Welcome to the OvenSENTINEL™ Help Guide! Choose a topic from each topic to find answers and get an overview plus step-by-step instructions.

<table>
<thead>
<tr>
<th>Help Guide</th>
<th>Declaration of Conformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>This OvenSENTINEL™ Help Guide explains how to use the ECD OvenSENTINEL™ Intelligent Monitoring Solution System and software.</td>
<td>The undersigned hereby declares, on behalf of the ECD Inc., that the above-referenced product, to which this declaration relates, is in conformity with the provisions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Graphic Symbols</th>
<th>Copyright Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>OvenSENTINEL™ and this Help Guide use graphic symbols which help identify at a glance several Dangers, warnings, functions, as well as indicate the status of the cabinet.</td>
<td>Information that protects the exclusive right to make copies, license, and otherwise exploit any portion of this Help Guide.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operator Safety Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The safety information in this section is for the benefit of operating personnel. Warnings and Cautions will also be found throughout the manual where they apply.</td>
<td></td>
</tr>
</tbody>
</table>
**How to use this Help Guide**

This Guide is written for users of varied experience. If a section covers information you already know, feel free to skip to the next section.

- You **do not need** to be a computer expert to use this manual or the software.
- The Users Help Guide assumes you are familiar with Microsoft® Windows®.

**Graphic Symbols**

**Product Symbols:**

- **Warning:** Whenever this internationally recognized symbol is used on the product, additional information concerning that particular feature or function appears in the Help Guide.

- **Waste Electrical and Electronic Equipment (WEEE). Unit should be recycled; Do not disposed of in land-fill.**

- **Warning:** Electrical Shock / Electrocution Hazard.

- **Positive Polarity**

- **Direct Current (DC) Power**

- **Alternating Current (AC) Power**

- **Conformity marking for certain products sold within the European Economic Area (EEA)**

- **Moves the control display menu cursor up or increments a user entered value.**

- **Moves the display menu cursor down or decrements a user entered value.**

- **Selects the current highlighted menu item in the display or approves a user set value.**
**Help Guide Symbols:**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="i" /></td>
<td>Informs the user that the note includes important information.</td>
</tr>
<tr>
<td><img src="image" alt=" bulb" /></td>
<td>Informs the user that the note includes a handy tip.</td>
</tr>
<tr>
<td><img src="image" alt="sigma" /></td>
<td>Informs the user of an equation used.</td>
</tr>
<tr>
<td><img src="image" alt="exclamation" /></td>
<td>Informs the user that the note identifies conditions or practices that could result in damage to the equipment.</td>
</tr>
<tr>
<td><img src="image" alt="times" /></td>
<td>Informs the user that the note identifies conditions or practices that could result in personal injury or damage to property other than the equipment.</td>
</tr>
</tbody>
</table>
Operator Safety Information

Hardware changes or modifications to the components are not expressly approved by ECD. and could void the warranty of the product.

The warranty will not cover damage caused by neglect or abuse of this product. To maintain the safety features incorporated in this product, operation must be in strict compliance with the requirements specified herein.

For protection of the components, observe the following:

• **NEVER** operate the OvenSENTINEL™ components in flammable or explosive atmospheres. Such usage constitutes a fire or explosion risk.
• **NEVER** immerse the OvenSENTINEL™ components in liquids.
• **NEVER** subject the OvenSENTINEL™ components to sharp impacts.
• **NEVER** excessively stress the OvenSENTINEL™ cables.
• **NEVER** expose the OvenSENTINEL™ components to corrosive environments.

Battery Warnings:

• Replace the batteries with same type only. Real-Time Clock/Memory Backup Battery: 3.6V 1.2Ah cell, LS14250 (ANSI 1/2AA, IEC 1/2R6) by Saft or equivalent. Using alternate batteries may present a risk of fire or equipment damage.
• Do not attempt to recharge the Real-Time Clock/Memory Backup Battery, disassemble, or dispose of in fire. Always dispose of used batteries promptly and properly.
• Do not expose to temperature above 100°C (212°F).
• Keep the batteries away from children.
• The batteries may explode if mistreated.
• The batteries contain electrolytes.
Declaration of Conformity

Electronic Controls Design, Inc.

4287-B S.E. International Way
Milwaukie, Oregon U.S.A. 97222-8825
(503) 659-6100 / (800) 323-4548
FAX: (503) 659-4422

OvenSENTINEL™ Station E58-6928-42

The undersigned hereby declares, on behalf of the ECD Inc., that the above-referenced product, to which this declaration relates, is in conformity with the provisions of:

SAFETY:
IEC 61010-1 “Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements”

EMISSIONS:
EN 61000-3-2:2014 “Electromagnetic Compatibility (EMC) - Limits For Harmonic Current Emissions ...”
EN 61000-3-3:2013 “Electromagnetic Compatibility (EMC) - Limitation of voltage changes, voltage fluctuations and flicker ...”
FCC 15.107:2015 Class A “Conducted Limits”
FCC 15.109(g):2015 Class A “Radiated emission limits”
ICES-003:2012 Class A “Information Technology Equipment (ITE) – Limits”

IMMUNITY:
EN 61000-6-1:2007 “Electromagnetic Compatibility (EMC). Immunity for residential, commercial and light-industrial environments”

The Technical Construction File required by this Directive is maintained at the corporate headquarters of ECD, Inc.

Name: Todd Clifton
Position: President & CEO
Signature: 
Date: July, 2019
This section guides the user through the development of the Baseline Profile, OvenSENTINEL™ Product Creation, Monitoring and Reports.

<table>
<thead>
<tr>
<th><strong>Step #1: Baseline Profile</strong></th>
<th>How to create Baseline Profiles.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step #2: Product Creation</strong></td>
<td>How to create Products.</td>
</tr>
<tr>
<td><strong>Step #3: Monitoring</strong></td>
<td>How to Monitor Products/oven.</td>
</tr>
<tr>
<td><strong>Step #4: Reports</strong></td>
<td>How to create customized Reports of the recorded Product/oven data.</td>
</tr>
</tbody>
</table>
Step #1: Baseline Profile

The OvenSENTINEL™ System requires a Baseline Profile to be established. To ensure success when monitoring Products with the OvenSENTINEL™ System, it is important that when creating and recording a Baseline Profile (*.XMG) it is properly configured. To complete this process, ECD M.O.L.E.® MAP software is required.

Baseline Profile Settings:

- **Record Baseline Profile (Data Run)**
- **Read Baseline Profile (Data Run)**
- **Machine Information**
  - Recipe/Zone Settings (Setpoints)
  - Conveyor Speed
  - Zone Lengths
- **Oven Model Alignment**
- **Assembly Information**
- **KPI (Key Process Indicators)**

*Baseline Profile Vital Setting*

If you have already created M.O.L.E.® MAP thermal profiles that contain these profile settings, proceed to **Step #2: Product Creation** where they can be imported using the **Add Product** process.
Record Baseline Profile (Data Run)

This Wizard guides the user through a typical process on how to set a M.O.L.E. Profiler up for recording a Baseline Profile (data run).

1) Activate the M.O.L.E.® MAP software.
2) Connect the M.O.L.E. Profiler to the computer.
3) Set an Reflow Environment. Either open an existing Environment Folder or create a new one.

If the Reflow Environment is not displayed on the Environment Sidebar, the user can use either the Open Environment Toolbar button or select the Open Environment Folder command from the File Menu.
4) On the **M.O.L.E.** menu, click **Setup Instrument** and the workflow wizard appears.

When navigating through the wizard, the step list on the left uses a color key to inform the user of the current step, steps that have been completed and remaining steps.

- **Current**
- **Completed**
- **Remaining**

5) Select the desired instrument from the dialog box to make active. If there are none listed, click the **Scan for Instruments** command button to detect all available instruments.

6) Click the **Next** command button.
7) Set instrument name and recording interval.

8) Click the **Next** command button.

When using the SuperM.O.L.E.® Gold Profiler, the sending of data erases any currently stored data.
9) Confirm the assembly information (board size, sensor locations and a product image).

10) Click the **Next** command button.
11) Verify the instrument status. This dialog box displays the health of the M.O.L.E. Profiler such as Power Pack charge, internal temperature, thermocouple temperatures.

If everything is **OK**, the dialog box displays a **GREEN** symbol. If there are any items that may prevent the user from collecting good data, they are highlighted and a yellow **Warning** symbol is displayed.

12) Select the **Finish** command button to complete the Setup Instrument wizard.
13) Place the M.O.L.E. Profiler in the appropriate thermal barrier making sure the Thermocouple and/or Sensor wires are not damaged.

![Warning]
Never permit the M.O.L.E. Profiler to exceed the absolute maximum warranted internal temperature, as permanent damage may result. The warranty will not cover damage caused by exceeding the maximum specified internal temperature.

14) After the oven stabilizes, turn the M.O.L.E. Profiler ON and press the record button.

![Info]
The record button will need to be pressed even if the M.O.L.E. Profiler is configured to start if the start parameters **Trigger Temperature** or **Points Delay** are configured.

15) Pass the thermally protected M.O.L.E. Profiler and test assembly through the machine.

![Warning]
It is highly recommended that protective gloves are used when retrieving the thermal barrier from the oven and when opening the thermal barrier.

16) As the test assembly and M.O.L.E. Profiler emerge from the machine, carry the test assembly with sensors attached and the M.O.L.E. Profiler in the Thermal barrier to a table or flat surface.

![Info]
If a sensor is removed before the M.O.L.E. Profiler has stopped collecting data, the data for that channel might become distorted.

17) Open the Thermal barrier and if the Activity LED is still flashing this means the M.O.L.E. Profiler is still recording and it must be stopped.

18) Remove the M.O.L.E. Profiler from the Thermal barrier. Handle it carefully, as the case may still be warm.

19) Disconnect the sensors from the M.O.L.E. Profiler and place it near the computer.
Read Baseline Profile (Data Run)

The Download Data workflow is a wizard that downloads a recorded Baseline Profile (data run) from the M.O.L.E. Profiler.

1) Activate the M.O.L.E.® MAP software.

2) Connect the M.O.L.E. Profiler to the computer.

3) Confirm the correct Reflow Environment is set.

If the Reflow Environment is not displayed on the Environment Sidebar, the user can use either the Open Environment Toolbar button or select the Open Environment Folder command from the File Menu.

4) On the M.O.L.E. menu, click Read Instrument and the workflow wizard appears.
5) On the Start dialog box, click the Download Data command button and the workflow wizard appears.

When navigating through the wizard, the step list on the left uses a color key to inform the user of the current step, steps that have been completed and remaining steps.

- Current
- Completed
- Remaining

6) Select the desired instrument from the dialog box to make active. If a M.O.L.E. Profiler has already been selected during a different process, the software automatically selects the M.O.L.E. Profiler connected to the COM Port previously used.

7) Click the Next command button.
8) Select the desired Baseline Profile (data run) and then click the **Finish** command button to complete the wizard and read from the M.O.L.E. Profiler.

![](image1.png)

9) When the Baseline Profile (data run) has been downloaded, the software prompts the user to specify new file name (*.XMG).

![](image2.png)

10) When finished, click the **Save** command button to complete the process.
Machine Information

This sets machine information that is displayed on the Data Graph so the user can visually see how the Baseline Profile (data run) lines up with the machine.

When setting machine information, this data will be applied to the currently selected data run only.

1) Activate the M.O.L.E.® MAP software.
2) On the Machine menu, click Set Machine Information.
3) Select a machine from the machine drop down list.
If your machine does not appear in the list, continue to set the machine information and select the **Save As** command button to save the new machine settings as an (*.XMR) file in the current Environment. This new machine file will appear in the machine drop down list.

4) Set the machine zone units.
5) Set the number of all machine zones (heating and cooling).
6) Set the machine temperature units.
7) Set the machine conveyor speed and units. The software uses this value to calculate the Time (X) Scale values when **Distance** units are displayed.

To properly display a machine model on the Data Graph, a conveyor speed must be set.

8) In the machine zone matrix set:
   - Zone names (descriptions)
   - Zone lengths (If you do not have zone measurement information, use a tape measure to determine the zone sizes).
   - Zone temperatures (top / bottom)
   - Zone types (heating or cooling)
9) Click the **OK** command button to set the machine information for the displayed thermal profile.
Oven Model Alignment

Oven model alignment accurately reflects how each oven zone influenced the Baseline Profile (data run). All of the KPI measures depend on proper oven model alignment so if it is not, OvenSENTINEL™ recorded data will not be accurate.

If the oven model does not appear on the Data Graph, .

There is two primary methods to align the oven model in M.O.L.E.® MAP, align profile peaks and moving the process origin. Both methods need to align the end of the last hottest zone in the oven model with the Data Plot peaks of the Baseline Profile (data run).

Align profile peaks:

If sensors are placed so they enter and exit machine zones at different times, the resulting Data Plots lag behind one another. The Align Profile Peaks command automatically aligns the Time (X) axis maximum peak values for each Data Plot and the end of the last hottest zone in the oven model.

A conveyor speed must be set to properly use this command.

1) On the Profile menu, click Align Profile Peaks.
The channel lag values are automatically calculated, and the Data Plots adjust to reflect them. A check mark appears to the left of the command indicating the software is in **Align Profile Peaks** mode.

If a Data Plot in the Data Graph is bad (i.e. open, intermittent or detached thermocouple) it may prevent the oven model to align. Data Plots can be suppressed by clicking the corresponding channel check box in the Data Table. This allows the software to align good Data Plot peaks and the oven model.
Move the Process Origin:

If there is something preventing oven model alignment using Align Profile Peaks, the user can manually adjust the oven model by moving the Process Origin. This is the gray vertical line at the left edge of the oven model that indicates where the assembly process starts. Manually moving the Process Origin may take a couple attempts to align the end of the last hottest zone in the oven model with the Data Plot peaks of the Baseline Profile (data run).
**Assembly Information**

This sets assembly information associated with the thermal profile.

- When setting assembly information, this data will be applied to the currently selected thermal profile only.

1) Activate the M.O.L.E.® MAP software.
2) On the **Assembly** menu, click **Set Assembly Information**.
3) Enter an assembly part number.

![Set Assembly Information dialog box](image)
4) Click the **Notes** command button if you would like to enter part documentation about the test assembly being profiled.

![Add Notes dialog box](image)

5) Click the image file **Browse** command button to select a product image. Image files supported by the software are Jpeg (.jpg), Bitmap (.bmp), and Tiff (.tif).

![Select Image dialog box](image)
6) Enter the test assembly board length, width and thickness.

7) Enter the sensor location descriptions. These descriptions can be the location where each sensor is connected to the test assembly. The channel color associated with the description indicates which Data Plot on the Data Graph it represents.

8) Enter sensor location dimensions. Sensor Locations can also be set by dragging sensor location markers on the selected image. To move the markers, click the **Enlarge** command button below the assembly image and the **Set Sensor Locations** dialog box appears.

![Set Sensor Locations dialog box]

X-dimensions are measured from the leading (right) edge or the first edge to enter the process, and Y dimensions are from the top down.

![Set Assembly Information dialog box]

9) Click the **OK** command button accept.
KPI (Key Process Indicators)

The KPI Data Table should include various user configured parameter values that are critical to your Baseline Profile (data run). Each column after the Sensor Locations allows the user to define parameters using the M.O.L.E.® MAP Template commands.

This information is saved with the *.XMG file and will be imported when creating a product. If any KPI measures are configured using M.O.L.E.® MAP Time (X) Reference Lines, they will not be imported as they are not supported in OvenSENTINEL™.

The Baseline Profile (*.XMG) can now be imported into OvenSENTINEL™ software. This Baseline Profile (*.XMG) applies to this oven only as any slight difference in the oven and/or process will affect the success of monitoring product.
**Step #2: Product Creation**

Once a Baseline Profile has been established, it can be used to create a new Product. Each Product defines the requirements for that product, machine properties that achieve those requirements, and the actions you wish to perform if those requirements are not met.

Product Creation Settings:

- **Process**
- **Assembly**
- **Machine Settings**
- **Alerts**
- **Probe Temperatures**

If you have product established, you may proceed to [Step #3: Monitoring](#).
**Process**

This is where process information for OvenSENTINEL™ Product is established from a Baseline Profile or existing Product.

1) Activate the OvenSENTINEL™ software and select the **Product View** button.

2) Select the **Add Product** button from the **Product Manager**.

![OvenSENTINEL™ Software Interface]

Settings that display an asterisk (*) are required.

3) On the **Add Product** window, select **MAP Profile** or **Import OvenSENTINEL™ Product**.

- **MAP Profile** imports an existing (*.XMG) Baseline Profile (data run) specifically for the oven from ECD M.O.L.E.® MAP software. See topic [Step #1: Baseline Profile](#) for more information.

- **Import OvenSENTINEL™ Product** is a copy and tweak process that considerably speeds up the Product creation process. It loads an existing Product created for the oven or an identical oven, and allows the user to modify (tweak) the settings as needed.

  This topic covers the more common process of creating a Product from a **MAP Profile**.
4) Select the **Browse** button to navigate to the location of the Baseline Profile (*.XMG) file.
5) Select the (*.XMG) file and click the **Open** button. This loads the Baseline Profile data and the KPI calculations established in M.O.L.E.® MAP. It also loads the assembly and machine information.

It is very important that the selected thermal profile (*.XMG) was created on the oven that OvenSENTINEL™ is monitoring. If the selected thermal profile (*.XMG) was not from the same oven, it will be rejected and the user notified of the mismatch.
6) Enter a **Unique Product name** in the box. This field is populated with the assembly name from the selected thermal profile (*.XMG). It can be changed however, must remain unique from any existing Product. To assist the user, this box displays a confirmation symbol in addition to a list of currently used Products.

Once a valid profile is loaded, the **Profile Shape** and **Data Table KPI Measures** are displayed.
7) Select the **Status** of the product.

- **Active**: When set, this is displayed in the Product list. This is the default for all new Products.

- **Inactive**: When set, this Product is no longer visible in the Product list, it can be found when using "inactive" on the Product Filter. Products are typically set to inactive when the Product is not likely to be monitored or the user would like to reduce the amount of Products in the list. It can be set to active at anytime by editing the Product.
8) Select the **Configure...** button in SPC Options to set the number of sample measurements. This is how many recorded data points (samples) for this Product to be used in SPC Cp; CpK calculations. Refer to Topic **Appendix> Statistical Process Control (SPC) Background Information** for more information.

- This setting can be edited with the **Product Manager**. Refer to topic Products for more information.

![SPC options](image)

9) Click the **Next** button to configure **Assembly** information.
Assembly

Set or edit assembly information associated with the selected Baseline Profile that was selected for the Product.

This information is imported from the *.XMG file and can be changed/modified.

1) If you would like to assign or update an identification image, select the Add image button to navigate to the location of the Product image. Image files supported by the software are Jpeg (.jpg), and PNG (.png).
2) Select the image file and click the **Open** button.

3) If you would like to enter or update part documentation about the Product, add **Notes** to the text box.
4) Enter or update the **Dimensions** of the Product.

5) Click the **Next** button to configure **Machine Settings**.
Machine Settings

Set or edit machine information that is used to properly display the Dynamic Profile on the Data Graph when Monitoring.

This information is imported from the *.XMG file and can be changed/modified.

1) In the machine zone matrix, set or update the zone temperature setpoints (top / bottom).

![Machine Settings Interface](image-url)
To enter top and bottom zone temperature with different setpoints, un-select the associated checkbox.

2) Set or edit the machine conveyor speed and units. The software uses this value to determine the Time (X) Scale for the Dynamic Profile during product Monitoring. Refer to Topic Step #3: Monitoring for more information. This must be set to the speed of the conveyor when the Baseline Profile was recorded.
3) If the oven requires a machine warm up delay prior to Product monitoring, enter the desired time in the **Delay** text box. When set, this delay starts a countdown timer after the oven has completed the warm up and met the KPI and oven specifications set in the Alerts table. Refer to topic **Operation>Step #2: Product Creation>Machine Settings>Alerts** for more information.

4) If you would like to enter or update machine notes about the machine or process, add **Notes** to the text box.
5) If you would like to **Require User "OK" before Recording Starts**, select the check box. If this is set for this Product, a check box is displayed during Product changeover on the notification screen. This requires the user to manually allow the software proceed after all prior product boards have exited the oven and the KPI Spec Confirmation process is complete. Refer to topic **Step #3: Monitoring** for more information.

![Image of the software interface with the check box highlighted.](image-url)

6) Click the **Next** button to configure **Alerts**.
Alerts

The user can assign warning and alarm alert limits and the notification actions. The software allows alerts for KPI measurements, oven measurements and Barcodes (if Barcode is configured with the system). If an alert is issued and the selected associated action is executed.

- This information is imported from the *.XMG file and can be changed/modified.

1) Select a desired **Warning** check box for **UWL** (upper warning limit), **LWL** (lower warning limit) and/or **CpK** limit to activate. Enter a warning limit value for **UWL**, **LWL** and/or **CpK** that warns the operator when the parameters violate these limits. Typically, these values are set a little tighter than the Alarm specification limits so the system can inform the operator that the value is trending toward violating the Alarm specification.

- If setting alerts, the software does not require both warnings and alarms to be set for the desired measurement.

**KPI Measurement Warnings**

**Hardware Measurement Warnings**
The software allows Alerts to be applied to individual channels. Remove the check mark from the Link check box. This expands the list to reveal the individual channels for the KPI Parameter.
2) Click the **Warning Actions** button to select the desired warning actions **Light Tower**, **Audio**, **Prevent Recording** and/or **Email**.

- **Light Tower** warning alert action is always selected, since the included Status Badge always provide a visual alert (Yellow). The light tower is an optional feature.

- **Audio** warning alert action is available if the optional Light Tower is installed with the system and you wish to have audio alerts. **Email** warning alert action is available if **Mail Configuration** is set up for the system and you wish to receive alerts via Email. Refer to topic **Software Workspace>Preferences** for more information.
3) Select a desired **Alarm** check box for **USL** (upper specification limit) and/or **LSL** (lower specification limit) to activate. Enter an alarm value for **USL** and/or **LSL**. The software monitors the selected measurements and issues an alert if the specification limits are violated.

**Alert** If the oven has a Barcode, alerts can be set for missing and validation of product barcodes.
The software allows Alerts to be applied to individual channels. Remove the check mark from the Link check box. This expands the list to reveal the individual channels for the KPI Parameter.
4) Click the **Alarm Actions** button to select the desired alarm actions **Light Tower**, **Audio**, **SMEMA** and/or **Email**.

- **Light Tower** alarm alert action is always selected, since the included Status Badge always provide a visual alert (Red). The light tower is an optional feature.
- **Audio** alarm alert action is available if the optional Light Tower is installed with the system and you wish to have audio alerts.
- **SMEMA** alarm alert action is available if the optional SMEMA Interface is install with the system.
- **Email** alarm alert action is available if **Mail Configuration** is set up for the system. Refer to topic Software Workspace>Preferences for more information.

If the optional SMEMA Interface is installed with the system, activating the alert action will signal the SMEMA to open the machine ready circuit. This is intended to stop up-stream product from entering the oven.

6) Click the **Next** button to add current **Probe Temperatures**.
Probe Temperatures

This process records the board level thermal conditions of the oven that created the Baseline Profile. These recorded values are then used when monitoring and recording data for the Dynamic Profile which is a predicted profile based on the current temperatures and conveyor speed of the oven and the Baseline Profile.

Prior to Applying Probe Temps, the oven must be at the same conditions as the oven was when the Baseline Profile was recorded. The software allows a temperature variance for each zone since zone temperatures are not always the same at the board level compared to the zone setpoints from the imported (*.XMG).

1) Click the Apply Probe Temperature button and a dialog box appears displaying the machine setpoints and actual probe temperatures.

![Diagram of Apply Probe Temperature dialog box]

2) If all the zone temperature probe values are within 20°C, the software displays the value in green and a check mark. If you wish to accept, click the OK button record these values.

If any of these values are not met, it is recommended to click the Cancel button, confirm the setpoints are correct and wait for the oven to stabilize at the correct settings.
Step #3: Monitoring

When the OvenSENTINEL™ is monitoring and recording the data, there are three views; Profile, Machine and SPC. The Profile represents a predicted "Dynamic" profile based on the current temperatures. The Machine view displays an animation of the recording process when product (boards) are being processed through the oven. The SPC view shows historical control charts for a selected measurement.

Start Recording

Once or more Products have been properly configured, the user can start monitoring and recording the data for the selected Product.

1) On the Product Management View, select a Product on the Product Manager.
2) Select the **Start Recording** button from the **Product Identifier**.
3) Prior to monitoring, the software displays the notification panel. This panel includes the required Machine Settings for the product and an step indicator when initiating the recording process. When the KPI and Oven measurements are in specification, the notification panel auto hides and recording begins.

When the notification panel is displayed, it can be hidden by selecting the Alerts button. To display select the Alerts button again.
When the user starts the recording process and one or more KPI and/or oven specifications are not met, the software displays them on the Specification List and the associated symbol in the stabilization step is red. Recording does not start until all measurements are within specification.
The Profile View is where the Dynamic Profile is displayed when monitoring.

1) Select the **Profile** button to display. When OvenSENTINEL™ is monitoring a Dynamic Profile is displayed which represents a predicted profile based on the current temperatures and conveyor speed in the oven plus the Baseline Profile. The KPI Table includes user configured KPI parameter values imported from the Baseline Profile (*.XMG). Each row in the Table represents the channel sensor data.
Monitoring - Machine View

The Machine View displays an animation of the oven and board tracking.

1) Select the **Machine** button to display. The user can view current zone temperatures, zone set-points, conveyor speed, hardware components (barcode, in/out sensors, SMEMA option) and product location. The animation displays boards at the various tracking locations specifically configured for your OvenSENTINEL™ System.
If an individual board is physically removed from the process or is falsely reported, the user can select the red delete cross associated with the board to remove it from the Monitoring process.
Monitoring - SPC View

The SPC view displays TrueProfile™ KPI or Oven values as an Individual or X Bar and R control charts. The user selects the value to chart from a series of drop down boxes that list the available values to display a SPC chart. Refer to Appendix: TrueProfile™ for the full definition.

Before a TrueProfile™ KPI SPC Chart can be displayed, boards must have exited the oven. TrueProfile™ KPI values are recorded individually over time for each board as it passes through the oven.

1) Select the SPC button to display.
2) Select TrueProfile™ or Oven from the drop down box. TrueProfile™ key process indicator parameters (KPI) from the Baseline Profile or Oven measurements captured during the monitoring process is selected.
3) Select a **Measurement** from the next drop down box. This box is a list of available TrueProfile™ KPI parameters or Oven measurements.
4) If selecting a TrueProfile™ KPI Measurement, select a **Channel** from the next drop down box. This box is a list of available sensor channels from the Baseline profile.
5) Select a Sample and Subgroup size for the TrueProfile™ KPI Measurements or Oven values. Sample size sets the number of measurements displayed on the SPC view when monitoring. The Subgroup samples are averaged to produce each data point on the SPC chart on an Individual or X Bar R control chart.
Monitoring – Auto Changeover

The OvenSENTINEL™ software has the ability to automatically changeover products from one Product to another as the new Product is read by the barcode while current product is completing. To enable this feature, the OvenSENTINEL™ System must be equipped with a barcode reader in addition to each product (boards) having unique a barcode.

To evoke auto changeover, the Product being monitored must be configured to be used in changeover in addition to the Product set to enter the oven. Both Products must also have unique barcodes.

1) Select a Product from the Product Manager.
2) Select the Edit Product button from the Product Manager.
3) Select **Alerts** from the **Edit Product** dialog box.

4) Select the **Barcode Alerts** tab.
5) Select the **Validate barcode** and **Use for changeover** check boxes. They both **MUST** be selected for changeover to be evoked.
6) Enter a barcode that is associated with the specific Product being edited. Enter by typing in the **Criteria** text box and selecting the **Add** symbol. If the Product requires multiple barcodes, repeat this step for each one.

Barcodes can be specified by adding a list, Filter (Prefix, Contains, Suffix) or an Regular expression. To learn, build, & test Regular Expressions (RegEx / RegExp) you can use RegExr, which is an online tool. For this example List will be used.
7) Once the barcode(s) are loaded, select the **Done** button to save the Product.
8) Once OvenSENTINEL™ detects a valid barcode associated with a different Product that is configured for auto changeover, the notification panel appears displaying the status of the auto changeover process. If the SMEMA option is configured with the system, it stops additional boards from entering the oven during Product changeover.

When the notification panel is displayed, it can be hidden by selecting the **Alerts** button. To display select the **Alerts** button again.
Step #4: Reports

The Reports view allows the user to access historical recorded data in report form.

Standard Reports:

For detailed information on OvenSENTINEL™ Standard Reports, refer to Topic Software Workspace>Reports.

1) Select the Report View button and select the New Report button from the Report Manager.
2) Select a desired Report from the drop down list.

3) Select a desired Product from the drop down list.
4) Enter a desired **Date** (MM/DD/YY) and **Time** (HH:MM AM/PM) range. Then select the Apply Filter to display the results.

The Report Query includes the Date/Time filter because the reports have a maximum limit of 500 recorded events.

5) Select the desired Board ID and then **Generate Report** button to display the report in the workspace.

The Product TrueProfile™ is the only report that requires the user to select a Board ID.
6) The report can be viewed within the workspace or printed.
### TrueProfile™

<table>
<thead>
<tr>
<th>Process Origin</th>
<th>Conveyor Speed: 70.00 cm/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>285</td>
<td></td>
</tr>
<tr>
<td>255</td>
<td></td>
</tr>
<tr>
<td>225</td>
<td></td>
</tr>
<tr>
<td>195</td>
<td></td>
</tr>
<tr>
<td>165</td>
<td></td>
</tr>
<tr>
<td>135</td>
<td></td>
</tr>
<tr>
<td>105</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

### TrueProfile™ KPI

<table>
<thead>
<tr>
<th>Time Between Temperature</th>
<th>Maximum Temperature</th>
<th>Time Above Temperature</th>
<th>Slope Peak to Temperature</th>
<th>Maximum Positive Slope</th>
<th>Slope Temperature to Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>150-183°C</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>sec</td>
<td>°C</td>
<td>sec</td>
<td>°C/sec</td>
<td>°C/sec</td>
<td>°C/sec</td>
</tr>
<tr>
<td>74.00</td>
<td>210.0</td>
<td>44.00</td>
<td>1.481</td>
<td>3.350</td>
<td>2.350</td>
</tr>
<tr>
<td>96.00</td>
<td>216.1</td>
<td>48.00</td>
<td>1.356</td>
<td>4.000</td>
<td>3.777</td>
</tr>
<tr>
<td>88.00</td>
<td>209.4</td>
<td>46.00</td>
<td>1.111</td>
<td>3.056</td>
<td>3.138</td>
</tr>
<tr>
<td>85.00</td>
<td>210.0</td>
<td>47.00</td>
<td>1.111</td>
<td>3.056</td>
<td>3.162</td>
</tr>
<tr>
<td>121.0</td>
<td>212.2</td>
<td>36.00</td>
<td>1.389</td>
<td>3.667</td>
<td>3.905</td>
</tr>
<tr>
<td>113.0</td>
<td>213.9</td>
<td>45.00</td>
<td>1.551</td>
<td>4.111</td>
<td>4.022</td>
</tr>
<tr>
<td>Delta</td>
<td>49.00</td>
<td>6.667</td>
<td>12.00</td>
<td>0.498</td>
<td>1.056</td>
</tr>
</tbody>
</table>

### Oven Recipe

<table>
<thead>
<tr>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
<th>Zone 4</th>
<th>Zone 5</th>
<th>Zone 6</th>
<th>Zone 7</th>
<th>Zone 8</th>
<th>Zone 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>170 °C</td>
<td>160 °C</td>
<td>160 °C</td>
<td>170 °C</td>
<td>180 °C</td>
<td>240 °C</td>
<td>240 °C</td>
<td>102 °C</td>
<td>50 °C</td>
</tr>
</tbody>
</table>

---

User Operation Guide | A58-6928-06 R1.1.0  Page 71
Here is how to contact ECD:

We offer many ways to service your problems. You can call our Service/Test technicians, visit our web site to view our FAQ section (Frequently asked Questions) or send us e-mail explaining your problem in detail.

When calling our Service/Test technicians or sending us e-mail, please include the following information:

- Product Description
- Product Serial Number
- OvenSENTINEL™ Software Version

Telephone: +(1) 800.323.4548
           +(1) 503.659.6100
FAX: +(1) 503.659.4422
Email: support@ecd.com
Internet: http://www.ecd.com
APPENDIX

This section provides in depth supporting information about the OvenSENTINEL™ System.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Statistical Process Control (SPC) Background Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs or requirements of the System.</td>
<td>The subset of SPC that is incorporated into OvenSENTINEL™ Software.</td>
</tr>
</tbody>
</table>

**TrueProfile™ KPI Measurements**
What is it? How does it work?
### Specifications

#### SENSORS

**Zone Temperature Probe (Custom per Oven Make & Model):**

<table>
<thead>
<tr>
<th>Solid Shell:</th>
<th></th>
</tr>
</thead>
</table>
| **EXTERNAL CONSTRUCTION:** | Extension cable - SS Overbraid shield.  
Probe - ¼" OD x 0.020 Wall SS tubing. |
| **INTERNAL CONSTRUCTION:** | Type K conductors with Magnesium Oxide filler. |
| **MAXIMUM PROBE TEMPERATURE:** | 350°C (662°F) |
| **LIMITS OF ERROR (WHICHEVER IS GREATER):** | Special: ±1.1°C (1.98°F) or 0.4% |
| • T/C junctions are electrically isolated from each other, and the SS tube.  
• SS tubing and T/Cs must withstand 325°C continuous |

<table>
<thead>
<tr>
<th>Flexible:</th>
<th></th>
</tr>
</thead>
</table>
| **EXTERNAL CONSTRUCTION:** | Extension cable - SS Overbraid shield.  
Probes - SS Overbraid shield. |
| **INTERNAL CONSTRUCTION** | Type K conductors w/Fiberglass Sleeving. |
| **MAXIMUM PROBE TEMPERATURE:** | 350°C (662°F) |
| **LIMITS OF ERROR (WHICHEVER IS GREATER):** | Special: ±1.1°C (1.98°F) or 0.4% |

#### Optical Board Entry and Exit:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUPPLY:</strong></td>
<td>24VDC</td>
</tr>
<tr>
<td><strong>OUTPUT:</strong></td>
<td>NPN (open-collector transistor)</td>
</tr>
<tr>
<td><strong>PHYSICAL DIMENSIONS (W x H x D):</strong></td>
<td>11.2mm (0.44&quot;) X 25.4mm (1.0&quot;) X 20mm (0.79&quot;)</td>
</tr>
</tbody>
</table>

#### Inductive Conveyor Speed:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUPPLY:</strong></td>
<td>24VDC</td>
</tr>
<tr>
<td><strong>OUTPUT:</strong></td>
<td>NPN (open-collector transistor)</td>
</tr>
<tr>
<td><strong>PHYSICAL DIMENSIONS (W x D):</strong></td>
<td>8mm (0.31&quot;) X 45mm (1.77&quot;)</td>
</tr>
</tbody>
</table>
**PHYSICAL**

**Station:**

<table>
<thead>
<tr>
<th>PHYSICAL DIMENSIONS (W x H x D):</th>
<th>266.7mm (10.5&quot;) x 241.3mm (9.5&quot;) x 47.6mm (1.88&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUTS:</td>
<td></td>
</tr>
<tr>
<td>THERMOCOUPLE (24):</td>
<td>Type K, ± 1.5°C (2.7°F)</td>
</tr>
<tr>
<td>DIGITAL (7):</td>
<td>Boolean: True/False (1/0)</td>
</tr>
<tr>
<td></td>
<td>Frequency: 10-1,000Hz ± 1 Hz</td>
</tr>
<tr>
<td></td>
<td>Period: 0-10 Seconds ± 1 Millisecond</td>
</tr>
<tr>
<td>RS-485 (1):</td>
<td>MODBUS Protocol</td>
</tr>
<tr>
<td>RS-232 (2):</td>
<td>ASCII</td>
</tr>
</tbody>
</table>

**DISPLAY / NOTIFICATION**

**Station:**

<table>
<thead>
<tr>
<th>DISPLAY:</th>
<th>2.7&quot; OLED</th>
</tr>
</thead>
</table>

**Status Badge / Light Tower (Optional):**

| RED:                            | Out-of-Spec Indicator                              |
| GREEN:                          | System Ready                                       |
| YELLOW:                         | System Warning                                      |

**ENVIRONMENTAL LIMITATION SPECIFICATIONS**

- Temperature range 0-50°C (32-122°F)
- Maximum relative humidity 80%
- **Keep strong electromagnetic fields away.** The thermocouple wires serve as an antenna for electromagnetic radiation. If field strength of 3 volts per meter is present (usually due to close proximity of radio transmitters) while the OvenSENTINEL™ Station is collecting data, the accuracy of the data may be compromised.

**SOFTWARE REQUIREMENTS**

| RED:                            | Out-of-Spec Indicator                              |
| GREEN:                          | System Ready                                       |
| YELLOW:                         | System Warning                                      |
TrueProfile™ KPI Measurements

TrueProfile™ detects the product entering the oven and tracks the board through the oven, collecting the temperatures of each oven zone, using the sensors in the oven’s zones, while the board is in each zone. If the temperature in a given zone is measured more than once, while a board is in that zone, the average of the two or more measurements are recorded for that zone. The same is true for the conveyor speed since it is measured multiple times while each board progress through the oven.

The product’s collection of zone temperatures (see Figure 1) and average conveyor speed measurements at the time the board is in each zone are the values used to predict the board’s “TrueProfile™” and then extract the KPI measurements. These are the “TrueProfile™” KPI measurements. This is a superior method of performing the prediction because it records the actual zone temperatures over time, the time the board was actually in each zone, verses a snapshot at some instant in time. It also lets you pinpoint which board or boards truly failed the specifications rather than assuming ALL boards in the oven at the time of the snapshot failed.

![Figure 1: Boards through the oven collect the zone temperatures while they are in each zone](image-url)

The board's collection of zone temperatures measured over time, as the board was in each zone and the average conveyor speed, are used to predict the product profile.
Statistical Process Control (SPC) Background Information

This topic deals with the subset of SPC that is incorporated into software. It does not address general SPC principals. A working knowledge of general statistical principals and SPC terms is assumed and is not addressed here. There are many good basic SPC books such as the DataMyte Handbook where this information may be obtained.

Reflow operators, engineers and production managers are expected to understand their soldering process so as to deliver quality products cost effectively. This is a continuous process.

First, the machine must be checked for consistency. A standard or typical set up should be routinely checked prior to any process set point determinations, or actual production run machine checks. Only after the machine has been determined to be operating correctly and not experiencing abnormal variation, should data from the machine be utilized. SPC is all about identifying common or normal variation from abnormal variation.

Second, the correct process set points must be determined for a particular product. Utilizing the M.O.L.E.® Thermal Profiler, the correct set points for a particular product may be determined. These set points, if selected correctly and followed, should deliver the maximum throughput of quality product.

Third, the machine must consistently deliver the correctly determined set points. SPC will help identify common or normal variation from abnormal variation. Checking the machine using your M.O.L.E.® and the software with its SPC capability will help ensure that the machine is consistently performing to its set points and your expectations.

Fourth, repeat the above three steps. Continuous improvement is a never-ending cycle. Check the long-term variation of the machine by graphing typical set point samples. Using the M.O.L.E.®, re-check/adjust part number specific set points to maximize your quality throughput. Check the machine during a part number run to control the machine variation from that part number’s actual ideal set points.

While SPC had its start in high volume repetitive operations, SPC is applicable to many other types of operations as well. However, SPC can be difficult to apply to short runs. Short runs may be runs that take a long time to process, runs in which multiple samples are difficult to collect, and runs where samples are difficult to place into subgroups or runs where small quantities are run.

The software charts will be more meaningful to the user if SPC charts are generated based on data sets that have the same set points each time.

Process Capability

A process capability index is a standard measure of how a process compares with its specification limits—how a process is performing relative to how it is supposed to perform. As opposed to the
control chart, which shows detailed information about how the data compares with control limits, a capability index is a summary of how the data compares with the specification limits.

Two common capability indicators are \( \text{Cp} \) and \( \text{Cpk} \). These values are shown in the Statistics Box on the SPC Workspace.

For both of the index values, the data used to determine them is dictated by the subgroup size (\( N \)) chosen by the user. In the case where \( N=1 \), individual data is used—for \( N>1 \), average data is used (\( \bar{x} \)).

The charts on the next page give a graphical representation of the concept of \( \text{Cp} \) and \( \text{Cpk} \). Notice that in each graph, the same upper and lower specification limits (USL, LSL) are used. The values of \( \text{Cp} \) and \( \text{Cpk} \) will differ according to the data that is compared with those specifications.

Depending on the particular process being monitored, the desired value for \( \text{Cp} \) and \( \text{Cpk} \) may differ. In general, however, a \( \text{Cp} \) and \( \text{Cpk} \) of 1.33 or above is desired. This assures that the process is not only capable of meeting the required specification limits, but also has a built-in margin for error that may be needed in special circumstances. In addition to targeting a certain minimum \( \text{Cp} \) and \( \text{Cpk} \), it is also desirable to have these two values equal one another. This indicates that the process is well-centered between the specification limits.

\[
\begin{array}{|c|c|}
\hline
\text{Sensor 1} & \\
\text{N:} & 25 \\
\text{Min:} & 209.3 \degree \text{C} \\
\text{Max:} & 210.9 \degree \text{C} \\
\bar{x}: & 209.95 \degree \text{C} \\
\text{Std-Dev:} & 0.471298 \\
\text{Cp:} & 5.66 \\
\text{Cpk:} & 3.5 \\
\hline
\end{array}
\]

\( \text{Cp} \geq 1.33 \): Data tightly distributed.

\( \text{Cpk} \geq 1.33 \): Data well inside spec limits.
**Cp = 1.00:** Data fills entire spec range.

**Cpk = 1.00:** Data fills entire spec range.

**Cp > 1.00:** Data tightly distributed. If it were centered between the spec limits, no data would lie beyond those limits.

**Cpk < 1.00:** Some data is outside the spec limits.

**Cp < 1.00:** Data not tightly distributed. If it were centered between the spec limits, some data would still lie outside those limits.

**Cpk < 1.00:** Some data is outside the spec limits.

The equations used to calculate the index values are as follows:

\[
Cp = \frac{USL - LSL}{6 \times (Std.Dev.)}
\]

\[
Cpk = \frac{USL - \bar{x}}{3 \times (Std.Dev.)} \quad \text{OR} \quad Cpk = \frac{\bar{x} - LSL}{3 \times (Std.Dev.)}, \text{ whichever is less}
\]

As can be interpreted from the above equations, Cp gives an indication of how narrow the data distribution is relative to the width of the specification limits. Essentially, it indicates how well the process would be able to stay within the specified limits if the data were perfectly centered between those limits.
Cpk compares the widest half of the data distribution to the appropriate specification limit. It indicates whether the process is capable of meeting the specification as indicated by the “worst half” of the measurements. Unlike Cp, the Cpk index measures process capability without assuming the data is well-centered.