel database.**
- **If Run Times are scaled, clicking APPLY will also overwrite the existing Run Times in the Sentinel database.**

In the **Sentinel Auto Programming** window, it is possible to assign programs that overlap so that more stations will irrigate simultaneously than the maximum number that is set in the **Special Data** for the same field unit. In such a case, the **Flow Optimizer** will include all programs, although the field unit will not run them all. **Floptize** will warn you if this condition exist for any unit. You should go back to the **Auto Programming** window for that field unit and make sure that no more programs overlap than the maximum allowed, otherwise, increase the **Maximum Stations On** in **Special Data** for that unit.

Chapter 16 : Utilities and Troubleshooting

Sentinel has several utilities to help in the initial installation, configuring and trouble-shooting the system. These include **Serial Port Scan**, **Communication Test**, and **Sentinel Diagnostics**.

Serial Port Scan

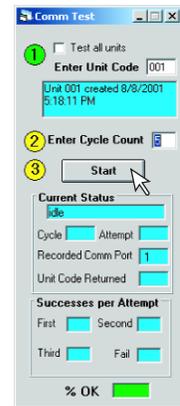
If you are not sure which serial port to select for field unit communication in **Special Data** or you are having trouble with communication, you can use this screen to automatically detect which hardware is connected to each of the PC's serial communication ports (**Comm Port**). You can scan any one or all of the serial ports, up to four. If no device is connected to a port or if Sentinel attempts to scan a port that does not exist, **Unknown** will be checked for that port. If you are using a **Central Interface Modem**, **Sentinel Modem** will be checked for the port it is connected to. If you have a field unit directly connected to your computer, **Sentinel Satellite** will be checked for that port. If you have a phone modem, **Phone** will be checked for that serial port.



Communication Test

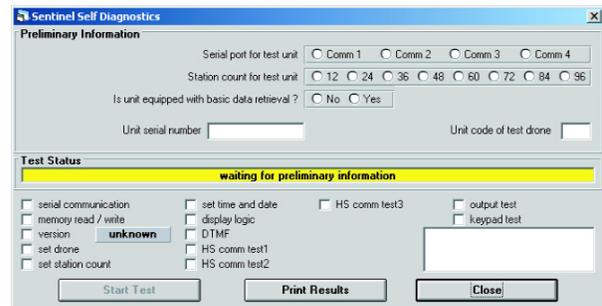
The **Communication Test** can be set to test communication with any one or all field units. Select **Communication Test** item from the **Utility/Diagnostics** menu. The **Comm Test** window will be displayed. You can then check (1) **Test all units** to test every unit in the system or **Enter Unit Code** of the unit being tested. To test each unit several times, enter the number of tests desired in **Cycle Count** (2).

Click on **Start** (3) to begin the test. The **Communications In Progress** window will launch after activation.



Field Unit Diagnostics

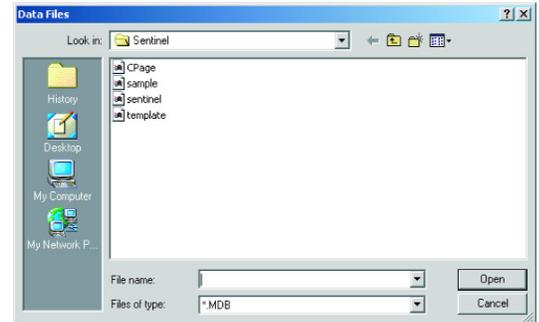
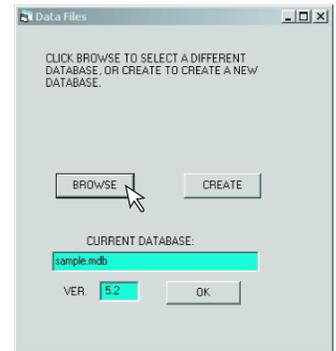
The **Field Unit Diagnostics** will test a number of features in a field unit. The correct **Comm Port** and **Station Count** must be selected. The items tested are listed on the screen and they will be checked off automatically as each test is completed. The unit being tested should be connected to your central computer. You should have a second field unit available as a test drone to test communication between units. You will need to use the field controller's keypad and display to complete the output test and keypad test.



Database Selection

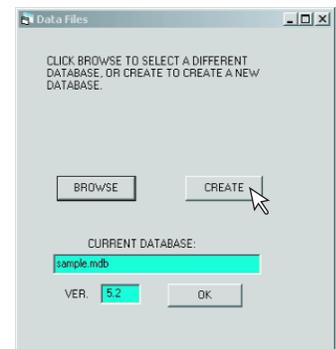
All Sentinel data in the central computer is stored in a single large database file. The default file name is **Sentinel.mdb**. The user may wish to save backup copies of the entire database under different names. Also, a sample database is provided called **sample.mdb** in the Sentinel directory folder. A utility is provided in the **Select Database** menu under the Sentinel **Setup** option. The **Data Files** window allows switching between the original file, **Sentinel.mdb**, and the sample or another valid Sentinel database file. A valid file is one which is created by the Sentinel program or a copy of one that was originally created in Sentinel.

The currently selected database is displayed in the box at the bottom of the **Data Files** screen. To select a different database, click **Browse**. A new window will open that allows you to select a Sentinel database file from any folder on any drive to which your computer has access. Remember that it must be a Sentinel database file to be valid. Other files may appear in the list if they have a similar extension (*.mdb), but Sentinel cannot read any files it did not create. Selection of an invalid file will generate an error message. When a valid file is chosen, the name will appear in the text box. Clicking **Open** then **OK** will automatically open the **Software Configuration** screen.



Creating a New Sentinel Database

Launch the **Data Files** window from the **Setup/Select Database** menu to create a new Sentinel database. From the **Data Files** window, click the **CREATE** button which launches another utility window. In this window, select the proper drive and folder on the computer or network where you want the new file to reside. Type the file name of your choice at the bottom text box. Do not type the file extension. The file extension **.MDB** will be automatically added. Click **Save**, then **OK**.



APPENDIX A: Hand-Held Radio Operation and Commands

The **Sentinel Hand-held Radio Interface** (HHRI) can be used to access the Sentinel satellite field unit. With the Sentinel HHRI, you are able to turn on and off individual stations or clusters of programs. During HHRI operation, the satellite is placed in one of two modes: **Normal** mode and **Secure** mode. All field units under **Normal** mode will react to the transmitted commands sent by the HHRI, regardless of the field unit number. Under **Secure** mode, the HHRI transmits the command to a specific field unit number. Only that specific unit will react to the commands.

Normal Mode - To set a field satellite unit for **Normal mode** operation, send **##CCC#** command where **CCC** is the unit code. Press the hand-held radio **PTT** button (Push To Talk) to transmit the command. Send **##** to exit Normal mode operation. The field unit displays **A** while in Normal mode. Transmitted Normal mode commands will be received by all field units placed in the Normal mode.

Action	Command	Operation
Turn on a station for 30 minutes.	nn	Station nn (where nn is the specified station) will irrigate for 30 minutes. After 30 minutes, the station will stop irrigating and the satellite awaits for the next command.
Turn on a station for a specified amount of time.	nn h tt	Station nn will irrigate until the specified hour (h) and minutes (tt) expire. As an example, entering 12 1 30 will energize station 12 for 1 hour and 30 minutes.
Turn on multiple stations.	nn nn nn	Use this command to turn-on multiple units for 30 minutes. The desired Satellite stations are listed in series (nn nn nn). As an example, entering 12 13 14 will energize station 12–14 simultaneously.
Increment operation to the next station.	3	Sending the 3 command will step-up, increment, the currently operating station. As an example, if station 16 is currently in operation and the 3 command is transmitted, station 16 will stop and station 17 will initiate operation.
Decrement operation to the next station.	1	Sending the 1 command will step-down, decrement, the currently operating station. As an example, if station 16 is currently in operation and the 1 command is transmitted, station 16 will stop and station 15 will initiate operation.
Turn off the last station energized.	*	Send the * command to turn-off the last station that was turned on. If station 16 was the last station energized and * command was transmitted, station 16 will stop operation.
Turn off a specific station.	nn*	Send a nn* command to turn-off individual stations. As an example, to turn-off station 16 from a series of irrigating stations, send a 16* command.
Turn off all stations in operation within the same satellite unit.	**	To turn-off multiple stations that are in operation within the same unit, send a ** command. As an example, the satellite unit has stations 12–14 in operation. To turn-off all stations with one command, send a ** command.
Place a station in Rain OFF.	nn dd*	Use this command to place a station in Rain OFF for a specified number of days. Entering 16 05* command will disable station 16 (nn) of from all Sentinel Satellite unit for 5 (dd) days.

Sequence Related Commands Under Normal Mode

Action	Command	Operation
Set sequence time.	00 h tt	If running a sequence of stations, use this command to set the run time duration. As an example, sending 00 1 30 command instructs the satellite unit to run a sequence for 1 hour and 30 minutes.
Start sequence operation.	nn#	Send this command to start irrigation for all station in sequence, where nn is the first station to irrigate.
Increment sequence.	3#	Sending this command will step from the currently operating station to the next higher station number. As an example, if station 16 is currently in operation and the 3# command is transmitted, station 16 will stop and station 17 will initiate operation.

Set sequence time.	1#	Sending this command will step from the currently operating station to the next lower station number. As an example, if station 16 is currently in operation and the 1# command is transmitted, station 16 will stop and station 15 will initiate operation.
Start sequence operation.	00#	Sending this command will stop the satellite unit's sequence operation.

Semi Auto Program Commands Under Normal Mode

Action	Command	Operation
Start cluster program.	#Cp#	This command instructs the satellite to start a specified cluster program. The C designates the cluster number, 1 for cluster A, 2 for cluster B, etc. The p designates the program number within the specified cluster. As an example, if command # 24 # is transmitted, cluster B program 4 will start.
Stop cluster program.	#C3*	This command instructs the satellite to stop the specified cluster in operation. The C designates the cluster number (1 for cluster A, 2 for cluster B, etc.) to stop operation.

Secure Mode

To set a field satellite unit for **Secure mode** operation, send **##CCC##** command where **CCC** is the unit code. Press the hand-held radio's **PTT** button (Push To Talk) to transmit the command. Only the specified unit will respond to transmitted commands. Send **CCC ##** to exit Secure mode operation. The field unit will displays S while in Secure mode.

Action	Command	Operation
Turn on station for 30 minutes.	CCC nn	Station nn (where nn is the specified station) of unit CCC (where CCC is the unit code)will irrigate for 30 minutes. After 30 minutes, the station will stop irrigating and the satellite awaits for the next command.
Turn on a station for a specified amount of time.	CCC nn h tt	Station nn of unit CCC will irrigate until the specified hour (h) and minutes (tt) expire. As an example, entering 555 12 1 30 will energize station 12 of unit 555 for 1 hour and 30 minutes.
Turn on multiple stations.	CCC nn nn nn	Use this command to turn-on multiple units for 30 minutes. The desired satellite stations are listed in series after the unit number. As an example, entering 555 12 13 14 will energize station 12–14 of unit 555.
Increment operation to the next station.	CCC 3	Sending this command will step from the currently operating station to the next higher station number. As an example, if station 16 of unit 555 is currently in operation and the 555 3 command is transmitted, station 16 will stop and station 17 will initiate operation.
Decrement operation to the next station.	CCC 1	Sending this command will step from the currently operating station to the next lower station number. As an example, if station 16 of unit 555 is currently in operation and the 555 1 command is transmitted, station 16 will stop and station 15 will initiate operation.
Turn off last station energized.	CCC *	Send a CCC * command to turn-off the last station that was turned-on. If station 16 was the last station energized on unit 555 and a 555 * command was transmitted, station 16 will stop operation.
Turn off a specific station.	CCC nn *	Sending this command allows you to turn-off individual stations. As an example, to turn-off station 16 of unit 555, send a 555 16 *.
Turn off all stations in operation within a satellite unit.	CCC **	To turn-off multiple stations that are in operation within a specified unit, send a CCC **, where CCC specifies the satellite unit.
Place a station in Rain OFF.	CCC nn dd *	Use this command to place a station in Rain OFF for a specified number of days. Entering 555 16 05 * command will disable station 16 (nn) of Satellite unit 555 (CCC) for 5 (dd) days.

Sequence Related Commands Under Secure Mode

Action	Command	Operation
Set sequence time.	CCC 00 h tt	If running a sequence of stations, use this command to set the run time duration. As an example, sending 555 00 1 30 command instructs satellite unit 555 to run a sequence for 1 hour and 30 minutes.
Start sequence operation.	CCC nn #	Send this command to start irrigation for all station in sequence, where CCC is the satellite unit and nn is the first station to irrigate in sequence.
Increment sequence.	CCC 3 #	Sending this command will step from the currently operating station to the next higher station number. As an example, if station 16 of unit 555 is currently in operation and the 555 3 # command is transmitted, station 16 will stop and station 17 will initiate operation.
Decrement Sequence	CCC 1 #	Sending this command will step from the currently operating station to the next lower station number. As an example, if station 16 of unit 555 is currently in operation and the 555 1 # command is transmitted, station 16 will stop and station 15 will initiate operation.
Stop sequence operation.	CCC 00 #	Sending 555 00 # will stop satellite unit 555's sequence operation.

Semi Auto Program Commands Under Secure Mode

Action	Command	Operation
Start cluster program.	CCC #Cp#	This command instructs the satellite unit CCC to start the specified cluster program. The C designates the cluster number, 1 for cluster A, 2 for cluster B, etc. The p designates the program number within the specified cluster. As an example, if command 555 #24# is transmitted, cluster B program 4 of unit 555 will start.
Stop cluster program.	CCC #C3*	This command instructs the satellite unit CCC to stop the specified cluster in operation. The C designates the cluster number (1 for cluster A, 2 for cluster B, etc.) to stop operation.

Appendix B: Log Files

Sentinel uses four different types of log files to save information about communications, alarms, etc. that can be viewed. All of the log files can be accessed from the folder where Sentinel is installed and can be viewed with **Word** or **Notepad**.

Activity Log

```
7/15/2003 8:20:06 PM ==> Starting Sentinel Automatic Communication Module.
7/15/2003 8:20:07 PM » Automatic ET transmission [0.0779] to 2 units.
7/15/2003 8:20:15 PM » Unit 103 Successful transmission of ET = 0.0779 Rain = 0
7/15/2003 8:20:24 PM » Unit 105 Successful transmission of ET = 0.0779 Rain = 0
7/15/2003 8:20:24 PM » - ET was successfully sent to 2 units, of 2 attempted.
8/29/2003 4:11:27 PM ==> Receipt of Special Data from 2 units.
8/29/2003 4:11:37 PM ==> Special Data rec'd from unit 103 with field version 1.19
8/29/2003 4:11:47 PM ==> Special Data rec'd from unit 105 with field version 1.31
8/29/2003 4:11:47 PM ==> Special Data received from 2 units, of 2 attempted.
```

The general information about communications between the Sentinel Central Computer and the field units is logged in the **Activity Log**, which is saved as **Sentinel.log**. It can be accessed from the **Sentinel File** menu. This file will include the type of each communication activity (i.e. transmission of time/date, zone data, ET values, etc.) and the time that it occurred. It will also list communication errors and an indication of whether communication succeeded or failed with each unit.

All communications that Sentinel logs are recorded in this file with the exceptions of **Alarms** and **Run Time Reports**, which have their separate log files.

Alarm Log

```
8/28/2003 6:20:10 PM ==> Starting Sentinel Automatic Communication Module.
8/28/2003 6:20:10 PM » Sentinel Automatic Communication Module Running.
8/28/2003 6:20:10 PM » Polling Alarms from 2 units.
8/28/2003 6:20:21 PM » ! Alarm # 197 power failure in unit # 103
8/28/2003 6:20:21 PM » Unit 103 Successful
8/28/2003 6:20:33 PM » ! Alarm # 126 current alarm in unit # 105 station 26
8/28/2003 6:20:33 PM » ! Alarm # 132 current alarm in unit # 105 station 32
8/28/2003 6:20:33 PM » ! Alarm # 197 power failure in unit # 105
8/28/2003 6:20:33 PM » unit # 105 Last ON: 8/3/2003 04:47 PM
8/28/2003 6:20:33 PM » unit # 105 Last OFF: 8/3/2003 04:45 PM
8/28/2003 6:20:33 PM » Unit 105 Successful
8/28/2003 6:20:33 PM » - Alarms checked in 2 units, of 2 attempted.
```

Sentinel logs the time and alarms received when polling the alarms from the field units, whether polled from the **Sentinel Group Operations** menu, Alarms shortcut or from schedule polling in **AutoComm**. The alarm log is stored in the **calarms.log** file located in the folder where Sentinel is installed.

Notice in the sample that when Sentinel polled field unit 105, it found a power failure alarm and displayed the time when it occurred and when power was restored. Unit 103 also had a power failure but the time was not displayed. Unit 103 is an older field unit with an earlier firmware version that does not support power failure time log. This is also apparent from the **Sentinel.log** listing in which receipt of **Special Data** from the similar field units revealed that unit 103 has firmware version 1.19 while unit 105 has firmware version 1.31. This emphasizes the importance of receiving **Special Data** from all units, to update information regarding field unit firmware version and settings, before setting up the field units.

Run Time Report

```

7/16/2003 1:20:33 AM »Get Run Times from 2 units. † overlap; ‡ overlap+run; * deviation
-----
UNIT 103----- Actual -----+----- Expected -----
PROGRAM TODAY YESTERDAY TODAY YESTERDAY Starts Base Total Next Rain
Days Days
CAP1 ... ... ... 0 ... ... 0
CAP2 ... ... 5:00 5:00 1 5:00 5:00 ... 0 *
CAP3 ... ... 6:00 6:00 1 6:00 6:00 ... 0 *
CAP4 ... ... 6:00 6:00 1 6:00 6:00 ... 0 *
CBP1 ... ... 6:00 6:00 1 6:00 6:00 ... 0 *
CBP2 ... ... 6:00 6:00 1 6:00 6:00 ... 0 *
CBP3 ... ... 6:00 6:00 1 6:00 6:00 ... 0 *
CBP4 ... ... 6:00 6:00 1 6:00 6:00 ... 0 *
CCP1 ... ... 6:00 6:00 1 6:00 6:00 ... 0 *
CCP2 ... ... 6:00 6:00 1 6:00 6:00 ... 0 *
CCP3 ... ... 6:00 6:00 1 6:00 6:00 ... 0 *
CCP4 ... ... ... 0 ... ... 0
CDP1 ... ... ... 0 ... ... 0
CDP2 ... ... ... 0 ... ... 0
CDP3 ... ... ... 0 ... ... 0
CDP4 ... ... ... 0 ... ... 0
Water Sunday Monday Tuesday Wednesday Thursday Friday(Saturday) Weekly
Used: 00000 00000 00000 00000 00000 00000 00000 00000 total: 0 gal
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec YTD
00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000
---Unit 103---PC: 07/16 01:20---FU: cal.day: 7---Sched.Day: 6---DC: 10 AM--- Alarm

UNIT 105----- Actual -----+----- Expected -----
PROGRAM TODAY YESTERDAY TODAY YESTERDAY Starts Base Total Next Rain
Days Days
CAP1 ... ... ... 0 ... ... 0
CAP2 6:00 6:00 6:00 6:00 1 6:00 6:00 ... 0
CAP3 6:00 6:00 6:00 6:00 1 6:00 6:00 ... 0
CAP4 6:00 6:00 6:00 6:00 1 6:00 6:00 ... 0
CBP1 6:00 6:00 6:00 6:00 1 6:00 6:00 ... 0
CBP2 6:00 6:00 6:00 6:00 1 6:00 6:00 ... 0
CBP3 6:00 6:00 6:00 6:00 1 6:00 6:00 ... 0
CBP4 6:00 6:00 6:00 6:00 1 6:00 6:00 ... 0
CCP1 1:10 1:10 6:00 6:00 1 6:00 6:00 ... 0 *
CCP2 0:50 0:50 6:00 6:00 1 6:00 6:00 ... 0 *
CCP3 0:50 0:50 6:00 6:00 1 6:00 6:00 ... 0 *
CCP4 ... ... 4:00 4:00 1 4:00 4:00 ... 0 *
CDP1 ... ... 3:00 3:00 1 3:00 3:00 ... 0 *
CDP2 ... ... 3:00 3:00 1 3:00 3:00 ... 0 *
CDP3 ... ... 3:00 3:00 1 3:00 3:00 ... 0 *
CDP4 ... ... 3:00 3:00 1 3:00 3:00 ... 0 *
Water Sunday Monday Tuesday Wednesday Thursday Friday(Saturday) Weekly
Used: 00000 00000 00000 00000 00000 00000 00000 total: 0 gal
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec YTD
00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000
---Unit 105---PC: 07/16 01:21---FU: cal.day: 7---Sched.Day: 6---DC: 10 AM--- Alarm

7/16/2003 1:21:03 AM » Run Times received from 2 units, of 2 attempted.
-----
end Run Times Report -----

```

Sentinel will generate a file with the runtime report if the **Run Time Report** option is selected in **AutoComm** when polling the alarms. The runtime data received from each unit that is included in the alarm poll is included in this file. The file name of this log will be **RRMMDDYY.LOG**, where **RR** represents Runtime Report and **MM DD YY** represents the month, day and year of the report respectively. For example, **RR071604.LOG** is the runtime report generated by Sentinel on July 16, 2004. You can access the **Run Time Report** from the displayed **Alarm Poll** results or by opening the file found in the Sentinel folder with **Word** or **Notepad**.

Run Time Deviations

Sentinel also creates a condensed version of the **Run Time Report**. This file lists only the programs that have a discrepancy between the programmed and the actual run time from the same data set during the **Alarm Poll**. For convenience, programs that ran normally are eliminated so that problems can be quickly evaluated. The file name of the **Runtime Deviation** report will be **RDMDDYY.LOG** where **RD** represents Runtime Deviation and **MM DD YY** represents the month, day and year of the report respectively. For example, **RD071604.LOG** is the runtime deviation generated by Sentinel on July 16, 2004. You can access the runtime deviation report by clicking the **Deviations Only** button from the Alarms window or by opening the file found in the Sentinel folder with **Word** or **Notepad**.

Client's Regulatory Responsibilities

REGARDING ANY AND ALL RADIO COMMUNICATIONS SYSTEM(S) AND RELATED COMPONENTS THAT ARE PURCHASED FROM TORO, IT IS THE CLIENT, **AND NOT TORO**, THAT IS RESPONSIBLE FOR OBTAINING, COMPLYING WITH, AND MAINTAINING, **AT CLIENT'S EXPENSE**, ANY AND ALL LICENSES, PERMITS, CODES AND OTHER SUCH REGULATORY REQUIREMENTS RELATED TO CONSTRUCTION, ZONING, CLEARANCE AND OTHER SUCH REGULATION AS ISSUED AND ENFORCED BY ALL APPLICABLE INTERNATIONAL, FEDERAL, STATE, COUNTY, MUNICIPAL, LOCAL AND OTHER GOVERNING BODIES INCLUDING BUT NOT LIMITED TO, THE FEDERAL COMMUNICATIONS COMMISSION (FCC), THE FEDERAL AVIATION ADMINISTRATION (FAA), THE ENVIRONMENTAL PROTECTION AGENCY (EPA), OR ANY STATE LEGISLATURE, COUNTY COMMISSION, COUNTY ZONING BOARD, CITY COUNCIL, CITY/MUNICIPAL ZONING BOARD, COUNTY BUILDING INSPECTION DEPARTMENT, CITY/MUNICIPAL INSPECTION DEPARTMENT, ETC.

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