18.3.3

Operating Instructions Tankvision LMS NXA86B

Skin Temperatures





- 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.



# **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 1.2 1.3 1.4	Document function6Symbols6Documentation7Registered trademarks7
2	Basic safety instructions 8
2.1 2.2 2.3	Requirements for the personnel8Intended use8IT security8
3	Product description
3.1	Product identification
4	Overview 10
-	
5	Configuring 13
<b>5</b> .1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9 5.10	Configuring13Gauge Device13DCC Host15Shell Layers16Sensor Configuration16Configure Thresholds/Alarms18Options20Temperature Maps20Historical Skin Temperatures21Trending24TM188 Comms Details27
<b>5</b> 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9 5.10 <b>6</b>	Configuring       13         Gauge Device       13         DCC Host       15         Shell Layers       16         Sensor Configuration       16         Configure Thresholds/Alarms       18         Options       20         Temperature Maps       20         Historical Skin Temperatures       21         Trending       24         TM188 Comms Details       27         Testing       29

# 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.

### A WARNING

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

#### **A** 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<sup>®</sup>, Windows<sup>®</sup>

Microsoft and Windows are registered trademarks of the Microsoft Corporation

### 1.4.2 Modbus<sup>TM</sup>

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

## 1.4.3 Java®

Java is a registered trademark of Sun Microsystems, Inc.

## 1.4.4 Mozilla<sup>®</sup> Firefox<sup>®</sup>

Mozilla and Firefox are registered trademarks of the Mozilla Foundation

### 1.4.5 Android<sup>®</sup>

Android, Google Play and the Google Play logo are registered trademarks of Google Inc.

## 1.4.6 iPhone<sup>®</sup>, iPad<sup>®</sup>

iPhone and iPad are trademarks of Apple® Inc., registered in the U.S. and other countries.

### 1.4.7 Legal notice concerning trademarks

All company/product names and/or all company logos may be trade names, trademarks and/or registered trademarks of Endress+Hauser, its affiliates or of their respective owners with which they are associated.

# 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: <a href="https://www.products.endress.com/order-ident">www.products.endress.com/order-ident</a>

# 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**  $\rightarrow$  **Skin Temperatures**.

1	Skin Temperatures										x
	🔓 🧰 🦋 🗶 😤	🙈 🐟									
ľ											
1	TK001	Shell Laye	r All	•	1	Temperature Map	Operation			•	
	TK021			Temperature						_	_
		Position	Tag	(°C)	ŝ						
		1	8200110-1	-161.00	Ξ						
		2	8200110-2	-161.58							
		3	8200110-3	-161.58							
		4	8200110-4	-161.58							
l		5	8200110-5	-160.26							
		6	8200110-6	-161.45							
١		7	8200110-7	-161.61							
		8	8200111-1	-160.44							
		9	8200111-2	-160.83							
		10	8200111-3	-161.70							
		11	8200111-4	-161.48							
١		12	8200111-5	DN 00							
		13	8200111-6	-162.45							
		14	8200111-7	-162.30							
		15	8200112-1	-160.42							
		16	8200112-2	-162.75							
		17	8200112-3	-160.87							
		18	8200112-4	-162.78							
		19	8200112-5	-161.60							
L		20	8200112-6	-160.29							
		21	8200112-7	-160.15							
l.		22	8200112-8	-159.93							
		23	8200112-9	-163.00		_					
		24	8200112-10	-161.60							
		25	8200112-11	-161.25		-170.00	-165.00	-160.00	-155.00	-150	.00
		26	8200112-12	-162.82	Ψ.			Temperature (°C)			
L											

🖻 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:

Shel	Layer	Inside		•	Temperature Map	Operation			•
Pos	sition	Тад	Temperature (°C)		*				
	1	8200110-1	-161.00						
	2	8200110-2	-161.58						
	3	8200110-3	-161.58						
	4	8200110-4	-161.58						
	5	8200110-5	-162.57						
	6	8200110-6	-162.47				4		
	7	8200110-7	-160.62						
	8	8200111-1	-160.06	=					
	9	8200111-2	-159.87						
	0	8200111-3	-161.89						
	11	8200111-4	-159.95						
	12	8200111-5	DN 00						
	13	8200111-6	-159.97						
	4	8200111-7	-162.79						
	15	8200112-1	-160.42						
	16	8200112-2	-162.61	_	9		1. 1. 1.		
100	17	8200112-3	-161.51						
	18	8200112-4	-162.93			_			
	19	8200112-5	-161.60						
	20	8200112-6	-160.99				(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)		
	21	8200112-7	-162.03						
	22	8200112-8	-159.93						
	23	8200112-9	-163.00						
	24	8200112-10	-161.60						
	25	8200112-11	-159.81		-170.00	-165.00	-160.00	-155.00	-150.0
	26	8200112-12	-160.87	-			Temperature (°C)		

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.

P	osition 18
8	200112-4
Temperature:	-159.74°C
Last Update:	22/08/2011 09:05
Angle:	180°
Height:	10,000 mm

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.



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

Common Configuration - TK404: Modbus Temp Multiplexor TK101 TK101 TK202 TK303 TK404 F Secondary Enraf 854 F Se	Device Configuration		х
Common Configuration - TK404: Modbus Temp Multiplexor TK303 TK303 TK303 TK303 TK303 TK303 TK303 TK304 TK303 TK303 TK304 TS303 TK304 TS303 TK304 TS303 TK304 TS30 TK304 TS30 TS20 TS30 TS30 TS30 TS30 TS30 TS30 TS30 TS3	s 🔹 🔷 象 🛸 🕋		
<ul> <li>Troot</li> <li>Troot</li> <li>Troot</li> <li>Troot</li> <li>Troot</li> <li>Troot</li> <li>Troot</li> <li>Troot</li> <li>Primary Errat 854</li> <li>Backup Frant 854</li> <li>Device Duty: Auxiliary</li> <li>Master Data Collection Device: </li> <li>Commo Configuration</li> <li>Device Configuration</li> <li>Device</li></ul>		Common Configuration - TK404: Modbus Temp Multiplexor	
Local COM Port: 1 Backup COM Port: 0 Flow Rate Damping %: 15 Flow Rate Integration (Seconds): 10 Instrument Tag:	TK01     TK32     TK32     TK32     TK32     TK32     TK32     TK34     FScondary Ernat 854     FScondary Ernat 854	Device Duty: Auxiliary   Master Data Collection Device:	
Flow Rate Damping %: 15 Flow Rate Integration (Seconds): 10 Instrument Tag:	Auxiliary	Local COM Port: 1 Backup COM Port: 0	
Flow Rate Integration (Seconds): 10		Flow Rate Damping % : 15	
Instrument Tag:		Flow Rate Integration (Seconds): 10	
		Instrument Tag:	
OK Cancel App		OK Cancel App	,

☑ 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.

S Device Configuration				↔	
S 😻 🔷 S S					
Default	Dimensi	ons - TK404: Er	raf 854		
B- → TK202 B- → TK303					
⊡ ☐ TK404 ⊕- 🍄 Primary Enraf 854	Level:	AUTO v			
B - 2 Densitometer Sl6290 B - 2 Backup Enraf 854	Temperature:	AUTO v			
E- P Secondary Enraf 854 Common Configuration	Density:	AUTO v	•		
Dimensions     Device Configuration	Pressure:	AUTO v	•		
Auxiliary	Volume:	AUTO 💊	•		
	Mass:	AUTO 🔨	•		
			ОК	Cancel	Apply

☑ 6 Dimensions

S Device Configuration	
🕵 🐝 🐟 🕵 🕵 🕿	
➡ Default           ➡ TK101           ➡ TK202           ➡ TK333           ➡ TK404	Device Configuration - TK404: Modbus Temp Multiplexor
Primary Enrar 554     Primary Enrar 554     Backup Enrar 554     Paskometer 58290     Pa	Levice type. [modula relip motip =]
	Skin Temp. Fitted [/]
	OK Cancel Apply

☑ 7 Device Configuration



8 Auxiliary

# 5.2 DCC Host

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

💿 Data Commun	cations Controller
Events Service Port Settings	Tank Data TAS Data License Host Comms Slave Comms Strap Tables
COM Port: COM 1 COM 3 COM 4 COM 5	In Use 🔽 Protocol Modbus 🗨
COM 6 COM 7 COM 8 COM 9 COM 10 LPT 1	Address I Retries 3 Background 20 Seconds
	Hardware COM1 - 9600, N, 8, 1 Configure
Add Modem Port	Connect Always Poll Configure
Add Network Port	
Add OPC Port	
- Redundancy se	No Redundancy Configure
Options	Configure
-	

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:

Shell Layers				X
Inside				
Insulation				
Add Rer	nove			
		(	ОК	Cancel

🖻 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.

nk TK1	101	•					
Position	Tag	Description	Mount	Shell Layer	Angle (°)	Height (mm)	Radius (mm)
1	top1	roof	Ceiling	inside	45		15,000
2	top2	roof	Ceiling	inside	135		15,000
3	top3	roof	Ceiling	inside	225		15,000
4	top4	roof	Ceiling	inside	315		15,000
5	side1	wall	Wall	inside	0	20,000	
6	side2	wall	Wall	inside	60	20,000	
7	side3	wall	Wall	inside	120	20,000	
8	side4	wall	Wall	inside	180	20,000	
9	side5	wall	Wall	inside	240	20,000	
10	side6	wall	Wall	inside	300	20,000	
11	bot1	floor	Floor	inside	0		15,000
12	bot2	floor	Floor	inside	60		15,000
13	bot3	floor	Floor	inside	120		15,000
14	bot4	floor	Floor	inside	180		15,000
15	bot5	floor	Floor	inside	240		15,000
16	bot6	floor	Floor	inside	300		15,000
17			Unknown				
18			Unknown				
19			Unknown				
20			Unknown				
21			Unknown				

■ 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:

Mount	Shell Layer	Angle (°)
Ceiling	Inside	• 45
Ceiling	Inside	135
Ceiling	Insulation New	225
0.000	1	245

🖻 12 Drop down list

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

Name	

🖻 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.

▲ TK001		-
▲ Inside	<u>TK001</u>	
Wall		
Ceiling		
Floor		
		_

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.

Inside       Inside (Wall)         Ceiling       Enable High Temperature Alarm         Threshold       -155.00 °C         Enable Low Temperature Alarm       Threshold         Threshold       -165.00 °C         Enable Hot Spot Alarm       Highlight Hot Spots on Tank Visual         Threshold       2.50 °C         Enable Leak Alarm       Highlight Leaks on Tank Visual         Threshold       2.50 °C	D1	TK001
Floor Fl	Wall	Inside (Wall)
<ul> <li>Fineshold 150.00 °C</li> <li>Enable Low Temperature Alarm</li> <li>Threshold 165.00 °C</li> <li>Enable Hot Spot Alarm</li> <li>Highlight Hot Spots on Tank Visual</li> <li>Threshold 2.50 °C</li> <li>Enable Leak Alarm</li> <li>Highlight Leaks on Tank Visual</li> <li>Threshold 2.50 °C</li> </ul>	Floor	Enable High Temperature Alarm
Threshold -165.00 °C		Enable Low Temperature Alarm
Highlight Hot Spots on Tank Vis Threshold 2.50 °C Enable Leak Alarm Highlight Leaks on Tank Visual Threshold 2.50 °C		Threshold165.00 °C
Threshold 2.50 °C		Highlight Hot Spots on Tank Visualisation
Enable Leak Alarm  Highlight Leaks on Tank Visuali  Threshold 2.50 °C		Threshold 2.50 °C
Highlight Leaks on Tank Visual Threshold 2.50 °C		Enable Leak Alarm
Threshold 2.50 °C		Highlight Leaks on Tank Visualisation
		Threshold 2.50 °C
Hysteresis 1.00 °C		Hysteresis 1.00 °C

■ 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.

Available Columns	Current Columns	
Angle Description Height Last Update Mount Radius Shell Layer	Position Tag Temperature	•
	<b>«</b>	

🖻 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  $(\bullet)$  and down  $(\bullet)$ .

## 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.

aps		Details			
Cool Down		Description	Cool Down		
Орегация		Colour Map	Temperature (°C)	Colour	*
			-170.00	Navy	
			-130.00	e Aqua	
			-90.00	Lime	
			-60.00	#FFFFF80	
			-30.00	#FFFF8000	
			0.00	Red	
			50.00	White	
					-
				Add	Remove
	Add Remove		-100.00 Tempe	0.00 erature (°C)	

■ 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.



E 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.

🤣 History Criteri	ia X
Start Date/Time	21/08/2011 11:07
Stop Date/Time	22/08/2011 11:07 🔹
	Find Tanks
Tank	
	OK Cancel

🗷 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.

ſ	🤣 History Criteri	ia 🛛 🔍
	Start Date/Time	21/08/2011 11:07
	Stop Date/Time	22/08/2011 11:07 💌
		Find Tanks
	Tank	TK001 •
		OK Cancel

🖻 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**  $\rightarrow$  **Trending Config** in the pop-up menu as shown below.



🖻 22 Trending Config

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

	- I	
Trending Configuration		
General Threshold Filter Adv	/anced Filter	
Fields		
Select the element temperat	ures and skin temperatures to be trende	ed for each tank. To select the
element temperatures and s	kin temperatures to be trended for all ta	anks <u>click here</u> . N.B. This will
overwrite any selections ma	defor individual tanks.	
I = 1K202		
III. TK303		
± 1K404		
	ſ	OK Casad Assh
		UN Lance ADDIV

23 Trending Configuration

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

General	Threshold	Filter	Advanced Filter		
Fields Sel ele ove	ect the elem ment temper erwrite any s	ient tem ratures a election	peratures and skir and skin temperatu is made for individ	temperatures to be trended for each tank. To select the res to be trended for all tanks <u>click here</u> . N.B. This will ual tanks.	
	- TK202 - TK202 - TK404	y dary o meter ry ment Tei n Tempe	mperatures rratures	Skin Temperature 1 Skin Temperature 2 Skin Temperature 3 Skin Temperature 4 Skin Temperature 5 Skin Temperature 6 Skin Temperature 8 Skin Temperature 10 Skin Temperature 10 Skin Temperature 11 Skin Temperature 12 Skin Temperature 13 Skin Temperature 14 Skin Temperature 15 Skin Temperature 15 Skin Temperature 12	
				Skin Temperature 18	-

🗷 24 Highlight Sensors

Enter Historical Trending using the shortcut bar icon.



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

terval				
Date/Time Start 15/0	05/2012 09:22:38			
Date/Time End 16/0	05/2012 09:22:38			
Plot Interval	10 - Seconds			
end Fields				
Tank ID	Source Data	Auto Scale	Minimum Value	Maximum Value
TK101 (Auxiliary)	Skin Temperature 1			
TK101 (Auxiliary)	Skin Temperature 2			
	Skin Temperature 3	<b>V</b>		
TK101 (Auxiliary)				
TK101 (Auxiliary) TK101 (Auxiliary)	Skin Temperature 4			
TK101 (Auxiliary) TK101 (Auxiliary) TK101 (Auxiliary)	Skin Temperature 4 Skin Temperature 5	<ul> <li>✓</li> <li>✓</li> </ul>		
TK101 (Auxiliary) TK101 (Auxiliary) TK101 (Auxiliary)	Skin Temperature 4 Skin Temperature 5	<ul><li>✓</li><li>✓</li></ul>		
TK101 (Auxiliary) TK101 (Auxiliary) TK101 (Auxiliary) Reset	Skin Temperature 4 Skin Temperature 5	<ul> <li>✓</li> <li>✓</li> </ul>		

■ 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) $\times$ 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.

Setup Comm Port 1	×
Protocol © RTU C ASCII	
Baud Rate: 9600 💌	
Data Bits: 8	
Stop Bits: 1	
Parity: NONE -	
Hardware Flow Control	_
☐ Wait for DTR from Master	
Delay 0 ms after RTS before transmitting first character	
Delay 0 ms after last character before releasing RTS	
OK Cancel	

🖻 28 Setup COM Port

sta ModSim32 - ModSim1	-	o x
File Connection Display Window Help		
🚰 Modšim1 💼 🖸 💌		
Device Id: 1 Address: 0001 Length: 16 04: INPUT REGISTER •		
3001: < <49.435		
	,	

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 -16100 (/100 = -161 deg C) the normal LNG storage temperature
- 50536 is -15000 (/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 28550 mm Volume 55411.874  $\rm m^3$  (Chattanooga dimensions).



☑ 30 Skin Temperatures

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

ik (TK	101	•						
osition	Тад		Description	Mount	Shell Layer	Angle (°)	Height (mm)	Radius (mm)
1	top1	roof		Ceiling	inside	45		15,000
2	top2	roof		Ceiling	inside	135		15,000
3	top3	roof		Ceiling	inside	225		15,000
4	top4	roof		Ceiling	inside	315		15,000
5	side1	wall		Wall	inside	0	20,000	
6	side2	wall		Wall	inside	60	20,000	
7	side3	wall		Wall	inside	120	20,000	
8	side4	wall		Wall	inside	180	20,000	
9	side5	wall		Wall	inside	240	20,000	
10	side6	wall		Wall	inside	300	20,000	
11	bot1	floor		Floor	inside	0		15,000
12	bot2	floor		Floor	inside	60		15,000
13	bot3	floor		Floor	inside	120		15,000
14	bot4	floor		Floor	inside	180		15,000
15	bot5	floor		Floor	inside	240		15,000
16	bot6	floor		Floor	inside	300		15,000
17				Unknown				
18				Unknown				
19				Unknown				
20				Unknown				
21				Unknown				



# Index

# С

C Change history
<b>D</b> DCC Host
<b>E</b> Exception Responses
<b>G</b> Gauge Device
H Historical Skin Temperatures
I Intended use
M Modbus Initialisation
<b>O</b> Options
<b>R</b> Requirements for personnel
<b>S</b> Safety instructions
T         Temperature Maps       20         Testing       29         TM188 Comms Details       27         Trending       24



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