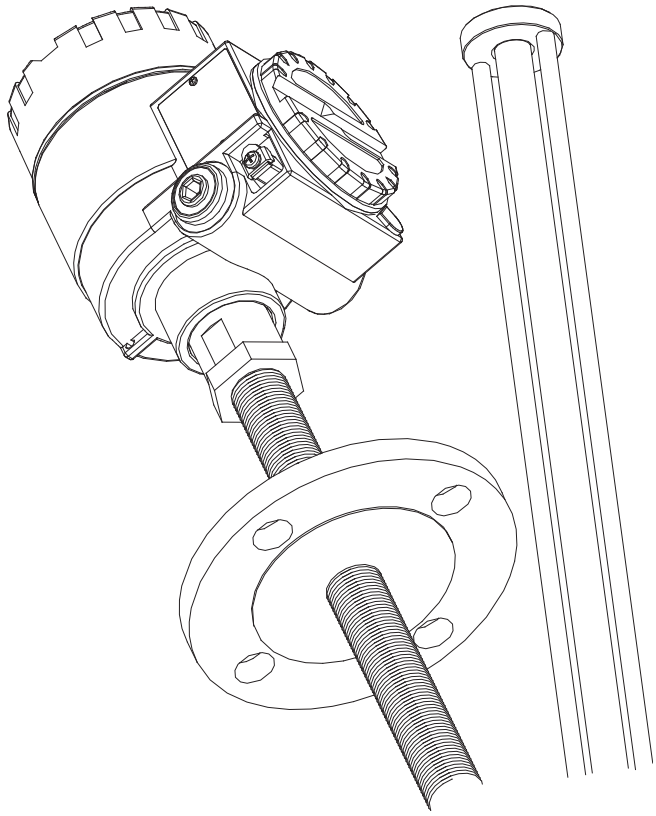
BA01026G/08/EN/19.15
71308663

Operating Instructions and Description of Instrument Function Prothermo NMT539

Temperature



Endress+Hauser
People for Process Automation

Basic Device Layout of Prothermo NMT539

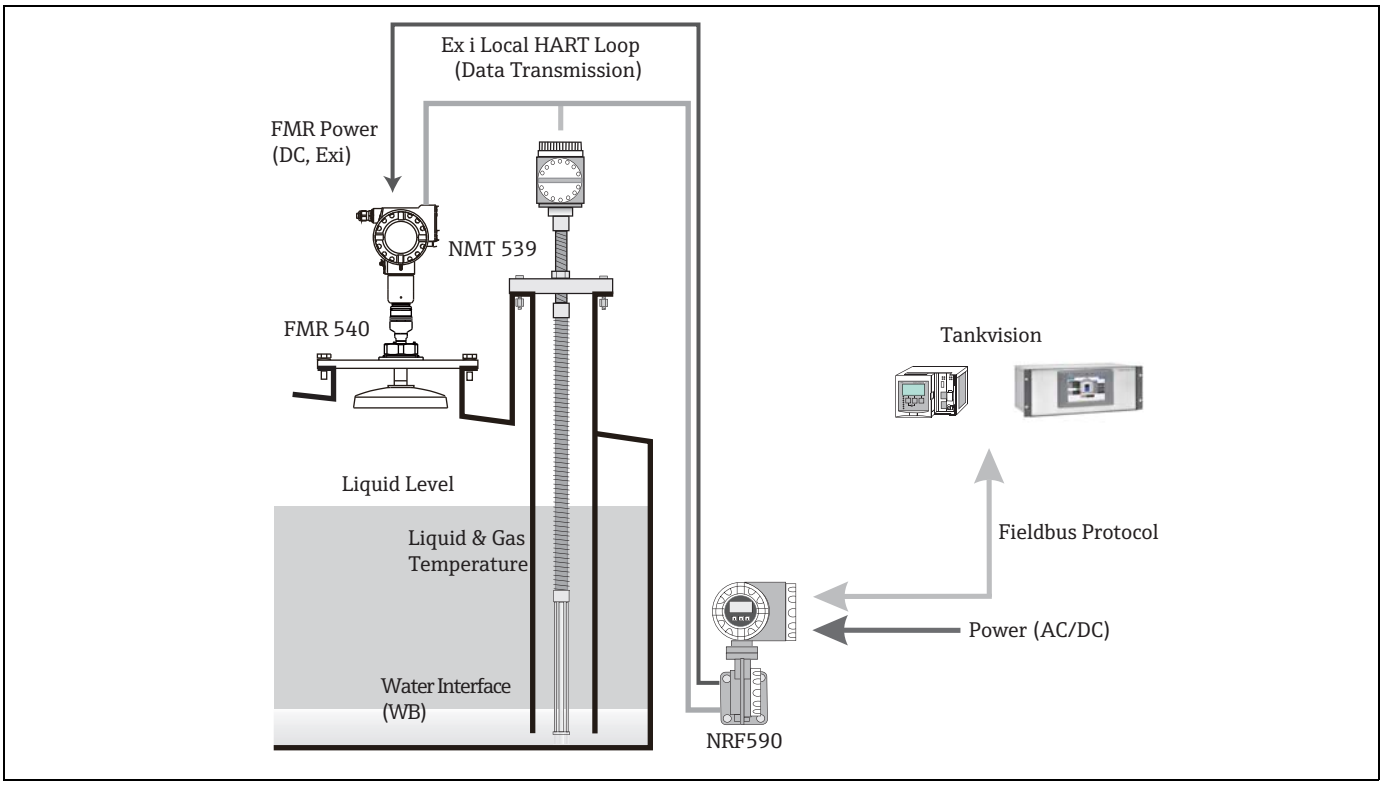


Figure 1: System Layout 1

1. Average Temperature Prothermo NMT539 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 NMT539. Refer to BA01025G/08/EN "Installation Instructions."

2. Wiring to Host Instruments (Tank Side Monitor NRF590 or Proservo NMS5/NMS7)

- 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 BA01025G/08/EN "Installation Instructions."

3. NMT539 Initial Setup

- Both NMT539's own device setting and local HART setting to the host instrument must be performed.

4. Data Flow from NMT539 to Host Instruments

- Individual element temperature data: Individual raw element temperature can be accessed regardless of liquid level information on the NMT539's data matrix.
- Average temperature data: The host instrument sends liquid level data on the local HART line to NMT539. NMT539 calculates both Gas and Liquid phase average temperature based on this given liquid level.
- WB (Water Bottom) 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 Notes on Safety Conventions and Symbols . . . 4
1.1 Symbols for Certain Types of Information 4

2 Initial Set Up 5
2.1 Local HART Connection 5
2.2 Device Setup: NRF590 6
2.3 Device Setup: NMS5/NMS7 7

3 Operation and Description of Instrument Function. 9
3.1 Local HART Device Designation 9
3.2 Device Data 9
3.3 Temperature Measurement 10
3.4 Water Bottom Measurement 22
3.5 Temperature + Water Bottom Measurement 28

4 Replacement 29

1 Notes on Safety Conventions and Symbols

To highlight safety-relevant or alternative operating procedures in this manual, the following conventions have been used, each indicated by a corresponding symbol on the left.

Symbol	Meaning
A0011189-EN	**DANGER!** This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
A0011190-EN	**WARNING!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
A0011191-EN	**CAUTION!** This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
A0011192-EN	**NOTICE!** This symbol contains information on procedures and other facts which do not result in personal injury.

1.1 Symbols for Certain Types of Information

Symbol	Meaning
A0011182	**Allowed** Indicates procedures, processes or actions that are allowed.
A0011183	**Recommendation** Indicates procedures, processes or actions that are recommended.
A0011184	**Forbidden** Indicates procedures, processes or actions that are forbidden.
A0011193	**Tip** Indicates additional information.

2 Initial Set Up

2.1 Local HART Connection

2.1.1 Endress+Hauser Tank Gauging Instrument

NMT539 is developed and designated primarily to work with Endress+Hauser tank gauging host instruments Tank Side Monitor NRF590 or Proservo NMS5/NMS7.
Both temperature and / or water bottom information are transmitted on a two wire i.s local HART loop to the host instrument. Since both NRF590 and NMS5/NMS7 have a pre-configured menu for NMT series functionality as default, simple wiring to NMT539 will complete the initial setup for NMT539.

⚠ CAUTION

- Refer to the Installation manual BA01025G/08/EN for NMT539 physical installation procedure prior to start up.
- The availability of each of the four parameters can vary depending on the selected NMT539 measurement function on the product code.

Temperature Measurement

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

Measurement Function

2: Water bottom + converter

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

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

2.2 Device Setup: NRF590

Connect the loop powered local HART communication cable from the NRF590 (intrinsically safe side compartment) to NMT539 according to Installation Instruction BA01025G.

Since NRF590 has been designed to recognize NMT539 as a specific Endress+Hauser local HART instrument, set up is easy.

2.2.1 HART Scanner

After the physical cabling between NMT539 and NRF590 is complete, scan all connected loop powered local HART devices by activating "HART SCAN" on NRF590.

⚠ WARNING

Not all NRF590 have fully accessible compatibility to recognize the NMT539. Consult with Endress+Hauser representatives to cross check the software and hardware version of NRF590.

2.2.2 NMT539 Specific Parameter Setup on NRF590

NOTICE

- Configuration of NMT539 parameters on the display of NRF590 is dependent on the installed software and hardware version of NRF590. Refer to the operating manual of NRF590 to determine accessible parameters.
- All required initial setup and configuration can be performed by FieldCare. Detailed information will be described in the following operation related chapters.

2.3 Device Setup: NMS5/NMS7

NMS5/7 is also specifically designed to recognize NMT539.
Terminals 24 and 25 of NMT539 and NMS5/NMS7 are connected by using local HART.

⚠ WARNING

The connection between NMS5/NMS7 and NMT539 is specified by Ex approval.
Refer to Installation Instruction BA01025G "4.4 Terminal Connection" for wiring.

2.3.1 Preparation of NMS5/NMS7

MS5/NMS7 must be pre-configured to accept the NMT539 connection via the multi drop local HART loop.

GVH362: NMT Connection

"Average Temp." must be selected in order to configure NMT539.

⚠ WARNING

To change this parameter, an access code is required. Refer to BA00401G "NMS5 Operation Instructions" for further information.

2.3.2 NMT539 Configuration on NMS5/NMS7

Most required NMT539 parameters can be configured on G4 "Temperature" matrix as it is on the display of NMS5/NMS7.

⚠ WARNING

WB (Water Bottom) sensor information is not available on NMS5/NMS7 before ROM version 4.24.
Consult with Endress+Hauser representatives to update the installed NMS5/NMS7 function.
Typical NMT539 parameters are displayed on the matrix of NMS5/NMS7

G0 Static Matrix

GVH010: Liquid Temp

Display average liquid temperature.

GVH013: Gas Temperature

Display gas average temperature.

G4 Dynamic Matrix: Temperature

GVH440: Liquid Temp

Display the same value indicated on GVH010 Liquid Temp.

GVH441: Gas Temperature

Display the same value indicated on GVH013 Gas Temperature.

GVH442: Measured Level

Display liquid level value established in NMS5/NMS7.
NMT539 must have liquid level data in order to calculate both liquid and gas phase average temperature.

GVH447: Reference Zero

Check that temperature transforming of measuring temperature resistor is performed correctly.
Allowable range: -1.0 to +1.0℃(+30.2 to +33.8℉)

GVH449: Reference 17

This temperature is used to check at the time of shipping.

GVH450 to 459: Temp No.1 to 10

Display the measuring value of temperature from each inserted element in the probe.
The value of element temperature above 11 to 16 must be selected at GVH470 "Select Point", then the values are shown at GVH473 "Element Temp."

GVH460 to 469: Element Position No.1 to 10

Display each element position in the probe.
Indicating element position above 11 to 16 must be selected at the GVH470 "Select Point", then the positions are shown at GVH474 "Element Position"

GVH470: Select Point

Select matrix of GVH471 "Zero Adjust", GVH473 "Element Temp", and GVH474 "Element Position." and input the desired element data.

GVH480: Diagnostic

Display of error code message. Refer to the error code chart in a later chapter of this manual.

GVH482: Total No. Element

Input 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.

NOTICE

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

GVH486: Bottom Point

The lowest inserted element position in the average temperature probe.

NOTICE

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

GVH487: Element Interval

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

NOTICE

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

3 Operation and Description of Instrument Function

This section is described for description for FieldCare.

NMT539 has segmented local HART device code depending on measurement function. Following 4 local HART device codes are normally pre-set at the factory by jumper setting.

⚠ WARNING

Do not change jumper setting by disassembling NMT539's internal module. It may cause major malfunction due to distorted precise factory calibration.

3.1 Local HART Device Designation

Local HART device code "184":
This code is the device code for temperature measurement function only. This 184 is specifically designed for NMT539 converter only version and converter + temperature version. No WB sensor is available with code 184.

Local HART device code "185":
This code is the device code for equipped NMT539 water I/F measurement function. FieldCare does not recognize code 185.

Local HART device code "186":
This code is the device code for fully equipped NMT539. NMT539 with converter + temperature + water bottom uses code 186.

3.2 Device Data

Tag Number: read and write
Default: local HART
This number is for 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
This number is for manufacture control number based on production process.

3.3 Temperature Measurement

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

NOTICE

Local HART device code will be only displayed when default header position or VH99 "Device Type Code" on FieldCare menu are available.

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

Measuring Function

0: Converter Only

1: Converter + temperature

4: Converter + temperature (W&M certification)

3.3.1 Primary Values: VH00 to VH09

VH00: Liquid Temp

Item type: read only
Range: -200℃ to 240℃

NOTICE

- Display measured liquid phase average temperature.
- Liquid level input must be provided by Micropilot radar level gauge (via NRF590) or NMS5/NMS7 series servo level gauge in order to calculate true liquid average temperature.

VH01: Gas Temp

Item type: read only
Range: -200℃ to 240℃
Display measured gas (vapor) phase average temperature.

NOTICE

Liquid level input must be provided by Micropilot radar level gauge (via NRF590) or NMS5/NMS7 servo level gauge in order to calculate true gas average temperature.

VH02: Measured Distance

Item type: read and write
Range: 0mm to 99999mm
Display provided liquid level by connected level gauge.
When level gauge is not connected, inputting liquid level is also available for the device test purpose.

VH07: Temperature 0

Item type: read only
Check that temperature transforming of measuring temperature resistor is performed correctly.
Allowable range: -1.0 to +1.0 ℃(+30.2 to + 33.8℉)

VH09: Temperature 17

Item type: read only
This temperature is used to check at the time of shipping.

3.3.2 Element Temperature 1: VH10 to VH19

VH10 to 19: Temperature 1 to 10

Item type: read only
Range: -200°C to 240°C
Display individual measured element temperature.

3.3.3 Element Temperature 2: VH20 to VH29

VH20 to 25: Temperature 11 to 16

Item type: read only
Range: -200°C to 240°C
Display individual element temperature.

VH26: Selec. Ave Method

Item type: select
Selection: Standard, Advanced
Selection average calculation method.

Standard:

Conventional Calculation Method
Regardless of tank shape, average temperature calculation will be performed based on following example. example: liquid temperature

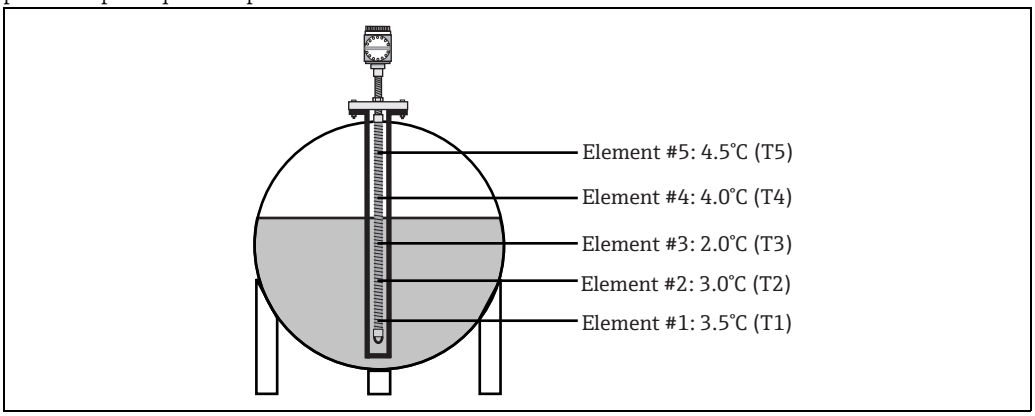


Figure 1: Conventional Calculation Method (Standard)

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)

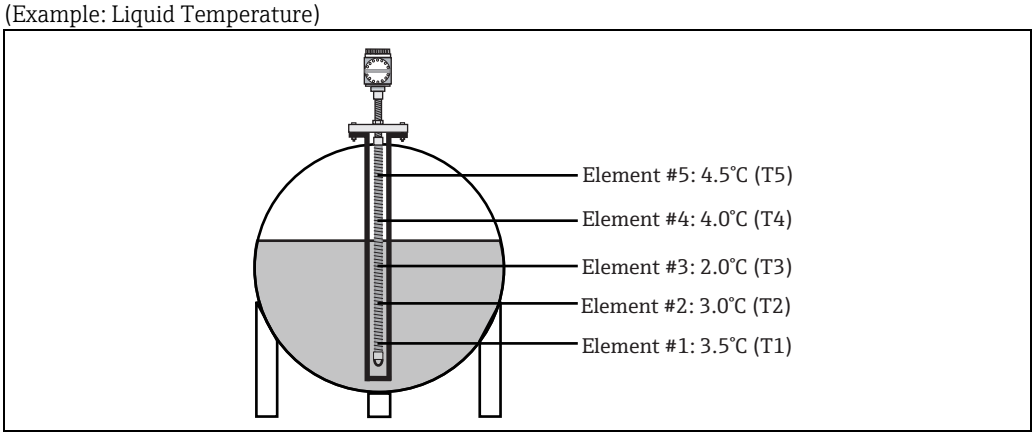


Figure 2: Conventional Calculation Method (Advanced) 1

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

NOTICE

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

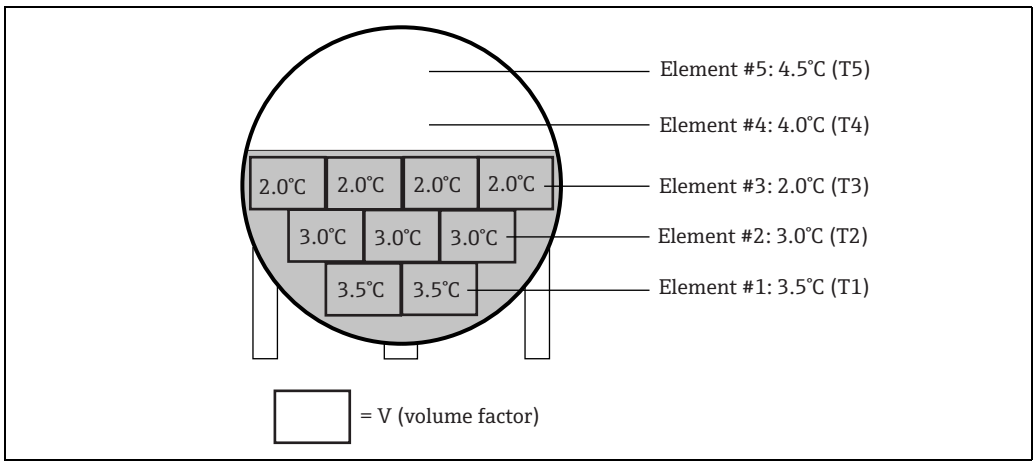


Figure 3: Conventional Calculation Method (Advanced) 2

(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: Display of Sequence

Item type: select
Selection: Spot, Multi
Select element physical layout in the probe.
NMT539 Converter Only version requires this function when it has connected to foreign average temperature probe.

WARNING

NMT539 Converter + Temperature version always has "Spot" element layout. Selecting parameter "Multi" will cause faulty calculation.

Spot:

When some elements are located in each input cable in the probe; average calculation is performed based on sum of submerged element temperature value/total number of element submerged.

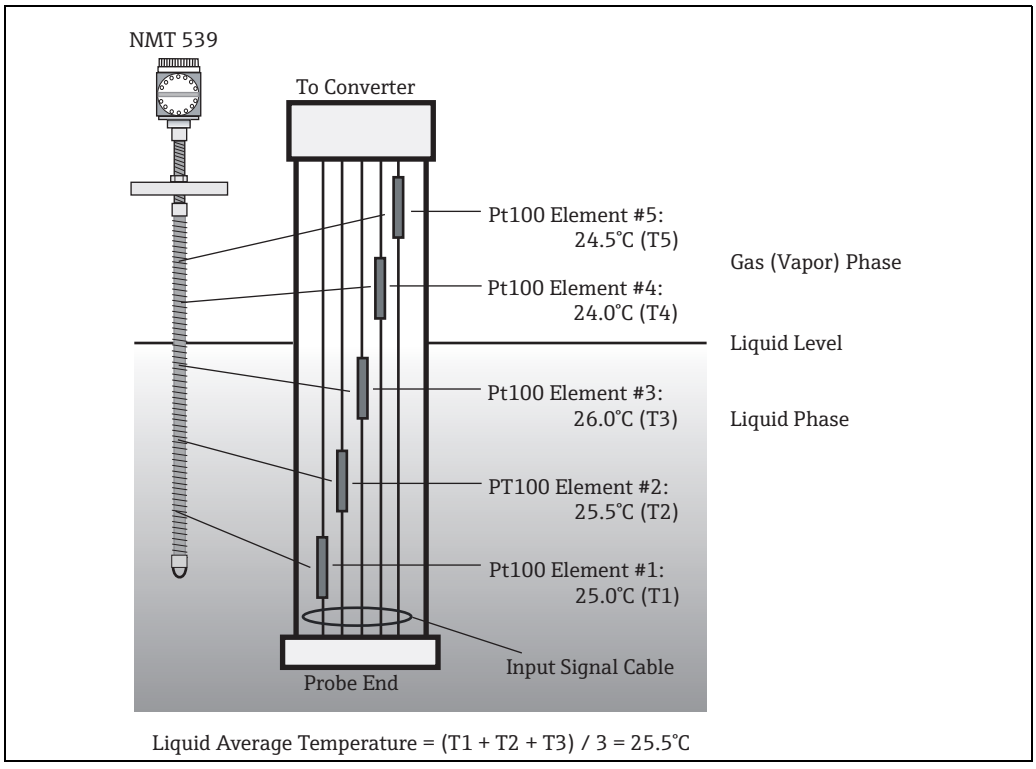


Figure 4: Spot Temperature

Multi:

When different or number of elements are located in each input cable; average temperature is considered as the closest submerged element to the liquid level.

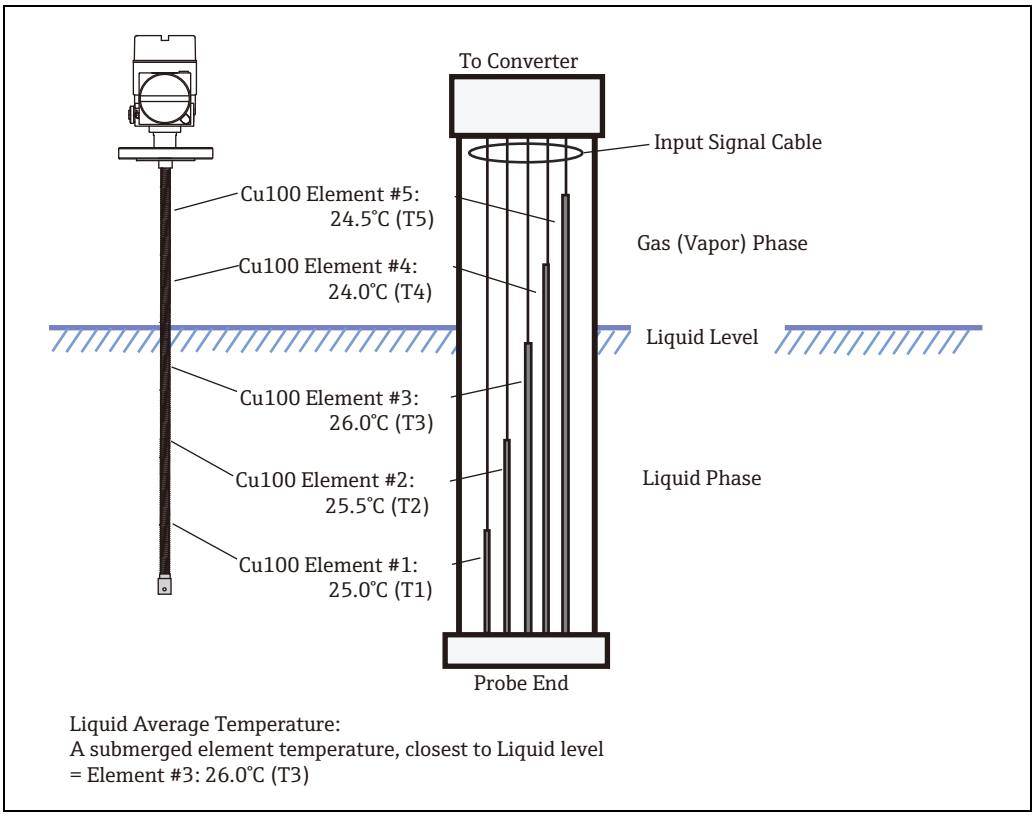


Figure 5: Multi Temperature

VH28: Lower Limit

Item type: read and write
Default value: -20.5°C
RANGE: -999.9°C to 999.9°C
Display 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 to 999.9°C
Display high limit temperature of measurement element. This value is used for judgment of element disconnection.

3.3.4 Element Position 1: VH30 to VH39

VH30 to VH39: Position 1 to 10

Item type: read and write
Range: 0mm to 99999mm
Individual element position from the bottom of the tank
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.

3.3.5 Element Position 2: VH40 to VH49

VH40 toVH45: Position 11 to 16

Item type: read and write
Range: 0mm to 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: Hysteresis Width

Item type: read and write
Default: 10mm
Range: 0mm to 99999mm
Element switching point hysteresis
Hysteresis, which is entered as an offset value, can prevent hunting caused by fluctuations as water surface. The width of hysteresis changes corresponding to the width of fluctuations.

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 to 99999mm
When a temperature element in the gas (vapor) phase is within the range of 300mm shown below, it is not used for the average temperature calculation of the gas temperature.

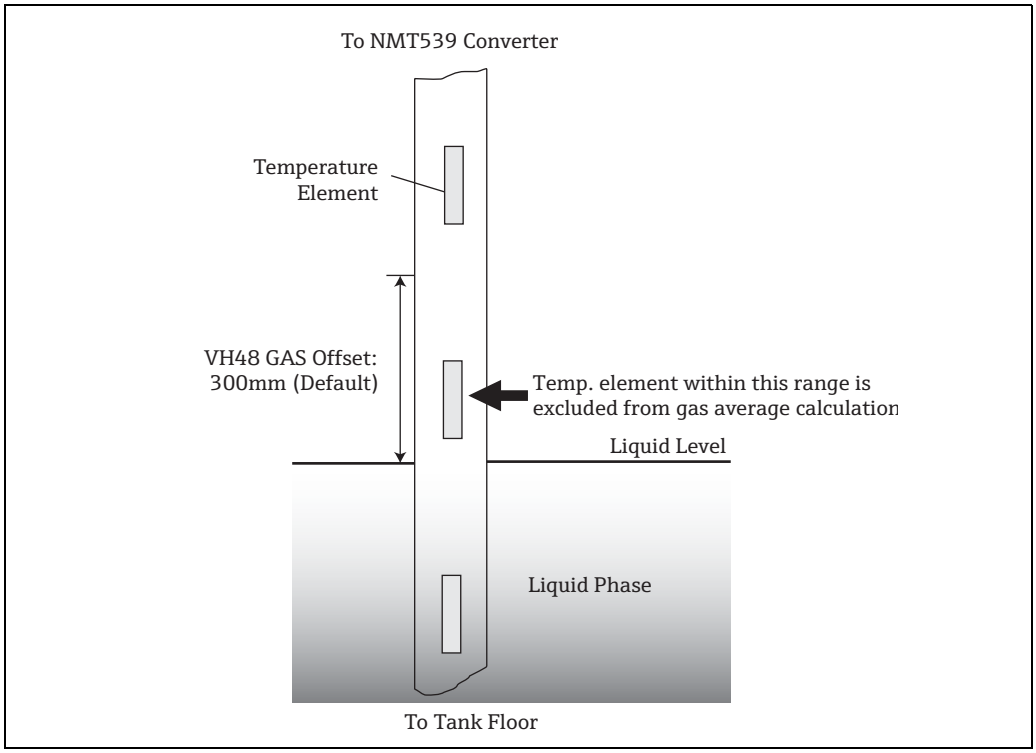


Figure 6: Gas Offset

VH49: Liquid Offset

Item type: read and write
Default: 300mm
Range: 0mm to 99999mm
When a temperature element in the liquid phase is within the range of 300mm shown below, it is not used for the average temperature calculation of the gas temperature.

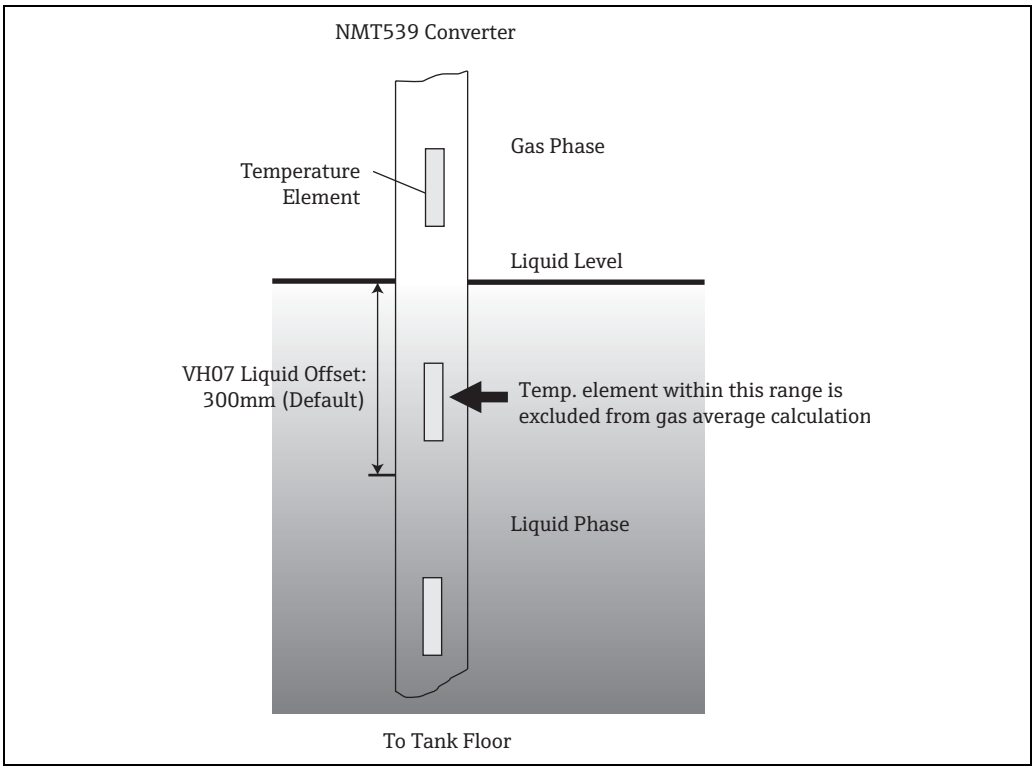


Figure 7: Liquid Offset

3.3.6 Advanced Temp: VH50 to VH59

VH53: Element Point

Item type: select
Default: 0
Selection: 0 to 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 to 99999mm
Display of the selected element position at VH53.

VH55: Element Volume

Item type: read and write
Range: 1 to 99999.9
Set additional factor on the selected element at VH53. Additional volume can be added to the individual element for advanced average temperature calculation (refer to "Select Average Method" for details on the description of VH26).

3.3.7 Temperature Adjustment: VH70 to VH79

VH70: Element Select

Item type: select
Range: 0 to 19
Select "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 to 1000.0
Zero adjustment of individual element selected at VH70
Comparing to precision reference thermometer, when measuring value shows minor offset value, the reading value can be adjusted.

NOTICE

Set "-0.2" in this matrix if 1) selected element #2 indicates 25.4°C and 2) reference thermometer indicates 25.2°C. After setting the value, the offset value which is based on the actual measuring value of the element #2 will be -0.2°C.

VH72: Adjust Span

Item type: read and write
Default: 1
Range: 0.8 to 1.2
The span adjustment can apply to all the installed temperature elements.
A linearized factor of given parameter is multiplied to raw element measurement for final calculation.

VH73: Temperature X

Item type: read only
Specified element temperature selected at VH70
Display the temperature of the element selected at VH70 and display the individual element temperature shown at VH10 - VH25.
The value is calculated based on the following formula.

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

VH74: Position X

Item type: read and write
Range: 0mm to 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
Display the element resistance selected at VH70.

VH76: Resistance Adjustment

Item type: read and write
Default: 0
Range: -1000.0 to 1000.0
Adjust the element resistance at VH70.
Minor resistance adjustment can be applied on the reading value.

NOTICE

Set "-0.3 Ohm" in this matrix if 1) selected element #5 indicates 100.3 Ohm and 2) reference precision resistor indicates 100.0 Ohm under the same environment condition. After setting the value, the offset value which is based on the actual measuring value of the element #5 will be -0.3°C.

VH77: Element Type

Item type: select
Selection: Pt100, Cu90, Cu100, PtCu100, JPt100
Select the element conversion formula when foreign average temperature probe is connected to NMT539 Converter Only version.

⚠ CAUTION

NMT539 Converter + Temperature version always consists "Pt100" element with "Spot" element layout. Do not change these parameters.

Element Conversion Formula:

Pt100 (formula above 0°C): R = -0.580195 x 10-4 x T2 + 0.390802 x T +100

Pt100 (formula below 0°C): R = -4.2735 x 10-10 x T4 + 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

R: Resistance Value T: Temperature

VH78: Average Number

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

NOTICE

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 to 999
Access code 530 to enable select and write command available

3.3.8 Device Setting 1: VH80 to VH89

VH80: Present Error

Item type: read only
Display the error message.
Following code will be indicated.
For detailed description, refer to the separate BA1025G Operating Instruction "Troubleshooting".

Error Code

0: No error presence
1: Common line open
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)
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: ℃
Selection: ℃, ℉, ℃K
Select the temperature display unit.
Based on universal local HART setting, ℃(HART code: 32), ℉ (HART code: 33), or ℃K (HART code: 35) is available.

NOTICE

Selection of temperature display unit only applies to reply data from NMT539. Data transmission from host gauge (NRF590 or NMS5/NMS7) to NMT539 is performed by ℃ unit only.

VH82: Element Number

Item type: read and write
Default: 10 (NMT539 Converter Only version)
Range: 1 to 16
Entering # of available temperature element.

⚠ CAUTION

This function mainly used with NMT539 Converter Only version.
Do not change the default parameter on NMT539 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 to 20
Set # of preamble for local HART communication.

⚠ CAUTION

Do not change default value. Changing value may cause communication error.

VH84: Distance Unit

Item type: select
Default: mm
Selection: ft., m, inch, mm
Select the level display unit.
The unit applies to liquid level display on VH02 "Liquid Level" and VH50 "Water Bottom Level."
Level units are coded based on universal local 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 (NMT539 Converter Only version)
Selection: Even Interval, Not Even
Select the element interval depending on the spacing layout.
This function is normally used for NMT539 Converter Only version.

⚠ WARNING

Do not change parameter on NMT539 Converter + Temperature version unless repairing.
Interval and individual element positions are physically determined at factory.

VH86: Bottom Point

Item type: read and write
Default: 500mm
Range: 0mm to 99999mm
Input the position of the lowest element (#1 element) from the tank bottom.
#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 (NMT539 Converter Only version)
Range: 0mm to 99999mm
Designate Even Interval spacing.

NOTICE

Changing element interval and setting element position are only applied to reconfigure switching points for average temperature calculation. The physical position of element does not change.

VH88: Short Error

Item type: read and write
Default: -49.5
Range: -49.5 to 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: 359.0
Range: -49.5 to 359.5
Selected element data is output when the element has open circuit
Method of display can be configured at VH92 "Error Display Select."

3.3.9 Device setting 2: VH90 to VH99

VH90: Device ID Number

Item type: read and write
Default: 0
Range: 0 to 16777214
In order to distinguish own device ID when NMT539 is connected in multi drop local HART loop.

⚠ CAUTION

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

VH91: Previous Error

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

VH92: Error Dis. Sel.

Item type: select
Default: 0_OFF
Selection: 0_OFF, 1_ON
Select the type of display of VH88 "Short Error Value" and VH89 "Open Error Value".
0_OFF: These 2 error messages will not be transmitted to the connected host gauge.
This function automatically excludes 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: read
Default: Set default setting depending on the specification at factory.

NOTICE

Write protection of hardware is located on main CPU board (CN3 connector).

VH94: Polling Address

Item type: read and write
Default: 2
Range: 1 to 15
Polling address for local 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
Display installed software version.

VH97: Hardware Version

Item type: read only
Display installed hardware version.

VH98: Below Bottom

Item type: select
Default: 0_OFF
Selection: 0_OFF, 1_ON
Display a type of error 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
Display the device type.

- 184: Temperature measurement function only
- 185: WB function only
- 186: Temperature + WB function

3.4 Water Bottom Measurement

A local HART device codes "185" is designated to perform only water bottom (water interface) measurement function.

NOTICE

local HART device code will be only displayed when default header position or VH99 "Device Type Code" on FiledCare menu is available.

The device of the temperature measurement function designated by order code is as follows.

Measuring Function
2: Converter + WB probe

3.4.1 Element Position: VH40 to VH49

VH47: Clear Memory

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

3.4.2 WB primary and Advanced Temp: VH50 to VH59

VH50: Water Level

Item type: read only
Display the measured water I/F level "Water Bottom."

NOTICE

Measurement value is calculated based on the following formula.

$$VH50 = \left[\frac{(VH52 - VG60) \times VH59}{VH63} \right] + VH58$$

VH52: Measured WB probe frequency
VH60: Empty Frequency
VH63: Frequency change/mm
VH59: Linear factor of WB probe
VH58: Offset value

VH51: Capacitance

Item type: read only
Range: 1000mm probe: 10 to 1000pF
2000mm probe: 10 to 2200pF
Display the calculated WB probe capacitance based on frequency.

VH52: WB Frequency

Item type: read only
Range: 1200Hz to 4500Hz
Display of WB probe measured frequency.

VH57: Sel. Water Span

Item type: select
Selection: 1000mm, 2000mm
Select WB probe length.

VH58: Offset Water

Item type: read and write
Default: about 100 to 110 This value is configured individually at the factory
Range: -200 to +2000
Set WB level offset of measuring value.

NOTICE

When measured WB value is 530mm and hand dip measurement indicates 535mm;
Enter +5.000 at VH58. This allows a constant adjustment of offset value of +5mm.

VH59: Water Span

Item type: read and write
Default: 1
Range: 0.1 to 99.9
Adjust a linearity of WB probe capacitance.
The linear incline can be adjusted in order to compensate minor WB probe characteristic.

3.4.3 WB Adjustment and Operation Power: VH60 to VH69

VH60: Empty Frequency (Frequency of VH58)

Item type: read and write
Default: 1about 1800 to 200Hz, this value is configured individually at the factory
Range: 0Hz to 9999Hz
Enter measured frequency (VH52 value) when WB probe is submerged in oil (and when WB probe does not touch water).

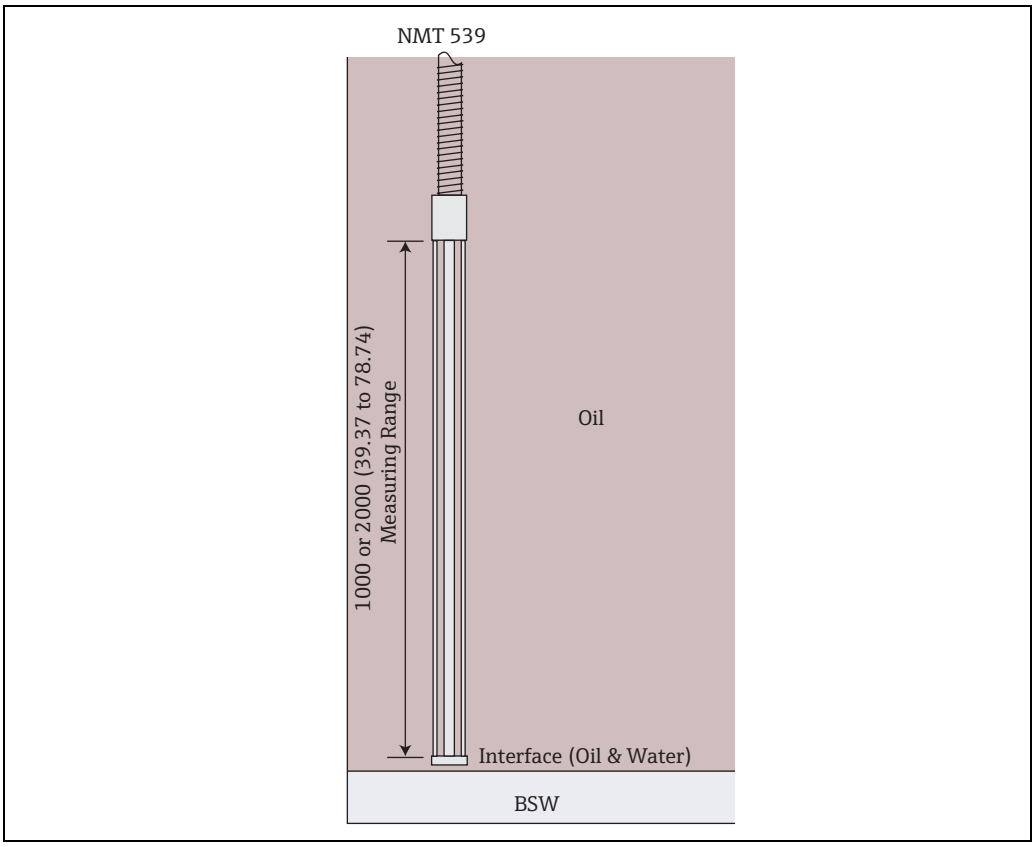


Figure 8: Empty Frequency, Unit of Measurement: mm (in)

VH61: Full Frequency

Item type: read and write
Default: about 3600 to 4400Hz, this value is configured individually at the factory
Range: 0 to 9999Hz

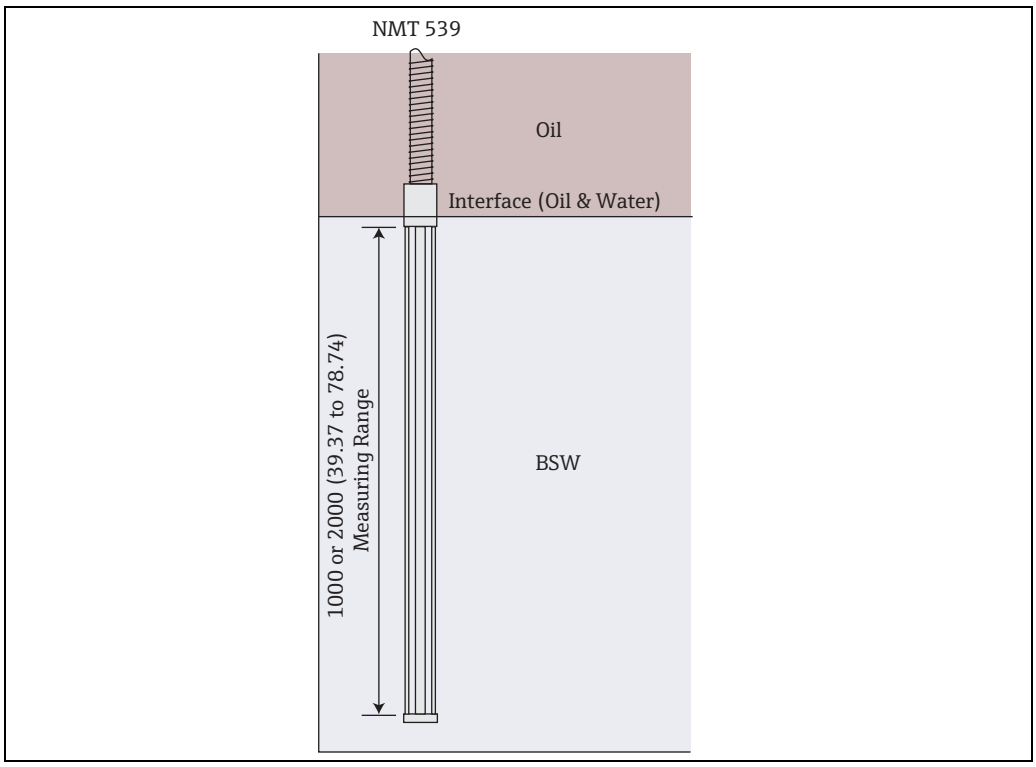


Figure 9: Full Frequency, Unit of Measurement: mm (in)

VH62: Probe Length

Item type: read and write
Default: about 800mm or 1800mm, this value is configured individually at the factory.
Range: 1mm to 9999mm
Enter the WB probe calibration distance (length).
An actual measurement range is determined by the physical probe length.

NOTICE

The default setting of probe length is 800mm or approximately 1800mm. The calibration was done at the factory as follows: 1) for VH60 "Empty Frequency" under no-water-environment (0mm water I/F); 2) for VH63 "Water Factor" the probe is set at linearity; and 3) for VH61"Full Frequency" the probe is set so that it is completely submerged in water (1000mm or 2000mm or more water I/F).

Formula: (VH61 - VH60) / VH62 = VH63
Example at factory default:

- VH57 = 1000mm
- VH58 = 108.1mm
- VH60 = 2127.4Hz
- VH61 = 4291.8Hz
- VH62 = 797.2mm
- VH63 = 2.71Hz/mm

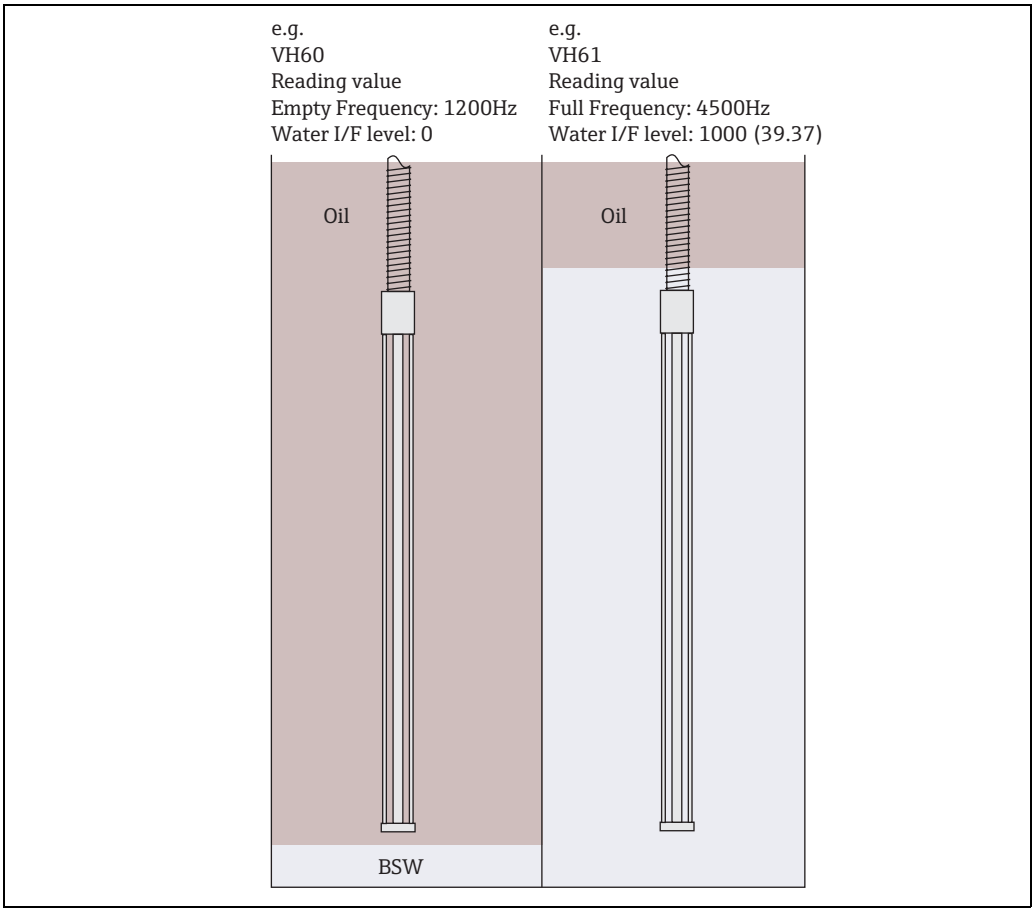


Figure 10: Probe Length, Unit of Measurement: mm (in)

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

Re-calibration at Actual Site in Operating Tank

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

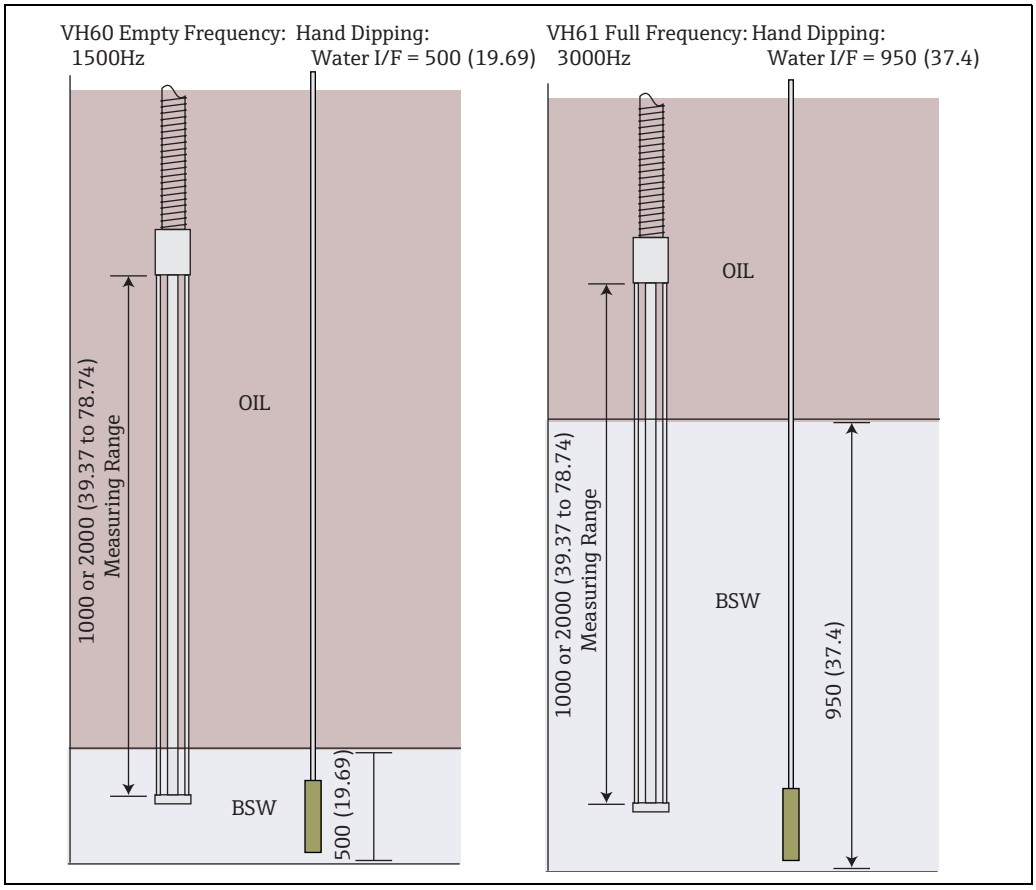


Figure 11: Re-calibration, Unit of Measurement: mm (in)

e.g.:

950mm - 500mm = 450mm

Re-calibrated WB probe linearity in operating tank

(3000Hz - 1500Hz) / 450 = 3.33Hz / 1mm

- VH60 Empty Frequency: 1500Hz (input VH52 value for the case of 500mm)
- VH61 Full Frequency: 3000Hz (input VH52 value for the case of 950mm)
- VH62 Probe Length: 450mm (input calculated result)
- VH63 Water Factor: 3.33Hz (reference)

⚠ WARNING

The actual in-tank condition of WB probe linearity may vary depending on the default conditions. The probe linearity is largely affected by the characteristics of liquid (both oil and water), in-tank temperature, and other surrounding environment may offset the probe linearity.

VH63: Water Factor

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

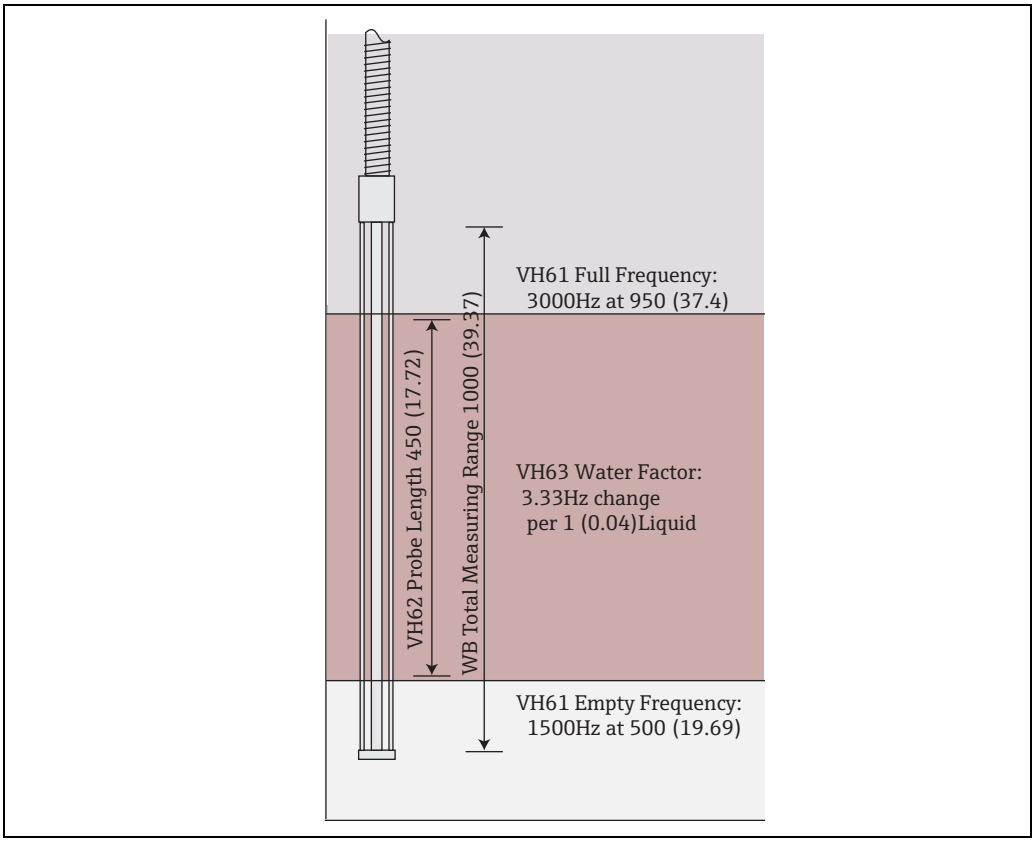


Figure 12: Water Factor

NOTICE

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 to 255 (0 to 3V)
Display the temperature element line (both signal and common) running voltage. Detected voltage across common line (shall be between 0 to 3V) is converted at a range from 0 to 255 count when it is displayed.

VH68: Output Current

Item type: read and write
Default: 16000 at 6mA
Range: 0 to 65535
Output current is set according to the specification.

⚠ CAUTION

Do not change default value. It has been set at shipment.

VH69: Reference Voltage

Item type: read and write
Default: 10 (PTB type approx.93)
Range: 0 to 255
This parameter is to draw the failure alarm of the power supply. NMT539 operates the supply voltage at 15VDC or more via multi drop local HART loop under normal operating condition. NMT539 transmits error message when supply voltage drops 15VDC or less.

3.4.4 Temperature Adjustment: VH70 to VH79

NH79: Protect Code

Item type: read and write
Default: 0
Range: 0 to 999
Access code 530 is to enable selection and configuration

3.5 Temperature + Water Bottom Measurement

Local HART device code "186" is designated to perform both temperature and Water Bottom functions as a fully integrated NMT539. Available parameters and functions are as follows. Description of these parameters are based on FieldCare menu.

NOTICE

HART device code will be only displayed when default header position or VH99 "Device Type Code" on FieldCare menus is available.
Designated temperature and Water Bottom measurement function device is based on the following order structure.

Measuring Function

3: Converter + temperature + WB

5: Converter + temperature + WB (W&M certification)

Refer to the previous sections about temperature and Water Bottom measurement function.

4 Replacement

After replacing CPU board of NMT539, the parameters must be manually re-entered into the replaced CPU board for proper functions.

After replacing CPU board, check the following Matrix parameters.

NMS5/NMS7 GVH	FieldCare/Contents
443	Level Select
450 to 459	Element position No. 1to 9
470	Element Select (element 0 to 15)
474	Position X (set element position at GVH=470)
482	Element Number
485	Kind of Interval
486	Bottom point
487	Element Interval (when selecting evenly interval at GVH=485)

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