Part I: The CowTek HealthWatch™ System

Overview

The CowTek HealthWatch™ system uses an electronic ETD BOLUS™ (Elevated Temperature Detection bolus) to monitor cattle for infections or illnesses which cause loss in weight gain or milk production. The ETD BOLUS™ consists of a weighted capsule which rests in the animal's rumen and incorporates temperature monitoring and recording circuitry together with a radio-frequency transmitter to report changes in internal temperature which may indicate illness or infection. In addition to simple long-term health monitoring, the HealthWatch™ system also offers special veterinary monitoring and fertility detection modes.

> Note: fertility detection is presently in development and is not offered as a reliable indicator. This feature is included, however, because it is being used in laboratory settings for further research.

Also, because cattle are less thermally stable than some species and because their normal internal temperatures can vary with seasonal, climatic and regional conditions, the ETD BOLUS™ accepts threshold reporting levels which can be set either using the Desktop Exciter prior to implanting the bolus.

Hardware Components:

To manage and monitor report transmissions from the boluses and to control operational modes, in addition to the temperature boluses, the HealthWatch™ system includes three types of external device: a Desktop Exciter to initialize boluses and a Field Receiver to monitor cattle over a wide area.

Temperature Bolus

The ETD BOLUS™ is an active, battery-powered temperature monitoring device which records and tracks temperature changes. The bolus is designed to ignore minor temperature fluxuations caused by diet or exertion while reporting prolonged elevated temperatures which are indications of illnesses or infections which demand attention and treatment.

Figure 1:   The CowTek HealthWatch™ Temperature Bolus

The ETD BOLUS™ is sealed in an inert polypropylene capsule and weighted to prevent the bolus from being expelled from the rumen or from being passed through the digestive system. Powered by a sealed lithium battery, the ETD BOLUS™ has a functional lifespan – without attention – of approximately five years.

Because a cow's normal temperature can vary according to the temperature of their environment, the ETD BOLUS™ monitors and calculates a 'normal reference' temperature for each animal, adjusting this reference temperature according to seasonal and climatic changes.

In addition to long-term health monitoring, the ETD BOLUS™ can also be used for veterinarian monitoring to report reactions to injections, implants or other treatments and can be used for ovulation monitoring (in development) to report when an animal is ready for artificial (or natural) insemination following the use of fertility stimulants.

NOTICE TO THE USER

Any changes or modifications not expressly approved by CowTek, Inc for compliance could void your authority to use the equipment.

FCC WARNING

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Desktop Exciter

The Desktop Exciter is used to 'turn on' a pill before it is given to the cow or bull.

> Because of FCC requirements for active transmitter devices and to ensure maximum battery life (estimated ~5 years), the HeathWatch™ temperature pills are shipped in a QUIET or OFF mode and must be initialized before use.

The Desktop Exciter – see Figure 2 – has a recessed grove on the top shaped to the orientation of the pill; three mode buttons labeled WAKEUP, FERTILITY and VETERINARY and three threshold buttons labeled WINTER, NORMAL and SUMMER. In addition there are two LEDs – one RED and one GREEN – which show operation and status; one serial port (DB9, RS232, not shown); and a power connection (not shown).
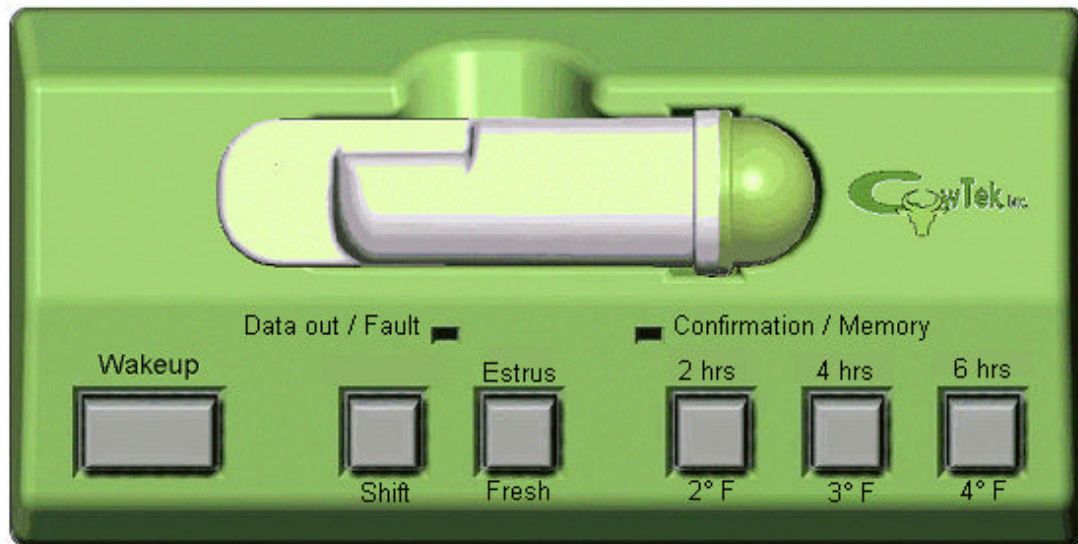
Figure 2: *The Desktop Exciter*

Components

The Desktop Exciter includes a 12-volt power supply (120VAC to12VDC) and a serial cable for connections to a desktop computer.

Field Receiver

The Field Receiver consists of a control box and a pole-mounted antenna and is used to monitor and record messages transmitted by HealthWatch™ temperature pills in cattle over a wide area. The Field Receiver control panel does not provide switches to select operational modes or change temperature thresholds.
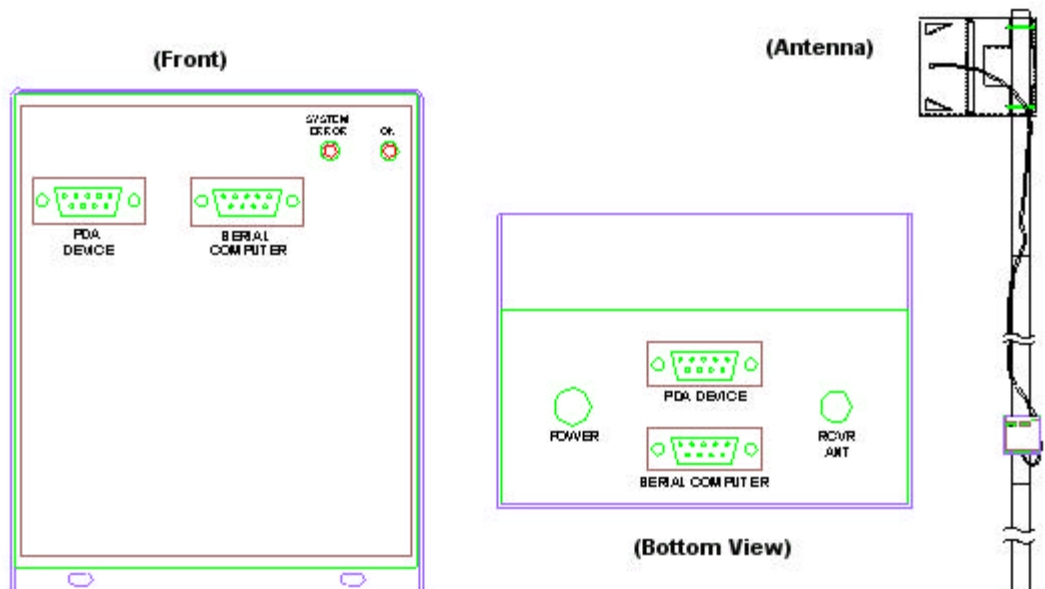

Figure 4: *The Field Receiver Control and Antenna*

The number and locations of Field Receivers necessary are determined by the area to be covered including such factors as the number of cattle, and the size and location of the pens or other enclosures being monitored.

The Field Receiver control box has one LED pair (RED/GREEN) to report status information (see **LED Indicators**) and a set of four serial connectors, one power connection and one RF connector (see **Ports and Connections**).

> **Note**: the two DB9 connectors on the front of the Receiver control box (one male, one female) and the two DB9 connectors on the bottom (one male, one female) are all connected as a single serial port. The two types and two positions simply provide convenient connections for either a handheld (PDA) device or a desktop or laptop computer.

Components

The Field Receiver includes a 12-volt power supply (120VAC to 12VDC) and a coaxial cable (control panel to antenna unit).

Optional components include:

- PDA (handheld) to DB9 serial cable – required for handheld versions of HealthWatch™ Monitor and Commander programs.

- DB9 Serial cable (M/F) – required for desktop/laptop connection to run HealthWatch™ Monitor and Commander programs.

LED Indicators

The Field Receiver has one LED pair (one red, one green) on the control box. Functionally, the LEDs are used for error and status reporting as:

<div align="center">Error / Status Reporting</div>

LED	Display	Meaning	Duration
GREEN	slow blink	reports waiting for download	until data is dumped to handheld / desktop or until reset
RED / GREEN	alternating	system error	until reset

Ports and Connections

The Desktop Exciter and Field Receiver each provide one or more serial connections allowing a desktop, laptop or handheld computer to be connected to the device for monitoring and data collection.

Desktop Exciter

The Desktop Exciter provides a single DB9, RS232 connection suitable for a desktop or laptop but may be connected to a handheld device using null modem and gender-changer adapters. The Desktop Exciter also has one coaxial plug for a 12-volt DC power supply (required).

Field Receiver

The Field Receiver control box has four DB9, RS232 connections; two positioned on the front of the box and two on the bottom. One connector in each pair is for a handheld (PDA) computer while the other provides a connection to a desktop or laptop system. All of these connectors, however, share a single serial port and only one device should be connected at any time. Also on the bottom of the control box, a power connector provides 12-volts DC while a coaxial (TV) cable connects to the field antenna.

The Field Receiver antenna is powered through the coaxial connection to the control panel.

HealthWatch™ Software Components:

The HealthWatch™ system is supported by three software utilities: the HealthWatch™ Monitor which displays reports collected by the receivers; the Commander which provides an alternate command module as well as collecting information from tags as they are initialized and the Cross-Reference Editor which assists the user in match the unique pill IDs to visible ear tag numbers or other more convenient references. Each of these utility programs are documented further in separate sections, following.

Part II: HealthWatch™ Operations

Desktop Exciter Operation

The Desktop Exciter must be used to initialize a HealthWatch™ ETD bolus before use. The Exciter can also be used to set the FERTILITY or FRESH/VET modes and, in the NORMAL mode, can set the fever threshold settings and reporting period.

Initialization

To initialize a HealthWatch™ ETD bolus:

1. Place the bolus in the fitted groove (Figure 1) with the 'duckbill' to the left as indicated by the shape of the recess.

> **Note**: the bolus must be placed correctly in the fitted groove before any operation can be executed.

2. Press the WAKEUP (STATUS) button

In response, the red LED will turn on briefly to show that the command is being sent to the pill. When a confirmation is received that the command has been accepted, the GREEN LED will light for 7-15 seconds indicating the pill is active and has been placed in the DEFAULT operational mode with the temperature threshold set to NORMAL (see **Operation Modes** following).

If the operation is not successful – because the command was not acknowledged or because of any other error – the RED LED will blink rapidly for ~15 seconds.

> An alternating RED/GREEN blink indicates a system error. To correct this, power down the Desktop Exciter by unplugging the power cord from the unit and waiting for 10 seconds before restoring power.
>
> If the error condition persists, contact CowTek Technical Support.

The Desktop Exciter can also be used to select either the FRESH/VET or FERTILITY modes or to set the fever thresholds and monitoring periods.

To select either the any of the modes, the bolus must previously have been initialized using the WAKEUP command. To change modes, place the bolus in the Desktop Exciter groove and press the button for the desired operational mode.

To reset a bolus to the NORMAL mode, repeat the WAKEUP command.

 (The functions of the DEFAULT, FRESH/VET and FERTILITY modes are described following under **Operation Modes**.)

> When the FERTILITY or FRESH/VET modes conclude their normal operation, the HealthWatch™ temperature bolus automatically reverts to NORMAL operation.

The boluses monitor and calculate normal reference temperatures for each individual animal, adjusting the reference temperatures according to seasonal and climatic conditions. These threshold settings allow the temperature pills to respond more appropriately than a single, fixed threshold temperature setting. The temperature settings are discussed following under **Threshold Settings.**

Monitoring the Desktop Exciter

The Desktop Exciter offers a single serial (DB9, RS232) port to provide communications with the HealthWatch™ Commander running on a desktop or handheld device.

The HealthWatch™ Commander software provides two useful functions:

- allowing monitoring of responses from the Desktop (or Long Range) Exciter.
- collecting bolus IDs as they are initialized.

When any command is sent to a HealthWatch™ temperature bolus, each device responds with a unique serial number which is displayed as an eight-character (hexadecimal) number.

In turn, for your convenience, the desktop HealthWatch™ Monitor programs allow these pill serial numbers to be mapped to visible ear tag numbers (or any other identifier of your choice) using a cross-reference table prepared using the HealthWatch™ Commander during bolus initialization or, later, using the HealthWatch™ Cross-Reference Editor. Both utilities are described following.

Operational Modes

Three operational modes – NORMAL, FRESH/VET and FERTILITY – provide reporting parameters and performance operations for different purposes. Each mode is described following.

Normal Mode

In the NORMAL mode of operation, the pill monitors temperatures watching for an individual reading which diverges from the reference temperature. When a chill/fever reading is found, the bolus continues to monitor temperature readings for the set watch period. If the average temperature deviation for the watch period remains greater than the threshold, the bolus automatically transmits a fever report.

As long as the average temperature deviation remains above the threshold level, a transmission is sent hourly for the first six hours (6 transmissions), every four hours for the next twelve hours (3 transmissions), every six hours for the next 24 hours (4 transmissions), every twelve hours for 48 hours and finally every twenty-four hours until the average temperature falls below the threshold setting.

Fever Reporting Intervals (Default Mode)

Day	1	2	3	4	5	6	7
Interval	hourly	hourly	hourly	2 hours	2 hours	2 hours	2 hours

Fresh/Vet Mode

The FRESH/VET mode is selected to monitor an animal's temperature regardless of threshold settings. In FRESH/VET mode, the current temperature is reported every hour for the first three days (72 transmissions), then every two hours for the next four days (48 transmissions).

When the FRESH/VET mode concludes, the pill reverts automatically to the NORMAL mode of operation.

Veterinary Reporting Intervals

Day	1	2	3	4	5	6	7
Interval	hourly	hourly	hourly	2 hours	2 hours	2 hours	2 hours

Fertility Mode (in development)

When initiated, the FERTILITY (or OVULATION) test mode samples temperatures at one-half hour intervals for twenty-four hours but without reporting, watching for a trigger temperature of 103.5°. This is an immediate temperature reading, not an average, and is irrespective of the normal trigger temperature.

Once the OVULATION trigger level has been found, the pill reports the current temperature every half-hour for the first twelve hours (24 transmissions) and then every hour for the next twelve hours (12 transmissions).

When the FERTILITY mode concludes, the pill reverts automatically to the DEFAULT mode of operation with the previous threshold (WINTER, NORMAL or SUMMER) setting.

Fertility Alert Intervals

Every half-hour for 12 hours:	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0
Every hour for 12 hours:	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0

Reference Temperature Averages

Because normal bovine body temperatures vary to some degree according to the outside temperatures and according to diet, the temperature bolus samples the individual animal's temperature 32 times per day to create daily averages and then uses the last sixteen daily averages to calculate an average reference temperature for the individual.

Threshold Settings and Watch Periods

Threshold settings and watch periods are used to determine how potential chill/fever conditions are monitored and reported. Threshold settings can be 2°, 3° or 4° (F) and the watch period can be 2, 4 or 6 hours.

> Note: these settings are intended as a guideline only and are not a substitute for your own experience and knowledge of local conditions.

HealthWatchä Commander

The HealthWatch™ Commander – illustrated below – is a utility which allows a desktop (handheld version available) computer to be attached to the Desktop Exciter.

Using the HealthWatch™ Commander requires a desktop or laptop computer and the appropriate cable to connect to the Desktop Exciter.

Using the Commander, the same operations supported by the device buttons can be executed from the screen. The Commander, however, offers the additional capabilities of setting the clock on the Exciter/Receiver and – *recommended* – building a cross-reference list matching temperature pill IDs to visible tag number or any other form of labeling desired.
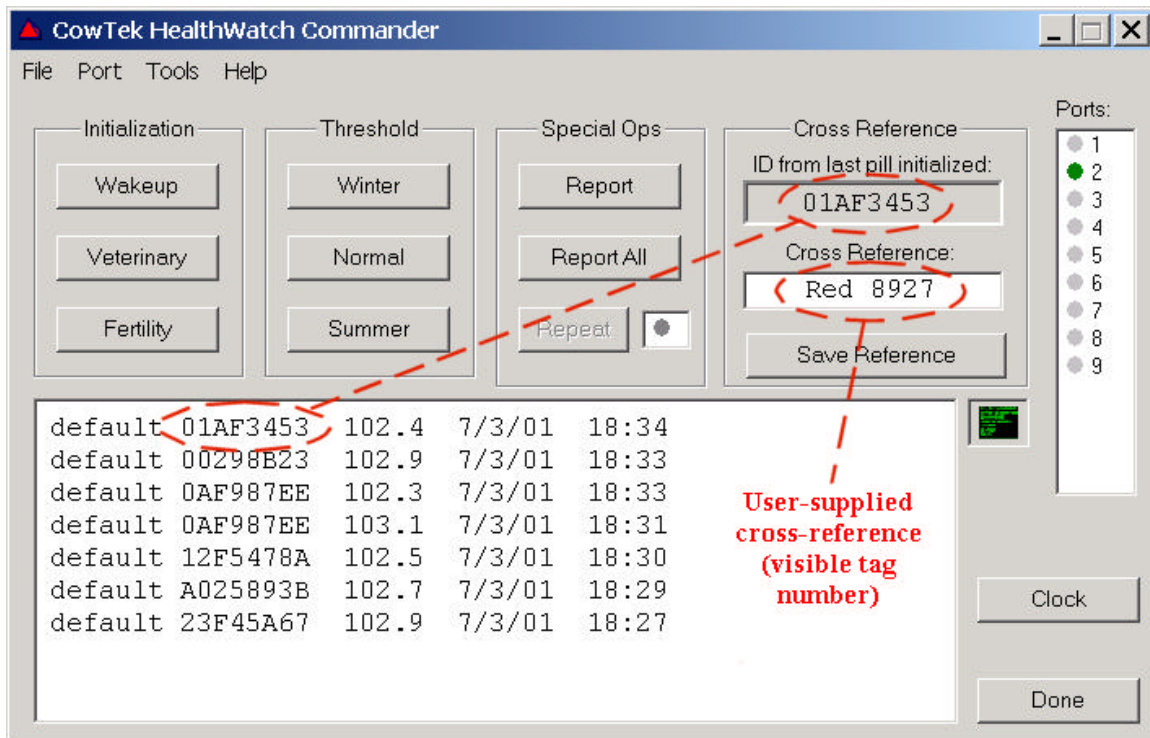
Figure 4: The HealthWatch Commander

Setting the Exciter / Receiver Clock

The HealthWatch temperature pills do not have internal clock/calendars but rely on the Desktop Exciter and Field Receivers to provide the date/time stamps for the pill transmissions. If these clocks are not correct, the information received may be difficult to interpret. For this reason, the Commander offers the CLOCK function which uses the computer's (or handheld's) internal clock and calendar settings to set the receiver's clock and calendar.

> **Note**: before using the CLOCK function, ensure that the system clock and calendar on your computer are set correctly.

Creating Cross Reference Entries

As each pill is initialized, the bolus's ID appears in the Cross Reference frame. To create a cross-reference list, simply enter the visible tag number or any other reference or label desired in the edit field and click the SAVE REFERENCE button.

> Alternately, if it is not practical to match visible (ear tag) references to bolus IDs at the time the bolus is initialized, the bolus ID can be written directly on the plastic capsule using a permanent marker (do not use an 'erasable' marker) or can be written on a strip of masking tape (remove before implanting).

When the bolus is given to the animal, you may either create a paper list matching the bolus ID to a visible reference (such as the ear tag number) and later enter these using the Cross-Reference Editor – XREFEDIT.EXE – or you may use the Cross-Reference Editor (either the handheld or desktop version) to enter the numbers directly.
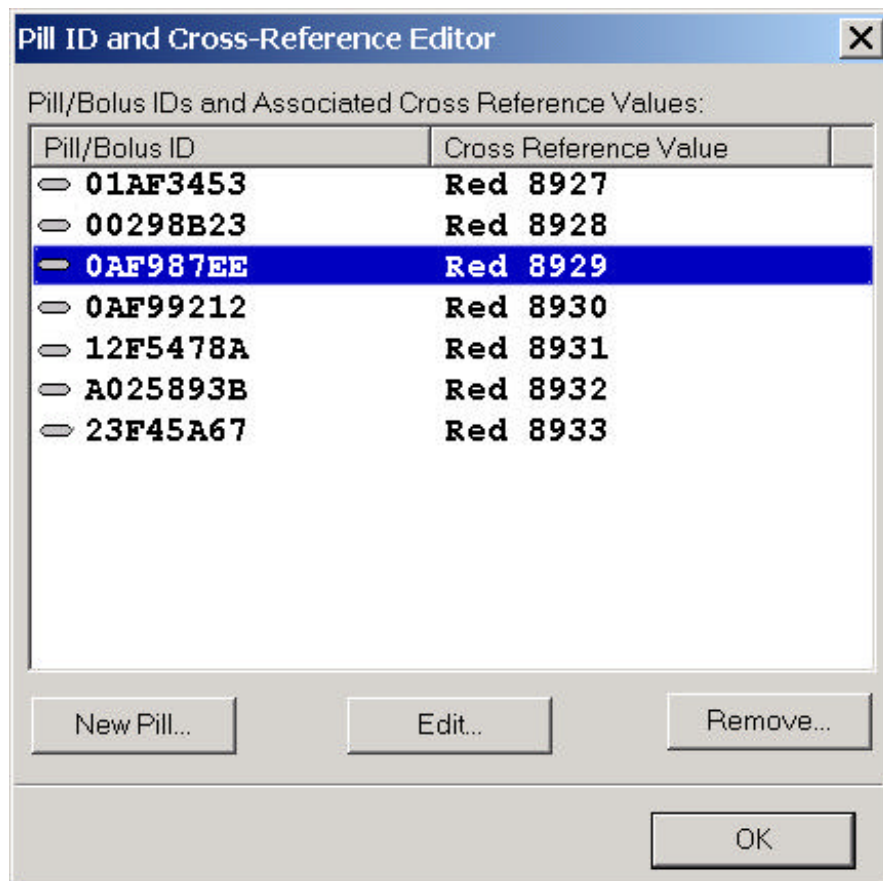
Note: When you create the cross-reference table, your visible tag numbers are displayed automatically in place of the bolus ID numbers.

HealthWatchä Cross-Reference Editor

The Cross-Reference Editor (on the Tools menu) is a utility program allowing the user to create a cross-reference table matching the ETD BOLUS™ IDs to visible ear tag numbers or any other desired references.

As described in the HealthWatch™ Commander, a simple data file can be created while initializing the temperature boluses or, alternately, the Cross-Reference Editor utility can be used to enter and cross-reference the bolus IDs at a later time.

The Cross-Reference Editor program allows ETD BOLUS identifiers to be entered together with their corresponding visible tag IDs. Because the bolus IDs are in hexadecimal format, these entries are checked for numerical validity. The visible tag IDs, of course, are not checked and may take any form desired.

Pill ID and Cross-Reference Editor

Pill/Bolus IDs and Associated Cross Reference Values:

Pill/Bolus ID	Cross Reference Value
01AF3453	Red 8927
00298B23	Red 8928
0AF987EE	Red 8929
0AF99212	Red 8930
12F5478A	Red 8931
A025893B	Red 8932
23F45A67	Red 8933

New Pill...   Edit...   Remove...

OK

The NEW PILL button creates a blank entry; allowing entry of both the Bolus ID and the visible tag number.

The EDIT button allows the current (selected) entry to be edited or revised.

The REMOVE button permits the selected entry to be removed but does require confirmation before deleting the entry.

By default, the items listed are sorted by visible tag ID number but may be sorted by pill ID if desired. Simply click on the CROSS-REFERENCE VALUE or PILL/BOLUS ID column headers to change the sort order.

> The SAVE CHANGES button is disabled unless there are changes in the data list which should be saved and you will be prompted for confirmation if you attempt to exit without saving changes.

Command Summary

Temperature Bolus Commands

These commands are sent to the temperature bolus via the Desktop Exciter or through the HealthWatch™ Commander software.

COMMAND	OPERATION	THRESHOLD
WAKEUP	initializes the temperature bolus	NORMAL
VET	reports at half-hour intervals for 12 hours, then at hourly intervals for 12 hours	N/A
FERTILITY	reports when internal temperatures indicate ovulation	103.5° F
WINTER	resets VET or FERTILITY modes to DEFAULT mode, sets reporting threshold to seasonal temperature level	WINTER
NORMAL		NORMAL
SUMMER		SUMMER
STATUS	reports current temperature	N/A

Data Retrieval Commands

These commands are sent by the HealthWatch™ Commander to retrieve data from the Field Receiver.

COMMAND	FUNCTION
REPORT	Field Receiver returns all reports not previously sent
REPORT_ALL	Field Receiver returns all reports in memory
SET_TIME	Sets the receiver's clock using the current (system) date and time

Report Data Formats

Key word	Bolus S/N	° F	Date / Time	Interpretation
default	1234AF56	101.3	12/07/01 10:32	Normal health, bolus is in DEFAULT mode
failed	6546F125	–	12/06/01 11:03	Bolus failure report, causes may include internal moisture or component failure
fertility	34589234	–	12/06/01 11:08	Bolus entering fertility mode
ovulation	27835A23	103.7	12/06/01 11:12	Ovulation trigger temperature has been reached
shutdown	654734E2	–	12/06/01 11:05	Bolus deactivation report
time_failed	–	–	–	Clock error / reset error
time_set	–	–	12/06/01 13:05	Clock has been reset to time shown
vet	12AC5632	102.3	12/06/01 10:48	Veterinarian mode report
working	873D6790	102.8	12/06/01 11:01	Normal health, responding to STATUS request

Menu Options

The HealthWatch Commander provides menu options for the **File**, **Port, Tools** and **Help** menus.

On the **File** menu, you will find three options as:

- ➢ **Clear Report** – clears the displayed report from the screen.
- ➢ **Export Report to Text** – allows the HealthWatch reports to be exported to a text file.
- ➢ **Exit** – exits the program.

On the **Port** menu, you will be offered a list of serial ports as COM1 through COM9. Select the appropriate port to communicate with the desktop or field receiver. The Ports bar (at the right) shows a corresponding list with the selected port highlighted.

> Note: Your system may or may not have physical ports corresponding to all of those offered. In many cases, you will only have physical ports COM1 and COM2 or ports COM1 through COM4.

On the **Tools** menu, you have two options as:

- ➢ **Edit Pill ID Mappings** – calls the Cross-Reference Editor described preceding.
- ➢ **Clear Pills Memory** – clears (resets) the receiver's memory. The receiver's contents will be downloaded to the HealthWatch Commander prior to erasure.

The **Help** menu has a single option; the **About** dialog which displays the HealthWatch Commander version ID.