TM13K

User's Manual

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1 Introduction

The *TM13K* is a high-performance temperature and motion data logger. It includes a high-resolution temperature sensor, a motion and vibration sensor, an accurate date/time clock and a non-volatile 13000-point recording memory. Its very small size allows it to be attached to or embedded within the monitored equipment.

2 Applications

- Logging hours of operation or duty rate of motors machinery and equipment.
- Monitoring of storage, transport conditions and movements of perishable items (fresh produce… etc.)
- Detection and recording of the operation and handling of certain items or equipments.
- Monitoring of indoor and outdoor temperatures
- Monitoring of freezer temperatures
- Monitoring of incubator temperatures
- Monitoring of habitat temperature for exotic animals
- Monitoring of in-casing computer and server temperatures

A temperature alarm function provides a visual indication when the temperature has been out of the specified bounds.

A motion alarm provides a visual indication when the total number of hours of operation of the monitored equipment, or a number of detected motion events is over a set limit.

The *TM13K* can monitor and record temperature and motion for years on a small coin battery. Its weather-proof sealed construction allows it to be used in harsh environments.

The *TM13K* connects to a PC using its USB adapter cable. The *TM13K_Manager* application is provided to setup its operating parameters and download, visualize and export the recorded data. The application can also be used to monitor temperature and motion in real time.

3 Warnings

 *Do not expose the TM13K to temperatures exceeding the limits set by the battery type that is used:*

- CR2032: -20 degC to 70 degC (-4 degF to 158 degF)
- BR2032: -30 degC to 80 degC (-22 degF to 176 degF)

Do not expose the TM13K to temperatures exceeding the absolute safe limits -30 degC to 80 degC (-22 degF to 176 degF)

 *Do not submerge the TM13K in liquids so that liquids may enter the battery compartment or MLI connector.*

 *If used outdoors make sure the TM13K has the battery compartment and MLI connector facing down, so water will not accumulate inside the battery compartment.*

Only use the MLI cable provided with the TM13K.

Do not expose the TM13K to high electro-magnetic fields such as arc welders, induction heaters… etc. Do not expose the TM13K to static electricity.

If possible do not remove the battery while the TM13K is recording as this may adversely affect the long-term reliability of the recording memory.

Only use the TM13K as specified in this manual.

4 Getting Started

4.1.1 Software Installation

1 Unzip the *TM13K_Manager_Installer* package
2 Run Setup.exe. This installs the *TM13K_Manager* application, as well as its *MLI* cable driver and documentation.

Note: Perform the software installation above BEFORE connecting the MLI cable into the PC.

4.1.2 Hardware Installation

1 Connect the *MLI* cable into an available USB port of the PC
2 Verify that the PC properly detects the cable and loads the driver. In case of doubt see the *Troubleshooting* section.

4.1.3 Initial Test and Configuration

1 If this is not already the case, insert a fresh BR2032 battery in the battery compartment. Be careful about battery polarity. See the *Battery Change* subsection in the *Maintenance* section for detailed instructions.
2 Upon battery insertion the LED starts blinking at a rate of once every two seconds. If this is not the case remove the battery, perform the reset procedure (see below) and insert the battery again.
3 Connect the *MLI* cable into an available USB port of the PC.
4 Connect the other end of the *MLI* cable into the *TM13K.*
5 Go into *Start\All Programs\TM13K*, and run *TM13K_Manager.exe*. The front-panel described in figure 4 appears, and the application tries to connect to the instrument. If it fails to find the instrument it indicates *No Device Found* and closes. If this is the case see the *Troubleshooting* section. Otherwise the application switches-on the *TM13K* and starts communicating with it.
6 If the Time and Date in the upper right corner of the application window are not properly adjusted the application asks if you want the time to be synchronized with the PC time. Only say yes if you know that the PC time is correct.
7 Upon stopping the application there is a choice of keeping the *TM13K* ON or switching it OFF. Switching it OFF preserves battery life, but prevents any off-line measurement. The *TM13K* is automatically forced ON whenever the *TM13K_Manager* application is run to set it up for operation.

5 Instrument Functions and Description

The instrument detects measures and optionally records:

- Current Temperature
- Maximum Temperature
- Minimum Temperature
- Average Temperature
- Motion/vibration (either number of motion/vibration events or accumulated hours of motion)
- Time

The instrument connects to a PC via its *MLI* adapter cable. The *TM13K_Manager* application is used to set its operating parameters and download recordings.

Note: Only use the MLI cable provided with the TM13K.

Figure 1: *TM13K* front

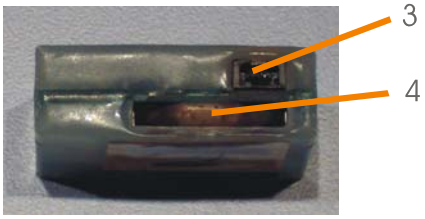

Figure 2: *TM13K MLI* cable socket and battery compartment

1. LED indicator
2. Temperature sensor
3. *MLI* cable connector
4. Battery compartment

Figure 3: *MLI* adapter cable

6 Principles of Operation

The *TM13K* starts working as soon as the battery is installed. Upon battery insertion the LED starts blinking at a rate of once every two seconds. The *TM13K* starts measuring motion, as well as current, minimum, and maximum temperatures. However it does not record until configured to do so by the *TM13K_Manager* application. Also its date and time are initially adjusted to December 1903.

The setup of the *TM13K* is done via the *TM13K_Manager* application. The application performs clock, temperature and motion alarm setup and optionally configures the *TM13K* for recording.

The *TM13K* can operate and record temperature and/or motion statistics for years on a small coin lithium battery. For instance if the recording interval is set to 1H, the *TM13K* can record the temperature maxima for more than 1.5 years.

6.1 Power-On / Power-Off Behaviour

When the battery is first installed into the instrument, or when the *TM13K_Manager* application is started and takes control of the *TM13K* it is switched ON. When the *TM13K_Manager* application is stopped the user has a choice to switch the *TM13K* OFF, or leave it ON. If a recording has been started there is no choice, the *TM13K* is kept ON when the application stops.

When the instrument is ON, even if it is not recording, it continues integrating real-time temperature and motion statistics. These statistics can be accessed the next time the instrument is connected to the *TM13K_Manager* application. The alarm functions are also active when the instrument is ON.

6.2 Real-Time Measurements and Statistics

6.2.1 Time

The *TM13K* accurately keeps track of time internally. The date and time can be adjusted by the *TM13K_Manager* application via its *MLI* cable.

6.2.2 Temperature

Temperature is measured once a second. From this raw measurement the *TM13K* continuously calculates the maximum, minimum and average temperature.

The temperature statistics can be displayed in deg C or deg F.

The *TM13K_Manager* application displays in real time the current, min and max temperatures, and the length of time to which the min and max values apply. The min and max temperatures can be cleared by the *TM13K_Manager* application.

Note: New since firmware revision 1.1 the min, max and alarm temperatures have the following behaviour:

After clearing the temperature statistics, the min and max temperatures and the temperature alarm are only taken into account after the temperature is observed at least once within the no-alarm temperature zone. This behaviour helps in situations where the TM13K has to be setup at a temperature that is outside the no-alarm zone. For instance in the case of freezer monitoring, when the TM13K is setup at room temperature with a no-alarm zone much below room temperature (for instance between -10 degC and -20 degC). In this example, after clearing the statistics, the TM13K will only record min and max temperatures, and detect temperature alarms after the temperature enters the -10 degC to -20 degC zone.

6.2.3 Motion/Vibration

The motion/vibration detector in the *TM13K* is a very sensitive omni-directional sensor. The motion and vibration thresholds are very low, which means that even tiny amounts of motion or vibration are detected.

Motion is detected once a second. Every second the *TM13K* makes an assessment of whether or not it is moving or vibrating. The *TM13K_Manager* application displays this information in two ways:

- Accumulated number of motion events. An event is defined as a period of one second while motion or vibration is detected.
- Accumulated number of hours of motion.

The two numbers represent the same information. The number of events is also the accumulated time of motion, expressed in seconds rather than in hours. However the two are not normally used in the same context. The accumulated motion time in hours is normally used in odometer applications, where the goal is to measure the number of hours of operation of a machine or piece of equipment. The number of motion events is more often used when motion occurs rarely and in discrete events.

The *TM13K_Manager* application displays in real time the accumulated motion in events or in hours, and the length of time to which the measurement applies. The accumulated motion can be cleared by the *TM13K_Manager* application.

6.3 Recording

When the *TM13K* is recording it integrates measurements over the specified *Log Interval*. At the end of each interval the selected measurements are written into solid-state memory. The motion and temperature statistics are then cleared and the next log interval is started.

The values that can be recorded are:

- Max Temperature
- Min Temperature
- Average Temperature
- Motion

For instance if the *Log Interval* is set to 10 min, and the Min, Max and Average Temperature are selected, then each point in the log indicates the Min, Max and Average Temperature measured over the preceding 10 min.

The *Log Interval* is adjustable in 1 second increments, from 1s to 12H.

The *TM13K* has a total combined recording depth of 13 000 points. For instance it can record 13 000 average temperatures or 6 500 combined Max temperatures / Motion events.

Each time the recording is started using the *TM13K_Manager* application a new log is created. Each log extends from the time the recording is started to the time it is stopped. Logs are stored sequentially in the recording memory. Each log can include different measurements, and be setup for a different interval. For instance a first log can be created, containing max temperature and motion every second for 10 minutes. Then a second log can be created, containing min, max and average temperatures every hour for 3 months. The *TM13K_Manager* application provides access to all the logs in memory.

When the recording reaches the end of the memory, the recording is automatically stopped.

The memory is non-volatile. In case of battery failure, the data recorded up to the battery loss is preserved.

 *If possible do not remove the battery while the TM13K is recording as this may adversely affect the long-term reliability of the recording memory.*

6.4 LED indicator and Alarms

The LED indicator can be used for two functions:

- Power Indicator: The LED flashes once every two seconds to indicate that the *TM13K is ON*.
- Alarm: The LED flashes twice every two seconds to indicate that the *TM13K* has measured a temperature or motion out of the set limits. The high and a low temperature limits, as well as the motion limits can be set by the *TM13K_Manager* application.

In addition the LED indicator can be kept always OFF even while the *TM13K is ON,* to increase battery life.

6.5 Battery Life

The battery life depends on the functions that are activated. When the *TM13K* is OFF its only function is to keep track of the time. In this state the battery can last for more than 10 Years. The operation of the LED indicator has a large impact on the battery life. When the *TM13K* is ON, with its LED ON, the battery life is 1.3 Years. When the *TM13K* is ON with its LED OFF the battery life increases to 3.3 Years. Recording and PC communications also have a small impact on battery life. The *TM13K_Manager* application indicates battery life as a function of the settings.

7 TM13K_Manager Application

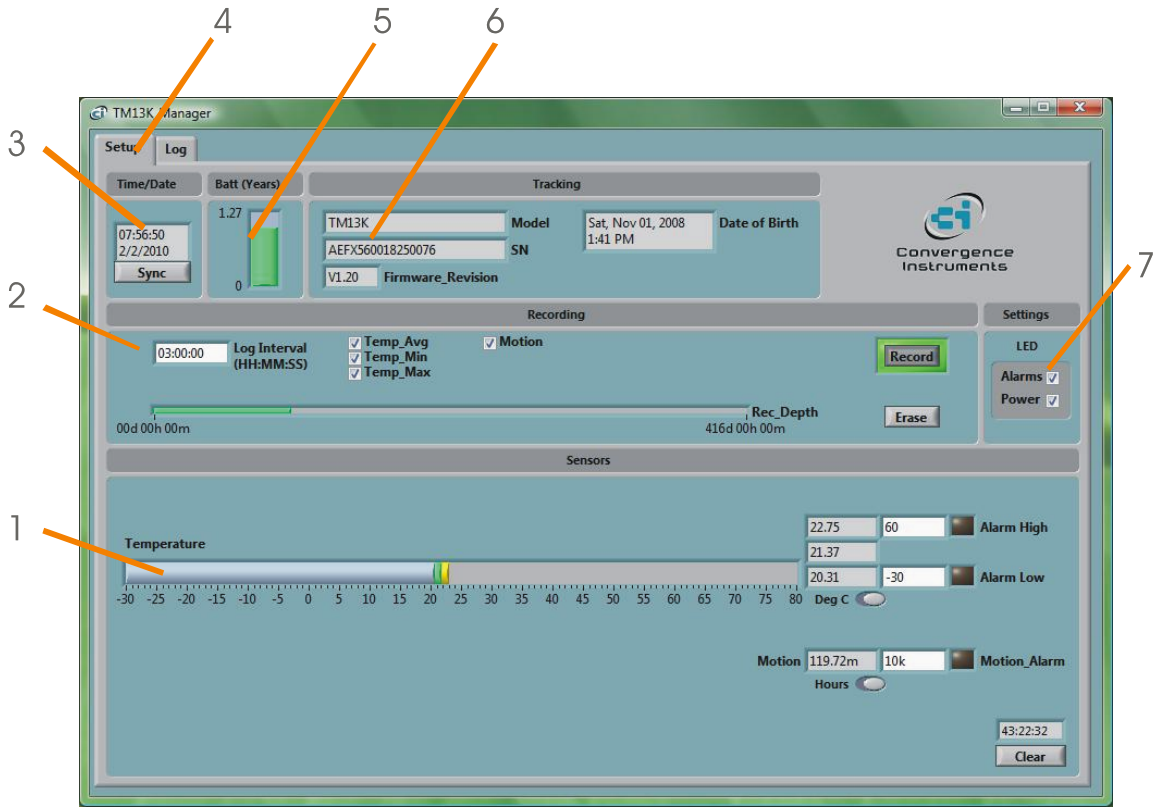

Figure 4: TM13K_Manager *Setup* tab

1. Real-time temperature and motion measurements and alarms field
2. Recording Setup Field
3. Date/Time Field
4. Tab Selector
5. Battery Condition and Lifetime
6. Instrument Tracking Information
7. LED Setup and Alarms Field

Figure 5: TM13K_Manager *Log* tab

1. Accumulated motion (events or hours)
2. Motion events/motion hours selector
3. Motion recording graph
4. Temperature recording graph
5. Pan and zoom buttons
6. Deg C/deg F selector
7. Data source indicator
8. Log number selector
9. Cursor
10. Cursor Display Area
11. File Save button
12. File Open button
13. Instrument Download button
14. Export button

7.1 Starting the Application

The application can be run with or without a *TM13K* connected. When a *TM13K* is not connected the application can only be used to display and analyze a previously saved log file. All the controls and indicators related to the instrument are grayed out.

To use the application to control a *TM13K* do the following:

1. Connect the *MLI* cable into an available USB connector on the PC
2. Connect the other end of the *MLI* cable into the *TM13K.* The *MLI* socket is polarized, if it does not insert easily, turn the connector over.
3. Go into *Start\All Programs\TM13K*, and run *TM13K_Manager.exe*.

4. The front-panel described in figure 4 appears, and the application tries to connect to the instrument. If it fails to find the instrument it indicates *No Device Found* and closes. If this is the case see the *Troubleshooting* section. Otherwise the application immediately starts communicating with the *TM13K*.

7.2 Main Functions

The application has two main tabs:

- **The *Setup* Tab:** Is used to setup the instrument and read current temperature and motion measurements (see figure 4).
- **The *Log* Tab:** Is used to read, display and export the data from the *TM13K (see figure 5)*.

7.3 Setup Tab

The setup tab is seen in figure 4. The setup tab is divided into six fields.

7.3.1 Time and Date Field

This field displays the internal time of the instrument. If the instrument time is not properly adjusted, press *Synchronize*. This synchronizes precisely the instrument time to the PC time. Make sure the PC time is accurate before synchronizing the instrument.

Note: The time synchronization is not allowed while the instrument is recording. Attempting to synchronize the time while a recording is in progress will trigger an error message to that effect.

7.3.2 LED Field

This field is used to setup the LED for power display, alarm display, or both. Operation of the LED has a large impact on the instrument's power consumption. Keeping the LED OFF while the instrument is working provides additional years of operation. This is reflected in the battery condition field.

When the LED is set to display alarms, it blinks twice every two seconds whenever a temperature or motion alarm is in effect.

When the LED is set to display the instrument power, it blinks once every two seconds whenever the instrument is ON.

7.3.3 Battery Condition Field

This field indicates the remaining battery capacity, as well as the total battery life (at the upper scale marker). The total battery life changes with the operating conditions. For instance completely switching-off the LED increases the total battery life to 3.2 Years. Battery life is reduced to 10 months while an alarm is being displayed.

The remaining battery capacity is calculated from the measured hours of operation. The calculation assumes that the battery was fresh when it was first installed in the instrument after reset.

Note: Because the instrument only consumes a tiny amount of current it can work for a minute or so in the ON state without a battery. If the battery is replaced without applying the reset procedure, the battery depletion indicator will not be reset. In effect the instrument will not know that a fresh battery has been installed.

7.3.4 Tracking Field

The tracking field provides instrument information, such as instrument model, serial number and firmware revision.

7.3.5 Recording Setup Field

Check boxes at the left of the recording setup field allow the user to select which values are to be recorded.

The *Recording Depth* bar provides two indications:

- The percentage of memory already used.
- The total memory capacity, in Days-Hours-Minutes. The total memory capacity is calculated as a function of the number of selected measurements and the log interval.

The *Log Interval* can be adjusted in Hours-Minutes-Seconds.

Note: All these adjustments are only modifiable when a recording is not in progress. A recording in progress uses the parameters that have been set when the recording was started.

To start a recording press the *Record* button. To stop a recording press the *Record* button again. A log is defined as a stretch of recording between the moment the recording is started and the moment it is stopped. Each time a recording is started a new log is created and stored in memory after the previous one. New logs can be created as long as there is some amount of recording memory available.

To erase the contents of the recording memory and make room for new logs press the *Erase* button.

7.3.6 Temperature and Motion Measurements Field

The temperature and motion measurement field provides information about the current temperature and motion measurements and statistics, as well as alarm settings.

- The temperature indicator displays the current temperature, as well as the maximum and minimum from the last time the *Clear* button was activated to the present time.
- The *Alarm_High* and *Alarm_Low* fields are used to set upper and lower limits for the temperature alarms. The LED indicators to the right of the *Alarm_High* and *Alarm_Low* fields are set when the corresponding alarm is in effect.
- The *degC/degF* selector sets the scale for all temperature indicators and controls to degrees centigrade or degrees Fahrenheit.
- The *Motion* field displays the cumulative motion since the last time the *Clear* button was pressed. The motion can be displayed in number of events, or hours of motion.
- The *Motion_Alarm* field to its right is used to enter a threshold above which an alarm is triggered. This can be used to display an alarm after a specified number of hours of motion, or after a specified number of motion events. The LED indicator to the right of the *Motion_Alarm* is set when the corresponding alarm is in effect.
- The Hours/Events selector sets the scale for the motion indicator and alarm control.
- The *Time* field indicates the length of time for which the temperature and motion statistics have been kept. In effect it is the length of time since the last action on the *Clear* button, or since the start of the last recording.
- The *Clear* button resets the temperature and motion statistics and the *Time* indicator.

7.3.7 Alarms

A temperature alarm is triggered whenever the temperature maximum is above the *Alarm_High* setting or the minimum is below the *Alarm_Low* setting. This means that when a temperature alarm is triggered, it stays ON until the maximum and minimum are cleared by pressing the *Clear* button. The *Alarm_High* and *Alarm_Low* settings are defined in the same scale (deg C or deg F) as the current display.

Note: New since firmware revision 1.1 the min, max and alarm temperatures have the following behaviour:

After clearing the temperature statistics, the min and max temperatures and the temperature alarm are only taken into account after the temperature is observed at least once within the no-alarm temperature zone. This behaviour helps in situations where the TM13K has to be setup at a temperature that is outside the no-alarm zone. For instance in the case of freezer monitoring, when the TM13K is setup at room temperature with a no-alarm zone much below room temperature (for instance between -10 degC and -20 degC). In this example, after clearing the statistics, the TM13K will only record min and max temperatures, and detect temperature alarms after the temperature enters the -10 degC to -20 degC zone.

A motion alarm is triggered whenever the cumulative motion indicator value rises above the *Motion_Alarm* threshold. Once set, the alarm stays ON until the motion indicator value is cleared by pressing the *Clear* button. The *Motion_Alarm* threshold can be set in number of events, or hours of motion. The scale for setting the threshold is the same as the one used for the motion indicator.

7.4 Log Tab

The log tab is seen in figure 5. It is used to retrieve the recorded information from the *TM13K* or from a saved file, and to display and export the recorded logs.

1. **Motion Totalizer:** Displays the total number of motion events or the total number of hours in motion. The total indicated corresponds to the displayed window. Zooming on a particular time frame excludes the data outside of the zoom window. When displaying motion time the format is Hours:Minutes:Seconds.
2. **Events/Hours Selector:** Sets the scale of the motion display in events or hours of motion.
3. **Motion Recording Graph:** Displays motion events or hours of motion as a function of time. If motion was not recorded the graph is empty.
4. **Temperature Recording Graph:** Displays temperature statistics as a function of time. Displayed measurements can be min, max and average. If a particular measurement was not recorded the corresponding curve is absent from the graph.
5. **Pan, Zoom and Cursor Buttons:** The magnifier glass has several modes for zooming in X and Y, or to go back to the full size view. The hand is used for panning in X and Y The cross is used to move the cursor on the graph. The cursor locks to the min, max and average curves.
6. **Deg C / Deg F Selector:** Changes the scale of the temperature graph to degrees C or degrees F.
7. **Data Source Indicator:** Indicates the source of the data being displayed. This is either the serial number of the instrument from which the data was downloaded, or the name of the file from which the data was read.
8. **Log Number Selector:** Selects a particular log in memory for display. The first recorded log has index 0, the last log has index N-1. When the recording memory is initially read the index is set to the newest (last) log in memory.
9. **Cursor:** The cursor can be moved on the graph. It locks to the min, max or average temperature graph.
10. **Cursor Display Area:** This area displays the time and temperature at the cursor location.
11. **File Save Button:** Press the button to save all the data downloaded from the instrument to a file for later recall and analysis. A browser window appears to select the file name and location.
12. **File Open Button:** Press the button to recall data previously saved in a log file.
13. **Instrument Download Button:** Press the button to download all the logs from the instrument to the screen for visualization and/or exporting.
14. **Export Button:** Press the button to export the record presently displayed to an Excel Tab-delimited file.

Note: Writing a new value directly to either the first or last marker of the X or Y scale rescales the graph so that this value is at the edge.

8 Improving Communication Speed

When the *MLI* cable is initially connected to the PC, the PC detects it and provides an initial configuration. This configuration is functional, but does not yield the best communication speed.

To improve the communication speed, follow the steps below:

- Connect the *MLI* cable into the PC and wait for the PC to recognize it. The PC normally makes a sound to indicate that the cable is recognized and its driver is loaded.
- Windows Vista: Go into *Control Panel>System and Maintenance>Device Manager.*
  Windows XP: Go into *Control Panel>Performance and Maintenance>System>Hardware>Device Manager.*
- In the Device Manager open the *Ports (Com and LPT)* item. Double click on the item named *USB Serial Port*. Make sure that the manufacturer reads *FTDI*. Otherwise find another item named *USB Serial Port*.
- Select the *Port Settings* tab. In this page click the *Advanced* button.
- To the right of the *Latency Timer (ms)*, adjust the latency to the minimum 1ms.
- Click OK to all the windows to close them.

9 Maintenance

9.1 Battery Change

To change the battery, follow the procedure below:

1. Gently tap the *TM13K* in the palm of your hand to dislodge the battery. Do not hit a hard surface as this could damage the instrument.
2. Apply the reset procedure (see below). This is important to ensure that the *TM13K* resets the battery depletion indicator to zero.
3. Slide a new battery in, making sure you observe the proper polarity. The positive contact of the battery (outer casing of the battery) should face towards the back of *TM13K* (see figure below).

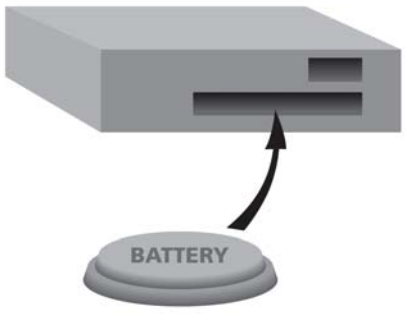

Figure 6: Battery polarity

9.1.1 Reset Procedure

Insert a small coin inside the battery compartment so that it touches the metal on both sides of the compartment. Be gentle to avoid damaging either surface of the battery compartment. Be certain that the coin touches both sides of the compartment, otherwise the reset will not be effective.

9.1.2 Battery Type

A BR2032 should be used to power the device when the full temperature range is expected (-30 degC to 80 degC or -22 degF to 176 degF). A CR2032 may be used, but has reduced temperature range (-20 degC to 70 degC or -4 degF to 158 degF).

Note: Be sure to respect the temperature limits set by the battery type that is inside the TM13K.In any case observe the absolute limits (-30 degC to 80 degC or -22 degF to 176 degF) to avoid damaging the instrument.

Note: Be sure to always install a fresh battery. The TM13K keeps track of how much the battery is depleted over time, but the battery state is only accurate if the instrument was started on a fresh battery, and was reset before battery insertion. After inserting a new battery make sure the depletion indicator in TM13K_Manager is reset to full.

9.2 Operation Outdoors

Thanks to its molded construction, the *TM13K* is weather-proof. When using it outdoors with a risk of rain or snow, make sure its battery compartment and *MLI* connector are facing down, so water will not accumulate inside the battery compartment.

9.3 Cleaning

Use soap and water on a damp sponge or soft cloth.

Note: Do not use solvents. Do not submerge in water.

9.4 In Case the *TM13K* is Submerged in Water

1. Remove the battery.
2. Submerge in demineralized water, making sure any salt deposits are properly dissolved. This is especially important if the instrument has been submerged in sea water.
3. Blow-dry using a hair dryer. Make sure the instrument is thoroughly dry. Be careful not to heat-up above the maximum limit of 80 degC.
4. Apply the reset procedure (see above).
5. Install a fresh battery.

9.5 Software and Firmware Upgrades

Software upgrades are found on our web site: www.convergenceinstruments.com.

After upgrading the software, if a firmware upgrade is required it will be applied automatically when the upgraded *TM13K_Manager* application is started.

10 Troubleshooting

10.1 Cable Driver Installation

If the *TM13K_Manager* application is unable to communicate with the *TM13K* it may be because the *MLI* cable driver failed to install properly. To check the cable driver installation follow the procedure below:

1. Disconnect the *MLI* cable.
2. Open the *Device Manager* on the PC. This is usually found in *Control Panel – System and Maintenance*.
3. Open the *Ports (COM and LPT)* item on the right.
4. Connect the *MLI* cable (Make sure you are using the *MLI* cable for the *TM13K* and not a standard USB cable*).*
5. Observe that the *Device Manager* window refreshes.
6. Under *Ports (COM and LPT)* verify that an item named *USB Serial Port (COMx)* has been created.
7. If not, disconnect the *TM13K* USB cable. Then Go into *Start\All Programs\TM13K_Manager\Driver_Install*, and run *CDM 2.04.06.exe*. This re-installs the cable driver. Go back to step 4.

10.2 Connection Problems

Failure to communicate with the PC can also be caused by poor *MLI* cable contacts. Make sure the *MLI* connector is fully inserted into the socket of the *TM13K.* Inspect the inside of the plug at the end of the cable, as well as the *MLI* socket on the instrument. If dirt or debris is lodged in the plug or socket, use a can of compressed air to expel it. If compressed air is not enough, use a clean piece of cloth dipped in alcohol. Make sure that cloth particles do not remain in the connector.

10.3 TM13K Reset

Because it only consumes a tiny amount of current, removing the battery does not immediately reset the *TM13K*. To make sure that the *TM13K* is properly reset, follow the procedure below:

1. Remove the battery
2. Insert a small coin inside the battery compartment so that it touches the metal on both sides of the compartment. Be gentle to avoid damaging either surface of the battery compartment.

11 Specifications

- Dimensions: 40mm x 30 mm x 12mm (1.57 in x 1.18 in x 0.5 in)
- Weight:: 16 g (0.6 oz)
- Construction: Weather-proof sealed construction
- Measurements:
  - Current temperature (degC or degF)
  - Max temperature
  - Min temperature
  - Average temperature
  - Motion (event count or hours of operation)
- Alarms :
  - Min Temperature
  - Max Temperature
  - Motion (number of events or hours of operation)
- Operating temperature range: -30 degC to 80 degC (-22 degF to 176 degF)
- Temperature resolution: 0.0625 degC (0.1125 degF)
- Temperature precision: 0.5 degC (0.9 degF)
- Temperature time constant: 10 min in air
- Temperature measurement interval: 1s
- Motion/vibration detector: Omni-directional
- Motion measurement interval: 1s
- Recording interval: Adjustable 1s to 12H, with 1s resolution
- Recording Depth: 13 000 individual measurement points
- Recording/erasure cycles: More than 10 000

- Recording memory type: Non-Volatile
- Battery life: Up to 3 Years while recording
- Battery type: Coin type lithium battery
  - BR2032 for full range (-30 degC to 80 degC)
  - CR2032 for reduced range (-20 degC to 70 degC)

12 Specifications of *TM13K_Manager* Software

- Windows XP and Windows Vista compatible
- Real-time display of temperature and motion measurements.
- Complete instrument configuration, including date/time, alarms, types of statistics recorded and recording rate.
- Collect and displays data while recording.
- Auto-scale, zoom and pan on temperature and motion graphs
- Export temperature and motion data to Excel format.