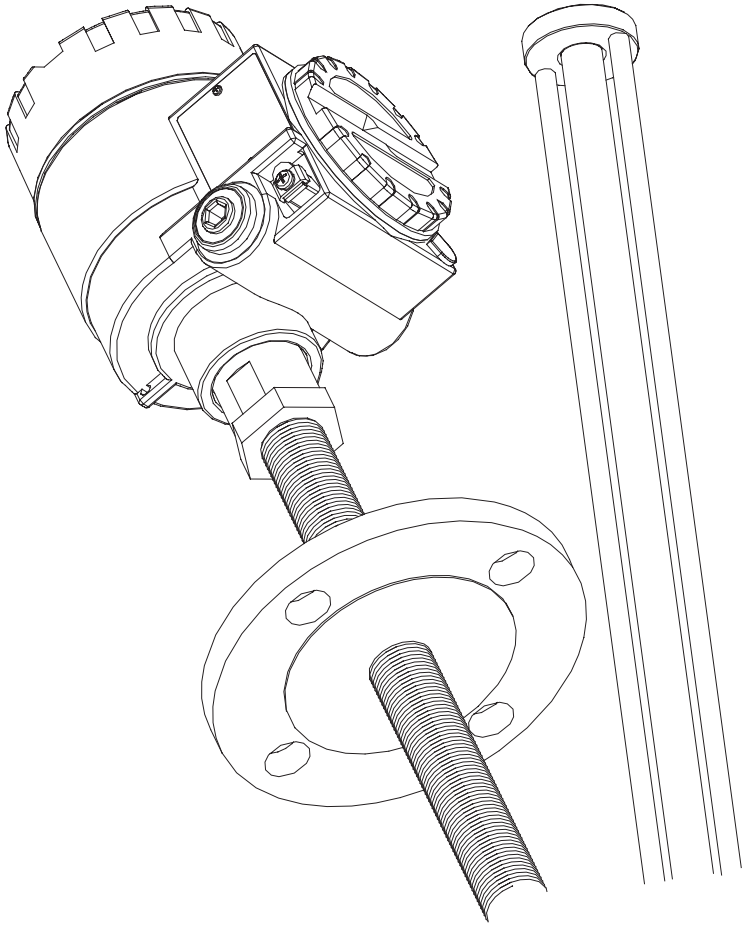
BA 026N/08/en/10.05

Valid as of software version:
V 01.00.00

Prothermo
NMT 539

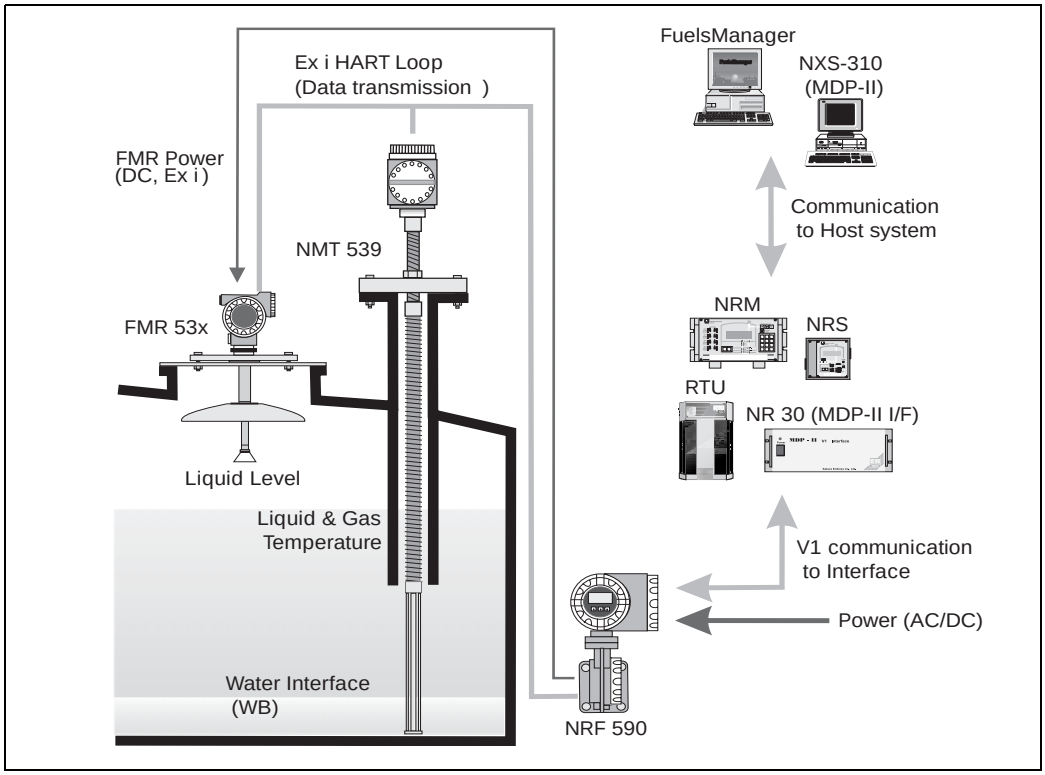
Operating Instructions and Description of Instrument Functions



Endress + Hauser

The Power of Know How

Basic device layout of the Prothermo NMT 539



Step 1. Prothermo installation on tank top

- The actual installation may require an installer to work in a hazardous area. Safety must be taken into account in order to avoid any harmful conditions.
- The installation method depends on the type of Prothermo. Refer to BA025N/08/en "Installation Instructions."

Step 2. Wiring to the host instruments (Tank Side Monitor NRF 590 or Proservo NMS 53x)

- Wiring material and conditions must be in accordance with intrinsically safe standards.
- One end (normally on the host instrument side) of the shield twisted pair of cables must be grounded at the terminal connection.
- Refer to BA025N/08/en "Installation Instructions."

Step 3. Prothermo NMT 539 initial setup

- Both NMT 539's own device setting and local HART setting to the host instrument must be performed.

Step 4. Data flow from the Prothermo NMT 539 to the host instruments

- Individual element temperature data: Individual row element temperature can be accessed regardless of liquid level information on the NMT 539's data matrix.
- Average temperature data: The host instrument sends liquid level data on the HART line to the Prothermo. The Prothermo calculates both Gas / Liquid phase average temperature based on this given liquid level.
- Water Bottom (WB) data: WB data and information are continuously scanned and transmitted by host instruments as long as the local HART connection is active.

Table of contents

1 Safety instructions

1.1 Designated use

The Prothermo NMT 539 is a multi-spot Pt100 average thermometer combined with a HART signal converter to meet the demand of temperature measurement for both custody transfer and inventory control applications. One unique feature is the implementation of capacitance water / oil interface measurement functionality (Water Bottom) for radar tank gauging applications together with the Endress+Hauser Micropilot S-series radars and the Tank Side Monitor NRF 590. Mounted on the tank top, the NMT 539 provides both temperature and water interface information on the two wire, intrinsically safe (i.s.) powered local HART loop. The designated host controller can be either the Endress+Hauser Tank Side Monitor NRF 590 or Proservo NMS 53x.

1.2 Installation, commissioning and operation

- Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorized by the operator of the facility.
- Personnel must absolutely and without fail read and understand this Operating Manual before carrying out its instructions.
- The instrument may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed without fail.
- The installer must make sure that the measuring system is correctly wired according to the wiring diagrams. The measuring system is to be grounded. Detailed Installation instructions are described in BA025N/08/en.
- Please observe all provisions valid for your country and pertaining to the opening and repairing of electrical devices.

1.3 Operational safety

Hazardous areas
Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an *integral part* of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory.
- Ensure that all personnel are suitably qualified.
- Observe the specifications in the certificate as well as national and local regulations.

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

Caution!
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

1.4 Return

The following procedures must be carried out before the NMT 539 is sent to Endress+Hauser for repair:

- Always enclose a duly completed "Declaration of Contamination" form. Only then can Endress +Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example, safety data sheet as per EN 91/155/EEC.
- Remove all residue which may be present. Pay special attention to the gasket grooves and crevices where fluid may be present. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.

Note!
A copy of the "**Declaration of Contamination**" is included at the end of this operating manual.

Caution!

- No instrument should be sent back for repair without all dangerous material being completely removed first, e.g. in scratches or diffused through plastic.
- Incomplete cleaning of the instrument may result in waste disposal or cause harm to personnel (burns, etc.). Any costs arising from this will be charged to the operator of the instrument.

1.5 Disposal

In case of disposal, please separate the different components according to their material consistency.

1.6 Software history

Software version / Date	Software changes	Documentation changes
V 01.01.00 / 09.2003	Original software. –	

1.7 Contact addresses of Endress+Hauser

The addresses of Endress+Hauser are given on the back cover of this operating manual. If you have any questions, please do not hesitate to contact your E+H representative.

1.8 Notes on safety conventions and symbols

In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding symbol in the margin.

Safety conventions

Symbol	Meaning
	**Warning!** A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument
	**Caution!** Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument
	**Note!** A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned

Explosion protection

	**Device certified for use in explosion hazardous area** If the device has this symbol embossed on its name plate, it can be installed in an explosion hazardous area
	**Explosion hazardous areas** Symbol used in drawings to indicate explosion hazardous areas. – Devices located in and wiring entering areas with the designation “explosion hazardous areas” must conform with the stated type of protection
	**Safe area (non-explosion hazardous area)** Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. – Devices located in safe areas still require a certificate if their outputs run into explosion hazardous areas

Electrical symbols

	**Direct voltage** A terminal to which or from which a direct current or voltage may be applied or supplied
	**Alternating voltage** A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied
	**Grounded terminal** A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system
	**Protective grounding (earth) terminal** A terminal which must be connected to earth ground prior to making any other connection to the equipment
	**Equipotential connection (earth bonding)** A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice

2 Identification

2.1 Device designation

2.1.1 Nameplate

The following technical data are given on the instrument nameplate:

FIg 1 Information on the nameplate of the Prothermo NMT 539 with ATEX approval, "Converter only" version.

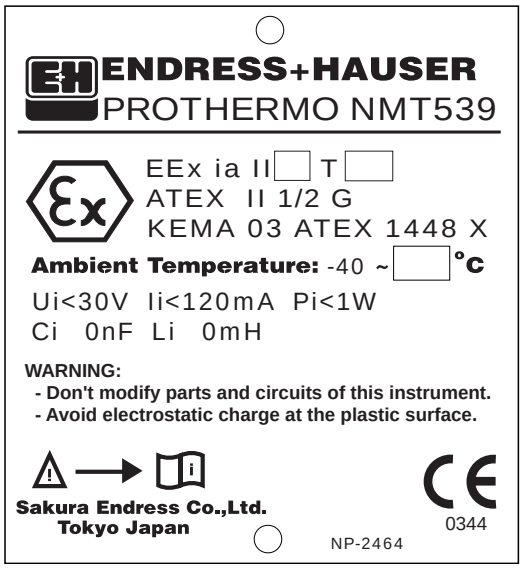


Fig 2 Information on the nameplate of the Prothermo NMT 539 with ATEX approval.

2.1.2 Ordering structure

Ordering structure NMT 539

10	**Protection class**											
	0	IP 65 weather proof										
	7	IS Class 1, Div 1, Gp CD, FM... pending										
	8	Class 1, Div 1, Gp CD, CSA										
	A	Ex ia IIB T4, TIIS... pending										
	B	EEx ia IIB T2 - T6, ATEX										
	9	Special version										
20		**Measuring function**										
		0	Converter only									
		1	Temperature + Converter									
		2	Water Bottom + Converter									
		3	Temperature + Water Bottom + Converter									
		4	Temperature + Converter (with W&M certification)... pending									
		5	Temperature + Water Bottom + Converter (with W&M certification)... pending									
		9	Special version									
30			**Temperature measuring range**									
			0	Temp. device not selected								
			1	-40... +100°C (-40... +212°F)								
			2	-55... +235°C (-67... +455°F)								
			3	-200... +71°C (-328... +160°F)... pending								
			4	-18... +80°C (-0.4... +175°F)... pending								
			9	Special version								
40				**WB measuring function**								
				0	WB device not selected							
				1	1m (3.3ft)							
				2	2m (6.6ft)							
				9	Special version							
50					**Cable entry**							
					A	G(PF) 1/2" x1, thread						
					B	NPT 1/2" x1, thread						
					C	PG16 x1, thread						
					D	M20 x1, thread						
					Y	Special version						
60						**Process connection**						
						0	JIS 10K 50A RF, flange					
						1	ANSI 2" 150lb RF, flange					
						2	DIN DN50 PN 10RF, flange					
						3	JPI 50A 150lb RF flange					
						4	PF 3/4" (NPS 3/4"), universal coupling... Converter only Type 1					
						5	M20, thread... Converter only Type 2					
						9	Special version					
70							**Number of temp element**					
							A	2... Pt100 elements				
							B	3... Pt100 elements				
							C	4... Pt100 elements				
							D	5... Pt100 elements				
							E	6... Pt100 elements				
							F	7... Pt100 elements				
							G	8... Pt100 elements				
							H	9... Pt100 elements				
							J	10... Pt100 elements				
							K	11... Pt100 elements				
							L	12... Pt100 elements				
							M	13... Pt100 elements				
							N	14... Pt100 elements				
							O	15... Pt100 elements				
							P	16... Pt100 elements				
							Q	Element not selected				
							Y	Special version				
NMT 539												Complete product designation

80	**Element spacing**	
	1	2000mm (79")
	2	1500mm (59")
	3	1000mm (39")
	4	Custom element positioning and spacing
	5	3000mm (118")
	6	Spacing not selected
	7	UK standard (converter only)
	9	Special version

90	**1 to 30m (30,000mm) probe length (below flange to end of probe)**	
	A	... mm probe length
	B	probe not selected
	Y	Special version

100	**Mounting attachment**	
	A	No installation material
	B	Anchor weight (Tall profile)
	C	Anchor weight (Low profile)
	D	Tension wire + wire hook + top anchor (NPT 1")
	Y	Special version

NMT 539	Complete product designation

2.2 Scope of delivery

Caution!

It is essential to follow the instructions concerning the unpacking, transport and storage of measuring instruments given in the chapter, Incoming acceptance, transport and storage.

The scope of delivery consists of:
- Assembled instrument
- Accessories

Accompanying documentation:
- Installation manual
- Operation and Description of Instrument Functions
- Approval documentation: if this is not included in the operating manual.

2.3 Certificates and approvals

CE mark, declaration of conformity
The instrument is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The instrument complies with the applicable standards and regulations in accordance with EN 61010 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures." The instrument described in this manual thus complies with the statutory requirements of the EG directives. Endress+Hauser confirms the successful testing of the instrument by affixing to it the CE mark.

2.4 Registered trademarks

HART ®
Registered trademark of HART Communication Foundation, Austin, USA

ToF ®
Registered trademark of the company Endress+Hauser GmbH+Co. KG, Maulburg, Germany

2.5 Incoming acceptance, transport, storage

2.5.1 Incoming acceptance

Check the packing and contents for any signs of damage.
Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

2.5.2 Transport

Caution!

Follow the safety instructions and transport conditions for instruments of more than 18 kg.

2.5.3 Storage

Pack the measuring instrument so that it is protected against impacts from storage and transport. The original packing material provides the optimum protection for this.
The permissible storage temperature is -40 °C…+85 °C (-40 °F...+185 °F).

3 Initial set up

3.1 Local HART connection

3.1.1 As an Endress+Hauser tank gauging instrument

The NMT 539 has been developed and designated primarily to work with the Endress+Hauser tank gauging host instruments Tank Side Monitor NRF 590 or Proservo NMS 53x.
Both temperature and / or water bottom information are transmitted on a two wire i.s HART loop to the host instrument. Since both the NRF 590 and NMS 53x have a pre-configured menu for NMT series functionality as default, simple wiring to the NMT 539 will complete the initial setup for the NMT 539.

Note!
Please refer to the Installation manual BA025N/08/en for the NMT 539 physical installation procedure prior to start up.

3.1.2 As a standalone generic HART instrument

The NMT 539 is a HART foundation registered intrinsically safe loop powered device. The NMT 539 provides four basic types of data as standard and parameter information via HART protocol, command 3. Configuration to host communication can be performed by a HC (Hand Communicator) or the Endress+Hauser ToF field service tool to set a specific HART address.

Note!
The availability of each of the four parameter can vary depending on the selected NMT 539 measurement function on the product code.

Temperature measurement

20: Measurement function
0: Converter only
1: Temperature + converter

These four basic data are available as standard.
1. Average liquid temperature
2. Average gas phase temperature
3. Level (entered liquid level at "VH02 measured distance")
4. Device status

Water Bottom (WB) measurement

20: Measurement function
2: Water bottom + conveter

These four basic data are available as standard.
1. Water bottom level
2. WB probe capacitance
3. WB probe frequency
4. Device status

Temperature + water bottom + converter

20: Measurement function
3: Temperature + water bottom + converter

These four basic data are available as standard.
1. Average liquid temperature
2. Water bottom level
3. Average gas phase temperature
4. Device status

3.2 Device set up: Tank Side Monitor NRF 590

Connect the loop powered HART communication cable from the NRF 590 (intrinsically safe side compartment) to the NMT 539 according to BA025 "Installation Instructions."

Since the Tank Side Monitor NRF 590 has been designed to recognize the NMT539 as a specific Endress+Hauser HART instrument, set up is easy.

3.2.1 HART scanner

After the physical cabling between the NMT 539 and the NRF 590 is complete, scan all connected loop powered HART devices by activating "HART SCAN" on the Tank Side Monitor.

Caution!
Not all Tank Side Monitor NRF 590 have fully accessible compatibility to recognize the NMT 539. Consult with your Endress+Hauser representative to cross check the software and hardware version of the NRF 590.

3.2.2 The NMT 539 specific parameter set up on the NRF 590

Note!
Configuration of NMT 539 parameters on the display of the NRF 590 is dependent on the installed software and hardware version of the NRF 590. Please refer to the operating manual of the Tank Side Monitor NRF 590 to determine accessible parameters.

All required initial setup and configuration can be performed by the ToF field service tool. Detailed information will be described in the following operation related chapters.

The NMT 539 device set up and parameters display on the NRF 590 will be available soon...

3.3 Device set up: Proservo NMS 53x

The Proservo NMS 53x is also specifically designed to recognize the NMT 539. Connect local HART cabling between the NMT 539 and the NMS 53x on terminals 24 and 25.

Caution!
Depending on the required certification of the connected NMS 53x, the terminal arrangement of 24 and 25 may have legal consequences. Confirm the order code of the NMS 53x to clarify the intrinsically safe designation on terminals 24 and 25.

3.3.1 Preparation of Proservo NMS 53x

The Proservo NMS 53x must be pre-configured to accept the NMT 539 connection via the multi drop HART loop.

GVH362: NMT connection
"Average Temp." must be selected in order to configure the NMT 539.

Caution!
To change this parameter, an access code is required. Please refer to the BA006 NMS 53x operation manual for further information.

3.3.2 NMT 539 configuration on Proservo NMS 53x

Most required NMT 539 parameters can be configured on G4 "Temperature" matrix as it is on the display of the NMS 53x.

Caution!
Water Bottom (WB) sensor information is not available on the Proservo before ROM version 4.24. Please consult with your Endress+Hauser representative to update the installed Proservo function.

Typical NMT 539 parameters (equivalent to the NMT 535 and 538) are displayed on the matrix of the Proservo NMS 53x

G0 Static matrix

GVH010: Liquid Temp
Calculated average liquid temperature value, determined by the NMT 539

GVH013: Gas Temperature
Calculated average gas phase temperature value, determined by the NMT 539

G4 Dynamic Matrix: Temperature

GVH440: Liquid Temp
The same value indicated on GVH010 Liquid Temp

GVH441: Gas Temperature
The same value indicated on GVH013 Gas Temperature

GVH442: Measured Level
Liquid level value established in the Proservo NMS 53x. The NMT 539 must have liquid level data in order to calculate both liquid and gas phase average temperature.

GVH447: Reference Zero
Indication of the converted 100 Ohm reference resistor deviation value compares to the actual inserted element value in the temperature probe. The reading value of reference resistor and its deviation are continuously monitored during operation to prevent from performing an incorrect calculation. Indicated tolerance should be within ±0.15°C (±0.27°F) depending on element characteristics, e.g. Pt100 elements have 100 Ohm

resistance at 0°C (32°F); therefore,the reading value should be within 0°C ± 0.15°C (32°F ± 0.27°F) or less.

GVH449: Reference 150
Indication of the converted 200 Ohm reference resistor deviation value compares to the actual inserted element value in the temperature probe. The reading value of reference resistor and its deviation are continuously monitored during operation to prevent from performing an incorrect calculation. Indicated tolerance should be within ±0.15°C (±0.27°F) depending on element characteristics.

GVH450~459; Temp No.1~10
The temperature reading value from each inserted element in the probe.The reading element temperature above 11~16 must be selected at the GVH470 "Select Point", then the read value at the GVH473 "Element Temp."

GVH460~49; Element Position No.1~10
Each element position in the probe. Indicating element position above 11~16 must be selected at the GVH470 "Select Point", then the read position at GVH474 "Element Position"

GVH470: Select Point
A matrix to select the desired element data on GVH471 "Zero Adjust", GVH473 "Element Temp" and GVH474 "Element Position."

GVH480: Diagnostic
Display of error code message. Please refer to the error code chart in a later chapter of this manual.

GVH482: Total No. Element
Enter the number of installed temperature elements in the average temperature probe.

GVH485: Type of Interval
Select type of element interval.
Even: Element spacing will be equally spaced by providing the distance at GVH487 "Element Interval", and the lowest element position can be set at GVH486 "Bottom Point."
Not Even: Element spacing will be unequally distributed. As a result, each element position must be manually entered.

Note!

This parameter setting is only used to change the theoretical element position within NMT539's software for average calculation purposes. If does not effect the physical location of the temperature element position.

GVH486:Bottom Point
The lowest inserted element position in the average temperature probe.

Note!

This parameter setting is only used to change the theoretical element position within NMT539's software for average calculation purposes. If does not effect the physical location of the temperature element position.

GVH487:Element Interval
Enter the desired element interval when "Even" in GVH485 " Type of Interval" is selected.

Note!

This parameter setting is only used to change the theoretical element position within NMT539's software for average calculation purposes. If does not effect the physical location of the temperature element position.

4 Operation and Description of Instrument Function

NMT 539 has segmented HART device code depending on measurement function. Following 4 HART device codes are normally pre-set at the Sakura factory by jumper setting.

Caution!
Do not attempt to change jumper setting by disassembling NMT 539's internal module. It may cause major malfunction due to distorted precise factory calibration.

4.0.1 HART Device designation

HART device code "183":
Designated device code when NMT 539 is connected to older version Proservo NMS 53x (software version 4.24 or older). NMT 539 will be recognized just like a previous NMT series NMT 535 / 538. As a result only temperature related function will be activated within the system. No WB sensor equipped version NMT 539 is available with code 183.

HART device code "184":
Device code for temperature measurement function only. Similar to code 183, but this 184 is specifically designed for NMT 539 converter only version and converter + temperature version. No WB sensor is available with code 184.

HART device code "185":
Device code 185 has very segmented function due to its purpose. No temperature measurement function is available. Designation to be a single minded water I/F measurement sensor.

HART device code "186":
Device code for fully equipped NMT 539. Both temperature and Water Bottom measurement function is available.

4.0.2 Device Data

Tag Number:read and write
Default:HART
A customer specific device identification and control number (or name). Tank name, site number, or any other ID can be entered.

Assembly Number: read and write
Default:0
Manufacture control number based on production process.

4.1 Temperature measurement

These 2 HART device codes "183 and 184" are designated to perform only temperature measurement function. Available parameter and function are follows. Description of these parameters are the information based on ToF tool menu.

Note!
HART device code will be only visible when default header position or VH99 "Device Type Code" on ToF tool menu is available.

Designated temperature measurement function device is available on following product order code.

20:Measuring Function
0:Converter Only
1:Converter + temperature
4:Converter + temperature (W&M certification)

4.1.1 Primary values: VH00 ~ VH09

VH00 Liquid Temp
Item type:read only
Range:-200°C ~ 240°C

Note!
Display of measured liquid phase average temperature. Liquid level input must be provided by Micropilot radar level gauge (via Tank Side Monitor) or Proservo NMS 53x series servo level gauge in order to calculate true liquid average temperature.

VH01 Gas Temp
Item type:read only
Range:-200°C ~ 240°C
Display of measured gas (vapor) phase average temperature.

Note!
Display of measured gas (vapor) phase average temperature. Liquid level input must be provided by Micropilot radar level gauge (via Tank Side Monitor) or Proservo NMS 53x series servo level gauge in order to calculate true gas average temperature.

VH02 Measured Distance
Item type:read and write
Range:0mm ~ 99999mm
Display of provided liquid level by connected level gauge. Manual level input, directly entering desired level value, is also available for the device test purpose.

VH07 Temperature 0
Item type:read only
Display of converted 100 Ohm reference resistor deviation value compares to actual inserted element value in temperature probe. The reading value of reference resistor and its deviation are continuously monitored during operation to prevent from performing an incorrect calculation.

Caution!
Indicated tolerance should be within ±0.15°C (±0.27°F) depending on element characteristics, e.g. Pt100 element has 100 Ohm resistance at 0°C (32°F); therefore, the reading value should be within 0°C ± 0.15°C (32°F ± 0.27°F) or less.

VH09 Temperature 17
Item type:read only
Display of the converted 200 Ohm reference resistor deviation value compares to the actual inserted element value in the temperature probe. The reading value of reference resistor and its deviation are continuously monitored during operation to prevent from performing an incorrect calculation. Indicated tolerance should be within ±0.15°C (±0.27°F) depending on element characteristics.

4.1.2 Element Temperature 1: VH10 ~ VH19

VH10 ~ 19 Temperature 1 ~ 10
Item type:read only
Range:-200°C ~ 240°C
Display of individual measured element temperature.

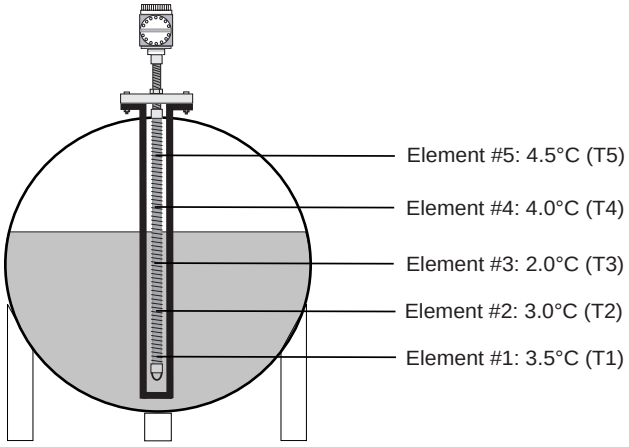
4.1.3 Element Temperature 2: VH20 ~ VH29

VH20 ~ 25 Temperature 11 ~ 16
Item type:read only
Range:-200°C ~ 240°C
Display of individual element temperature.

VH26 Selec. Ave Method
Item type:select
Selection:Standard, Advanced
Selection of average calculation method.

Standard:

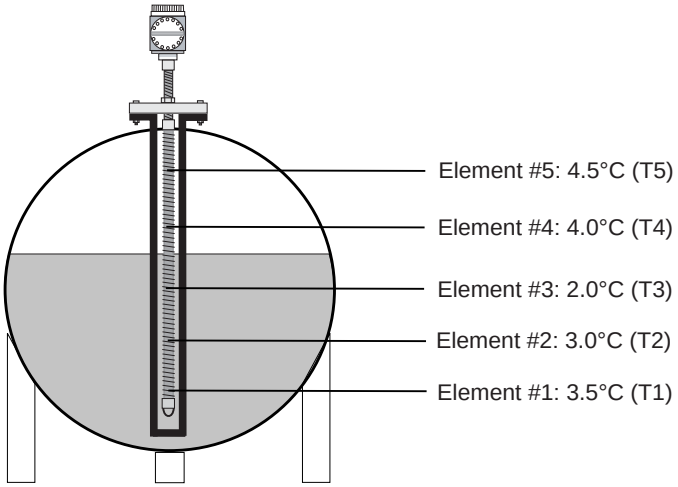
A Conventional calculation method. Regardless of tank shape, average temperature calculation will be performed based on following example (example: liquid temperature).



Formula:(T1 + T2 + T3) / # of element in liquid phase
= Average temperature (3.5°C + 3.0°C + 2.0°C) / 3 = 2.83°C

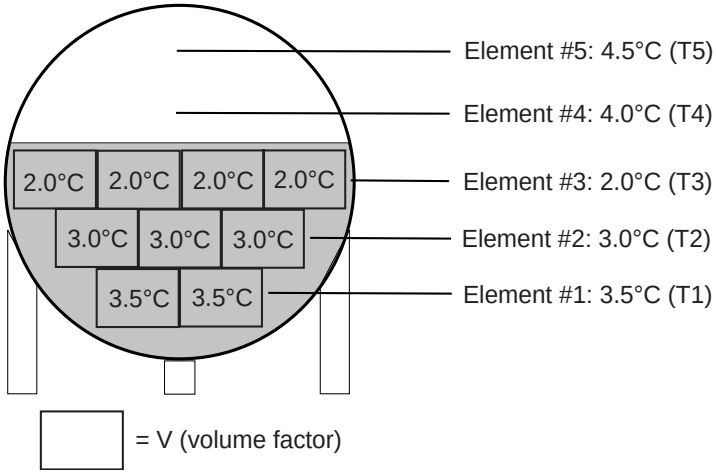
Advanced:

Average temperature calculation with additional factor to compensate unequal volume distribution (example: liquid temperature).



Formula: (T1*V1 + T2*V2 + T3*V3) / (V1 + V2 + V3) = Average temperature

Note!
V = # of additional volume factor and related parameters are determined at VH53, 54 and 55.



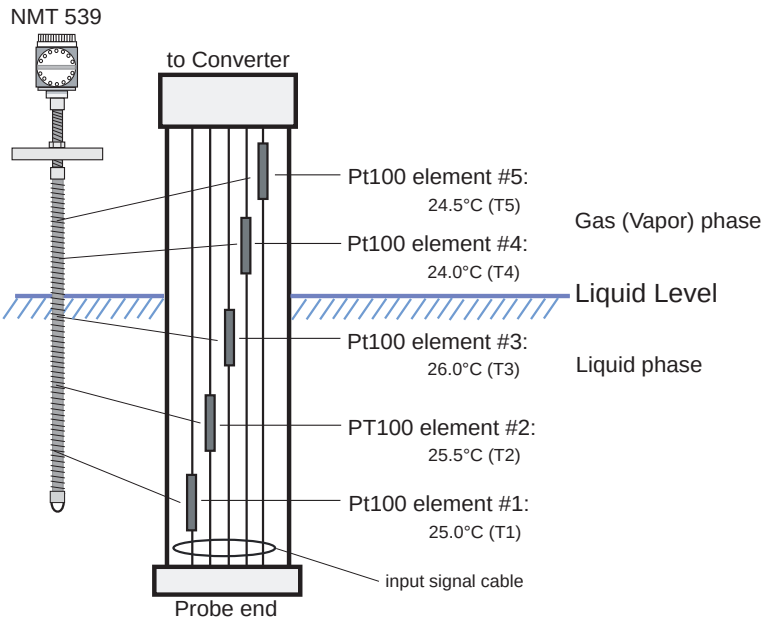
(3.5°C x 2 + 3.0°C x 3 + 2.0°C x 4) / (2 + 3 + 4) = 2.67°C

VH27 Multi Spot Type
Item type:select
Selection:Spot, Multi
Selection of element physical layout in the probe, mainly NMT 539 Converter Only version requires this function when it has connected to foreign average temperature probe.

Caution!
On the contrary, NMT 539 Converter + Temperature version always has "Spot" element layout. Selecting parameter to "Multi" will cause faulty calculation.

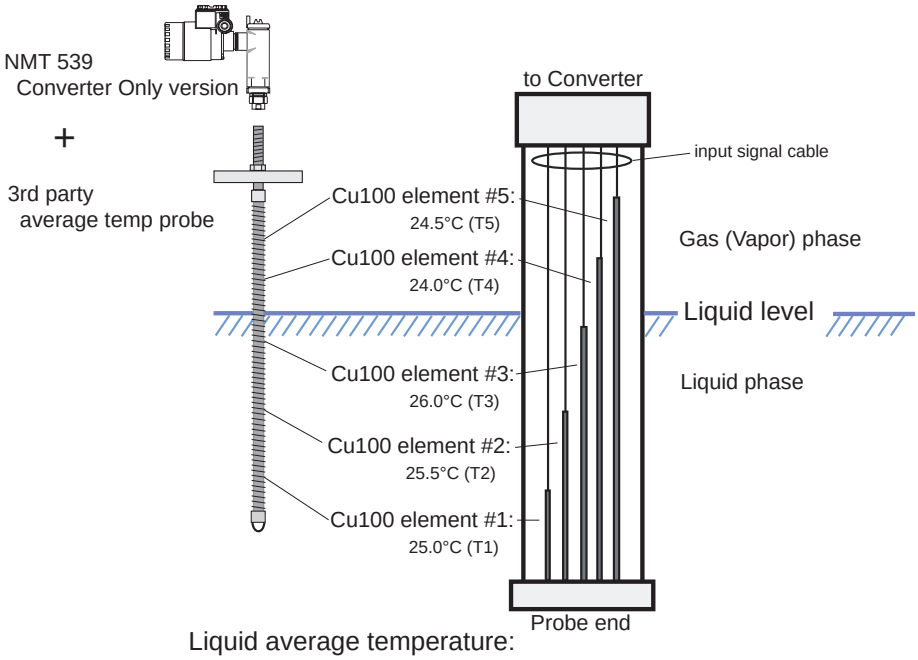
Spot:

Same number of element (resistance and material) locates in each input cable in the probe. Average calculation is performed based on *sum of submerged element temperature value / total number of element submerged*.



Liquid average temperature = (T1 + T2 + T3) / 3 = 25.5°C

Multi: Different length or number of element inserted in each input cable. Average temperature is considered as the closest submerged element to the liquid level.



Liquid average temperature:
A submerged element temperature, closest to Liquid level
= Element #3: 26.0°C (T3)

VH28 Lower Limit
Item type:read and write
Default value:-20.5°C
RANGE:-999.9°C ~ 999.9°C
Low limit temperature alarm parameter when measurement detects below design and approved temperature.

VH29 Upper Limit
Item type:read and write
Default value:245°C
Range:-999.9°C ~ 999.9°C
Hi limit temperature alarm parameter when measurement detects above design and approved temperature.

4.1.4 Element Position 1: VH30 ~ VH39

VH30 ~VH39 Position 1 ~ 10
Item type:read and write
Range:0mm ~ 99999mm
Individual element position from tank bottom. Calculation is automatically performed when element spacing "Even" is selected at VH85. All of element position must be manually entered when "Not Even" element spacing is selected at VH85.

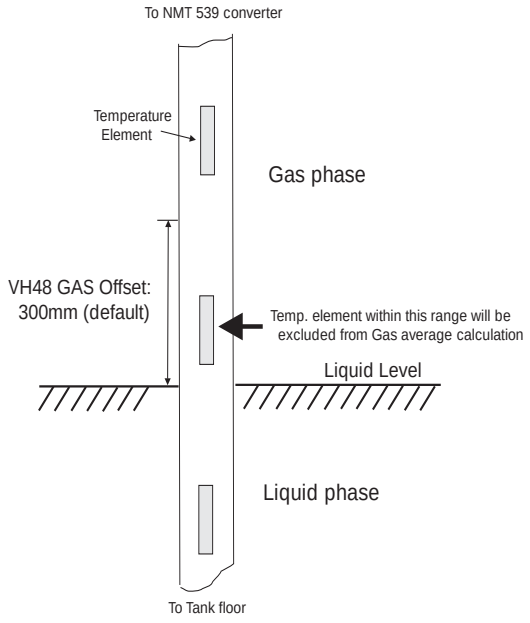
4.1.5 Element Position 2: VH40 ~ VH49

VH40 ~VH45 Position 11 ~ 16
Item type:read and write
Range:0mm ~ 99999mm
Individual element position from tank bottom. Calculation is automatically performed when element spacing "Even" is selected at VH85. All of element position must be manually entered when "Not Even" element spacing is selected at VH85.

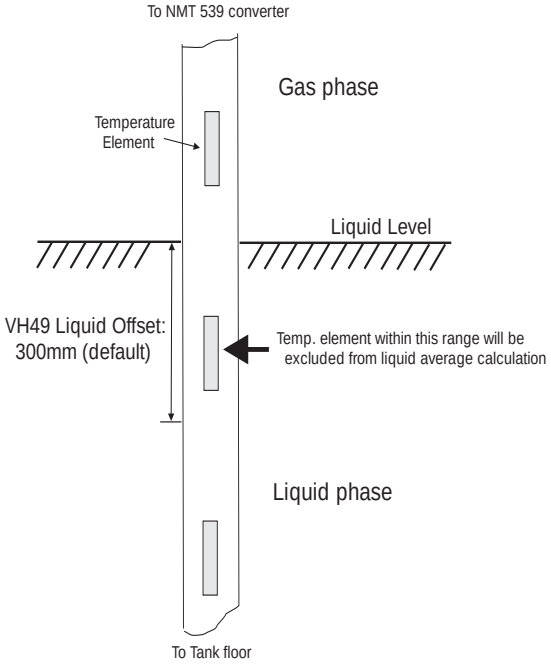
VH46 Hysterese Width
Item type:read and write
Default:10mm
Range:0mm ~ 99999mm
Element switching point hysteresis. Entered hysteresis as a offset value is added on the liquid level when the liquid level is raising, subtracted when lowering to prevent from hunching by unstable liquid surface condition.

VH47 Clear Memory
Item type:select
Default:None (0)
Selection:None, Clear
Reset matrix parameter to default setting.

VH48 Gas Offset
Item type:read and write
Default:300mm
Range:0mm ~ 99999mm
A function to exclude specific element(s) from gas (vapor) phase average temperature calculation when element(s) stay within entered value from given liquid level.



VH49 Liquid Offset
Item type:read and write
Default:300mm
Range:0mm ~ 99999mm
A function to exclude element (s) from liquid phase average temperature calculation when element (s) stays within entered value from given liquid level.



4.1.6 WB primary and Advanced temp: VH50 ~ VH59

VH53 Element Point
Item type:select
Default:0
Selection:0 ~ 15 (element #1 = 0, element #16 = 15)
Select element number for "Advanced" average calculation at VH26. Selected element position will be displayed on VH54 "Element Position" and enable to change additional volume factor at VH55 "Element Volume."

VH54 Element Position
Item type:read only
Range:0m ~ 99999mm
A display of selected element position on VH53.

VH55 Element Volume
Item type:read and write
Range:1 ~ 99999.9
Setting additional factor on selected element at VH53. Extra volume can be added on specific element for advanced average temperature calculation. (Details, please refer to the description of VH26 "Select Average Method" on page 18)

4.1.7 WB Adjustment and Operation Power: VH60 ~ VH69

VH67 Common Voltage
Item type:read only
Range:0 ~ 255 (0 ~ 3V)
A display of temperature element line (both signal and common) running voltage. Detected voltage across common line (shall be between 0 ~ 3V) is converted to range of 0 ~ 255 count when it is displayed.

VH68 Output Current
Item type:read and write
Default:16000 at 6mA
Range:0 ~ 65535
Adjustment of NMT 539 current consumption. In order to prevent current over shoot within multidrop HART loop, this function limits the NMT 539 power consumption based on set parameter. Normally, NMT 539 with temperature measurement function is operated within 6mA of current consumption. Use a tester to check the current flow in the loop. Reducing the value makes NMT 539 to consume smaller current.

VH69 Ref Voltage
Item type:read and write
Default:200
Range:0 ~ 255
A parameter to draw power supply failure alarm. NMT 539 operates at minimum 16VDC of supply voltage via multi drop HART loop under normal operating condition. NMT 539 will transmits error message when supply voltage drops below 16VDC with default value setting 200.

4.1.8 Temperature Adjustment: VH70 ~ VH79

VH70 Element Select
Item type:select
Range:0 ~ 19
Selection of "need adjustment" temperature element (0 = #1 element, 15 = #16 element, 19 = reference 100 Ohm resistor). Detailed value and parameter of the element selected in this matrix can be shown in,
VH71 "Zero Adjust"
VH73 "Temperature X"
VH74 "Position X"
VH75 "Resistance X"
VH76 "Resistance Adj"

VH71 Zero Adjust
Item type:read andwrite
Default:0
Range:-1000.0 ~ 1000.0
Zero adjustment of individual element that is selected at VH70. The reading value can be adjusted when the measured temperature indicates minor offset value compare to precision reference thermometer.

Note!
Selected element #2 indicates 25.4°C, then reference thermometer indicates 25.2°C, then set "-0.2" in this matrix. #2 element now has constant artificial -0.2°C offset based on raw measurement.

VH72 Adjust Span
Item type:read and write
Default:1
Range:0.8 ~ 1.2
The span adjustment that applies to all of installed temperature element. A linearized factor of given parameter is multiplied to raw element measurement for final calculation.

Note!
All of displayed individual temperature value are calculated based on following formula.

VH73: "Temperature X" = raw element temperature x span (VH72) + zero offset (VH71)

VH73 Temperature X
Item type:read only
Specified element temperature selected at VH70. Shown value is also indicated at individual element temperature at VH10 ~ VH25. The value is calculated based on formula indicated on above VH72.

VH74 Position X
Item type:read and write
Range:0mm ~ 99999mm
A position of specified element at VH70. Each element positions are also determined when "Not Even" element spacing is selected at VH85.

VH75 Resistance X
Item type:read only
A display of specified element resistance selected at VH70.

VH76 Resistance Adj.
Item type:read and write
Default: 0
Range:-1000.0 ~ 1000.0
Adjustment of specified element resistance at VH70. Minor resistance adjustment can be applied on the reading value.

Note!
Selected element #5 indicates 100.3 Ohm, then reference precision resistor indicates 100.0 Ohm at the same environmental condition, then set "-0.3" in this matrix. #5 element now has constant artificial -0.3°C offset resistance based on raw measurement.

VH77 Element Type
Item type:select
Selection:Pt100, Cu90, Cu100, PtCu100, JPt100
A selection of element conversion formula when foreign average temperature probe is connected to NMT 539 Converter Only version.

Caution!
NMT 539 Converter + Temperature version always consists "Pt100" element with "Spot" element layout. Do not attempt to change these parameters.

Element conversion Formula:

Pt100 (formula above 0°C): $R = -0.580195 \times 10^{-4} \times T^2 + 0.390802 \times T + 100$
Pt100 (formula below 0°C): $R = -4.2735 \times 10^{-10} \times T^4 + 4.273 \times 10^{-8} \times T^3 - 0.58019 \times 10^{-4} \times T^2 + 3.90802 \times T + 100$
Cu90: $R = 0.3809 \times T + 90.4778$
Cu100: $R = 0.38826 \times T + 90.2935$
PtCu100: $R = 3.3367 \times 10^{-7} \times T3 - 2.25225 \times 10^{-5} \times T2 + 0.38416 \times T + 100.17$
JPt100:

VH78 Average Number
Item type:read and write
Default:1
Range;1 ~ 10
Number of sampling for average calculation prior to determine final display value. Increasing number of sampling will prevent from faulty display.

Caution!
Additional sampling # will cause slower reaction time on value switch over. Maximum 1 sampling sequence will take approximately 2 sec. {total 21 elements (16 temp elements and 5 integrated reference resistors)}

NH79 Protect Code
Item type:read and write
Default:0
Range:0 ~ 999
Access code 530 to enable select and write command available.

4.1.9 Device setting 1: VH80 ~ VH89

VH80:Present Error
Item type:read only
Display of error message presence. Following code will be indicated.

Error code

0:No error presence
1:Common line open
2: undetermined
3:#1 element open
4:#1 element short
5:#2 element open
6:#2 element short
7:#3 element open
8:#3 element short
9:#4 element open
10:#4 element short
11:#5 element open
12:#5 element short
13:#6 element open
14:#6 element short
15:#7 element open
16:#7 element short
17:#8 element open
18:#8 element short
19:#9 element open
20:#9 element short
21:#10 element open
22:#10 element short
23:#0 element over range
24:Memory defect (ROM)
25:#11 element open
26:#11 element short
27:#12 element open
28:#12 element short
29:Element exposed (liquid level below #1 element position)
30:undetermined
31:undetermined
32:Low power supply
33:#13 element open
34:#13 element short
35:#14 element open
36:#14 element short
37:#15 element open
38:#15 element short
39:#16 element open
40:#16 element short
41:Memory defect (RAM)
42:Memory defect (EEROM)
43:WB line open
44:WB line short

VH81 Temperature Unit
Item type:select
Default:°C
Selection:C, F, K
Selection of temperature display unit. Based on universal HART setting, °C(HART code: 32), °F(HART code: 33) and °K(HART code: 35) is available.

Note!
Selection of temperature display unit only applies to reply data from NMT539. Data transmission from host gauge (NRF 590 or NMS 53x) to NMT 539 must be performed by °C unit only (terminology of HART command 133)

VH82 Element Number
Item type:read and write
Default:10 (NMT 539 Converter Only version)
Range:1 ~ 16
Entering # of available temperature element. This function mainly used with NMT 539 Converter Only version.

Caution!
Do not change the default parameter on NMT 539 Converter + Temperature version. # of element on this version is pre-determined by customer's choice. It may cause faulty calculation or unnecessary error display.

VH83 No. of Preambles
Item type:read and write
Default:5
Range:2 ~ 20
Setting # of preamble for HART communication.

VH84 Distance Unit
Item type:select
Default:mm
Selection:ft., m, inch, mm
Selection of level display unit. It applies to both liquid level display on VH02 "Liquid Level" and VH50 "Water Bottom Level." Level units are coded based on universal HART setting, ft. (HART code: 44), m (HART code: 45), inch (HART code: 47), mm (HART code: 49).

VH85 Kind of Interval
Item type:select
Default:Even Interval (NMT 539 Converter Only version)
Selection:Even Interval, Not Even
Selection of element interval depending on spacing layout. This function is normally used for NMT 539 Converter Only version.
Caution!
Do not change its parameter on NMT 539 Converter + Temperature version unless repairing. Kind of Interval and individual element positions are physically determined at factory.

VH86 Bottom Point
Item type:read and write
Default:500mm
Range:0mm ~ 99999mm
Position of #1 element that is also called "Bottom Point." #1 element position becomes critically important when "Even Interval" is selected at VH85 because remaining element positions rely on this location of Bottom Point.

VH87 Element Interval
Item type:read and write
Default:1000mm (NMT 539 Converter Only version)
Range:0mm ~ 99999mm
Designated to Even Interval spacing.

Caution!
Changing element interval, setting element position, these are only applied to reconfigure switching points for average temperature calculation. The physical element position will never be changed!!

VH88 Short Error
Item type:read and write
Default:-49.5
Range:-49.5 ~ 359.5
A type of error message when any of element has short circuit. Method of display can be configured at VH92 "Error Display Select."

VH89 Open Error
Item type:read write
Default:359.9
Range:-49.5 ~ 359.5
A type of error message when any of element has open circuit. Method of display can be configured at VH92 "Error Display Select."

4.1.10 Device setting 2: VH90 ~ VH99

VH90 Device ID Number
Item type:read and write
Default:0
Range:0 ~ 16777214
In order to distinguish own device ID when NMT 539 is connected in multi drop HART loop.

Caution!
Changing device ID may lead to communication error because of mismatched pre-registered device ID and HART address.

VH91 Previous Error
Item type:read only
Display of error history. Coded error message will be the same contents as VH80.

VH92 Error Dis. Sel.
Item type:select
Default:0_OFF
Selection:O_OFF, 1_ON
Type of VH88 "Short Error Value" and VH89 "Open Error Value" display selection.

0_OFF:These 2 error messages will not be transmitted to the connected host gauge. This function automatically exclude defected element in average temperature calculation.

1_ON:Error message will be transmitted to the host gauge. As a result, VH88 and 89"s numeric error code will be displayed on host gauge default screen and may transmit to upper receiver as well.

VH93 Custody Mode
Item type:select
Default:0_OFF
Selection:0_OFF, 1_ON
A software switch to prohibit over write for Weight and Measure application when 1_ON is selected.

Note!
Hardware over ride protection is located on main CPU board. Set jumper terminal JP1 7-8 will enables no parameter re-configuration available.

VH94 Polling Address
Item type:read and write
Default:2
Range:1 ~ 15
Polling address for HART communication

VH95 Manufacture ID
Item type:read only
Default:17
A manufacture ID within E+H instrumentation.

VH96 Software Version
Item type:read only
A display of installed software version.

VH97 Hardware Version
Item type:read only
A display of recognized hardware version.

VH98 Below Bottom
Item type:select
Default:0_OFF
Selection:0_OFF, 1_ON
A type of error display when liquid level drops below #1 element (Bottom Point). Error code "29" is displayed on VH80 and VH91 when 0_ON is selected.

VH99 Device Type Code
Item type:read only
Device type will be displayed.
- 184:Temperature measurement function only
- 185:WB function only
- 186:Temperature + WB function

4.2 Water Bottom measurement

A HART device codes "185" is designated to perform only water bottom (water interface) measurement function. Available parameter and function are follows. Description of these parameters are the information based on ToF tool menu.

Note!
HART device code will be only visible when default header position or VH99 "Device Type Code" on ToF tool menu is available.

Designated temperature measurement function device based on order structure.
20:Measuring Function
2:Converter + WB

4.2.1 Element Position: VH40 ~ VH49

VH47 Clear Memory
Item type:select
Default:None (0)
Selection:None, Clear
Reset matrix parameter to default setting.

4.2.2 WB primary and Advanced temp: VH50 ~ VH59

VH50 Water Level
Item type:read only
A display of measured water I/F level "Water Bottom."

Note!
Measurement value is calculated based on following formula.

VH50 = (VH52) / (VH63) x (VH59) + (VH58)
VH52: measured WB probe frequency
VH63: frequency change / mm
VH59: linear factor of WB probe
VH58: offset value

VH51 Capacitance
Item type:read only
Range:1000mm probe: 10 ~ 1000pF
2000mm probe: 10 ~ 2200pF
3000mm probe: 10 ~ 3000pF
A display of calculated WB probe capacitance based on frequency.

VH52 WB Frequency
Itye type:read only
Range:1200Hz ~ 4500Hz
A display of WB probe measured frequency.

VH57 Sel. Water Span
Item type:select
Selection:1000mm, 2000mm, 3000mm
A selection of WB probe length.

Note!
A custom length (TSP) probe shorter than standard 1000mm also can be compatible with selecting 1000mm.

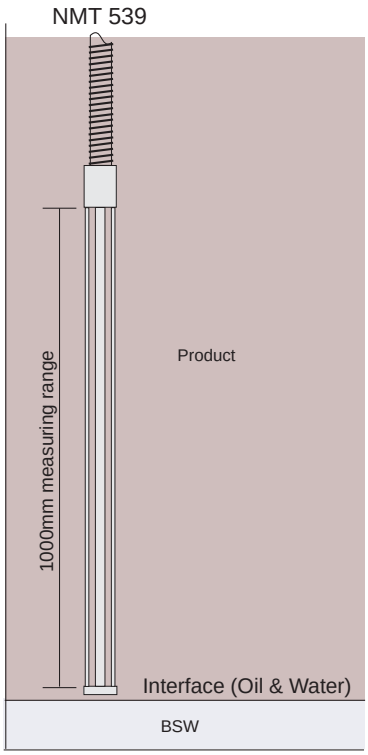
VH58 Offset Water
Item type:read and write
Default:0
Range:-200 ~ +2000
Enable to apply WB level offset on measured value.

Note!
Example, measured WB value is 530mm. Then, hand dip measurement indicates 535mm. Enter -5.000 in VH58 enables reducing entire measurement value -5mm of offset constantly.

VH59 Water Span
Item type:read and write
Default:11
Range:0.1 ~ 99.9
A linearity of WB probe capacitance adjustment. The linear incline can be adjusted in order to compensate minor WB probe characteristic.

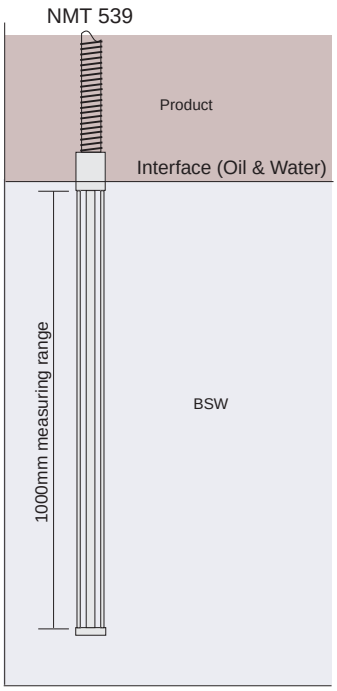
4.2.3 WB Adjustment and Operation Power: VH60 ~ VH69

VH60 Empty Frequency
Item type:read and write
Default:1200Hz
Range:0Hz ~ 9999Hz
Enter measured frequency (VH52 value) when WB probe is submerged in oil layer (no water touched on NMT 539 WB probe).



Note!
Default setting (0mm water level = 1200Hz) is established as a factory reference condition. Mark Interface (Oil and Water) level with manual hand dip or any other measuring method performed at "Empty Frequency" when re-calibration is required with actual condition.

VH61 Full Frequency
Item type:read and write
Default:4500Hz
Range:0 ~ 9999Hz
Enter measured frequency (VH52 value) when WB probe is detecting water I/F least 300mm.

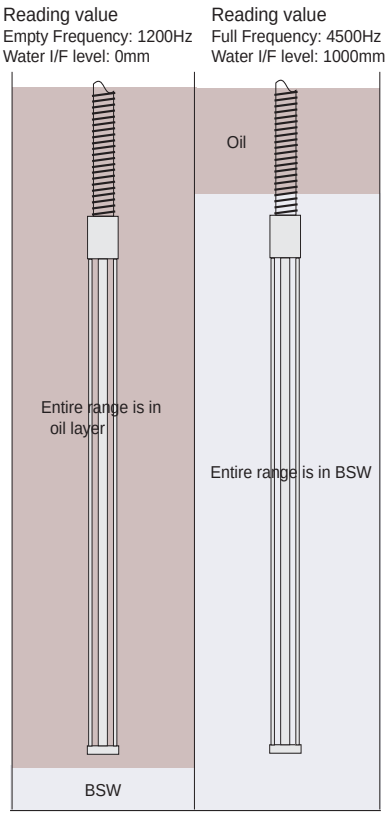


Note!
Default setting (1000mm water level = 4500Hz) is established as a factory reference condition. Mark Interface (Oil and Water) level with manual hand dip or any other measuring method performed at "Full Frequency" when re-calibration is required with actual condition.

VH62 Probe Length
Item type:read and write
Default:1000mm or 2000mm
Range:1mm ~ 9999m
Enter the WB probe calibration distance (length). An actual measurement range is determined by the physical probe length. However, available probe length in operating tank might be different from default value for re-calibration at the site.

Note!
Default setting has 1000mm or 2000mm probe length because of the factory calibration method utilizes absolutely no water (0mm water I/F) condition at VH60 "Empty Frequency", and completely submerged (above 1000mm or 2000mm water I/F) condition at VH61 "Full Frequency) to define probe linearity (VH 63 "Water Factor").

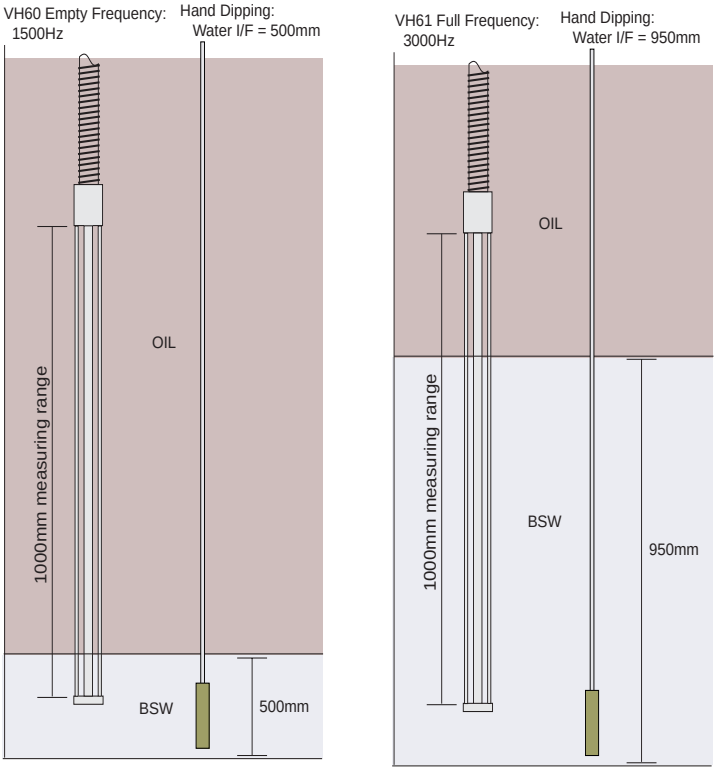
Formula: (VH61 - VH60) / VH62 = VH63
Example at factory default:
- VH60 = 1200Hz (Water I/F = 0mm)
- VH61 = 4500Hz (Water I/F = 1000mm)
- VH62 = 1000mm
- VH63 = 3.3Hz



(4500Hz -1200Hz) / 1000mm = 3.3Hz / 1mm

Re-calibration at actual site in operating tank

Performing re-calibration in operating tank will take several process in order to determine actual water I/F by employing auxiliary instrument. After performing manual water I/F dipping at 2 different BSW level, WB probe calibration distance (VH62 Probe Length) can be calculated as follow.



950mm - 500mm = 450mm

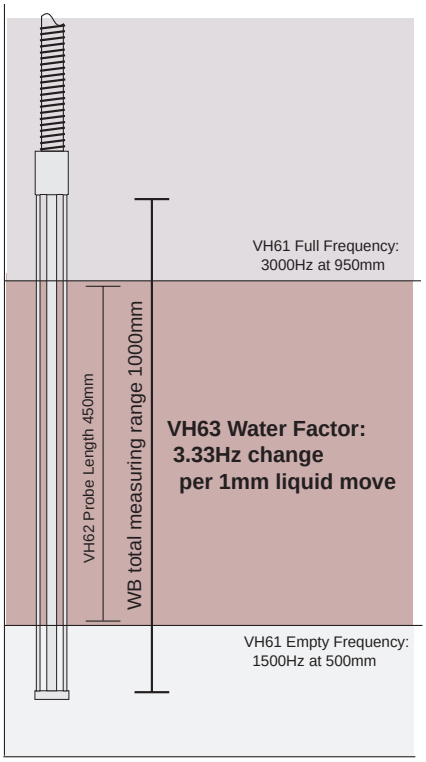
Re-calibrated WB probe linearity in operating tank
(3000Hz - 1500Hz) / 450 = 3.33Hz / 1mm

- VH60 Empty Frequency: 1500Hz
- VH61 Full Frequency: 3000Hz
- VH62 Probe Length: 450mm
- VH63 Water Factor: 3.33Hz

Caution!

WB probe linearity may differ from default condition to actual in-tank condition. Liquid characteristics (both oil and water), in-tank temperature and other surrounding environment can greatly effect on the probe linearity.

VH63 Water Factor
Item type:read only
A display of WB probe linearity per 1mm liquid movement in Hz (frequency) unit. The calculation is performed based on following formula.
(VH61 "Full Frequency" - VH60 "Empty Frequency") / VH62 "Probe Length" = VH63 "Water Factor."



Note!
Once, Water Factor is determined by given parameters, actual water I/F measurement is calculated from detected frequency to distance conversion.

VH68 Output Current
Item type:read and write
Default:16000 at 6mA
Range:0 ~ 65535
Adjustment of NMT 539 current consumption. In order to prevent current over shoot within multidrop HART loop, this function limits the NMT 539 power consumption based on set parameter. Normally, NMT 539 with temperature measurement function is operated within 6mA of current consumption. Use a tester to check the current flow in the loop. Reducing the value makes NMT 539 to consume smaller current.

VH69 Ref Voltage
Item type:read and write
Default:200
Range:0 ~ 255
A parameter to draw power supply failure alarm. NMT 539 operates at minimum 16VDC of supply voltage via multi drop HART loop under normal operating condition. NMT 539 will transmits error message when supply voltage drops below 16VDC with default value setting 200.

4.2.4 Temperature Adjustment: VH70 ~ VH79

NH79 Protect Code
Item type:read and write
Default:0
Range:0 ~ 999
Access code 530 to enable select and write command available.

4.2.5 Device setting 1: VH80 ~ VH89

VH80:Present Error
Item type:read only
Display of error message presence. Following code will be indicated.

Error code

0:No error presence
1:Common line open
2: undetermined
3:#1 element open
4:#1 element short
5:#2 element open
6:#2 element short
7:#3 element open
8:#3 element short
9:#4 element open
10:#4 element short
11:#5 element open
12:#5 element short
13:#6 element open
14:#6 element short
15:#7 element open
16:#7 element short
17:#8 element open
18:#8 element short
19:#9 element open
20:#9 element short
21:#10 element open
22:#10 element short
23:#0 element over range
24:Memory defect (ROM)
25:#11 element open
26:#11 element short
27:#12 element open
28:#12 element short
29:Element exposed (liquid level below #1 element position)
30:undetermined
31:undetermined
32:Low power supply
33:#13 element open
34:#13 element short
35:#14 element open
36:#14 element short
37:#15 element open
38:#15 element short
39:#16 element open
40:#16 element short
41:Memory defect (RAM)
42:Memory defect (EEROM)
43:WB line open
44:WB line short

VH83 No. of Preambles
Item type:read and write
Default:5
Range:2 ~ 20
Setting # of preamble for HART communication.

VH84 Distance Unit
Item type:select
Default:mm
Selection:ft., m, inch, mm
Selection of level display unit. It applies to both liquid level display on VH02 "Liquid Level" and VH50 "Water Bottom Level." Level units are coded based on universal HART setting, ft. (HART code: 44), m (HART code: 45), inch (HART code: 47), mm (HART code: 49).

4.2.6 Device setting 2: VH90 ~ VH99

VH90 Device ID Number
Item type:read and write
Default:0
Range:0 ~ 16777214
In order to distinguish own device ID when NMT 539 is connected in multi drop HART loop.

Caution!

Changing device ID may lead to communication error because of mismatched pre-registered device ID and HART address.

VH91 Previous Error
Item type:read only
Display of error history. Coded error message will be the same contents as VH80.

VH93 Custody Mode
Item type:select
Default:0_OFF
Selection:0_OFF, 1_ON
A software switch to prohibit over write for Weight and Measure application when 1_ON is selected.

Note!

Hardware over ride protection is located on main CPU board. Set jumper terminal JP1 7-8 will enables no parameter re-configuration available.

VH94 Polling Address
Item type:read and write
Default:2
Range:1 ~ 15
Polling address for HART communication

VH95 Manufacture ID
Item type:read only
Default:17
A manufacture ID within E+H instrumentation.

VH96 Software Version
Item type:read only
A display of installed software version.

VH97 Hardware Version
Item type:read only
A display of recognized hardware version.

VH99 Device Type Code
Item type:read only
Device type will be displayed.
- 184:Temperature measurement function only
- 185:WB function only
- 186:Temperature + WB function

4.3 Temperature + Water Bottom measurement

HART device codes "186" is designated to perform both temperature and Water Bottom function as a fully integrated NMT 539. Available parameter and function are follows. Description of these parameters are the information based on ToF tool menu.

Note!
HART device code will be only visible when default header position or VH99 "Device Type Code" on ToF tool menu is available.

Designated temperature and Water Bottom measurement function device is based on following order structure.

20:Measuring Function
3:Converter + temperature + WB
5:Converter + temperature + WB (W&M certification)

4.3.1 Primary values: VH00 ~ VH09

VH00 Liquid Temp
Item type:read only
Range:-200°C ~ 240°C

Note!
Display of measured liquid phase average temperature. Liquid level input must be provided by Micropilot radar level gauge (via Tank Side Monitor) or Proservo NMS 53x series servo level gauge in order to calculate true liquid average temperature.

VH01 Gas Temp
Item type:read only
Range:-200°C ~ 240°C
Display of measured gas (vapor) phase average temperature.

Note!
Display of measured gas (vapor) phase average temperature. Liquid level input must be provided by Micropilot radar level gauge (via Tank Side Monitor) or Proservo NMS 53x series servo level gauge in order to calculate true gas average temperature.

VH02 Measured Distance
Item type:read and write
Range:0mm ~ 99999mm
Display of provided liquid level by connected level gauge. Manual level input, directly entering desired level value, is also available for the device test purpose.

VH07 Temperature 0
Item type:read only
Display of converted 100 Ohm reference resistor deviation value compares to the actual inserted element value in the temperature probe. The Reading value of reference resistor and its deviation are continuously monitored during operation to prevent from performing incorrect calculation.

Caution!
Indicated tolerance should be within ±0.15°C (±0.27°F) depending on element characteristics, e.g. Pt100 elements have 100 Ohm resistance at 0°C (32°F); therefore, the reading value should be within 0°C ± 0.15°C (32°F ± 0.27°F) or less.

VH09 Temperature 17
Item type:read only
Display of the converted 200 Ohm reference resistor deviation value compares to the actual inserted element value in the temperature probe. The reading value of reference resistor and its deviation are continuously monitored during operation to prevent from performing an incorrect calculation. Indicated tolerance should be within ±0.15°C (±0.27°F) depending on element characteristics.Element Temperature 1: VH10 ~ VH19

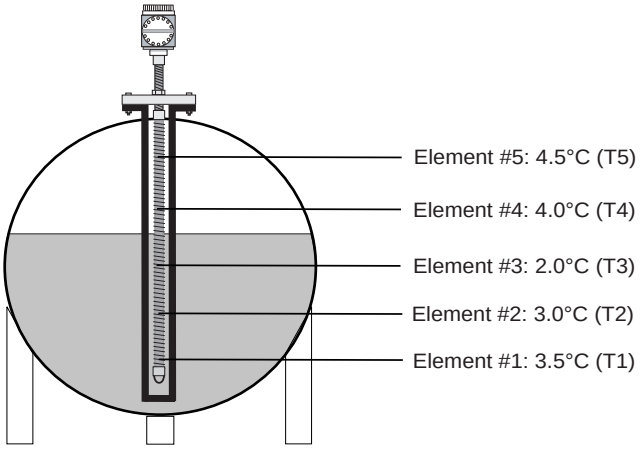
VH10 ~ 19 Temperature 1 ~ 10
Item type:read only
Range:-200°C ~ 240°C
Display of individual measured element temperature.

4.3.2 Element Temperature 2: VH20 ~ VH29

VH20 ~ 25 Temperature 11 ~ 16
Item type:read only
Range:-200°C ~ 240°C
Display of individual element temperature.

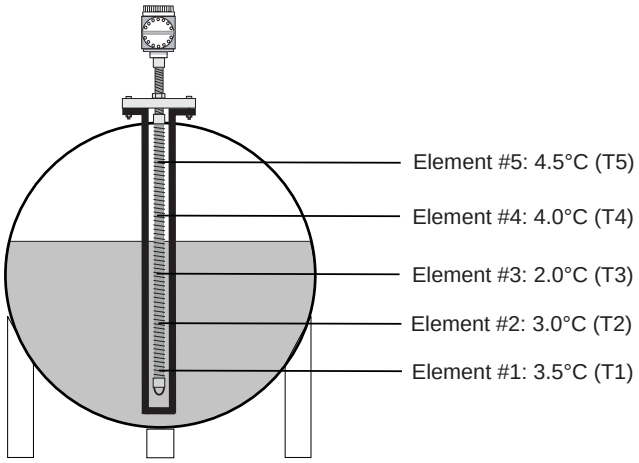
VH26 Selec. Ave Method
Item type:select
Selection:Standard, Advanced
Selection of average calculation method.

Standard: A Conventional calculation method. Regardless of tank shape, average temperature calculation will be performed based on following example (liquid phase).



Formula:(T1 + T2 + T3) / # of element in liquid phase
= Average temperature(3.5°C + 3.0°C + 2.0°C) / 3 = 2.83°C

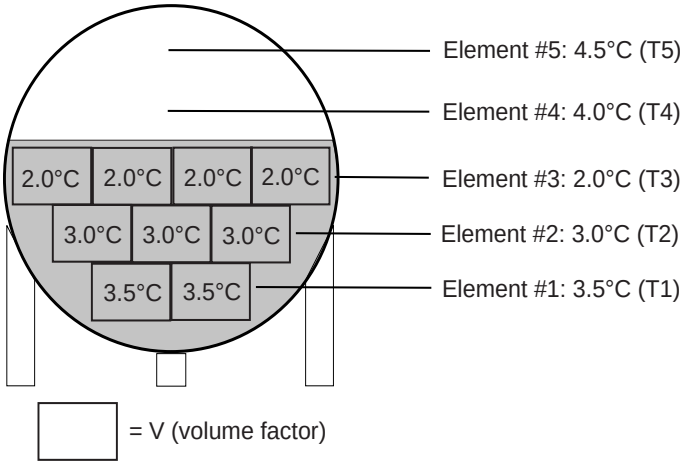
Advanced: Average temperature calculation with additional factor to compensate unequal volume distribution (liquid phase).



Formula: (T1*V1 + T2*V2 + T3*V3) / (V1 + V2 + V3) = Average temperature

Note!

V = # of additional volume factor that is determined at VH53, 53 and 55



(3.5°C x 2 + 3.0°C x 3 + 2.0°C x 4) / (2 + 3 + 4) = 2.67°C

VH27 Multi Spot Type

Item type:select

Selection:Spot, Multi

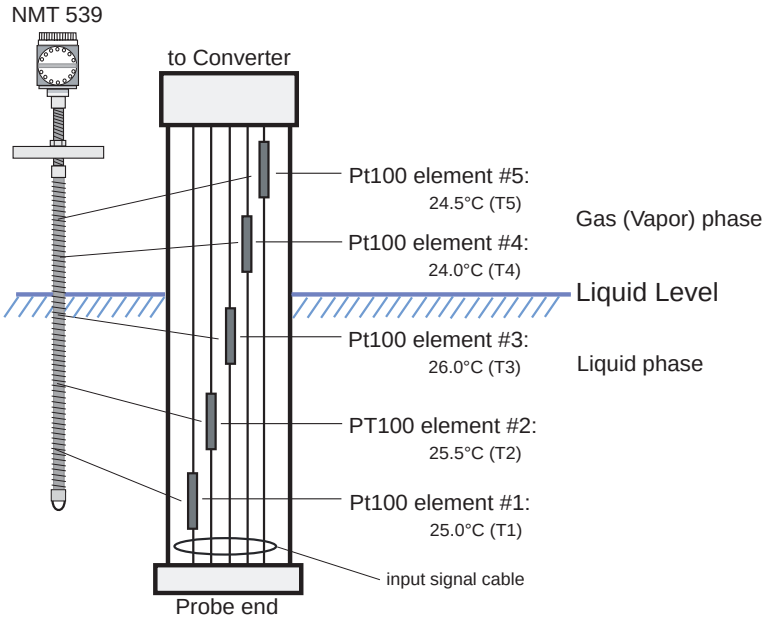
Selection of element physical layout in the probe, mainly NMT 539 Converter Only version requires this function when it has connected to foreign average temperature probe.

Caution!

On the contrary, NMT 539 Converter + Temperature version always has "Spot" element layout. Selecting parameter to "Multi" will cause faulty calculation.

Spot:

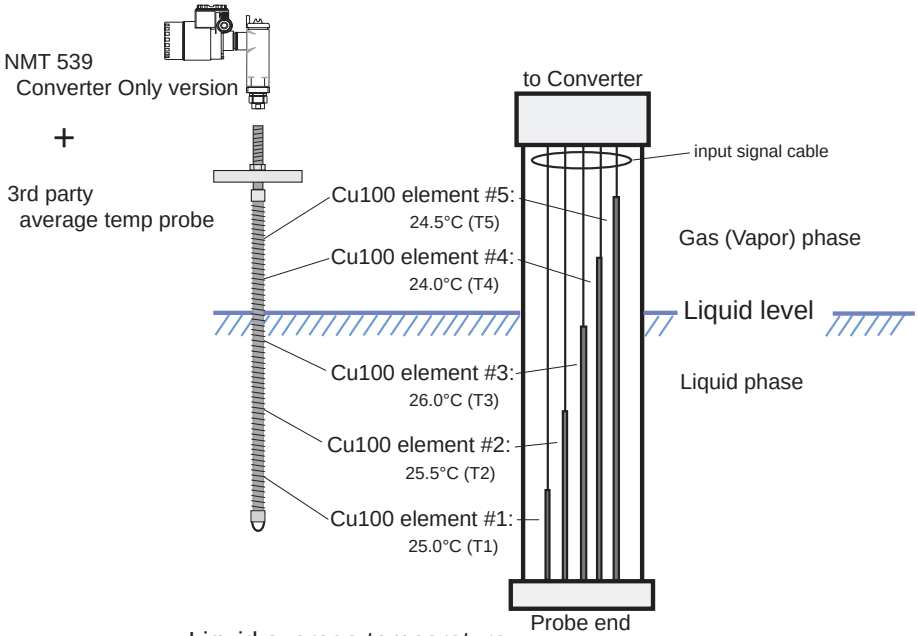
Same number of element (resistance and material) locates in each input cable in the probe. Average calculation is performed based on (sum of submerged element temperature value) / number of element submerged.



Liquid average temperature = (T1 + T2 + T3) / 3 = 25.5°C

Multi:

Different length or number of element inserted in each input cable. Average temperature is considered as the closest submerged element to the liquid level.



Liquid average temperature:
A submerged element temperature, closest to Liquid level
= Element #3: 26.0°C (T3)

VH28 Lower Limit
Item type:read and write
Default value:-20.5°C
RANGE:-999.9°C ~ 999.9°C
Low limit temperature alarm parameter when measurement detects below design and approved temperature.

VH29 Upper Limit
Item type:read and write
Default value:245°C
Range:-999.9°C ~ 999.9°C
Hi limit temperature alarm parameter when measurement detects above design and approved temperature.

4.3.3 Element Position 1: VH30 ~ VH39

VH30 ~VH39 Position 1 ~ 10
Item type:read and write
Range:0mm ~ 99999mm
Individual element position from tank bottom. Calculation is automatically performed when element spacing "Even" is selected at VH85. All of element position must be manually entered when "Not Even" element spacing is selected at VH85.

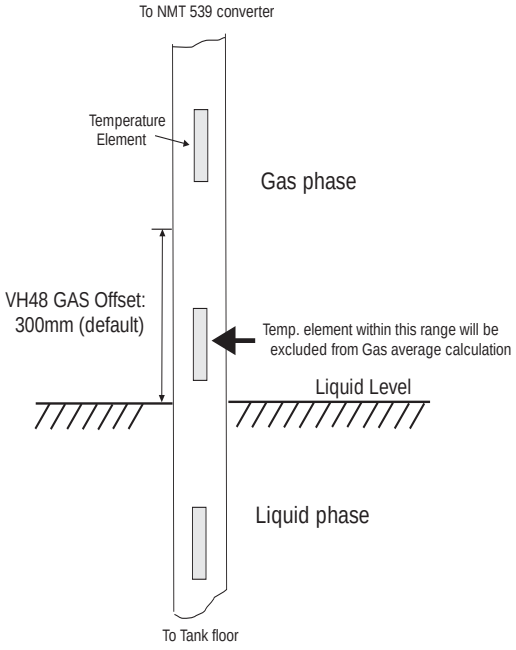
4.3.4 Element Position 2: VH40 ~ VH49

VH40 ~VH45 Position 11 ~ 16
Item type:read and write
Range:0mm ~ 99999mm
Individual element position from tank bottom. Calculation is automatically performed when element spacing "Even" is selected at VH85. All of element position must be manually entered when "Not Even" element spacing is selected at VH85.

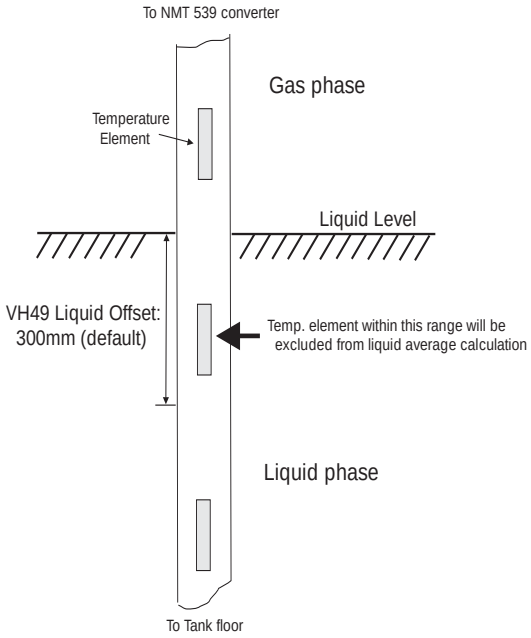
VH46 Hysterese Width
Item type:read and write
Default:10mm
Range:0mm ~ 99999mm
Element switching point hysteresis. Entered hysteresis as a offset value is added on the liquid level when the liquid level is raising, subtracted when lowering to prevent from hunching by unstable liquid surface condition.

VH47 Clear Memory
Item type:select
Default:None (0)
Selection:None, Clear
Reset matrix parameter to default setting.

VH48 Gas Offset
Item type:read and write
Default:300mm
Range:0mm ~ 99999mm
A function to exclude specific element(s) from gas (vapor) phase average temperature calculation when element(s) stay within entered value from given liquid level.



VH49 Liquid Offset
Item type:read and write
Default:300mm
Range:0mm ~ 99999mm
A function to exclude element (s) from liquid phase average temperature calculation when element (s) stays within entered value from given liquid level.



4.3.5 WB primary and Advanced temp: VH50 ~ VH59

VH50 Water Level
Item type:read only
A display of measured water I/F level "Water Bottom."

Note!
Measurement value is calculated based on following formula.

VH50 = (VH52) / (VH63) x (VH59) + (VH58)
VH52: measured WB probe frequency
VH63: frequency change / mm
VH59: linear factor of WB probe
VH58: offset value

VH51 Capacitance
Item type:read only
Range:1000mm probe: 10 ~ 1000pF
2000mm probe: 10 ~ 2200pF
3000mm probe: 10 ~ 3000pF
A display of calculated WB probe capacitance based on frequency.

VH52 WB Frequency
Itye type:read only
Range:1200Hz ~ 4500Hz
A display of WB probe measured frequency.

VH53 Element Point
Item type:select
Default:0
Selection:0 ~ 15 (element #1 = 0, element #16 = 15)

Select element number for "Advanced" average calculation at VH26. Selected element position will be displayed on VH54 "Element Position" and enable to change additional volume factor at VH55 "Element Volume."

VH54 Element Position
Item type:read only
Range:0m ~ 99999mm
A display of selected element position on VH53.

VH55 Element Volume
Item type:read and write
Range:1 ~ 99999.9
Setting additional factor on selected element at VH53. Extra volume can be added on specific element for advanced average temperature calculation. (Details, please refer to the description of VH26 "Select Average Method" on page 18)

VH57 Sel. Water Span
Item type:select
Selection:1000mm, 2000mm, 3000mm
A selection of WB probe length.

Note!
A custom length (TSP) probe shorter than standard 1000mm also can be compatible with selecting 1000mm.

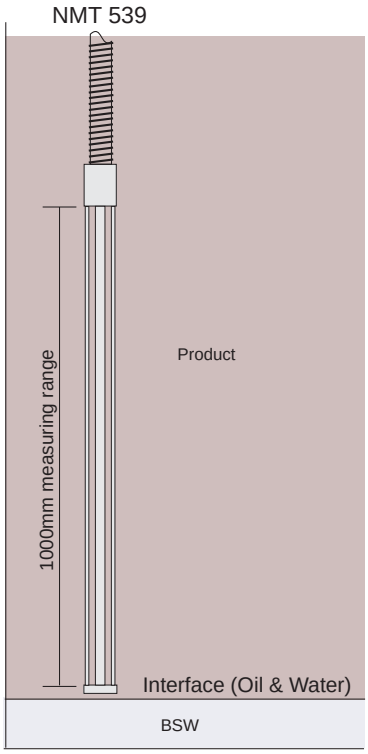
VH58 Offset Water
Item type:read and write
Default:0
Range:-200 ~ +2000
Enable to apply WB level offset on measured value.

Note!
Example, measured WB value is 530mm. Then, hand dip measurement indicates 535mm. Enter -5.000 in VH58 enables reducing entire measurement value -5mm of offset constantly.

VH59 Water Span
Item type:read and write
Default:11
Range:0.1 ~ 99.9
A linearity of WB probe capacitance adjustment. The linear incline can be adjusted in order to compensate minor WB probe characteristic.

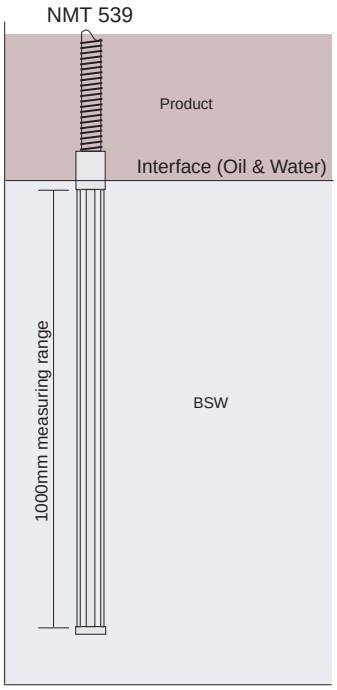
4.3.6 WB Adjustment and Operation Power: VH60 ~ VH69

VH60 Empty Frequency
Item type:read and write
Default:1200Hz
Range:0Hz ~ 9999Hz
Enter measured frequency (VH52 value) when WB probe is submerged in oil layer (no water touched on NMT 539 WB probe).



Note!
Default setting (0mm water level = 1200Hz) is established as a factory reference condition. Mark Interface (Oil and Water) level with manual hand dip or any other measuring method performed at "Empty Frequency" when re-calibration is required with actual condition.

VH61 Full Frequency
Item type:read and write
Default:4500Hz
Range:0 ~ 9999Hz
Enter measured frequency (VH52 value) when WB probe is detecting water I/F least 300mm.

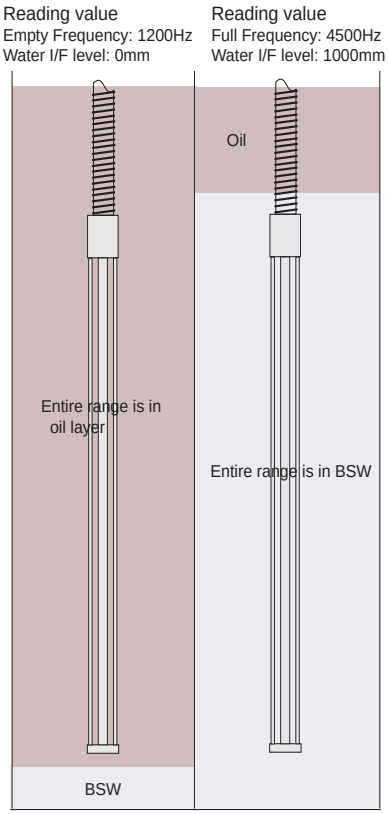


Note!
Default setting (1000mm water level = 4500Hz) is established as a factory reference condition. Mark Interface (Oil and Water) level with manual hand dip or any other measuring method performed at "Full Frequency" when re-calibration is required with actual condition.

VH62 Probe Length
Item type:read and write
Default:1000mm or 2000mm
Range:1mm ~ 9999m
Enter the WB probe calibration distance (length). An actual measurement range is determined by the physical probe length. However, available probe length in operating tank might be different from default value for re-calibration at the site.

Note!
Default setting has 1000mm or 2000mm probe length because of the factory calibration method utilizes absolutely no water (0mm water I/F) condition at VH60 "Empty Frequency", and completely submerged (above 1000mm or 2000mm water I/F) condition at VH61 "Full Frequency) to define probe linearity (VH 63 "Water Factor").

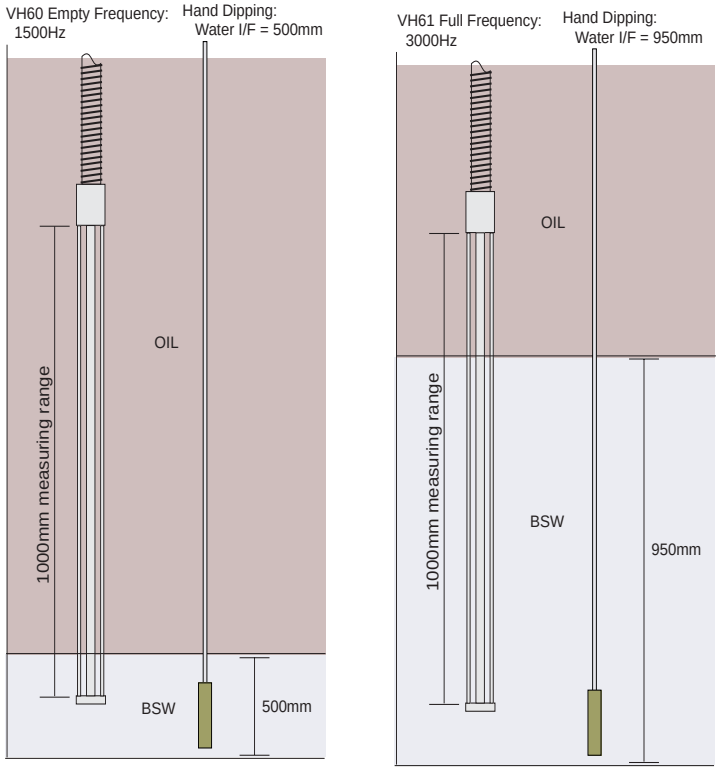
Formula: (VH61 - VH60) / VH62 = VH63
Example at factory default:
- VH60 = 1200Hz (Water I/F = 0mm)
- VH61 = 4500Hz (Water I/F = 1000mm)
- VH62 = 1000mm
- VH63 = 3.3Hz



(4500Hz -1200Hz) / 1000mm = 3.3Hz / 1mm

Re-calibration at actual site in operating tank

Performing re-calibration in operating tank will take several process in order to determine actual water I/F by employing auxiliary instrument. After performing manual water I/F dipping at 2 different BSW level, WB probe calibration distance (VH62 Probe Length) can be calculated as follow.



950mm - 500mm = 450mm

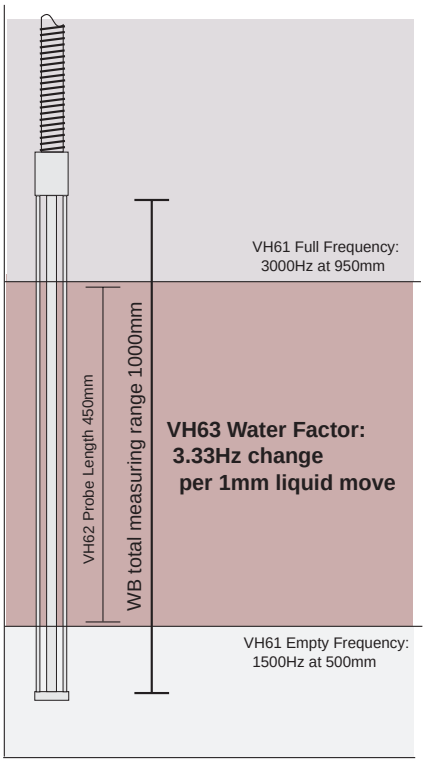
Re-calibrated WB probe linearity in operating tank
(3000Hz - 1500Hz) / 450 = 3.33Hz / 1mm

- VH60 Empty Frequency: 1500Hz
- VH61 Full Frequency: 3000Hz
- VH62 Probe Length: 450mm
- VH63 Water Factor: 3.33Hz

Caution!

WB probe linearity may differ from default condition to actual in-tank condition. Liquid characteristics (both oil and water), in-tank temperature and other surrounding environment can greatly effect on the probe linearity.

VH63 Water Factor
Item type:read only
A display of WB probe linearity per 1mm liquid movement in Hz (frequency) unit. The calculation is performed based on following formula.
(VH61 "Full Frequency" - VH60 "Empty Frequency") / VH62 "Probe Length" = VH63 "Water Factor."



Note!
Once, Water Factor is determined by given parameters, actual water I/F measurement is calculated from detected frequency to distance conversion.

VH67 Common Voltage
Item type:read only
Range:0 ~ 255 (0 ~ 3V)
A display of temperature element line (both signal and common) running voltage. Detected voltage across common line (shall be between 0 ~ 3V) is converted to range of 0 ~ 255 count when it is displayed.

VH68 Output Current
Item type:read and write
Default:16000 at 6mA
Range:0 ~ 65535
Adjustment of NMT 539 current consumption. In order to prevent current over shoot within multidrop HART loop, this function limits the NMT 539 power consumption based on set parameter. Normally, NMT 539 with temperature measurement function is operated within 6mA of current consumption. Use a tester to check the current flow in the loop. Reducing the value makes NMT 539 to consume smaller current.

VH69 Ref Voltage
Item type:read and write
Default:200
Range:0 ~ 255

A parameter to draw power supply failure alarm. NMT 539 operates at minimum 16VDC of supply voltage via multi drop HART loop under normal operating condition. NMT 539 will transmits error message when supply voltage drops below 16VDC with default value setting 200.

4.3.7 Temperature Adjustment: VH70 ~ VH79

VH70 Element Select
Item type:select
Range:0 ~ 19
Selection of "need adjustment" temperature element (0 = #1 element, 15 = #16 element, 19 = reference 100 Ohm resistor). Detailed value and parameter of the element selected in this matrix can be shown in,
VH71 "Zero Adjust"
VH73 "Temperature X"
VH74 "Position X"
VH75 "Resistance X"
VH76 "Resistance Adj"

VH71 Zero Adjust
Item type:read and write
Default:0
Range:-1000.0 ~ 1000.0
Zero adjustment of individual element that is selected at VH70. The reading value can be adjusted when the measured temperature indicates minor offset value compare to precision reference thermometer.

Note!
Selected element #2 indicates 25.4°C, then reference thermometer indicates 25.2°C, then set "-0.2" in this matrix. #2 element now has constant artificial -0.2°C offset based on raw measurement.

VH72 Adjust Span
Item type:read and write
Default:1
Range:0.8 ~ 1.2
The span adjustment that applies to all of installed temperature element. A linearized factor of given parameter is multiplied to raw element measurement for final calculation.

Note!
All of displayed individual temperature value are calculated based on following formula.

VH73: "Temperature X" = raw element temperature x span (VH72) + zero offset (VH71)

VH73 Temperature X
Item type:read only
Specified element temperature selected at VH70. Shown value is also indicated at individual element temperature at VH10 ~ VH25. The value is calculated based on formula indicated on above VH72.

VH74 Position X
Item type:read and write
Range:0mm ~ 99999mm
A position of specified element at VH70. Each element positions are also determined when "Not Even" element spacing is selected at VH85.

VH75 Resistance X
Item type:read only
A display of specified element resistance selected at VH70.

VH76 Resistance Adj.
Item type:read and write
Default: 0
Range:-1000.0 ~ 1000.0
Adjustment of specified element resistance at VH70. Minor resistance adjustment can be applied on the reading value.

Note!
Selected element #5 indicates 100.3 Ohm, then reference precision resistor indicates 100.0 Ohm at the same environmental condition, then set "-0.3" in this matrix. #5 element now has constant artificial -0.3°C offset resistance based on raw measurement.

VH77 Element Type
Item type:select
Selection:Pt100, Cu90, Cu100, PtCu100, JPt100
A selection of element conversion formula when foreign average temperature probe is connected to NMT 539 Converter Only version
.

Caution!
NMT 539 Converter + Temperature version always consists "Pt100" element with "Spot" element layout. Do not attempt to change these parameters.

Element conversion Formula:

Pt100 (formula above 0°C):R = -0.580195 x 10^{-4} x T^2 + 0.390802 x T +100
Pt100 (formula below 0°C):R = -4.2735 x 10^{-10} x T^4 + 4.273 x 10^{-8} x T^3 - 0.58019 x 10^{-4} x T^2 + 3.90802 x T + 100
Cu90:R = 0.3809 x T + 90.4778
Cu100:R = 0.38826 x T + 90.2935
PtCu100:R = 3.3367 x 10^{-7} x T3 - 2.25225 x 10^{-5} x T2 +0.38416 x T + 100.17
JPt100:

VH78 Average Number
Item type:read and write
Default:1
Range;1 ~ 10
Number of sampling for average calculation prior to determine final display value. Increasing number of sampling will prevent from faulty display.

Caution!
Additional sampling # will cause slower reaction time on value switch over. Maximum 1 sampling sequence will take approximately 2 sec. {total 21 elements (16 temp elements and 5 integrated reference resistors)}

NH79 Protect Code
Item type:read and write
Default:0
Range:0 ~ 999
Access code 530 to enable select and write command available.

4.3.8 Device setting 1: VH80 ~ VH89

VH80:Present Error
Item type:read only
Display of error message presence. Following code will be indicated.

Error code

0:No error presence
1:Common line open
2: undetermined
3:#1 element open
4:#1 element short
5:#2 element open
6:#2 element short
7:#3 element open
8:#3 element short
9:#4 element open
10:#4 element short
11:#5 element open
12:#5 element short
13:#6 element open
14:#6 element short
15:#7 element open
16:#7 element short
17:#8 element open
18:#8 element short
19:#9 element open
20:#9 element short
21:#10 element open
22:#10 element short
23:#0 element over range
24:Memory defect (ROM)
25:#11 element open
26:#11 element short
27:#12 element open
28:#12 element short
29:Element exposed (liquid level below #1 element position)
30:undetermined
31:undetermined
32:Low power supply
33:#13 element open
34:#13 element short
35:#14 element open
36:#14 element short
37:#15 element open
38:#15 element short
39:#16 element open
40:#16 element short
41:Memory defect (RAM)
42:Memory defect (EEROM)
43:WB line open
44:WB line short

VH81 Temperature Unit
Item type:select
Default:°C
Selection:C, F, K
Selection of temperature display unit. Based on universal HART setting, °C(HART code: 32), °F(HART code: 33) andand °K(HART code: 35) is available.

Note!
Selection of temperature display unit only applies to reply data from NMT539. Data transmission from host gauge (NRF 590 or NMS 53x) to NMT 539 must be performed by °C unit only (terminology of HART command 133)

VH82 Element Number
Item type:read and write
Default:10 (NMT 539 Converter Only version)
Range:1 ~ 16
Entering # of available temperature element. This function mainly used with NMT 539 Converter Only version.

Caution!

Do not change the default parameter on NMT 539 Converter + Temperature version. # of element on this version is pre-determined by customer's choice. It may cause faulty calculation or unnecessary error display.

VH83 No. of Preambles
Item type:read and write
Default:5
Range:2 ~ 20
Setting # of preamble for HART communication.

VH84 Distance Unit
Item type:select
Default:mm
Selection:ft., m, inch, mm
Selection of level display unit. It applies to both liquid level display on VH02 "Liquid Level" and VH50 "Water Bottom Level." Level units are coded based on universal HART setting, ft. (HART code: 44), m (HART code: 45), inch (HART code: 47), mm (HART code: 49).

VH85 Kind of Interval
Item type:select
Default:Even Interval (NMT 539 Converter Only version)
Selection:Even Interval, Not Even
Selection of element interval depending on spacing layout. This function is normally used for NMT 539 Converter Only version.

Caution!

Do not change its parameter on NMT 539 Converter + Temperature version unless repairing. Kind of Interval and individual element positions are physically determined at factory.

VH86 Bottom Point
Item type:read and write
Default:500mm
Range:0mm ~ 99999mm
Position of #1 element that is also called "Bottom Point." #1 element position becomes critically important when "Even Interval" is selected at VH85 because remaining element positions rely on this location of Bottom Point.

VH87 Element Interval
Item type:read and write
Default:1000mm (NMT 539 Converter Only version)
Range:0mm ~ 99999mm
Designated to Even Interval spacing.

Caution!

Changing element interval, setting element position, these are only applied to reconfigure switching points for average temperature calculation. The physical element position will never be changed!!

VH88 Short Error
Item type:read and write
Default:-49.5
Range:-49.5 ~ 359.5
A type of error message when any of element has short circuit. Method of display can be configured at VH92 "Error Display Select."

VH89 Open Error
Item type:read write
Default:359.9
Range:-49.5 ~ 359.5
A type of error message when any of element has open circuit. Method of display can be configured at VH92 "Error Display Select."

4.3.9 Device setting 2: VH90 ~ VH99

VH90 Device ID Number
Item type:read and write
Default:0
Range:0 ~ 16777214
In order to distinguish own device ID when NMT 539 is connected in multi drop HART loop.

Caution!

Changing device ID may lead to communication error because of mismatched pre-registered device ID and HART address.

VH91 Previous Error
Item type:read only
Display of error history. Coded error message will be the same contents as VH80.

VH92 Error Dis. Sel.
Item type:select
Default:0_OFF
Selection:O_OFF, 1_ON
Type of VH88 "Short Error Value" and VH89 "Open Error Value" display selection.

0_OFF:These 2 error messages will not be transmitted to the connected host gauge. This function automatically exclude defected element in average temperature calculation.

1_ON:Error message will be transmitted to the host gauge. As a result, VH88 and 89"s numeric error code will be displayed on host gauge default screen and may transmit to upper receiver as well.

VH93 Custody Mode
Item type:select
Default:0_OFF
Selection:0_OFF, 1_ON
A software switch to prohibit over write for Weight and Measure application when 1_ON is selected.

Note!

Hardware over ride protection is located on main CPU board. Set jumper terminal JP1 7-8 will enables no parameter re-configuration available.

VH94 Polling Address
Item type:read and write
Default:2
Range:1 ~ 15
Polling address for HART communication

VH95 Manufacture ID
Item type:read only
Default:17
A manufacture ID within E+H instrumentation.

VH96 Software Version
Item type:read only
A display of installed software version.

VH97 Hardware Version
Item type:read only
A display of recognized hardware version.

VH98 Below Bottom
Item type:select
Default:0_OFF
Selection:0_OFF, 1_ON
A type of error display when liquid level drops below #1 element (Bottom Point). Error code "29" is displayed on VH80 and VH91 when 0_ON is selected.

VH99 Device Type Code
Item type:read only
Device type will be displayed.
- 184:Temperature measurement function only
- 185:WB function only
- 186:Temperature + WB function

5 Maintenance

5.1 Maintenance

The NMT 539 Prothermo Average temperature + WB instrument requires no special maintenance.

Exterior cleaning
When cleaning the NMT 539, always use cleaning agents that do not attack the surface of the housing and the seals.

Repairs
The Endress+Hauser repair concept assumes that the measuring devices have a modular design and that customers are able to undertake repairs themselves. Spare parts are contained in suitable kits. They contain the related replacement instructions. All the spare parts kits which you can order from Endress+Hauser for repairs to the NMT 539 Prothermo are listed with their order numbers on later pages. Please contact Endress+Hauser Service for further information on service and spare parts.

Repairs to Ex-approved devices
When carrying out repairs to Ex-approved devices, please note the following:
- Repairs to Ex-approved devices may only be carried out by trained personnel or by Endress+Hauser Service.
- Comply with the prevailing standards, national Ex-area regulations, safety instructions (XA) and certificates.
- Only use original spare parts from Endress+Hauser.
- When ordering a spare part, please note the device designation on the nameplate. Only replace parts with identical parts.
- Carry out repairs according to the instructions. On completion of repairs, carry our the specified routine test on the device.
- Only Endress+Hauser Service may convert a certified device into a different certified variant.
- Document all repair work and conversions.

Replacement
After a complete Prothermo electronic module has been replaced, the parameters must be manually re-entered to the replaced new module in order to maintain the proper operation. Measurement can continue without having to carry out a new setup.

After an probe or electronic has been replaced, a new calibration should be carried out. This is described in the Service Manual SM00xN/08/en. 05.04.

6 Trouble-shooting

6.1 System error messages

Code	Description	Possible cause	Remedy
1	Common line open	Ground (common) line has open circuit. All of temperature element signal will be disabled or deffected.	check connector attachment on the module; then check continuety on common (black) cable to #1 cable (red)
3~39	Element open	Temperature element signal cable (#1 ~ 16) has open circuit.	check connector attachment on the module; then check continuety on pointed signal cable (#1 ~ 16)
4~40	Element short	Temperature element signal cable (#1 ~ 16) has short circuit.	disengage connector from the module; then check continuety on pointed signal cable (#1 ~ 16)
23	#0 element over range	When reference #0 element has more than ±1.1°C diviation from 0°C.	check power supply voltage on NMT 539 HART terminal H+ and H-
24	Memory defect (ROM)	When a defect was discovered during whole memory parameter check. Cyclic data comparison between previous check sum to current one.	replace main CPU board
29	Element exposed	Liquid level droped below #1 element position.	no liquid temperature measurement is available.
32	Low power supply	Supply voltage on multi drop HART loop to NMT 539 is withdrawn below 16VDC from designated host instrument.	check power supply on the host instrument and consumption of connected loop powered HART device
41	Memory defect (RAM)	A defct during Write and Read sequence was imcompleted.	replace main CPU board
42	Memory defect (EEROM)	A defect during Write command was imcompleted.	check the write command itself that is acceptable to NMT 539; if command is OK, replace main CPU board
43	WB line open	WB capacitance signal loop has open circuit.	check connectoe attachment on CF board at module in converter housing
44	WB line short	WB capacitance signal loop has short circuit	disengage connector and check continuety of WB signal between housing to signal cable

Tab. 1 System error messages

Note!

These error code will be mainly displayed on ToF tool display when the tool is properly connected. Method and description of error dIsplay on host instrument, please refer to documentation of Tank Side monitor NRF 590 or Proservo NMS 53x.

7 Technical data

7.1 Technical data at a glance

Application	
Application	The Prothermo NMT 539 performs precise liquid and gas phase average temperature measurement of custody transfer bulk storage tank application. Along with capacitance water to oil interface measurement probe, complete temperature and WB (BSW) level measurement in crude oil and other bi-layer liquid tank application are accomplished. • Standard 2" flange installation • Overall 30m (40m pending) temperature measurement range • Up to 1m or 2m of BSW measurement range (3m optional)
Function and system design	
Measuring principle	*Temperature measurement* NMT 539 consists of platinum charactorized temperature element "Pt100" up to 16 elements in SUS316 protection tube. Pt100 has an unique characteristic of linear resistance change across surrounding ambient temperature change. Module in NMT 539 converter head recives this resistance signal change as input variable and converts to temperature data. Then, all of converted and calculated data are transmitted on loop powered HART signal to designated host instrument *WB (water interface) measurement:* An attached capacitance level measurement probe detects presence of water. The level of water is converted into given frequency variable (default setting) and its data is transmitted via HART converter to connected host instrument.
Equipment architecture	see Installation Manual BA025N/08/en
Input	
Measured variable	*Temperature measurement* Temperature conversion range: -200 ~ +240°C Standard temp probe: -40 ~ +100°C Wide range temp probe: -55 ~ +235°C Fridge range temp probe: -200 ~ +71°C... pending *WB measurement* Standard probe range: 1m or 2m Optional range: 3m
Measuring range	see Technical Information TI042N/08/en
Output	
Output signal	• HART protocol (multi drop HART loop connection)
Signal on alarm	Error information can be accessed via the following interfaces and transmitted digital protocol (refer to the operation manials on following instruments) • Tank Side monitor NRF 590 • Proservo NMS 53x
Auxiliary energy	
Load HART	Minimum load for HART communication: 250 Ω
Cable entry	see Technical Information TI042N/08/en
Supply voltage	16 ~ 30VDC (on multi drop HART loop)

Current consumption	Less than 6mA with temperature maesurement Less than 12mA with WB (and temperature) measurement
Performance characteristics	
Reference operating conditions	• temperature = +25 °C (77 °F) ±5 °C (9 °F) • pressure = 1013 mbar abs. (14.7 psia) ±20 mbar (0.3 psi) • relative humidity (air) = 65 % ± 20%
Maximum measured error	Typical statements for reference conditions, include linearity, repeatability, and hysteresis: • Linearity: – Temperature: ±0.15°C (0.27°F) + number of element diviation (based on IEC class A standard) – WB: 4mm (±2mm) for 1m probe installed
Operating conditions	
Operating conditions	
Installation instructions	see Installation Manual BA025N/08/en
Environment	
Storage temperature	-40 °C ... +85 °C
Climate class	DIN EN 60068-2-38 (test Z/AD)
Degree of protection	• housing: IP 65, (Converter only, open housing: IP20) • probe: IP 68
Electromagnetic compatibility	When installing the probes in metal and concrete tanks and when using a coax probe: • Interference Emission to EN 61326, Electrical Equipment Class B • Interference Immunity to EN 61326, Annex A (Industrial)
Process conditions	
Process temperature range	see Technical Information TI042N/08/en
Process temperature limits	see Technical Information TI 042N/08/en
Process pressure limits	see Technical Information TI042N/08/en
Mechanical construction	
Design, dimensions	see Technical Infromation TI042N/08?en
Weight	see Technical Information TI042N/08?en
Material	see Technical Information TI042N/08?en
Process connection	see Technical Information TI042N/08?en
Certificates and approvals	
CE approval	The measuring system meets the legal requirements of the EC-guidelines. Endress+Hauser confirms the instrument passing the required tests by attaching the CE-mark.

External standards and guidelines	**EN 60529** Protection class of housing (IP-code) **EN 61010** Safety regulations for electrical devices for measurement, control, regulation and laboratory use. **EN 61326** Emissions (equipment class B), compatibility (appendix A – industrial area)
Ex approval	see »Ordering structure NMT 539« on page 8
Ordering Information	
	The E+H service organisation can provide detailed ordering information an information on the order codes on request.
Accessories	
	see Technical Information TI042N/08/en
Supplementary Documentation	
Supplementary Documentation	• System Information NMT 539 (SI 025N/08/en) • Technical Information (TI 042N/08/en) • Installation Manual (BA 025FN08/en)

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