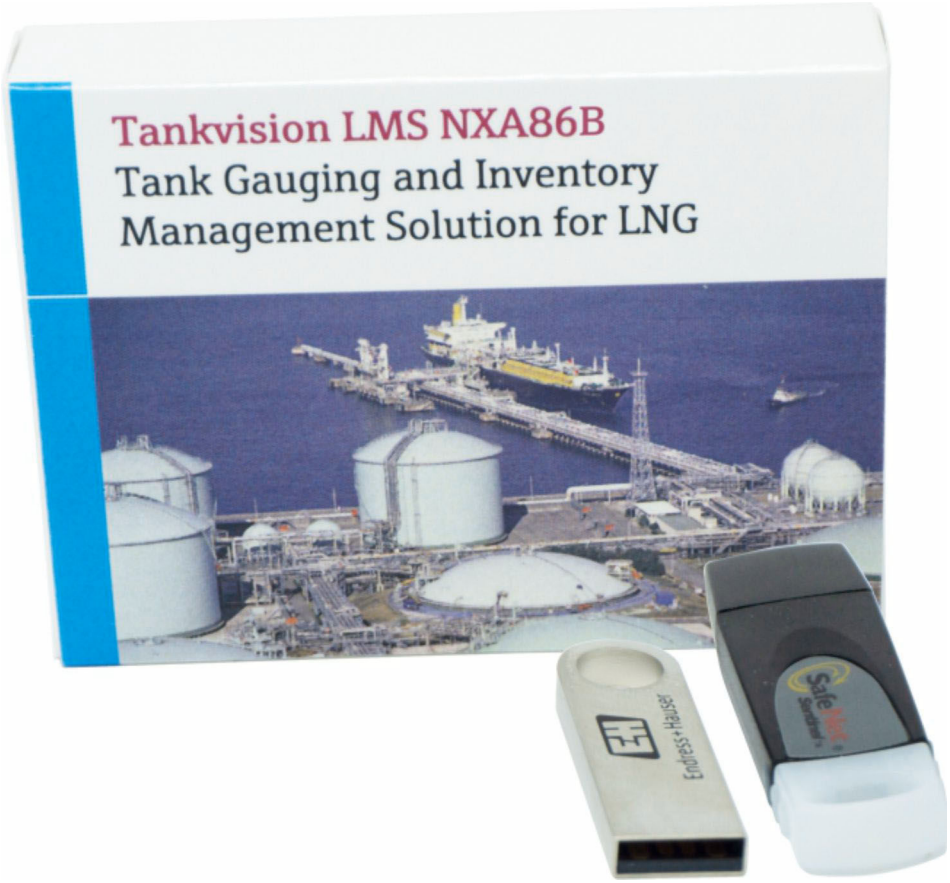
BA01703G/00/EN/03.24-00
71651404
2024-03-07

Valid as of version
18.3.3

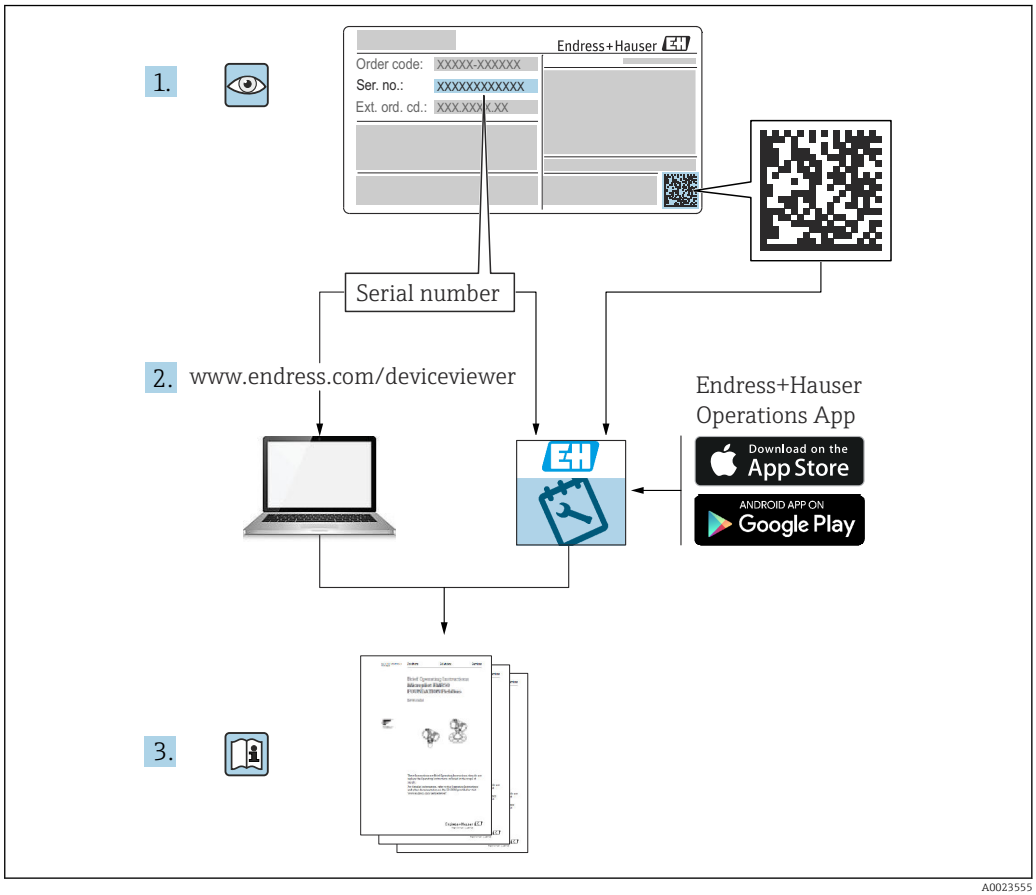
Operating Instructions
Tankvision LMS NXA86B

Skin Temperatures



Endress+Hauser
People for Process Automation

- Make sure the document is stored in a safe place such that it is always available when working on or with the device.
- To avoid danger to individuals or the facility, read the "Basic safety instructions" section carefully, as well as all other safety instructions in the document that are specific to working procedures.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser sales organization will supply you with current information and updates to this manual.


1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX.XXXX XX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
A0023555

Change history

BA01703G/01.17
- Valid for software version: 18.0.2 and 18.0.3
- Initial version

BA01703G/02.18
- Valid for software version: 18.1.1
- Changes to the previous version:
  Compatibility with Windows 10 and Windows Server 2016

BA01703G/03.24
- Valid for software version: 18.3.3
- Changes to the previous version:
  Compatibility with Windows 11 and Windows Server 2022. Minor changes to existing functionality.

Table of contents

1 About this document

1.1 Document function

This manual should support during the installation of Tankvision LMS NXA86B.

Beside basic PC operating knowledge no special training is needed to perform the Tank Gauging System operations. Nevertheless it is recommended receiving a training on the system by Endress+Hauser.

1.2 Symbols

1.2.1 Safety symbols

⚠ DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

⚠ WARNING
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

⚠ CAUTION
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol contains information on procedures and other facts which do not result in personal injury.

1.2.2 Symbols for certain types of information and graphics

Tip
Indicates additional information

Reference to documentation

Reference to graphic

▶
Notice or individual step to be observed

1., 2., 3.
Series of steps

Result of a step

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

1.3 Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

1.4 Registered trademarks

1.4.1 Microsoft®, Windows®

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1.4.2 Modbus™

Modbus is a registered trademark of Schneider Electric USA, Inc.

1.4.3 Java®

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1.4.4 Mozilla® Firefox®

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1.4.7 Legal notice concerning trademarks

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2 Basic safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- Are authorized by the plant owner/operator.
- Are familiar with federal/national regulations.
- Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:

- Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Follow the instructions in this manual.

2.2 Intended use

2.2.1 Intended use of Tankvision LMS NXA86B software

Tankvision LMS is a total LNG Tank Storage and Management solution for Peak Shaving, Receiving and Production LNG facilities. The LMS system has been designed to interface to all instruments commonly found on LNG storage tanks, and to collect and present the instrument data through a range of intuitive graphical user interfaces. A typical LNG Tank will have a wide range of measurement instruments to measure Liquid Level, Liquid Density, Liquid and Vapour Temperature, Liquid and Vapour Pressure, Skin Temperature and much more.

Typically each tank would be fitted with an LTD gauge, two further level gauges configured as a Primary and Secondary, and an Alarm Gauge. The LTD gauge is a servo operated unit mounted on the tank roof. The purpose of the LTD gauge is to take accurate profiles of temperature and density throughout the liquid, and whilst not profiling provide continuous liquid level, temperature and density measurement. The Primary and Secondary gauges can be either servo and or radar operated units also mounted on the tank roof. The purpose of these gauges is to provide continuous liquid level measurement, and average liquid temperature measurement. They provide redundancy on the measurement of level and temperature. The average liquid temperature is derived from a multi point temperature sensor device. The alarm gauge is often a servo or radar based gauge configured to provide volt free contact alarm status to an independent system.

An LMS system can operate in a simple standalone configuration or as a fully redundant system where security and integrity are of paramount importance. The LMS system has a flexible and scalable architecture allowing it to be tailored to a number of different applications easily.

2.3 IT security

Our warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

3 Product description

3.1 Product identification

The following options are available for identification of the software:

- Nameplate specifications
- Order code with breakdown of the software features on the delivery note
- Enter serial numbers from nameplates in *Device Viewer* (www.endress.com/deviceviewer): All information about the software is displayed.

For an overview of the technical documentation provided, enter the serial number from the nameplate in the *Device Viewer* (www.endress.com/deviceviewer).

3.1.1 Nameplate

The information that is required by law and is relevant to the product is shown on the nameplate, e.g.:

- Manufacturer identification
- Product name
- Order code
- Extended order code
- Serial number
- Barcode

3.1.2 Manufacturer address

Endress+Hauser SE+Co. KG
Hauptstraße 1
79689 Maulburg, Germany

Place of manufacture: See nameplate.

3.1.3 Order code and product version

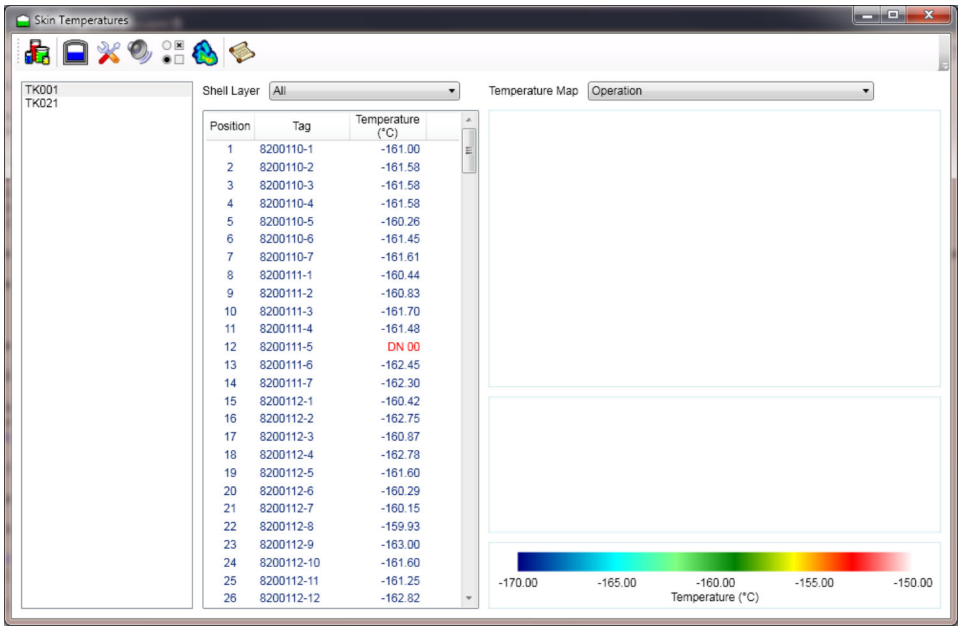
To find out the version of your software, enter the order code indicated on the nameplate in the search screen at the following address:
www.products.endress.com/order-ident

4 Overview

Skin Temperature sensors, located around the base, sides and roof of the LNG tank, are used to detect any anomalies in the shell insulation that may cause a leak of product. They are particularly used during the cool down period of a tank.

Up to 256 skin temperatures are supported per tank when used in conjunction with MHT TM188 Temperature Multiplexer devices.

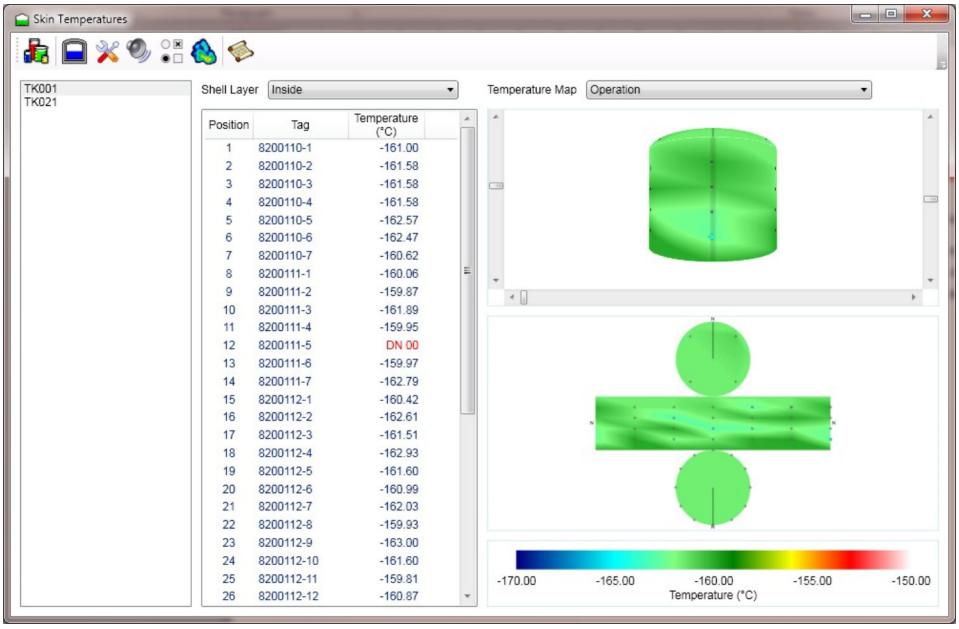
The new skin temperature application displays a list of tanks that have skin temperature sensors fitted: **View → Skin Temperatures**.



1 Main Screen

The main screen (see figure above) is divided into three sections. On the left is the list of tanks that have skin temperature sensors fitted; in the middle is the details of the skin temperature sensors for the selected tank, and on the right is a visualisation of the skin temperature for a specific shell layer.

The visualisation (see figure below) is only present if a specific shell layer is selected in the middle section:

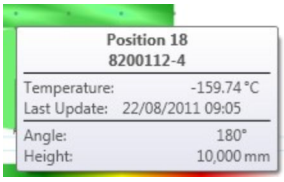


2 *Visualisation*

Tank List
Contains the list of tanks that have skin temperature sensors fitted.

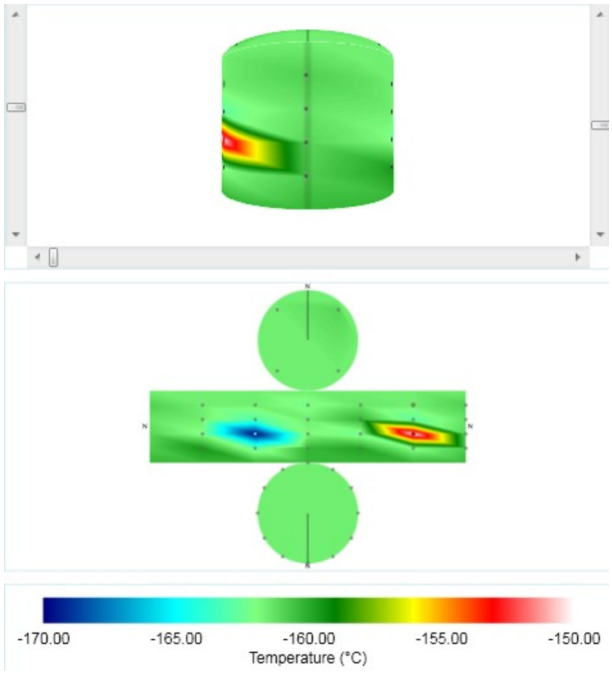
Shell Layer
Drop down list contains selection of:
- **All** – All sensors for the tank are listed.
- **All Defined** – All sensors that have a location defined are listed.
- **Specific Shell Layers** – Lists the sensors that are defined as belonging to the specified shell layer.

Visualisation
Drop down list contains the temperature maps that can be used to visualise the tank. Upper image is a three dimensional visualisation of the selected shell layer. The user can zoom in and out using the left hand scroll bar, rotate the tank using the bottom scroll bar, and tilt the tank using the right hand scroll bar. The lower image is a two dimensional visualisation of the selected shell layer.
When the mouse is moved over a sensor location (indicated by a dot) more information on the sensor is displayed as shown below.



3 *Sensor information*

If the status of a sensor indicates that it is invalid, the dot representing the sensor will flash. If the temperature reading for a sensor differs by more than a configured threshold from the average reading of the sensors in that portion of the tank (roof, floor, wall below product level, wall above product level) it is considered to indicate a hot spot or a leak. Hot spots are indicated by the sensor turning red, whilst leaks are indicated by the sensor turning blue. This is demonstrated below.

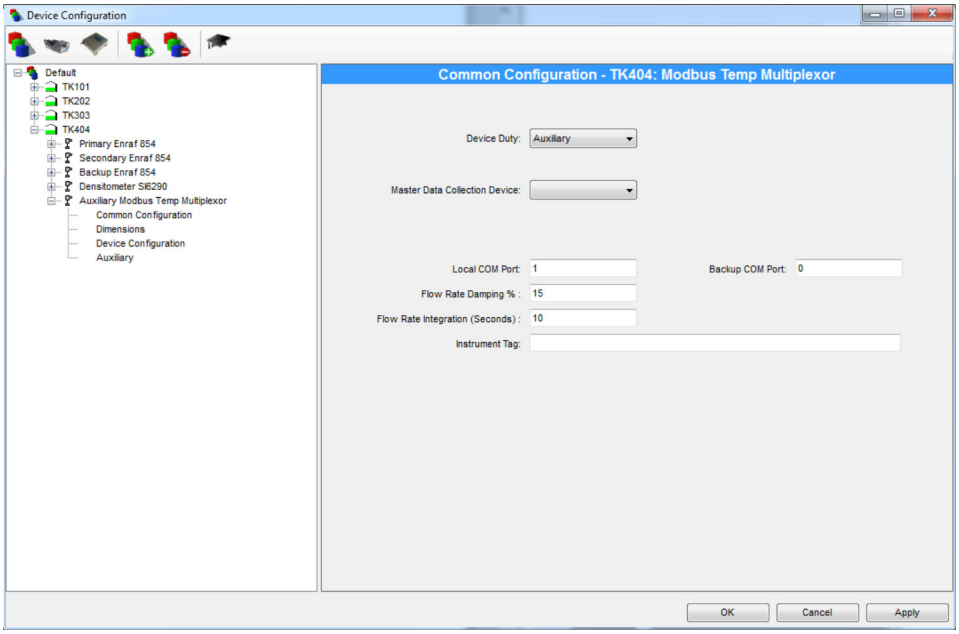


4 *Visualisation*

If the user clicks on the two dimensional image, the three dimensional image is rotated and tilted so that the selected point becomes visible.

5 Configuring

5.1 Gauge Device



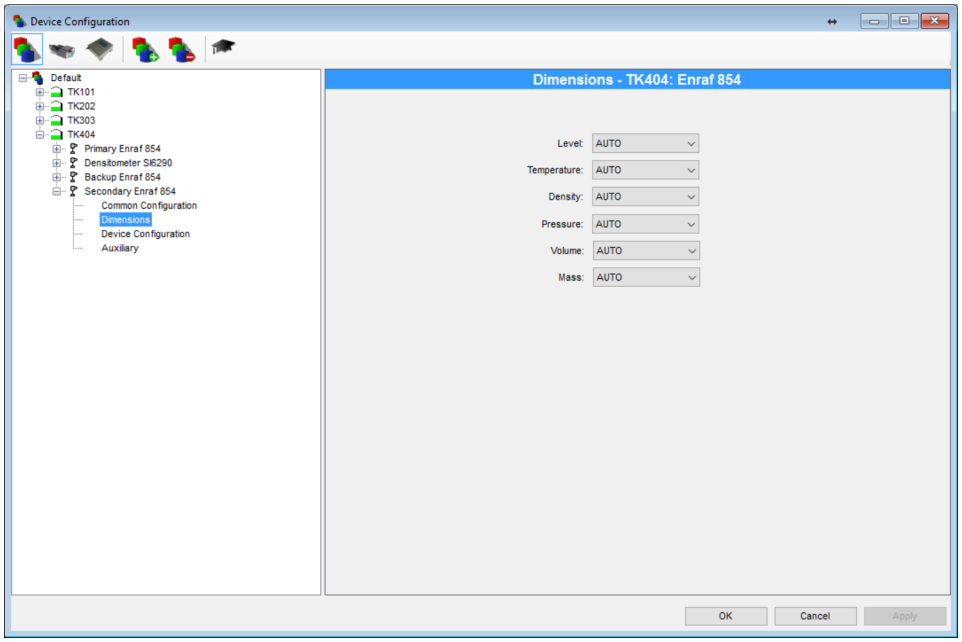
5 *Common Configuration*

An auxiliary device on TK404 which is the fifth gauge. Device type is Modbus Temp Multiplexor which has a modbus map to pick up the 16 sensor inputs from a TM188 multiplexer.

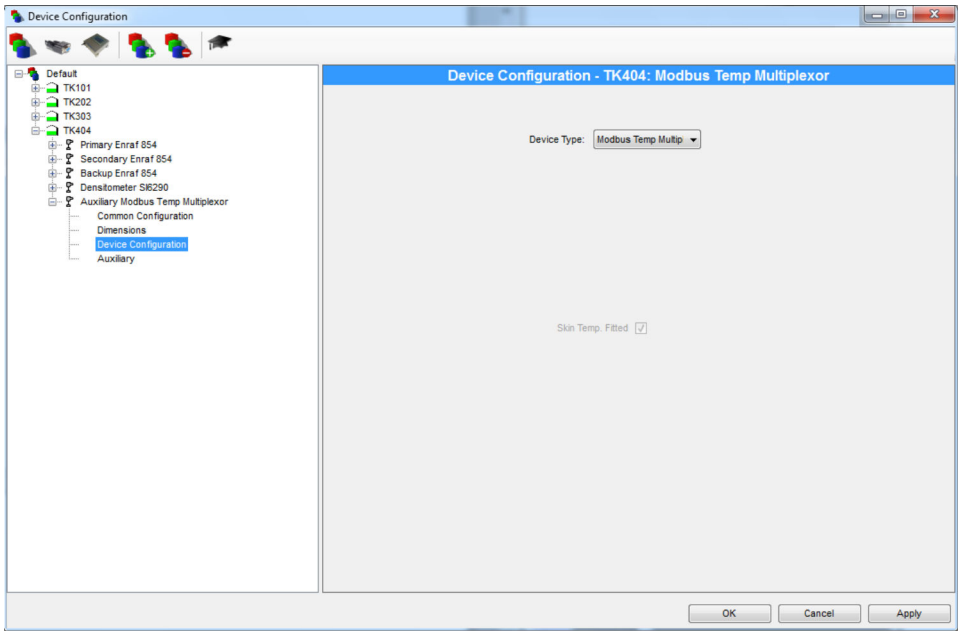
Set up as a Host Modbus device on COM 1 polling for 16 sensor inputs (configuration: 9600 8 none 1 none).

Check the **In use** box for the COM port!

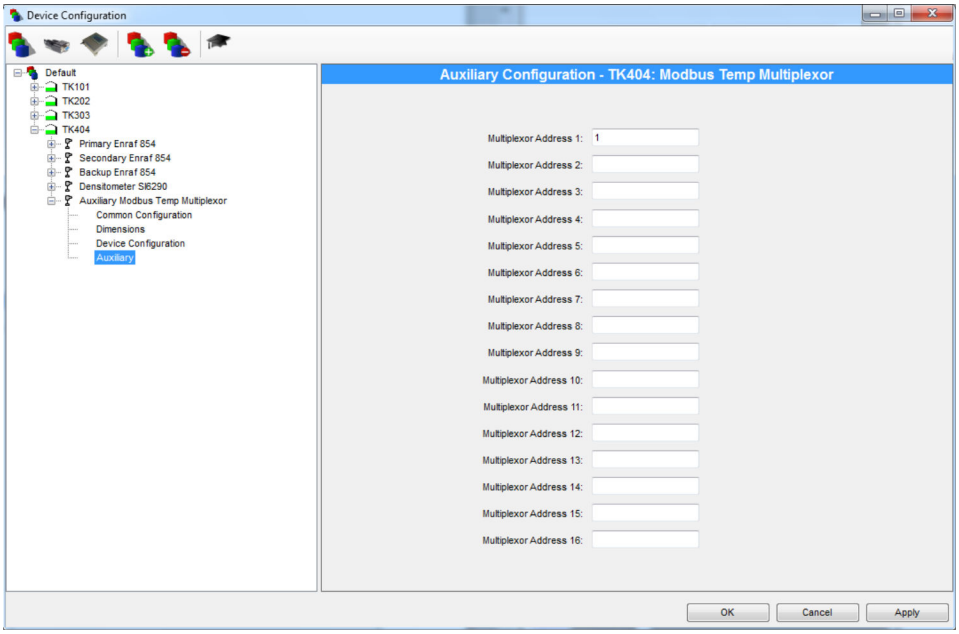
The Background Scan is reduced to 20 seconds from 3 minutes while configuring.



6 *Dimensions*



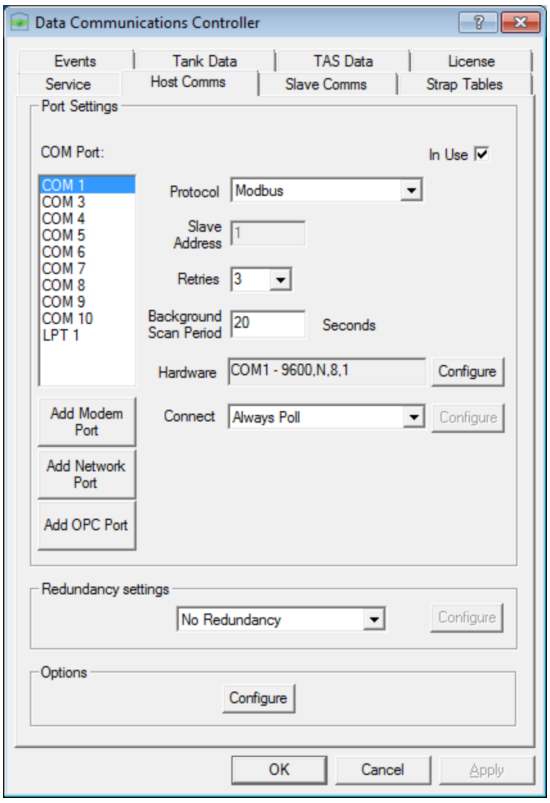
7 *Device Configuration*



8 *Auxiliary*

5.2 DCC Host

It may be necessary to stop/start DCC services to enable a connection.



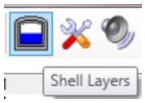
9 *DCC Host*

A crossover serial cable can be used for testing using modsim to simulate the TM188 and RS-232. See Testing section.

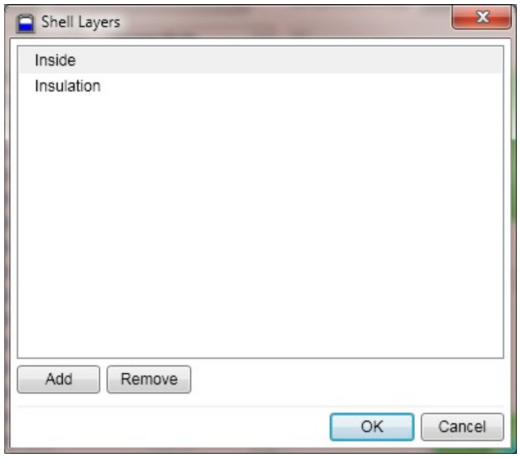
An RS-485/RS-232 converter or an RS-485 interface card is required for the actual TM188 multiplexer set up as it uses RS-485 for communications.

5.3 Shell Layers

The user can configure the names of the shell layers by clicking on the **Shell Layers** button.



This will display the **Shell Layers** configuration screen as shown below:

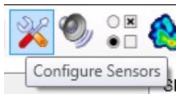


10 Shell Layers

To edit the name of the shell layer, click on that layer. To add a new shell layer, click the **Add** button. To remove the selected layer click the **Remove** button. To save changes and close the screen click the **OK** button. To close the screen without saving the changes click the **Cancel** button.

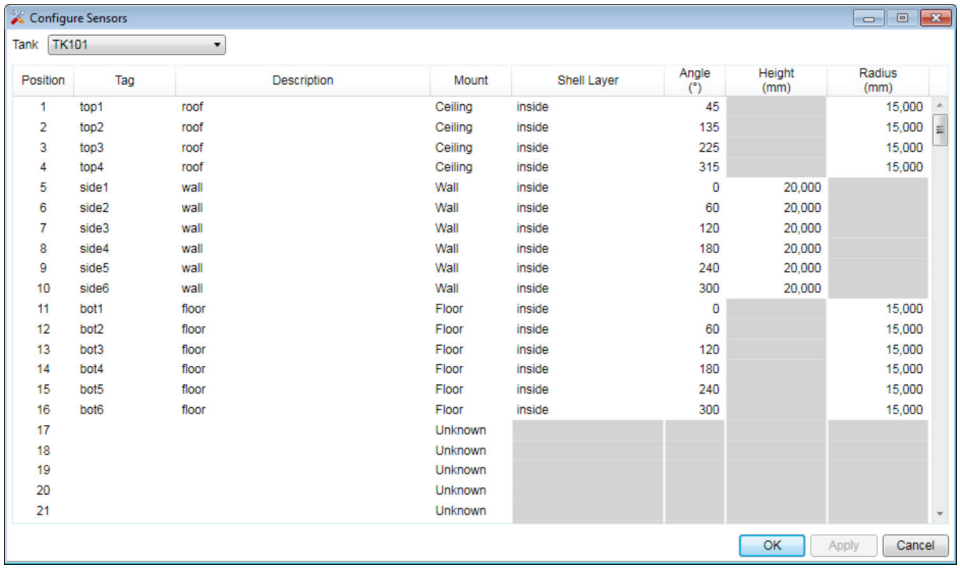
5.4 Sensor Configuration

The user can configure the sensors by clicking on the **Configure Sensors** button.



These can only be configured if there is a data connection – otherwise the sensor positions do not show up.

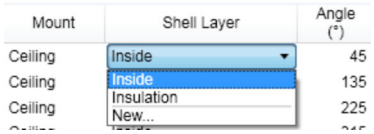
This will display the sensor configuration screen as shown below.



11 *Configure Sensors*

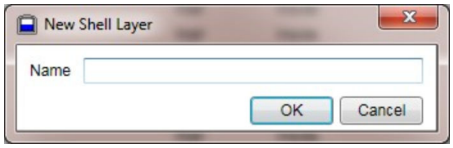
The user can select the tank for which the sensors are to be configured from the drop down list. The list contains only the tanks that have skin temperature sensors fitted. Once a tank is selected, the sensors for the tank are displayed in the grid.

The grid contains the following columns:
- **Position** – Index of the sensor. This field is read-only.
- **Tag** – Text field allowing entry of the sensor tag, up to twenty characters.
- **Description** – Text field allowing entry of a full description for the sensor, up to 255 characters.
- **Mount** – Drop down list allowing selection of the location of the sensor (**Unknown**, **Wall**, **Ceiling**, **Floor**).
- **Shell Layer** – Drop down list allowing selection of the shell layer in which the sensor is located. The list contains all the configured shell layers, plus an entry allowing the user to create a new shell layer:



12 *Drop down list*

If the user clicks on the **New...** entry, the **New Shell Layer** screen is displayed:



13 *New Shell Layer*

To create the new shell layer, the user should type the name of the new shell layer and then click the **OK** button. The new shell layer will automatically be selected in the sensor configuration screen.

- **Angle** – Text field allowing entry of the angle of the sensor relative to a set starting point for the tank. The set starting point is indicated on the tank visualisation as **N** (North). The angle is considered to be measured clockwise from the starting point (looking down on the tank) and is entered in degrees.
- **Height** – Text field allowing entry of the height of the sensor above the floor. This field is only available when the **Wall** mount position is selected for the sensor.
- **Radius** – Text field allowing entry of the distance of the sensor from the centre of the tank in the horizontal plane.
  This field is only available when the **Ceiling** or **Floor** mount position is selected for the sensor.

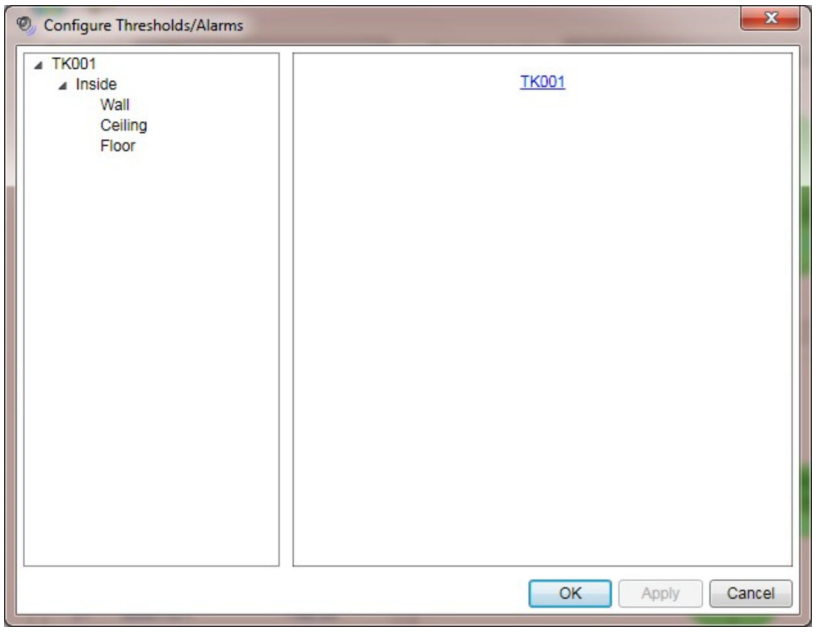
Each tank may have up to 256 skin temperature positions; however the actual number of temperatures depends on how many multiplexer devices are installed on the tank.

To save the sensor configuration changes for the tank the user should click the **OK** or **Apply** buttons. Clicking the **OK** button will close the screen once the changes have been saved successfully. To leave the screen without saving the changes the user should click the **Cancel** button.

5.5 Configure Thresholds/Alarms

The user can configure the alarms and thresholds for the skin temperature sensors for a tank by clicking the **Configure Thresholds/Alarms** button.

This will display the **Configure Thresholds/Alarms** screen as shown below.



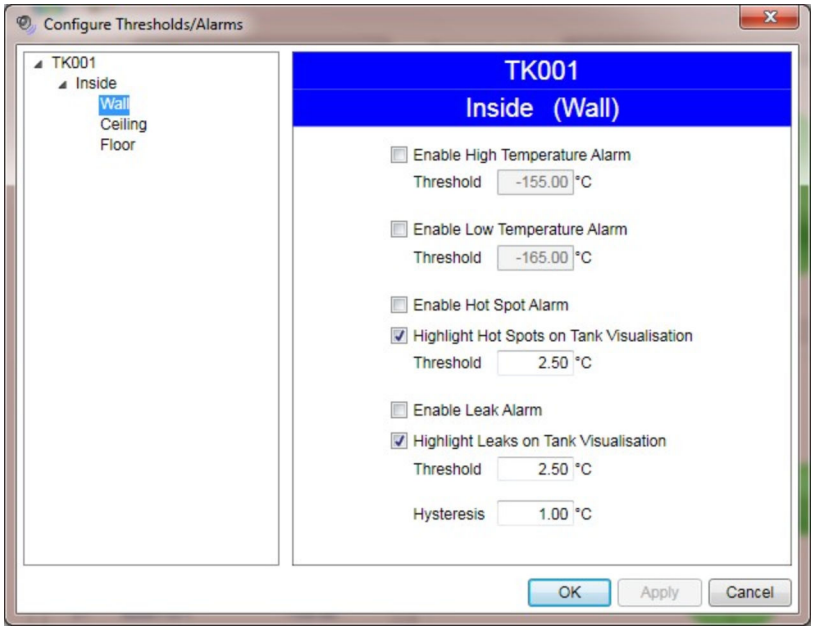
14 *Configure Thresholds/Alarms*

The tree view on the left hand side of this screen contains a list of tanks that have skin temperatures fitted and have had the skin sensors configured.

Each tank will have sub-entries for the shell layers that contain skin sensors for that tank. Each shell layer will have sub-entries for the mounts that contain skin sensors for that shell layer/tank combination.

If an entry other than a mount location is selected in the tree view, the right hand pane will contain one or more hyperlinks allowing navigation to the sub-entries of the currently selected item.

If a mount location is selected in the tree view, the right hand pane will display the threshold/alarm configuration information for that tank/shell layer/mount combination as shown below.



15 *Configuration*

Enable High Temperature Alarm
Indicates whether a high temperature alarm is to be raised if the median temperature of the sensors in the location rises above the entered threshold.

Enable Low Temperature Alarm
Indicates whether a low temperature alarm is to be raised if the median temperature of the sensors in the location falls below the entered threshold.

Enable Hot Spot Alarm
Indicates whether a hot spot alarm is to be raised if the temperature of a sensor in the location differs by more than the entered threshold from the median temperature of the sensors within that location.

Highlight Hot Spots on Tank Visualisation
Indicates whether a sensor is to be highlighted on the tank visualisation if the temperature of that sensor differs by more than the entered threshold from the median temperature of the sensors within that location.

Enable Leak Alarm
Indicates whether a leak alarm is to be raised if the temperature of a sensor in the location differs by more than the entered threshold from the median temperature of the sensors within that location.

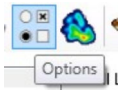
Highlight Leaks on Tank Visualisation
Indicates whether a sensor is to be highlighted on the tank visualisation if the temperature of that sensor differs by more than the entered threshold from the median temperature of the sensors within that location.

The difference between the hot spot and leak alarms is that the hot spots are sensors which are warmer than the median temperature whilst leaks are sensors which are colder than the median temperature.

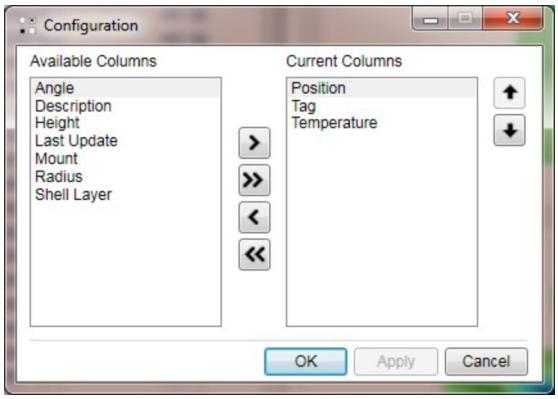
The **Hysteresis** field allows the user to define the margin at which the alarms are considered to be cleared.

5.6 Options

The user can configure the columns to be displayed for each sensor on the main screen by clicking the **Options** button.



This will display the Options screen as shown below.



16 *Options*

The user can move the selected column from the **Available Columns** list to the **Current Columns** list by clicking the add column button (>).

The user can move all the remaining columns from the **Available Columns** list to the **Current Columns** list by clicking the add all columns button (>>).

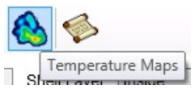
The user can move the selected column from the **Current Columns** list to the **Available Columns** list by clicking the remove column button (<).

The user can move all the remaining columns from the **Current Columns** list to the **Available Columns** list by clicking the remove all columns button (<<).

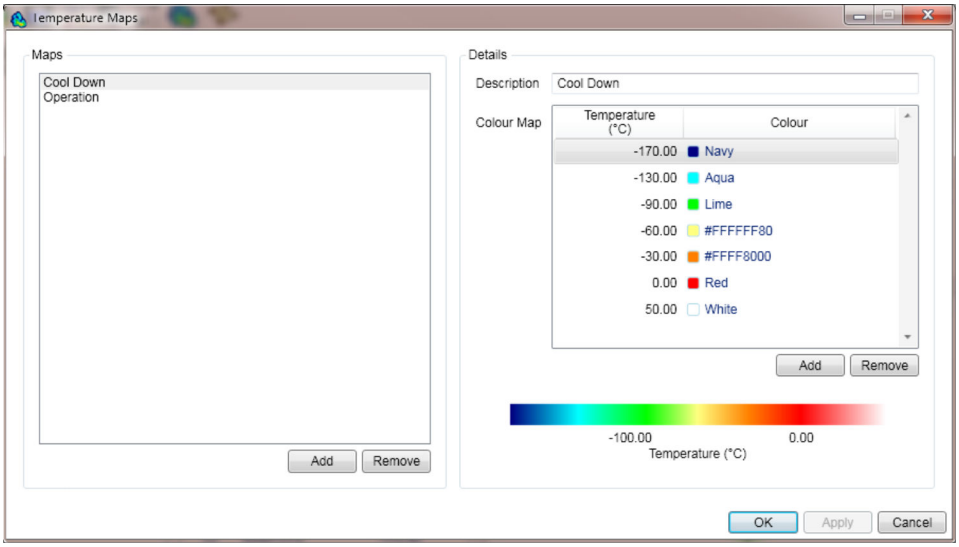
The user can reorder the **Current Columns** list by moving the selected item up (↑) and down (↓).

5.7 Temperature Maps

The user can configure the temperature maps used to display the tank visualisations by clicking the **Temperature Maps** button.



This will display the **Temperature Maps** screen as shown below.

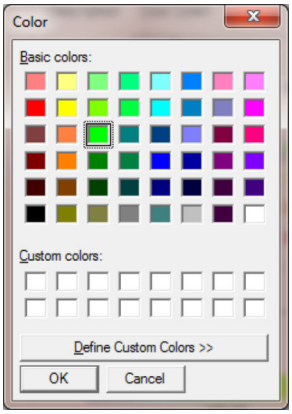


17 *Temperature Maps*

A list of currently configured maps is displayed on the left hand side of the screen. Two preconfigured maps are included for **Cool Down** and **Operation**. Additional maps can be created by clicking the **Add** button. Existing maps can be removed by selecting them and clicking the **Remove** button.

Details of the selected temperature map are displayed on the right hand side of the screen. To add new points to the colour map the user can click the **Add** button. To remove an existing point from the colour map the user can click the **Remove** button.

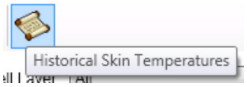
The points in the colour map can be edited to change the temperature or colour. The new temperature can be entered by clicking on the current figure and then typing the new value. The new colour can be selected by clicking on the current colour. This will cause a colour selection screen to be displayed as shown below.



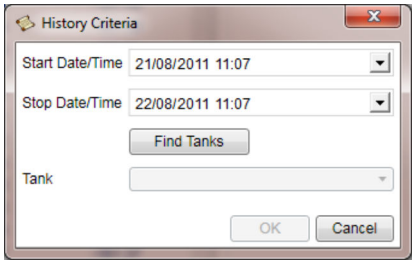
18 *Colour Selection*

5.8 Historical Skin Temperatures

The user can view historical skin temperatures (if they are being trended – see next section) by clicking the **Historical Skin Temperatures** button.

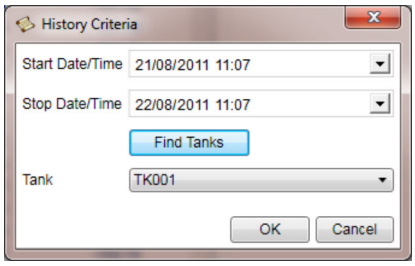


This will display the date/tank selection screen as shown below.



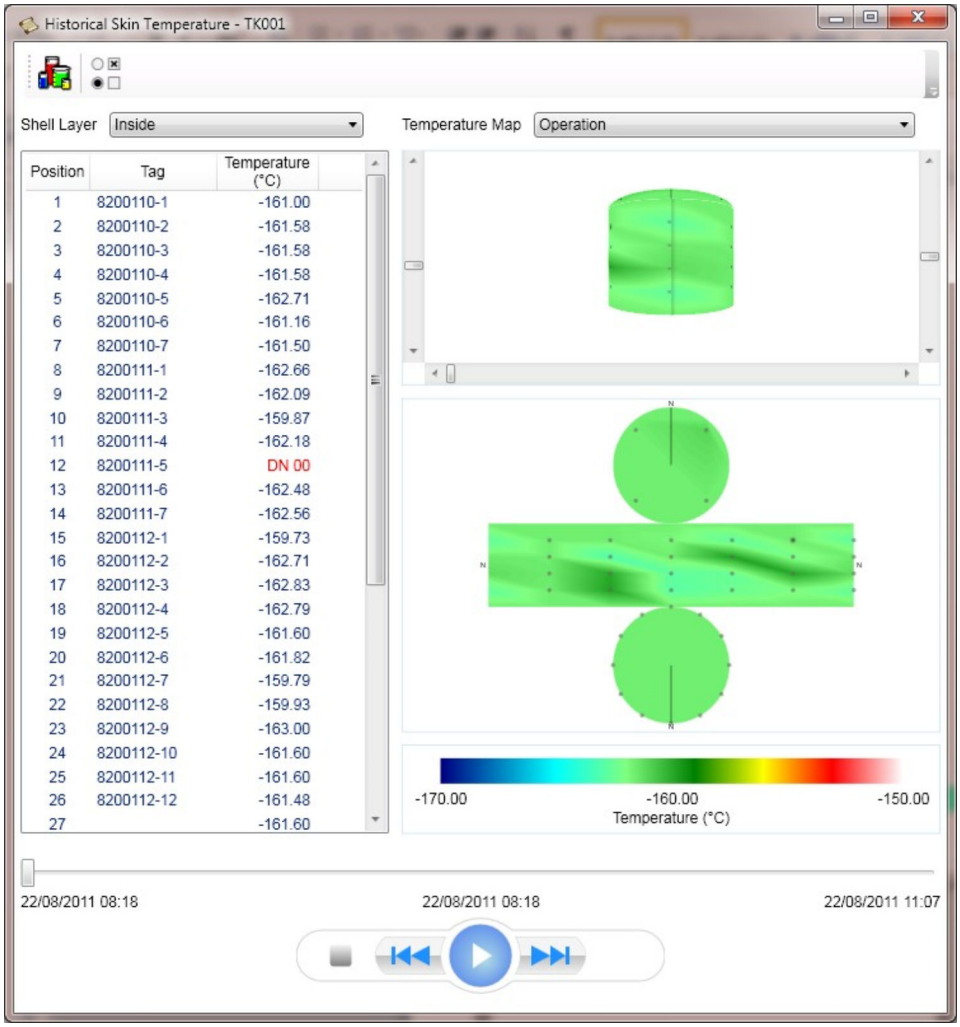
19 *History Criteria*

Once the user has entered a **Start Date/Time** and **Stop Date/Time** they must click the **Find Tanks** button to find the tanks for which skin temperature trending data is available between the entered date/times. If trending data is available the tanks list is populated with the relevant tanks and the user is able to select a tank as shown below.



20 *Select a tank*

Once the user has selected a tank they can display the **Historical Skin Temperature** screen (see below) by clicking the **OK** button.



21 Historical Skin Temperature

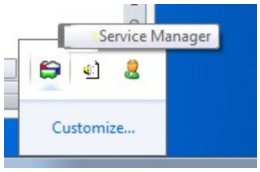
This screen is similar to the main skin temperatures screen with the following differences:

- The only configuration available is to change the columns displayed for the skin sensors. Any configuration data regarding the sensors, shell layers, visualisation thresholds and temperature maps are taken from the main screen.
- There is no tank list. Only the data for the tank selected in the date/tank selection screen is available.
- The date/time for which data is to be displayed can be selected by using the slider control at the bottom of the screen. The data can be animated using the controls below the slider to play, fast forward or rewind the current date selection.

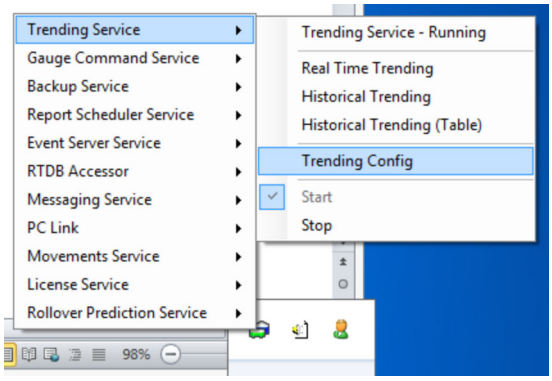
The users can open as many historical screens as they wish. However, all historical screens will be closed when the main screen is closed.

5.9 Trending

It is essential to have trending of Skin Temperatures set up in order to view Historical Skin Temperatures. Right click the **Service Manager** taskbar icon as shown below.

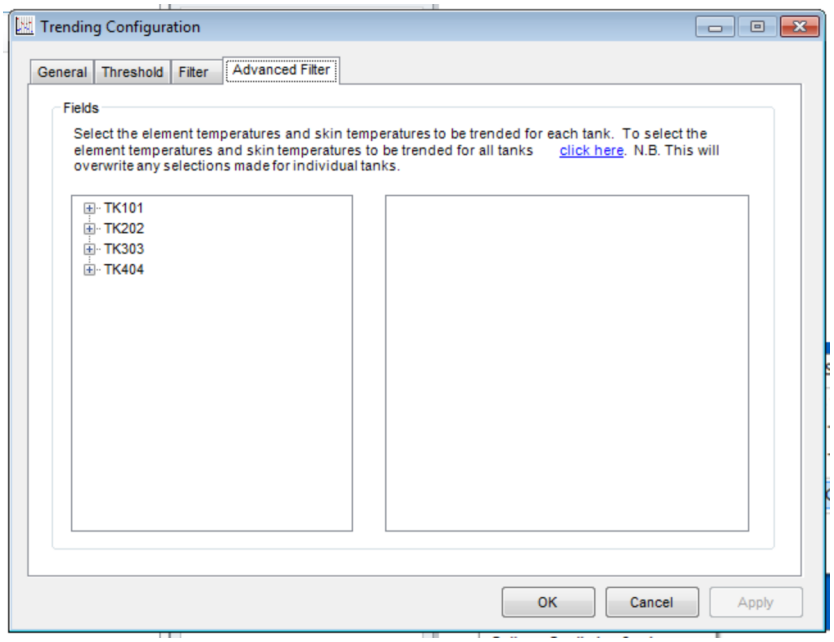


Select **Trending Service → Trending Config** in the pop-up menu as shown below.



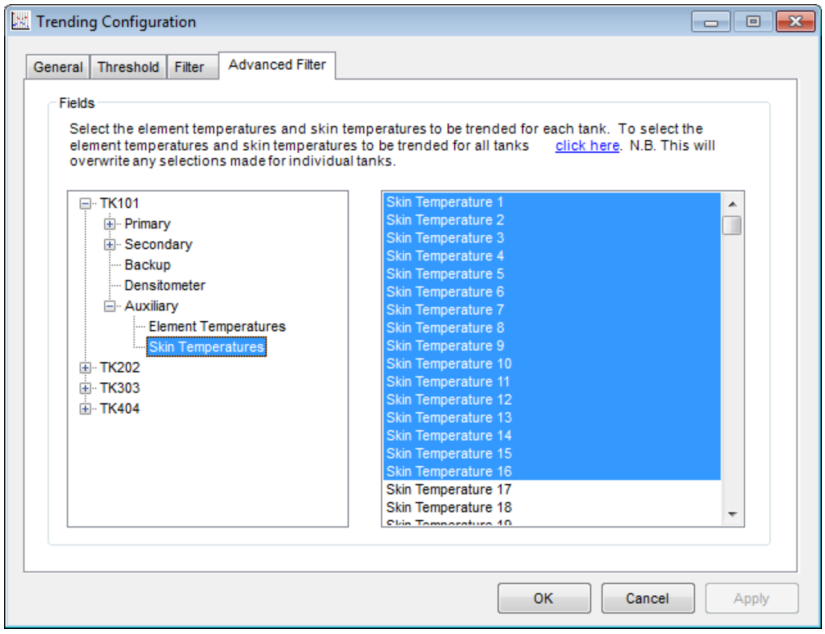
22 *Trending Config*

Once the screen (see below) opens, select the Tank required.



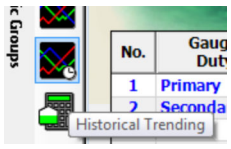
23 *Trending Configuration*

Select **Auxiliary** and then **Skin Temperatures** then highlight the desired sensors as shown below.

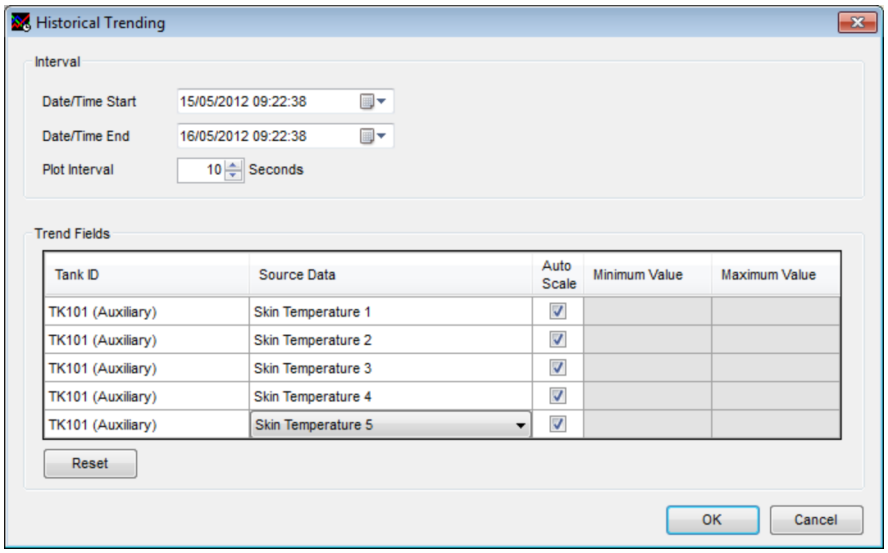


24 *Highlight Sensors*

Enter **Historical Trending** using the shortcut bar icon.

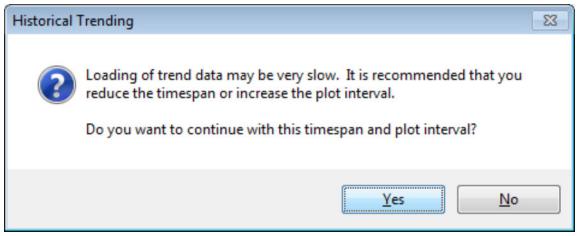


Configure the **Tank ID** and the **Source Data** as shown below.



25 *Configure*

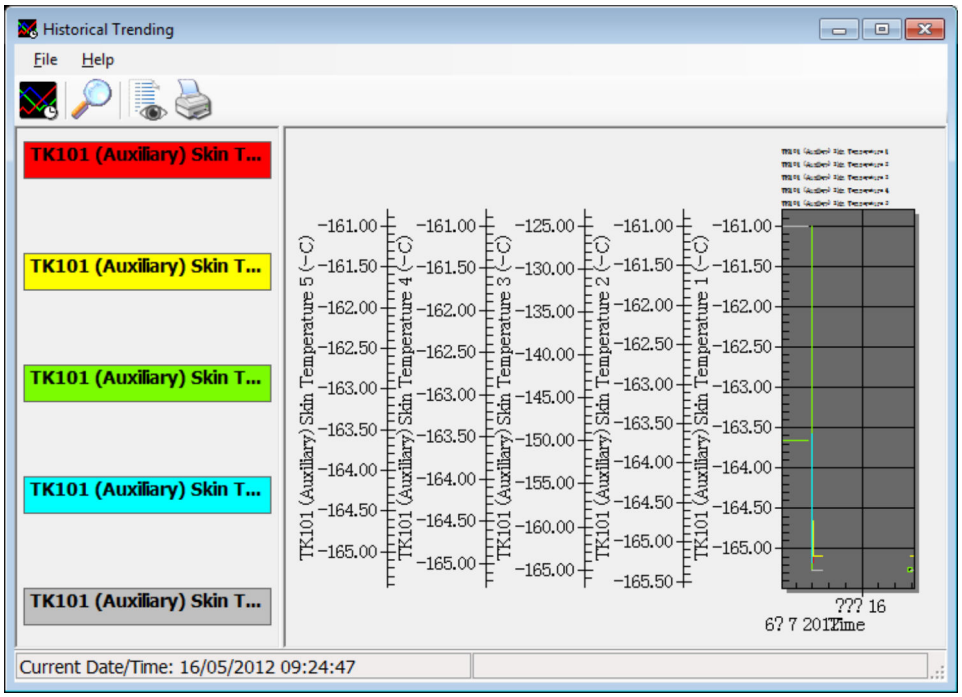
There may be a warning after clicking the **OK** button as shown below.



26 *Warning dialog*

Click the **OK** button again.

Check that the skin temperatures have been recorded and are shown in the trend as shown below.



27 *Trend*

It will now be possible to view Historical Skin Temperatures.

5.10 TM188 Comms Details

The data measured by the TM188 is exposed through a contiguous block of registers. These registers can be requested using Function 3 or 4.

The mapping of the temperature data is described in the table below:

Register Address	Data Item	Data Type	Range
0	Temperature 1	Signed 16 Bit Integer	−200.0 to +140 °C
1	Temperature 2	Signed 16 Bit Integer	−200.0 to +140 °C
2	Temperature 3	Signed 16 Bit Integer	−200.0 to +140 °C
3	Temperature 4	Signed 16 Bit Integer	−200.0 to +140 °C
4	Temperature 5	Signed 16 Bit Integer	−200.0 to +140 °C
5	Temperature 6	Signed 16 Bit Integer	−200.0 to +140 °C
6	Temperature 7	Signed 16 Bit Integer	−200.0 to +140 °C
7	Temperature 8	Signed 16 Bit Integer	−200.0 to +140 °C
8	Temperature 9	Signed 16 Bit Integer	−200.0 to +140 °C
9	Temperature 10	Signed 16 Bit Integer	−200.0 to +140 °C
10	Temperature 11	Signed 16 Bit Integer	−200.0 to +140 °C
11	Temperature 12	Signed 16 Bit Integer	−200.0 to +140 °C
12	Temperature 13	Signed 16 Bit Integer	−200.0 to +140 °C
13	Temperature 14	Signed 16 Bit Integer	−200.0 to +140 °C
14	Temperature 15	Signed 16 Bit Integer	−200.0 to +140 °C
15	Temperature 16	Signed 16 Bit Integer	−200.0 to +140 °C
16	Temperature 1	Signed 16 Bit Integer	See Note Below
17	Temperature 2	Signed 16 Bit Integer	See Note Below
18	Temperature 3	Signed 16 Bit Integer	See Note Below
19	Temperature 4	Signed 16 Bit Integer	See Note Below
20	Temperature 5	Signed 16 Bit Integer	See Note Below
21	Temperature 6	Signed 16 Bit Integer	See Note Below
22	Temperature 7	Signed 16 Bit Integer	See Note Below
23	Temperature 8	Signed 16 Bit Integer	See Note Below
24	Temperature 9	Signed 16 Bit Integer	See Note Below
25	Temperature 10	Signed 16 Bit Integer	See Note Below
26	Temperature 11	Signed 16 Bit Integer	See Note Below
27	Temperature 12	Signed 16 Bit Integer	See Note Below
28	Temperature 13	Signed 16 Bit Integer	See Note Below
29	Temperature 14	Signed 16 Bit Integer	See Note Below
30	Temperature 15	Signed 16 Bit Integer	See Note Below
31	Temperature 16	Signed 16 Bit Integer	See Note Below

5.10.1 Status and Scaling

Temperature Status is expressed in two different ways:

- When the Temperature measurement is valid, the value field will contain the temperature in degrees Celsius, scaled as shown, and the Status field will contain −1 (FFFF hex.).
  Note: Not used in LNG.
- If a temperature input goes open circuit or over-range, the value field will contain a hexadecimal value of 7FFF. A short circuited or under-range temperature input will give a hexadecimal value of 8000.

The host system can therefore use either of the above techniques to determine whether there is a temperature fault on any of the input channels.

The scaling of the temperature values is degrees Celsius (°C)×100. Therefore there is an implied two decimal places of resolution in the temperature value.

5.10.2 Modbus Initialisation

Data values within the Modbus Input Registers are initially set to "zero" with status set to "Data Not Ready". Once measurement of the RTD's has commenced, the register values will be frequently updated to reflect the current data values and status read from the RTD's.

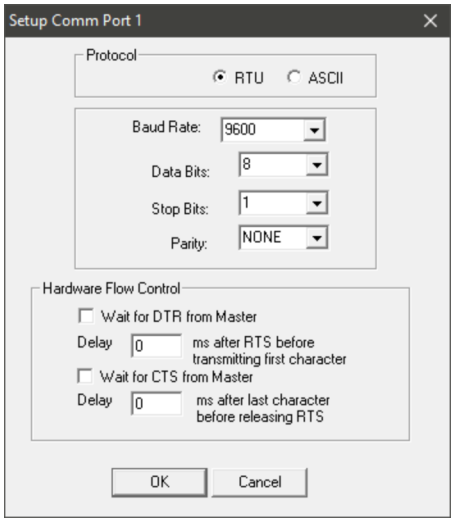
5.10.3 Exception Responses

The TM188 supports the use of Function Code 04 "Read Input Registers" and Function Code 03 "Read Holding Registers". Requests for any other Function Code will result in an Exception Response 01 "Illegal Function".

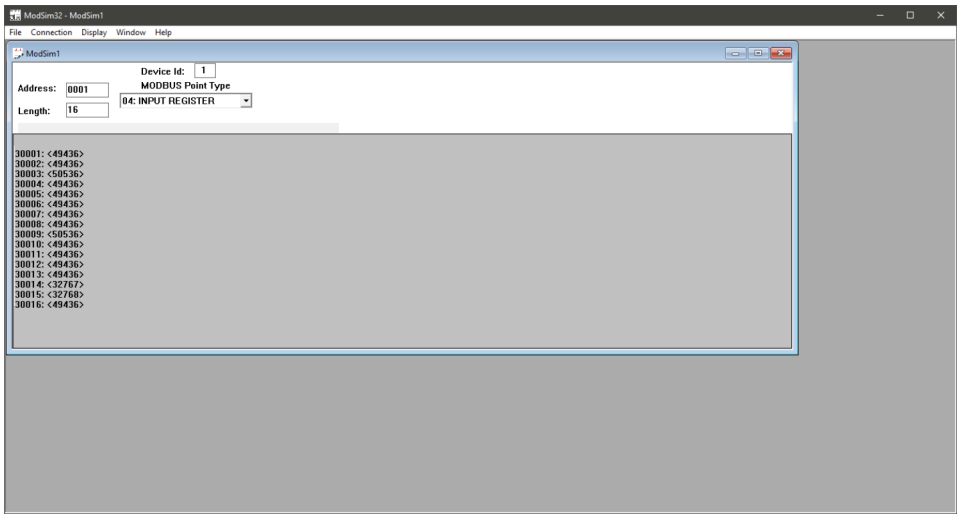
Requests for Input Registers which include any address outside the range detailed above will result in an Exception Response 02 "Illegal Data Address".

6 Testing

The application can be tested using a cross over serial cable and a suitable Modbus simulator software package to simulate the TM188 Multiplexer. The screenshots below are taken from the ModSim32®software package.



28 *Setup COM Port*



29 *ModSim32*

The outputs shown on the input registers are in decimal but due to the negative numbers appear as odd looking positive numbers.

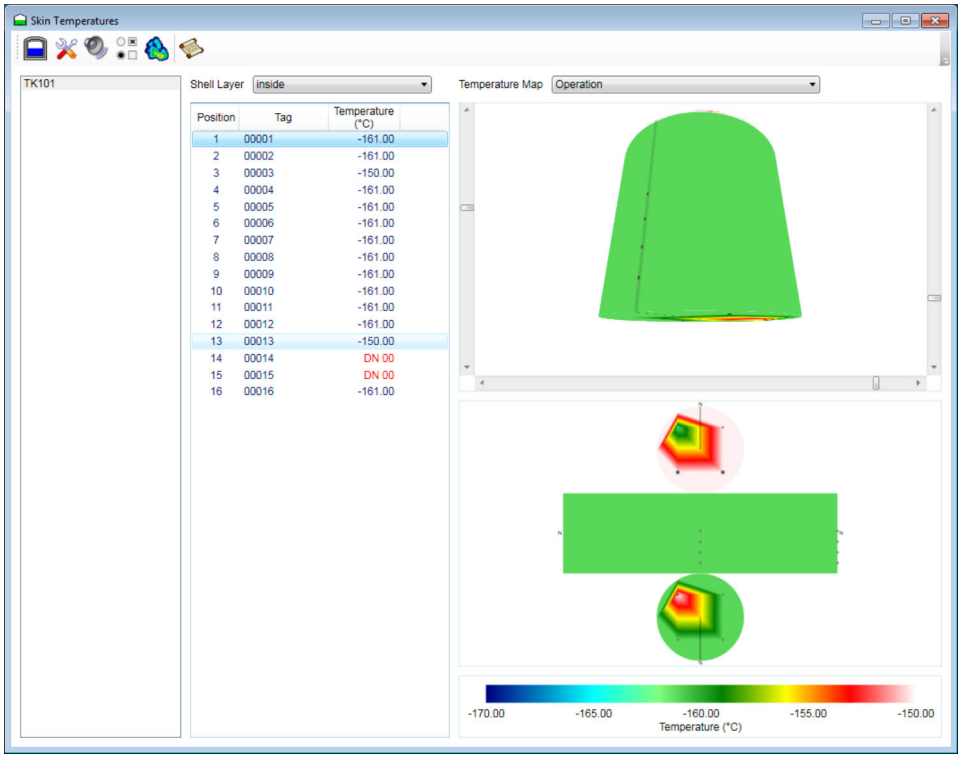
- 49436 is −16 100 (/100 = −161 deg C) – the normal LNG storage temperature
- 50536 is −15 000 (/100 = −150 deg C) – a hot spot
- 32767 is 7FFF hex – temperature input goes open circuit or over-range
- 32768 is 8000 hex – temperature input goes short circuited or under-range

The scaling of the temperature values is degrees Celsius (°C)×100. Therefore there is an implied two decimal places of resolution in the temperature value.

The results from this test are shown in the figure below.

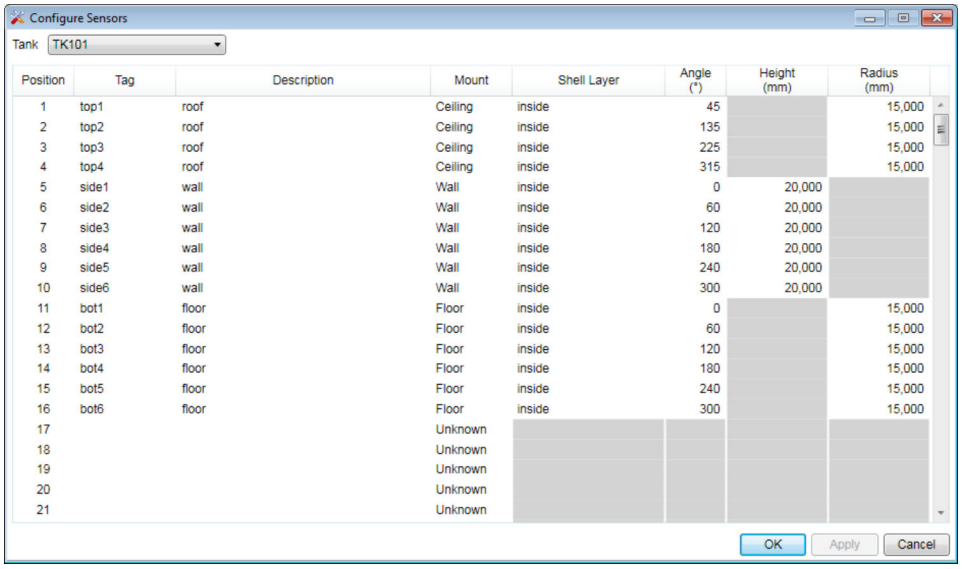
Notice the difference in the hotspots caused by the 2 non working sensors on the tank ceiling. (sensors order; 4 floor 6 wall 6 ceiling)

Set the Tank Capacity Table for TK101 to: level 28 550 mm Volume 55 411.874 m^3 (Chattanooga dimensions).



30 Skin Temperatures

Example sensor config 4 **Ceiling** 6 **Wall** and 6 **Floor** shown in the figure below.



31 Example sensor config

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