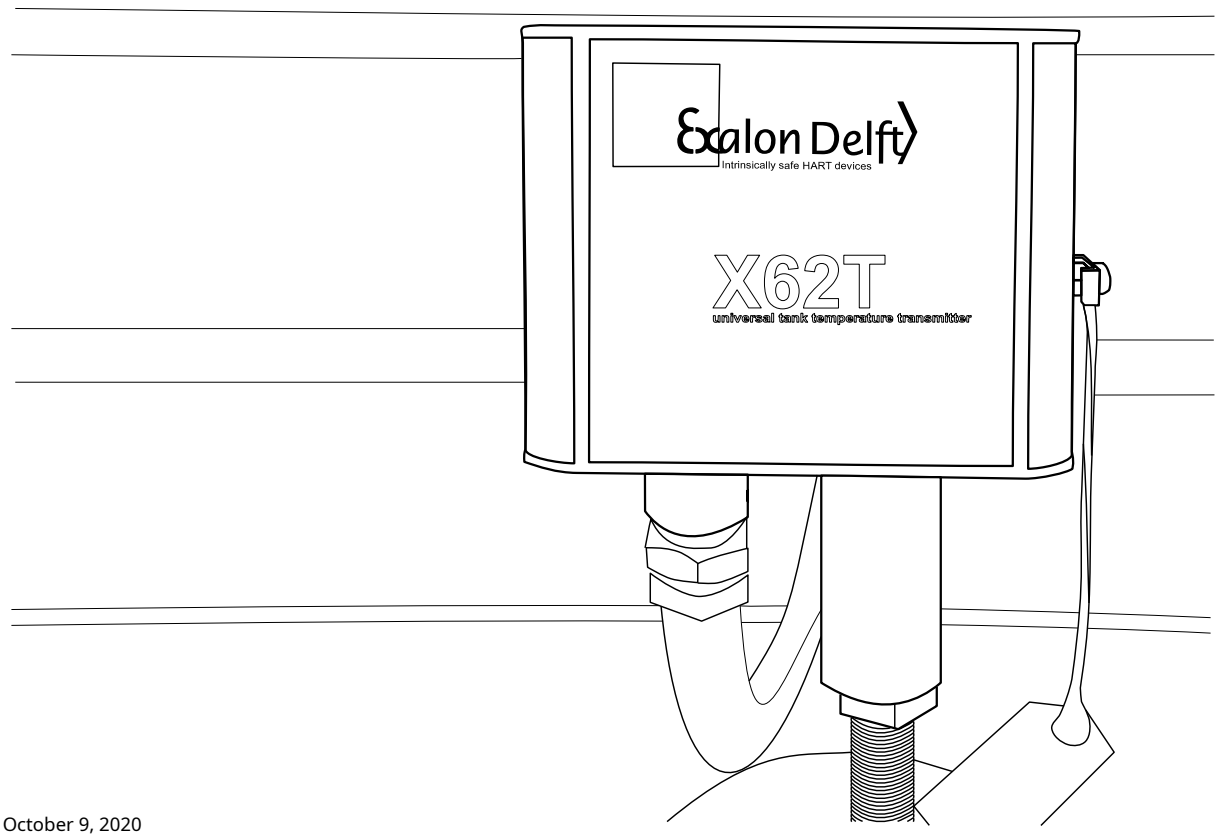
Excalon Delft
electronic product design

X62T-NMT Installation Guide



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Rev. 2

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1 Preface

1.1 Document conventions

Warnings, **Cautions** and **Notes** are used throughout this installation guide to bring special matters to the immediate attention of the reader.

- A Warning concerns danger to the safety of the technician or user.
- A Caution draws the attention to an action which may damage the equipment.
- A Note points out a statement deserving more emphasis than the general text.

1.2 Preface

This installation guide is intended for technicians involved in the mechanical and electrical installation of the Exalon Delft X62T Interface. The technician must have basic technical skills and knowledge of safety regulations and explosion proof equipment in hazardous areas and must work in accordance with the (local) requirements for electrical equipment in hazardous areas.

Warning
In hazardous areas it is mandatory to use personal protection and safety gear such as:
hard hat, fire-resistive overall, safety shoes, safety glasses and working gloves.
Avoid possible generation of static electricity.
Use non-sparking tools and explosion-proof testers.
Make sure no dangerous quantities of combustible gas mixtures are present in the working area.
Never start working before the work permit has been signed by all parties.
Pay attention to the kind of product in the tank. If any danger for health, wear a gas mask and take all necessary precautions.

The X62T is installed external to storage tanks and converts temperature and capacitance parameters from sensors provided by third parties which are installed inside the storage tank. Please refer to the sensor manufacturers installation guide for details on installing the sensor inside the tank.

Warning
Do not use the instrument for anything else than its intended purpose.

Warning
Improper installation of cable glands, conduits or stopping plugs will invalidate the
Ex approval of the X62T Interface.

Caution
The X62T Interface has intrinsically safe output/input circuits. Modifications to the instrument may only be carried out by trained personnel with written authorization from Exalon Delft. Unauthorized modifications will invalidate the approval certificate and impair safety.

1.3 Legal aspects

The mechanical and electrical installation shall only be carried out by trained personnel with knowledge of the requirements for installation of explosion proof equipment in hazardous areas.

- Deviation from any of the prescribed procedures.
- Execution of activities that are not prescribed.
- Neglect of the general safety precautions for handling tools, use of electricity and microwave radiation.

The contents, descriptions and specifications are subject to change without notice. Exalon Delft B.V. accepts no responsibility for any errors that may appear in this installation guide.

1.4 EC Declaration of Conformity

This Exalon Delft instrument is in conformity with all applicable EC Council Directives, including the EMC Directive 2014/30/EU and the ATEX114 Directive 2014/34/EU. Refer to the EC Declaration of Conformity supplied with each instrument separately.

1.5 Additional information

Please do not hesitate to contact Exalon Delft or its representative if you require additional information.

2 Introduction

2.1 What is the X62T-NMT?

The X62T is a Tank Thermometer transmitter based on the X62U multi-input HART transmitter. The X62U is a modern micro controller based transmitter design with inputs that are software configurable for precision resistor, thermocouple and capacitive sensor inputs. By programming different firmwares X62T-HART (HART configurable multi-input transmitter), X62T-MIT (Honeywell Enraf 862 MIT emulation), X62T-MIR (Honeywell Enraf 862 MIR emulation), X62T-VT (Honeywell Enraf 762 VITO® or 762 VITO®LT emulation), X62T-VR (Honeywell Enraf 762 VITO® MRT) and X62T-NMT (Endress+Hauser Prothermo NMT539) are implemented.

The X62T-NMT can be connected to Endress+Hauser Micropilot NMR81 gauges. Compatibility has been verified with the NMT359 Prothermo firmware version 151 and the NMR81 firmware version 01.04.01-1720.

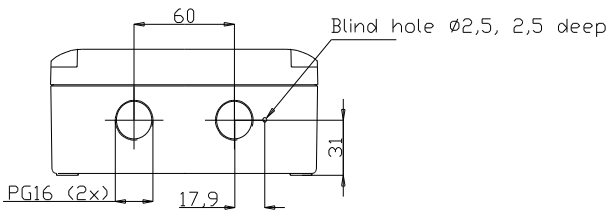
Both enclosure entry openings of the X62T-NMT (in deviation from the X62T Installation Guide PN 500013) are PG16:

- The cable entry allows a PG16 cable gland or adapter to be used (not supplied).
- The MTT entry is also PG16 with positioning hole compatible to the original Enraf MTT G1/2-G1/2 adapter. If you are upgrading from a Enraf 862 MIT this adapter will already be glued on top of the 864 MTT. In a new installation or when replacing a Enraf 762 VITO you will require a Exalon Delft X62T-G1/2-M/F adapter (sold separately).

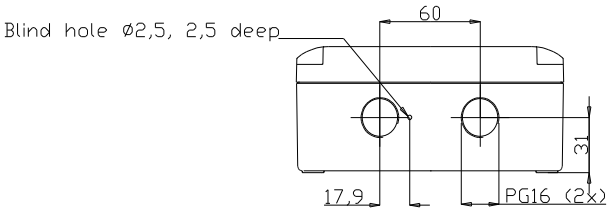
2 versions of the X62T-NMT enclosure can be selected: X62T-NMT/H and X62T-NMT/W:

/H This is the default enclosure.

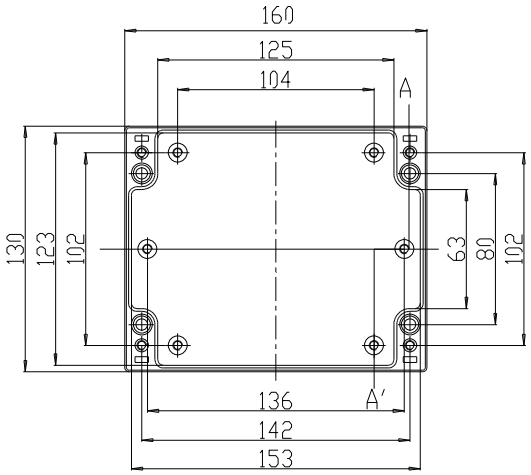
/W In certain installations with rigid conduits it may be difficult to mirror the external connections. In this case the /W enclosure can be applied. Internally the MTT wires will cross the host connection wires.
As the MIT wires and host wires are 2 different Intrinsically Safe circuits they MUST be kept isolated with a total of > 0.5mm solid isolation. An additional isolation sleeve (not supplied) may be needed to increase solid isolation.

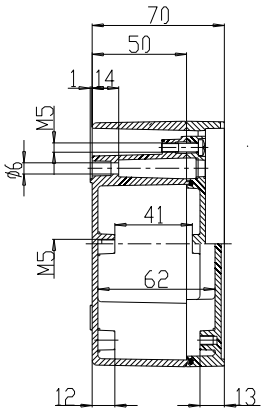


X62T-NMT/H



X62T-NMT/W





Mounting holes

3 Instructions for use in potentially explosive atmospheres

3.1 Explanation of the type identification code

Designation according to Directive 2014/34/EC: CE 0344 Ex II 2(1) G

- Notified body performing the QA surveillance: DEKRA Certification
- Equipment Group II : Surface Industries
- Equipment Category 2(1) : Suitable for installation in Zone 1 with wiring into Zone 0
- For explosive mixtures of gases, mists, or vapors in air

Ex marking (type of protection): **Ex ia IIB T4**

- Electrical apparatus with explosion protection Ex ia when connected to ATEX certified associated apparatus with protection [Ex ia] or Ex [ia]
- Gas group IIB
- Temperature class T4

EC-Type Examination Certificate Number: KEMA 06ATEX 0294X

Special conditions for use:
The programming terminal CN9 of the X62T is not Intrinsically Safe. Programming is only allowed using special tools provided by Exalon Delft.

Warning
Do not program the X62T in the Hazardous Area.

Caution
Connecting the X62T directly to a RS232 port may (unnoticeably) damage the Intrinsically Safe circuitry inside the X62T. The X62T shall only be connected to an Exalon Delft supplied programming adapter. Refer to your local distributor when a software upgrade is necessary.

3.2 Electrical connections

3.2.1 Environmental conditions

Temperature	-40 °C < Ta < +70 °C
Ingress Protection	IP65 (with proper installation)
Pressure	Atmospheric
Humidity	0 – 100%RH

3.2.2 Nominal input voltage

Input voltage	14V @ 10.5mA (low current mode)

3.2.3 Ex i parameters

Power supply / Output circuit / HART (CN1)		Sensors / Input circuit (CN3) (circuits combined)	
Ui	30V	Uo	5.9V
Ii	270mA	Io	62mA
Pi	1.2W	Po	92mW
Ci	5nF	Co	900uF
Li	-	Lo	30mH

Power supply / Output circuit are infallibly galvanically isolated from Sensors / Input circuit.

3.2.4 Grounding

Proper grounding of the X62T Interface to the tank (P.E.) is required. Use the external ground terminal on the X62T Interface housing.

Warning
When measuring the ground resistance, use a suitable explosion-proof tester.

Note
Grounding shall be performed according to local regulations.

3.2.5 Lightning protection

The field bus terminals of the X62T are floating except for a 90V gas arrester. If the field wiring isolation needs to be tested the internal wire from terminal CN1-2 and CN1-4 (see Figure 5: Connection of probe wires for an MTT or VITO MTT) to the enclosure may need to be temporarily disconnected.

3.2.6 Wiring inside the enclosure

Supply and input circuits are separate Intrinsically safe circuits. Keep wiring separated with a minimum distance of 6 mm. When necessary use a suitable cable binder (not supplied) or isolation sleeve.

3.2.7 Supply cable

Follow local regulations for routing of I.S. wiring. Use shielded twisted pair, loop resistance < 50Ω. Using Co / Lo from the gauge:
Cc ≤ Co – 5nF, Lc ≤ Lo.

Note
Use metallic cable glands (M16/EMC/IP68) to provide good contact between cable shield and X62T Interface housing.
The shield of the cable shall be connected inside the cable gland and connected to ground at both ends of the cable.

4 Verification before installation

4.1 Compatibility of the X62T-NMT to Enraf probes

The X62T-NMT supports the same MTT probes as the Enraf 862 MIT interface as well as 764 and 767 VITO MTT /LT based probes, 863 MRT and 361 MPT probes. See Table 1: Supported Enraf probes for a full list.

You can identify a compatible probe from the identification code on the type plate:

□□□□**YYYX**□□□**0**□□□**0**

Table 1: Supported Enraf probes

YYY	X	Description
864		Supported obsolete 16 spot probe. Pt100 at 65mm from probe bottom.
764	A	Supported obsolete 16 spot probe. Pt100 is the second spot at 1m from the probe bottom. Lowest spot at 65mm from probe bottom.
764	B	Supported obsolete 16 spot probe. Pt100 is the lowest spot at 65mm from probe bottom.
764	C	Supported16 spot temperature probe, Pt100 is the lowest spot at 1m from probe bottom.
764	D	Supported16 spot temperature probe. Pt100 is the second spot at 1m from the probe bottom. Lowest spot at 65mm from probe bottom.
766	A	Not supported obsolete combined water and 16 spot temperature probe. Pt100 is the lowest spot at 1m from probe bottom.
766	B	Not supported obsolete combined water and 16 spot temperature probe. Pt100 is the second spot at 1m from the probe bottom. Lowest spot at 65mm from probe bottom.
766	C	Not supported combined water and 16 spot temperature probe. Pt100 is the lowest spot, location see table.
766	D	Not supported combined water and 16 spot temperature probe. Pt100 is the second spot, location see table. Lowest spot at 65mm from probe bottom.
767	C	Supported 9 spot temperature probe, Pt100 is the lowest spot at 1m from probe bottom.
767	D	Supported 9 spot temperature probe. Pt100 is the second spot at 1m from the probe bottom. Lowest spot at 65mm from probe bottom.
768	C	Not supported Combined water and 9 spot temperature probe. Pt100 is the lowest spot, location see table.
768	D	Not supported Combined water and 9 spot temperature probe. Pt100 is the second spot, location see table. Lowest spot at probe bottom.
765	*	Not supported VITO Water probe only.
361		Supported MPT probe.

YYY	X	Description
365		Not supported Combined MPT and Water probe.
863		Supported MRT probe without spot element.
863		Supported MRT probe with spot element.
863		Not supported MRT probe with spot element and separate spot element for vapor.
863		Not supported Dual Element.

For MTT probes: when the Pt100 is the second spot, the lowest spot is a thermocouple. This lowest thermocouple spot is always wired with an ORANGE wire. With an ORANGE wire present, the probe type is D (or B, now obsolete).

4.2 Determine mechanical dimensions

4.2.1 Mechanical dimensions of an MTT or MTT LT

Mechanical dimensions can be determined from the MTT probe type identification plate. You will need these dimensions to configure the temperature transmitter correctly.

- The sensitive length is always measured from the position of the Pt100 to the highest element. From a Honeywell Enraf gauging system this value can be calculated from item ‘MK’ stored in the gauge.
- The lowest spot position is measured from the bottom of the probe to the center of the lowest spot element. The height from Tank Zero to the position of the lowest element is calculated by adding the height from tank zero to the bottom of the MTT to the position of the lowest spot element. From a Honeywell Enraf gauging system this value can be retrieved from item ‘MO’ stored in the gauge.

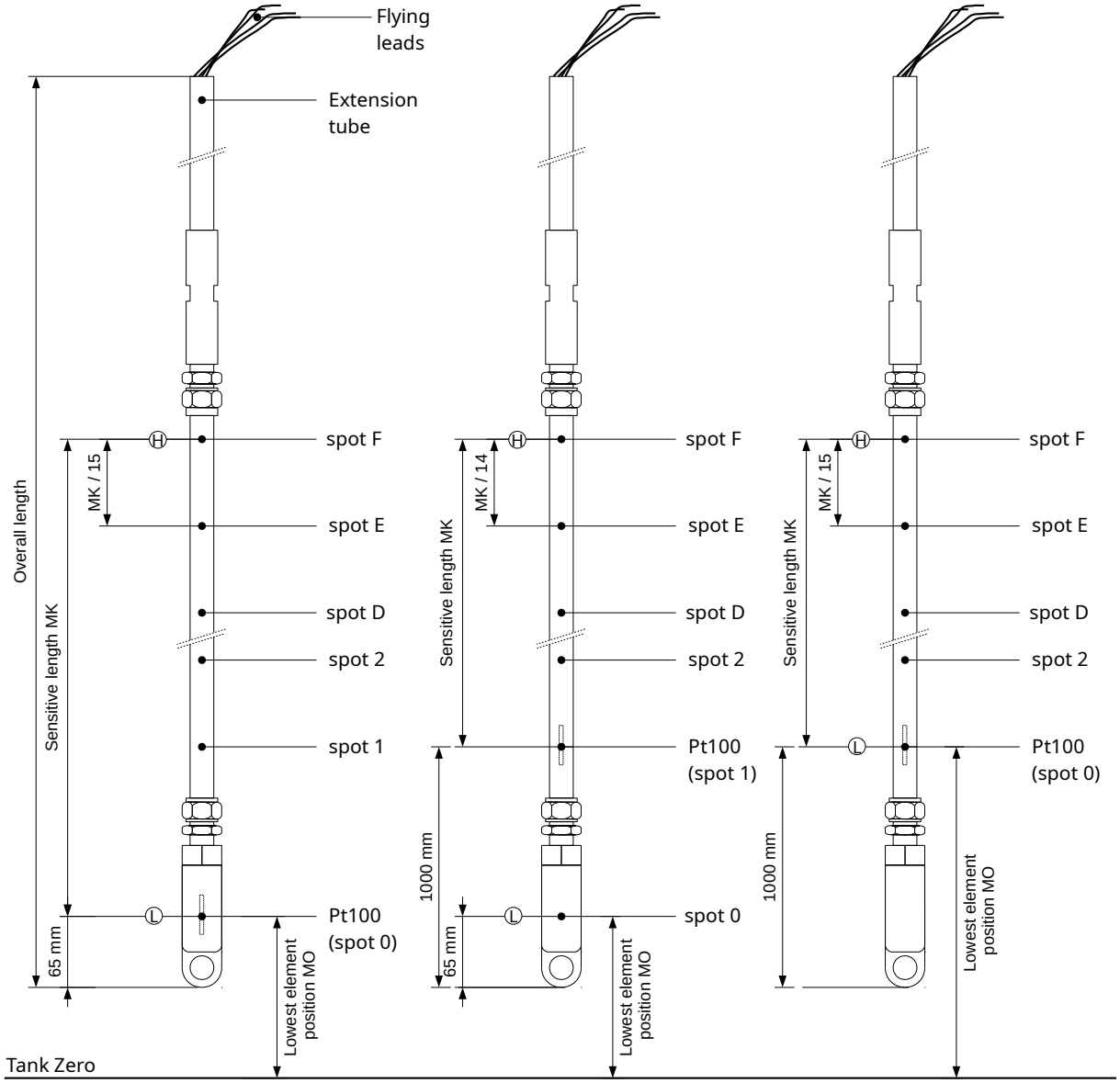


Figure 1: Mechanical dimensions of MTT probes

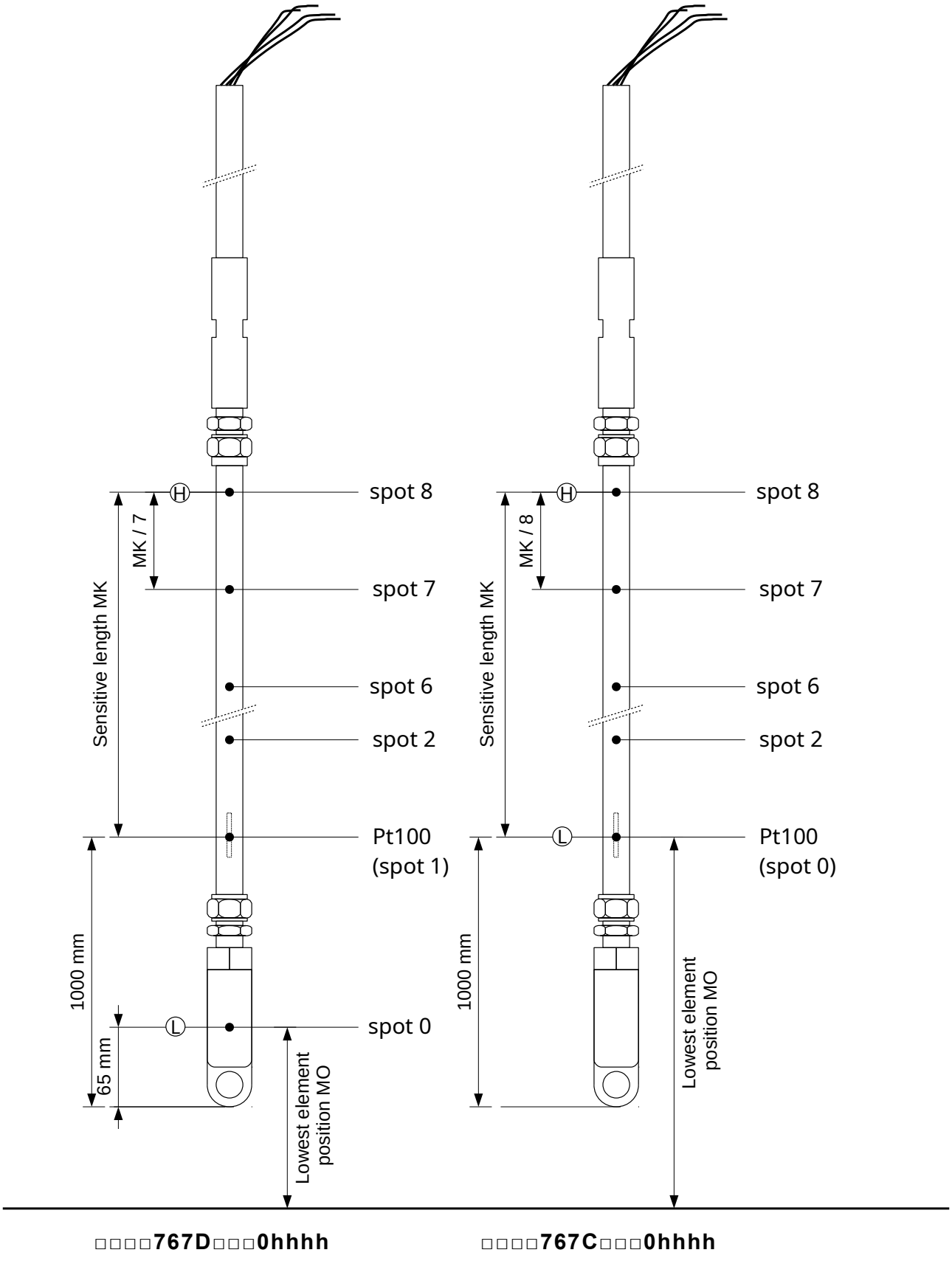


Figure 2: MTT LT probes

4.2.2 Mechanical dimensions of an RTD probe

For the 361 probes mechanical dimensions can be determined from the probe type identification plate (see Table 2: Mechanical dimensions for MPT probes).

For the 863 MRT Element Lengths are given in Table Table 3.

Table 2: Mechanical dimensions for MPT probes

	Temperature element offset **MO**[1]	Temperature sensitive length **MK**
□□□□**361**□□□**C**□□□□**hhhh**	100 cm	hhhh – 100 [cm]
□□□□**361**□□□**D**□□□□**hhhh**	15 cm	hhhh – 15 [cm]

Table 3: 863 MRT: Element Position/Length (m) from bottom end of probe

# of elements	**Without Spot**	**With Spot**
1	0.65	0.25
2	1.25	0.65
3	1.95	1.25
4	2.85	1.95
5	4.15	2.85
6	5.65	4.15
7	7.37	5.65
8	9.25	7.37
9	11.65	9.25
10	14.65	11.65
11	18.45	14.65
12	22.95	18.45
13	29.65	22.95
14	-	29.65

1 Note: for MRT/MPT MO is measured to the bottom of the probe, while for MTT MO is measured to the position of the lowest element.

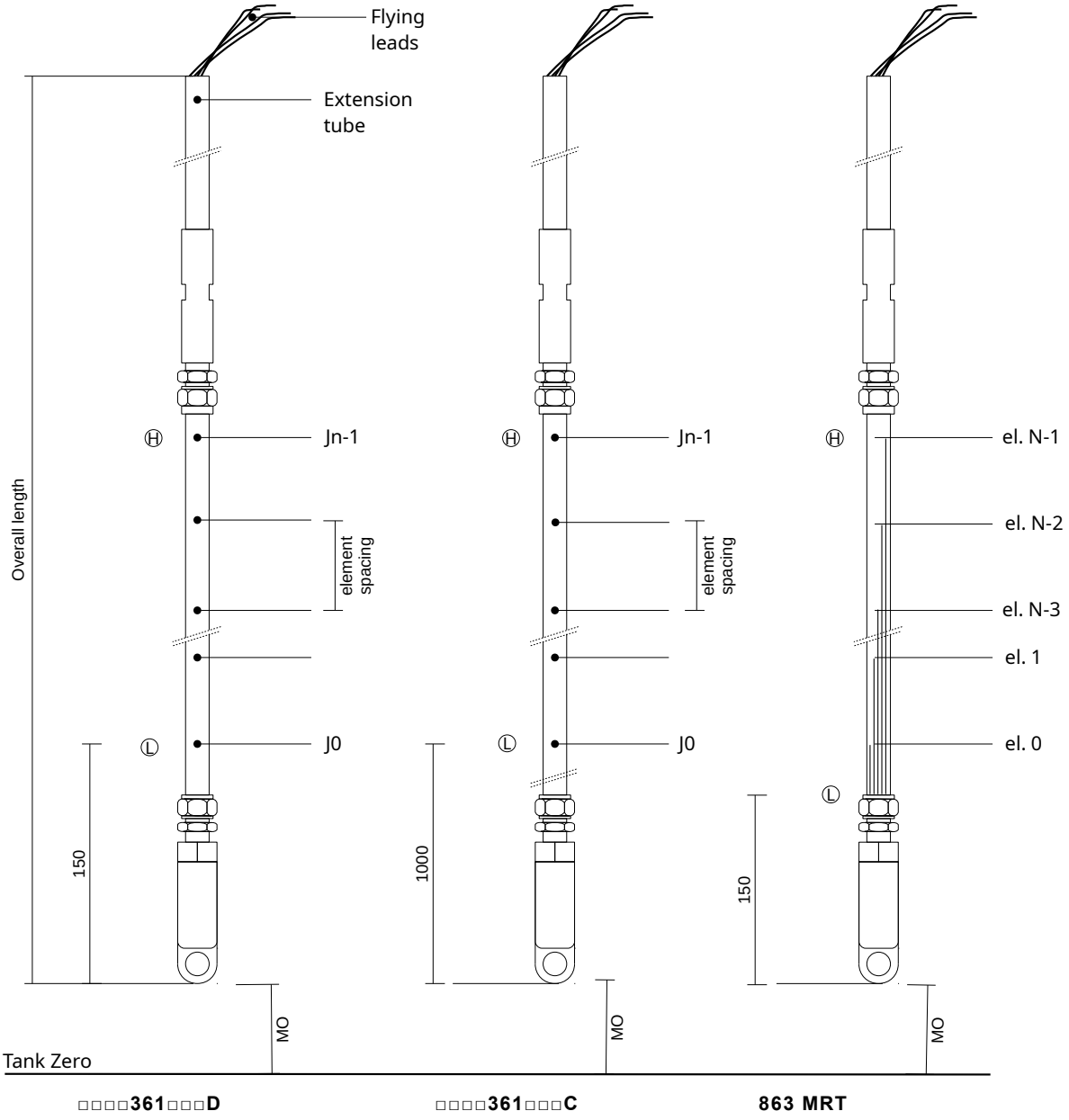


Figure 3: 361 and MRT probes

4.3 Prothermo NMT539 probe parameters

The X62T-NMT closely emulates the Prothermo NMT539. The NMT539 stores probe parameters internally and so does the X62T-NMT. Therefore configuration of the X62T-NMT is done in exactly the same way as for the NMT539.

The mechanical parameters of the probe need to be translated into variables for the Prothermo NMT539. The probe dimensions and element locations are configured using four variables:

- Kind of Interval (VH85). Set to 'Even' when the positions are equally spaced and can be specified by an interval value, set to 'Not Even' when the positions are not equally spaced and need to be specified per element.
- Element Interval (VH87), the distance between two elements. Used in case Kind of Interval is ‘Even’.
- Element Position (VH74). The individual positions of elements 1 to 16 (Element Select VH70). Used in case of Kind of Interval is 'Not Even'.
- Bottom Point (VH86), indicates the position of the lowest element.
- Multi/pot (VH27)
- Number of elements (VH82)

Ensure the units are correct, in Honeywell Enraf gauges **MO** and **MK** are mostly specified in meters while Element Interval on E+H instruments is by default specified in millimeters.

Table 4: Position related configuration parameters for probe types

Probe Type	#elements	Multi/Spot	Kind of Interval	Position Variables
361	4-14	Spot	Even	Bottom Point & Interval
863 MRT	1-13	Multi	Not Even	Per element & Bottom Point.
864	16	Spot	Even	Bottom Point & Interval
764A/D	16	Spot	Not Even	Per element. See below.
764B/C	16	Spot	Even	Bottom Point & Interval
767C	9	Spot	Even	Bottom Point & Interval
767D	9	Spot	Not Even	Per element. See below.

For MTT probes with an orange wire (764A, 764D & 767D) the Type of Interval cannot be 'Even' due to the position of the next (Pt100) spot. Therefore Kind of Interval must be set to 'Not Even'.

Table 5: Configure Positions when MO & MK are known (in mm).

Type	Num Elem	Bottom Point	Interval	Element Position		
				1st	2nd	Nth
864	16	MO	MK/15	-		
764B	16	MO	MK/15	-		
764A/D	16	-	-	MO	MO+935	MO+935+(N-2)(MK/14)
764C	16	MO	MK/15	-		
767C	9	MO	MK/8	-		

Type	Num Elem	Bottom Point	Interval	Element Position		
				1st	2nd	Nth
767D	9	-	-	MO	MO+935	MO+935+(N-2)(MK/7)
863	1-13	MO	-	MO + <Length from Table Table 3>		
361C/D	4-14	MO	MK/(N-1)	-		

Table 6: Configure Positions when MO & MK are unknown (in mm).

Type	Num Elem	Bottom Point	Interval	Element Position		
				1st	2nd	Nth
864	16	PP+65	(SL-65)/15	-		
764B	16	PP+65	(HH-65)/15	-		
764A/D	16	-	-	PP+65	PP+1000	PP+1000+(N-2)((HH-1000)/14)
764C	16	PP+1000	(HH-1000)/15	-		
767C	9	PP+1000	(HH-1000)/8	-		
767D	9	-	-	PP+65	PP+1000	PP+1000+(N-2)((HH-1000)/7)
863	1-13	PP	-	PP + <Length from Table Table 3>		
361C	4-14	PP+1000	(HH-1000)/N-1)	-		
361D	4-14	PP+150	(HH-150)/N-1)	-		

PP: Position of bottom of the Probe
HH: Position of Highest Element, read from the type plate.
SL: Sensitive Length, read from the type plate

To be able to calculate the average gas temperature for probes with averaging elements like the 863 MRT the lengths of these elements needs to be known. Therefore the positions need to be configured separately (using Kind of Interval (VH85) set to ‘Not Even’) and the Bottom Point (VH86) needs to be set. Then the required lengths can be calculated.

5 Installation

5.1 Powering the X62T-NMT

The X62T can be configured to draw a constant current of either 4 mA or 16 mA using a hardware switch (SW1 - Brown). When programmed with X62T-NMT firmware the current draw is intentionally increased with 6.5mA to 10.5mA or 22.5mA respectively. The low current mode should be selected (SW1 BROWN in OFF position).

When connected to an Endress+Hauser NMR81 in low current mode the supply voltage will always be sufficient (> 16V).

> ***Note***
> *Issuing a reset command to the gauge (NMR81) will temporarily cut power and RESET the X62.*

5.2 Mechanical connection

In case of an upgrade from 862 MIT to X62T-NMT an Enraf G1/2-G1/2 M/F adapter may already be installed on the adjusting pipe. This will be compatible with the X62T enclosure and does not need to be replaced if the O-ring is in good condition.

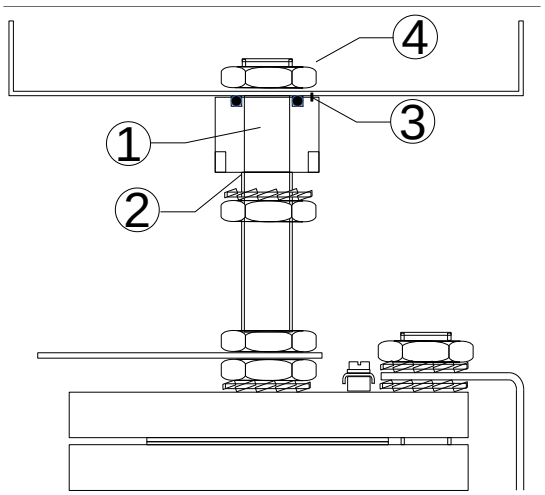


Figure 4: X62T-NMT installation

If needed, for example when replacing a VITO with an X62T an Exalon Delft G1/2-G1/2 M/F adapter can be ordered separately.

- Open the cover from the X62T enclosure.
- Remove the X62U from the enclosure.

- Place the empty X62T enclosure on top of the adapter (1) carefully positioning the position pin (3) in the enclosure blind hole.
- Secure the X62T enclosure using the half height G1/2 hexagon nut (4) and supplied shake proof washer until the O-ring is fully compressed and the enclosure will not be able to move.
- Turn the SS G1/2 hexagon nut onto the adjusting pipe (2) until 50mm of thread is free and place the SS shake proof washer.
- Feed the MTT wiring through the G1/2-G1/2 M/F adapter (1).
- Apply a suitable thread locking pipe sealant on the first 25mm of the MTT adjusting pipe (2).
- Turn the adapter (1) tightly onto the adjusting pipe (2) using a wrench on the adapter (3). Tighten the SS hex nut.

Caution
Do not attempt to tighten by applying force to the enclosure as this will damage the positioning pin.

5.3 Electrical connection for 864 MTT, 764 VITO MTT and 767 VITO MTT LT temperature probe

Connect the MTT or VITO MTT probes according to Figure 5: Connection of probe wires for an MTT or VITO MTT and VITO MTT LT according to Figure 6: Connection of probe wires for an VITO MTT LT.

Caution
Discharge tools to the tank before bringing into contact with the X62 terminals to prevent ESD (electrostatic discharges). Then FIRST connect one BROWN wire to terminal 3 on CN3. Damage due to ESD related events are not covered by the warranty.

Note
For MTT LT probes the non-used terminals should be connected to ground (for example CN3-1, CN3-2, CN3-4).

Connect blue wires to the terminals with blue color in the drawing, yellow to the yellow terminal, etc.:

- If an orange wire is present connect this to terminal 19 of CN3 and set SW2 RED to ON.

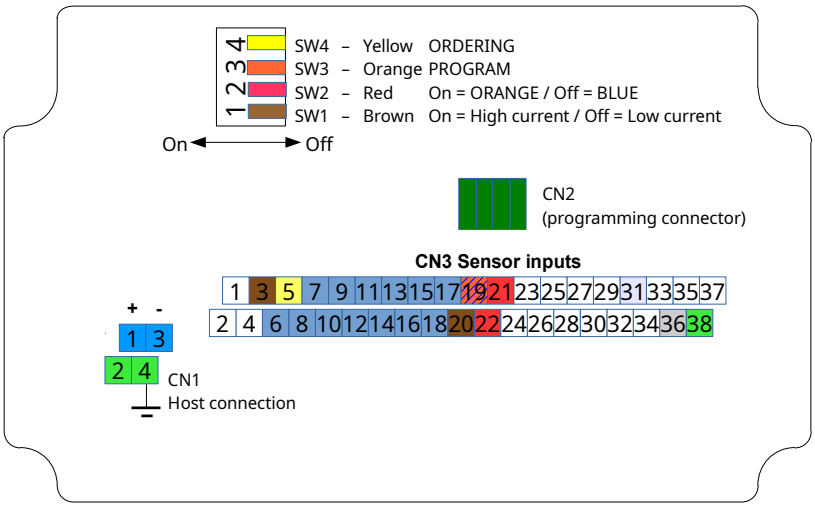


Figure 5: Connection of probe wires for an MTT or VITO MTT

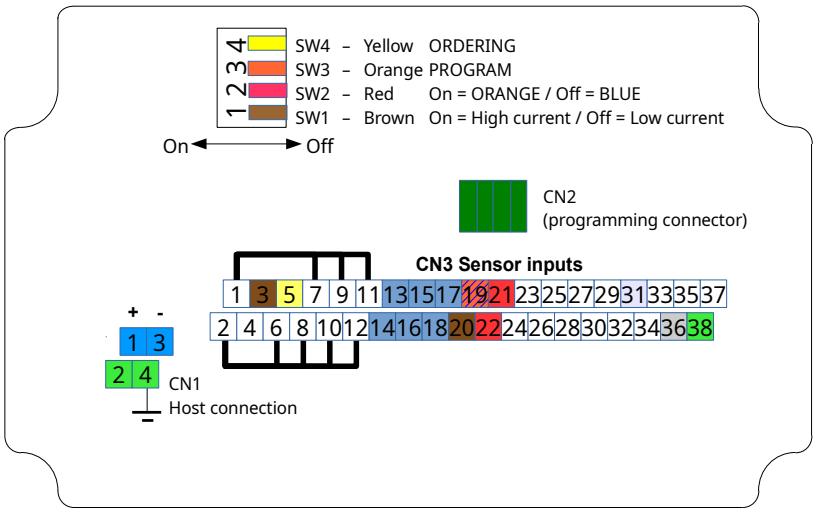


Figure 6: Connection of probe wires for an VITO MTT LT

Table 7: MTT and MTT-LT probe connections

X62T-NMT Terminal	MTT	MTT LT
5	Yellow (EL16)	Yellow (EL9)
6..12	Blue	GND (terminal 1 and 2)
13..18	Blue	Blue
19	Blue or Orange*	Blue or Orange*
20	Brown	Brown
21	Red	Red
22	Red	Red
3**	Brown	Brown

**) If the probe has no Orange wire then any blue one can be used.*
***) Any GND terminal can be used (1..4.*

5.3.1 Steps to Setup the X62T-NMT for use with an MTT or VITO MTT

- Set switch SW1 BROWN in Off position to enable low current mode.
- Verify switch SW3 ORANGE is in the Off position.
- Enable order detection of the thermocouples by setting switch SW4 YELLOW in On position. See the next section for details.
- Turn power of X62T on. Wait for 3 minutes minimum to perform the order detection.
- Turn power of X62T off and set switch SW4 YELLOW in Off position. All other switches need to be left in their current positions.

After the order detection is complete temperature should be indicated on the display of the NMR81.

5.3.2 Order Detection of Thermocouples

The Blue thermocouples of the MTT (LT) or VITO MTT (LT) can be connected in any order. Using the Yellow switch SW4 the X62T can be set in the mode to determine the connection order during power-up. This can take up to 3 minutes.

After detection the X62T stores the detected order in internal persistent storage (EEPROM) and uses this for operation. Once the correct connection order has been determined and stored turn off Ordering using SW4 YELLOW. If the X62T has no connection order information stored in memory it will do the order detection even with the Yellow switch Off. The resulted detected order will be used but not stored.

As the order of wires is stored in EEPROM the X62T will continue to function after power-up, even when a MTT wire is broken and automatic order detection is no longer possible.

> ***Note***
> *After connecting or reconnecting MTT wires the order of the Blue wires will most likely be changed and the correct thermocouple order must be re-detected. To make the X62T re-determine the order set switch SW4 YELLOW (Ordering) in position 'On' and turn the gauge power off and on.*

5.4 Electrical connection for 361 MPT, 863 MRT or other manufacturers RTD probes

> ***Caution***
> *Discharge tools to the tank before bringing into contact with the X62 terminals to prevent ESD (electrostatic discharges). Then FIRST connect one BROWN wire to terminal 3 on CN3. Damage due to ESD related events are not covered by the warranty.*

The X62-NMT supports three types of RTD measurements. Each kind of measurement allows a maximum number of elements.

> ***Note***
> *Type of RTD measurement, spot or averaging probe and linearization curve are always configured by Exalon Delft.*

Table 8: Maximum number of elements for different RTD probe types

Type of measurement	Number of RTDs
3-Wire Common Sense	16
3-Wire Individual Sense	9
4-Wire	6

For spot element probes the temperatures of the spots are computed assuming the element type is Pt100 using curves according to IEC60751:2008 (ITS-90). For averaging elements the element type is assumed to be Cu90. If you require other types of elements or another curve to be used contact Exalon Delft or its representative to help you configuring the X62T.

> *When the probe has less elements then the supported maximum the non-used terminals should be connected to ground.*

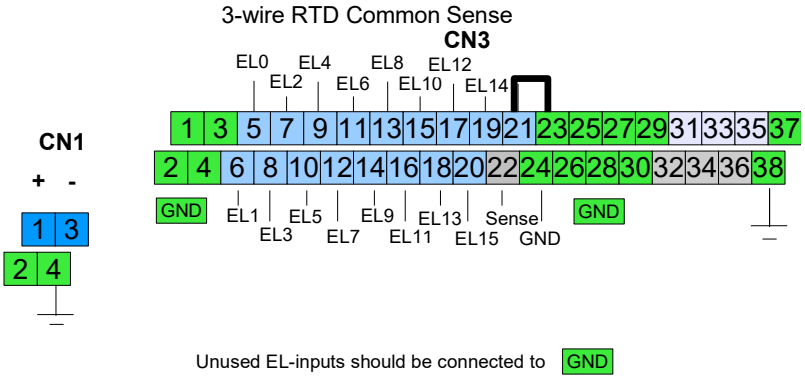


Figure 7: Connecting 3-Wire Common Sense RTD elements

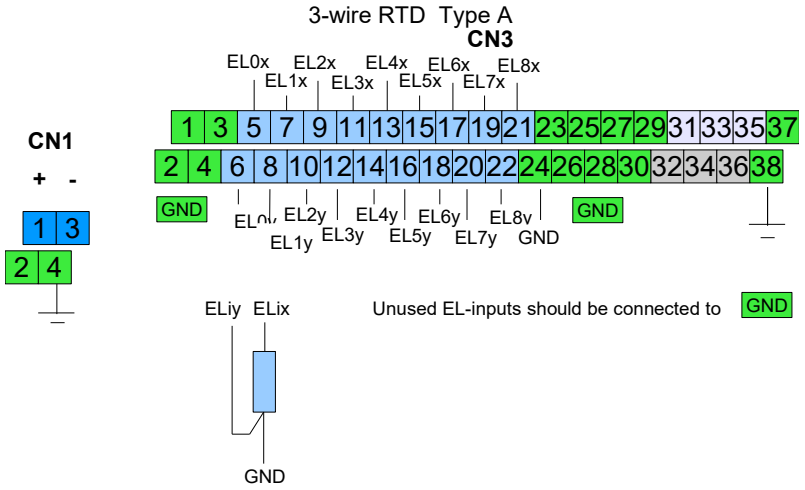


Figure 8: Connecting 3-Wire Individual Sense RTD elements

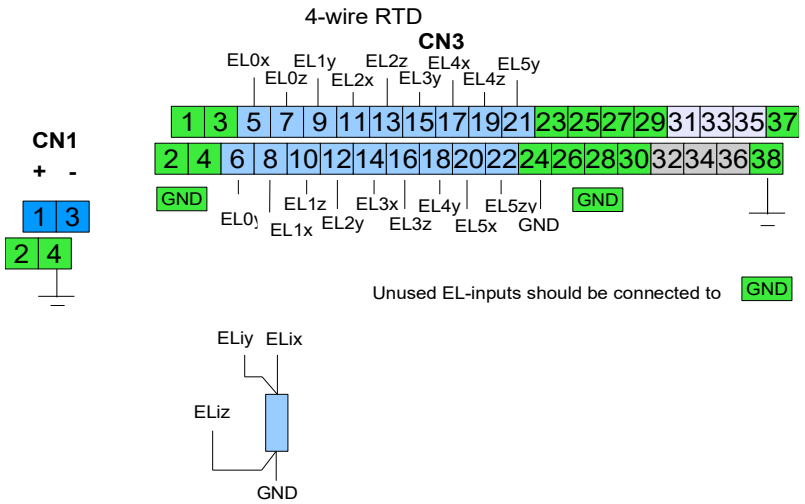


Figure 9: Connecting 4-Wire RTD elements

See Figure 10: Grounded terminals when having less elements where the terminals of the last element in a 4-wire configuration are connected to ground to have the X62 use 5 elements (instead of the maximum allowed 6).

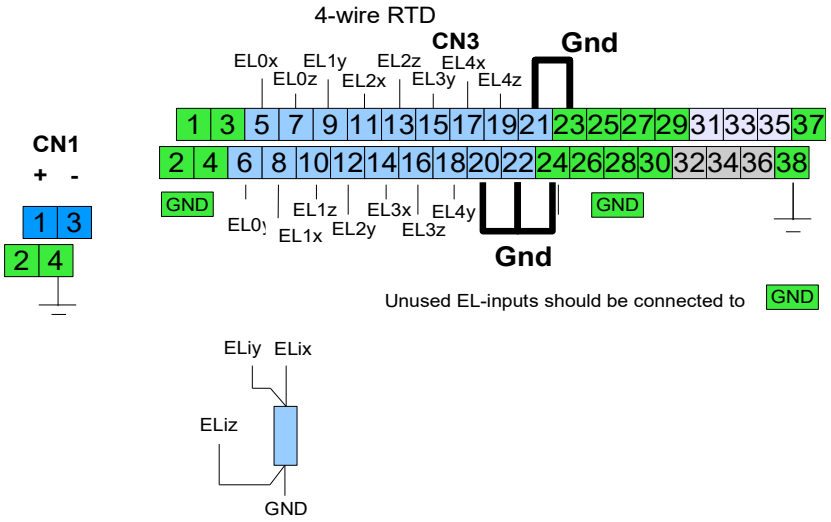


Figure 10: Grounded terminals when having less elements

5.4.1 361 MPT and 863 MRT probes

361 MPT and 863 MRT probes are connected using the 3-Wire Common Sense probe configuration. See Figure 11 and Table 9 for the exact wiring.

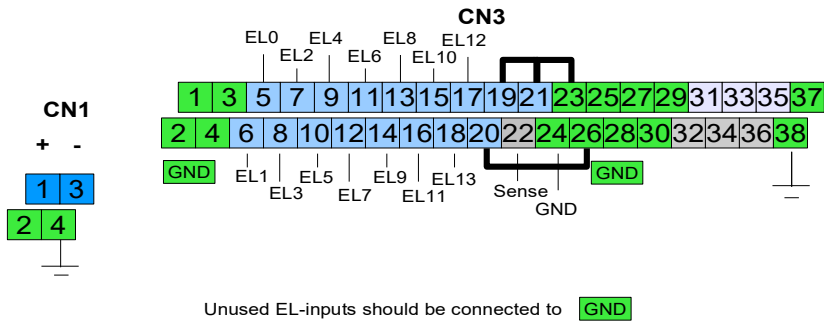


Figure 11: Connection of MRT and VITO MPT probes

Table 9: MRT and MPT probe connections

X62T-NMT Terminal	MPT	MRT without Spot	MRT with Spot
5, EL0	Brown, R1	Brown, R1	Red/White/Blue, Spot/R1
6, EL1	Red, R2	Red, R2	Brown, R2
7, EL2	Orange, R3	Orange, R3	Red, R3
8, EL3	Yellow, R4	Yellow, R4	Orange, R4

X62T-NMT Terminal	MPT	MRT without Spot	MRT with Spot
9, EL4	Green, R5	Green, R5	Yellow, R5
10, EL5	Blue, R6	Blue, R6	Green, R6
11, EL6	Violet, R7	Violet, R7	Blue, R7
12, EL7	Grey, R8	Grey, R8	Violet, R8
13, EL8	White, R9	White, R9	Grey, R9
14, EL9	Pink, R10	Pink, R10	White, R10
15, EL10	Red/Blue, R11	Red/Blue, R11	Pink, R11
16, EL11	Brown/Grey, R12	Brown/Grey, R12	Red/Blue, R12
17, EL12	Black/White, R13	-*	Brown/Grey, R13
18, EL13	Red/Green, R14	-	-*
22, Common Sense	Black, Rc	Black, Rc	Black, Rc
2, Gnd	Black, Gnd	Black, Gnd	Black, Gnd

*) If your MRT has 13 averaging elements connect the longest element to the next free terminal (T17)

5.5 Electrical connection to the NMR81

The NMR81 can have multie HART busses. We recommend to use the HART Ex i/IS interface (E bus).

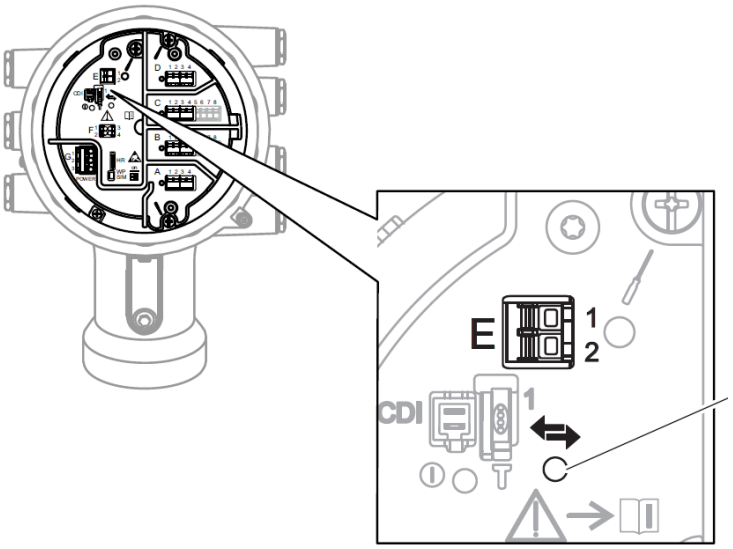


Figure 12: HART Ex i/IS interface of the Micropilot

The plus/minus of CN1 of the X62T should be connected to the “HART Ex i/IS interface” (Slot E) of the Micropilot. CN1 “+” (1) to E1 (H+) and CN1 “-” (2) to E2 (H-).

The X62 can also be used on the HART bus provided by an Analog I/O module containing a HART Ex i interface (port B or C). Note that these busses do not provide enough power for the X62T to work in High Current Mode.

5.6 DIP-switches of the X62T

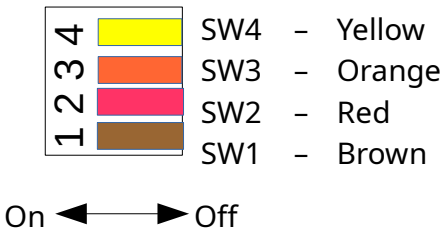


Figure 13: X62 DIP-switches

Table 10: Usage of the DIP switches when using RTD probes

Switch	Description
1 Brown	This switch configures the Current Mode of the X62T. For X62T-NMT this switch must always be in **Off** position for **Low Current Mode**.
2 Red	This switch is used for extra configuration of an MRT probe. When in the **On** position it indicates the lowest element of an MRT probe is a Pt100 spot instead of an averaging element. When in the **Off** position it indicates the lowest element is of the same type as the others.
3 Orange	This switch is for programming and must always be in **Off** position.
4 Yellow	This switch is reserved and must be in **Off** position.

Table 11: Usage of the DIP switches when using MTT probes

Switch	Description
1 Brown	This switch configures the Current Mode of the X62T. For X62T-NMT this switch must always be in **Off** position for **Low Current Mode**.
2 Red	When in the **On** position it indicates the lowest spot of a the probe is a Thermocouple element and the Pt100 is the 2nd element. When in the **Off** position it indicates the lowest spot is the Pt100 element.
3 Orange	This switch is for programming and must always be in **Off** position.
4 Yellow	This switch is used for element order detection. When in the **On** position at startup the element order is detected and when successful the order will be permanently stored. When in the **Off** position order detection is only done when no ordering information has been stored (and the detected order will not be stored).

6 Commissioning and Operation

6.1 Commissioning

The following settings are intended to set up temperature measurement quickly. For settings customized to your local installation please consult the manuals '*Operating Instructions Micropilot NMR81'* and '*Operating Instructions and Description of Instrument Function Prothermo NMT539'.*

6.1.1 Operating NMR81 Local Display

Initial steps to configure the X62T using the Micropilots local display:

- To open the menu press "E". If required, select Keylock off from the popup menu and press "E" again.
- Navigate to the Expert menu item and enter it (press "E"). On entering the "Expert" menu, an access code is always requested. If a customer specific access code has not been defined, "0000" has to be entered. "Access status display" should now show "Service".
- The menu for the X62T can now be found under "Input/Output | HART devices | HD @ 2 NMT".
- To load the configure options menu for the X62T go to the "NMT device config" and set "Configure device" to "yes".
- Enter the Access code (530) to remove the write protection of the X62T.

6.1.2 Operating Field Care / DeviceCare

Initial steps to configure the X62T using Field care or DeviceCare:

- Connect to the Micropilot and load the latest DTM.
- Navigate to the Expert menu item. On entering the "Expert" menu, an access code is required. If a customer specific access code has not been defined, "0000" has to be entered. "Access status tooling" should now show "Service".
- The X62T can be found under "Input/Output | HART devices | HD @ 2 NMT".
- To load the configure options menu for the X62T go to the "NMT device config" and set "Configure device" to "yes".
- Enter the Access code (530) to remove the write protection of the X62T.

If there is a "HD @ 2 NMT" but it is not responding use the "Forget device" option at the same menu level to have the Micropilot re-discover and connect with the X62T.

6.1.3 Linking X62T data to the tank variables

The Micropilot must be configured to use the X62T data as temperature input. Navigate to “Setup | Advanced setup | Application | Tank configuration | Temperature”.

- Temperature of the product: set “Liquid temp. source” to “HART device 2 temperature”.
- Temperature of the vapor above the product: set “Vapor temp. source” to “HART device 2 vapor temp”

Where the ‘2’ is replaced by the HART short address in use (2 is the default short address).

6.1.4 Configuration

Note
*At startup the X62T-NMT is in write protect mode. To enable configuration the **Protect code / Access code** must be set to 530.*

Note
The probe type is configured in the factory.

The following table lists the parameters to be used to configure the X62T to allow the Micropilot to correctly use the temperature data it reads from the X62T.

Table 12: X62T-NMT parameters used for configuring

Name	Variable	Description
Protect Code	VH79	Access code, 530 to unlock: enable select and write commands.
Total no. elements	VH82 GVH82	Number of elements. Depends on the probe. See chapter 4. When the probe type is “MTT” the number of elements defaults to 16. When set to 9 the probe type becomes “MTT LT”. Range: 1 .. 16
Bottom Point	VH86 GVH86	Default: 0.0 mm Range: 0.0 .. 99999.9 Position of the bottom-point element. Used when Kind of Element Interval is ‘Even’.
Kind of Interval (Type of Interval)	VH85 GVH85	'Even' (elements are evenly distributed over the probe) or 'Not Even' (not evenly distributed) Range: 0 .. 1
Element Interval	VH87 GVH87	default: 1000 mm Range: 0.0 .. 99999.9 Distance between two elements. Used when Kind of Element Interval is ‘Even’.

Name	Variable	Description
Gain Adjust (Span Adjust)	VH72	Default: 1.0 Range: 0.8 .. 1.2 Used for calibration. See below.
Multi/Spot	VH27	Does the probe consist of Spot elements or Averaging elements. Default: Spot elements (0) Range: 0 .. 1
Element Select	VH70 GVH70	Select an element: depends on number of elements. (See notes below.) Range: 1 .. 16
Element Position	VH74 GVH74	Position of the selected element. Use when *Kind of Interval* is 'Not Even' Range: 0.0 .. 99999.9
Zero Adjust	VH71 GVH71	Default: 0.0 degrees Celcius Range: -1000.0 .. 1000.0 Used for calibration. See below.

Notes:

- To modify variables 'Element Position' and 'Zero Adjust' first use 'Element Select' (VH70) to select the element to configure. This can be done in the "Element setup" menu. See the E+H manual 'Operating Instructions and Description of Instrument Function Prothermo NMT539'.
- Even though Element Select is internally a zero-based variable the NMR81 local display as well as DeviceCare require 1-based addressing so use 1 to select the 1st element etc.

Calibration data, Zero Adjust and Span Adjust, are used according to the following formula:

Temperature = Unadjusted temperature * Span (VH72) + Zero (VH71)

See also sections 4.2 Determine mechanical dimensions and 4.3 Prothermo NMT539 probe parameters for the correct values for 'Bottom Point' (VH86), 'Kind of Element Interval' (VH85) and 'Element Interval' (VH87) for the probe you are commissioning.

There are more parameters that can be configured but not from the NMR81 or it's DTM. See Table 13: NMT Additional configuration parameters (through NMT359 DTM). This requires using the NMT359 DTM and connect using a Commubox FXA 195 HART modem directly to the X62T-NMT. Exalon Delft or its representative can help you with configuring these parameters.

Table 13: NMT Additional configuration parameters (through NMT359 DTM)

Name	Variable	Description
Hysteresis	VH46	Default: 10 mm. Range: 0.0 .. 99999.9 Is added to the Gas/Liquid Offset to prevent frequent including/excluding elements.
Gas offset	VH48	Default: 300 mm. Range: 0.0 .. 99999.9 Minimum vapour immersion depth
Liquid offset	VH49	Default: 300 mm. Range: 0.0 .. 99999.9 Minimum product immersion depth
Distance unit	VH84	Length Unit. Defaults to Millimeters. Range: m, cm, mm, feet, inch Units can be changed but it is strongly recommended to keep the default values.
Output at error / Error Display Select	VH92	Default: Off Range: Off, On Enables use of VH89 and VH88.
Element Open value	VH89	Default: 359.0 degrees Celcius Range: -49.5 .. 359.5 Value shown for AVP/AVG when a used element is Open (disconnected) and Error Display Select is 'On'.
Element Shorted value	VH88	Default: -49.5 degrees Celcius Range: -49.5 .. 359.5 Value shown for AVP/AVG when a used element is Shorted (connected to ground) and Error Display Select is 'On'.
Below Bottom	VH98	Default: Off Range: Off, On Set error code to 29 when the liquid level drops below the bottom-point element.

The following process data and diagnostic codes are available.

Table 14: NMT compatible measurement values and diagnostic codes

Name	Variable	Remark
Process data		
Element Temperature	VH10..25	Temperature of elements 1..16
Liquid average temperature	VH00	AVP computed using Level
Gas average temperature	VH01	AVG computed using Level.
Level	VH02	value is sent by the Micropilot to the X62T

Name	Variable	Remark
Diagnostic codes		
No.0 element temperature	VH07	Accessible as Reference Zero but used for dynamic error reporting
Diagnostic or Actual error code	VH80	Current error. See Table 21: NMT Diagnostic codes.
Last Diagnostic error code	VH91	Previous error

6.2 Operation

6.2.1 NMR81 Local display

The local display on the Micropilot NMR81 will show information items according to it's configuration. For example:

```
NMRx                                SS
-------------------------------------
Level                      15001.4 mm
Liquid Temperature            23.4 °C
Vapour Temperature            35.3 °C
```

In case of no error nothing is displayed in the upper right corner. In case of an error the upper right corner contains two items a Status Symbol and a Status Signal:

- Status Symbol: ⊗ for Alarm or ⚠ for Warning
- Status Signal: 'F' for Failure, 'C' for Function Check, 'S' for Out of Specification and 'M' for maintenance Required.

In case of a 'Warning' the display will flash and show an error code. In case an 'Alarm' the display will flash in red and also show an error code.

6.2.2 Diagnostic data

Errors are reported using element temperature values, 'Diagnostic code' and values for 'Reference 0' (also called 'Temperature 0'). These can be reviewed from the following menus (both on the local display as well as in DeviceCare):

Table 15: Menus for diagnostic data

Data	Menu
Liquid & Vapor temperature	Expert | Input/output | HART devices | HD @ 2 NMT
Element temperatures	Expert | Input/output | HART devices | HD @ 2 NMT | Element Values | Element temperature
Diagnostics code & Reference 0	Expert | Input/output | HART devices | HD @ 2 NMT | Diagnostics

**) The '2' in 'HD @ X NMT' will be replaced with the HART* short *address in use. This defaults to 2.*

6.3 Troubleshooting MTT and VITO MTT Probes

The X62T-NMT orders the thermocouple wires prior to sending the measurement results to the NMR81. As a result the NMR81 does not know the real connection order of the blue wires to the X62T-NMT.

For diagnostic purposes the X62T-NMT provides the following mechanism:

- In case of a fatal error within the X62T the Diagnostic Code will be **23**. The 'Reference 0' is used to encode more information.
- In case of a wiring error causing the X62T to be unable to measure any temperature the Diagnostic Code will be **23**. The value of 'Reference 0' is used to encode more information.
- In case of an error while determining the order of the thermocouples (during commissioning) the Diagnostic Code will be **23**. The value of 'Reference 0' is used to encode more information.[2]
- In case of a non-fatal error in an MTT element the Diagnostic Code will contain an error code related to the malfunctioning spot number. To aid in locating the terminal of the defective spot the terminal number is encoded in its related spot temperature.

Example
*For example if spot 12 is connected to terminal 11 but the wire is open, the Diag. Code will be **27** and the temperature of spot 12 will be **411.0**.*

Table 16: Error events and related Diagnostic Codes

Diag. Code	Ref. 0	Functioning Spot	Erroneous Spot	AVG/AVP Temperature	Error
Fatal X62 errors					
23	+1	358	-	358	VCC failure
	+2				VEE failure
	+4				VBase failure
	+8				Rtest Failure
Fatal Probe errors					
23	360	358	-	358	SDEV failure

2 Note that when there is an error in this case the X62 will not continue measuring. A reset is required. So if the error has been resolved the reported error will remain 500 until the X62T has been reset.

Diag. Code	Ref. 0	Functioning Spot	Erroneous Spot	AVG/AVP Temperature	Error
	361				SDEV too large
	362				GND wire Failure
Fatal Wiring errors					
23	600 + Term. #	358	-	358	Wire error while order detection
	400 + Term. #		358		PT100 disconnected wire error
	500 + Term. #				PT100 grounded wire error
Non-fatal measurement errors					
1..22 25..28 33..40	0	Temperature	400 + Term. #	Actual avg / avp	Thermocouple disconnected wire error
Temperature warnings					
0	0	358	-	358	No data available yet
					No level set
Level Range warnings					
0	0	Temperature	N/A	358 / avp	Level above highest element. The AVG value is returned for AVP as well.
0				avg / avg	Level below lowest spot T1. The AVP value is returned for AVG as well. If Below Bottom (VH98) is **Off**
29				avg / avg	Level below lowest spot T1. If Below Bottom (VH98) is **On**

Table 17: Fault diagnosis

Step	Check	Description	Next
1	Display	C415 HART Offline	5
		Online	2

Step	Check	Description	Next
2	Diagnostic code	23	3
		1..22/25..28/33..40 (see for an explanation Table 21: NMT Diagnostic codes)	4
3	Check Reference 0	If < 64, MU is the sum of 1 Internal power supply failed 2 Internal power supply failed 4 Internal power supply failed 8 Internal Test Resistance failed 16 Internal Test Capacitance failed 32 Internal Test Capacitance failed	End
		Example: Reference 0 = 0.69999995E+01 nearest integer 7 = 1 + 2 + 4, all internal power supplies failed.	
		360 EMC error, to much noise 361 EMC error, to much noise	
		362 indicates a disconnected Ground wire	
		405 ... 422 indicates a wiring error The value 4xx.0 indicates a disconnected wire on terminal xx. (CN3)	
		520 ... 522 indicates a wiring error The value 5xx.0 indicates a shorted wire on terminal xx. (CN3)	
		605 ... 622 indicates a wiring error while order detection The value 5xx.0 indicates a wiring error on terminal xx. (CN3)	
		600 means the previous 6xx wiring error has been fixed but the system needs to be reset	
4	Check Element temperature of indicated element. (See Table 21 for error to element mapping.)	4xx.0 indicates an open connection on terminal xx 5xx.0 indicates a grounded connection on terminal xx	
5	Check voltage on CN1 1-3	> 14V. See 5.1 Powering the X62T-NMT. Set SW1 to low current or correct wiring to HCU/HPI.	End
End	Contact Exalon Delft or its representative for support		

6.4 Troubleshooting RTD Probes

For diagnostic purposes the X62T-NMT provides the following mechanism:

- In case of a fatal error within the X62T the NMR81 display will turn RED and the Diagnostic Code will be **23**. The Reference 0 is used to encode more information. See Table Table 18 Error events and related Diagnostic Codes.
- In case of a wiring error causing the X62T to be unable to measure temperature the NMR81 display will flash in red and the Diagnostic Code will be **23**. The value of Reference 0 is used to encode more information. See Table Table 18 Error events and related Diagnostic Codes.
- In case of a non-fatal error in an RTD element measurement the Diagnostic Code will contain an error code related to the malfunctioning element number. To aid in locating terminal of the defective element the terminal number is encoded in its related element temperature.

> ***Example***
> *For example if element 6 should be connected to terminal 11 but the wire is broken, the Diag. Code will be **13** and the temperature of element 6 will be **411.0**.*

Table 18: Error events and related Diagnostic Codes

Diag. Code	Reference 0	Functioning Spot	Erroneous Spot	AVG/AVP	Error
Fatal X62 errors					
23	+1 +2 +4 +8	358	N/A	358	VCC failure VEE failure VBase failure Rtest Failure
Fatal Probe/Wiring errors					
23	362	358	-	358	GND wire failure
1	363	358	-	358	Common Sense wire failure
Non-fatal measurement errors					
1..22 **25..28** **33..40**	0	Temperature	400 + Term. # 500 + Term. #	Actual avg / avp	disconnected wire error grounded wire error
Temperature warnings					

Diag. Code	Reference 0	Functioning Spot	Erroneous Spot	AVG/AVP	Error
0	0	358	-	358	No data available yet
Level Range warnings					
0				358 / avp	Level above highest Element
0	0	Temperature	-	avg / avg	Level below lowest Element If Below Bottom (VH98) is **Off**
29				avg / avg	Level below lowest Element If Below Bottom (VH98) is **On**

The terminal numbers for ground wires used in ‘3-Wire Individual Sense’ and ‘4-Wire’ are not known. When such a ground wire is disconnected they are encoded as if connected as listed in Table Table 19.

Table 19: Erroneous Spot value displayed in case of disconnected ground wire in 3-wire individual sense and 4-wire measurement.

Probe type	Erroneous Spot value displayed	Element with disconnected GND
3-Wire Individual Sense	401	1
	402	2
	403	3
	4044	4
	423	5
	424	6
	425	7
	426	8
	427	9
4-Wire	401	1
	402	2
	403	3
	404	4
	423	5
	424	6

Table 20: Fault diagnosis

Step	Check	Description	Next
1	Display	C415 HART Offline F411 HART 2 malfunction C413 NMT 2 open/short	5 3 2
2	Diagnostic code	23 1..22/25..28/33..40	3 4
3	Check Reference 0	If Reference 0 < 64, MU is the sum of 1 Internal power supply failed 2 Internal power supply failed 4 Internal power supply failed 8 Internal Test Resistance failed 16 Internal Test Capacitance failed 32 Internal Test Capacitance failed Example: Reference 0 = 0.69999995E+01 nearest integer 7 = 1 + 2 + 4, all internal power supplies failed. 362 indicates a disconnected Ground wire 405 ... 422 indicates a wiring error The value 4xx.0 indicates a disconnected wire error on terminal xx. (CN3) 505 ... 522 indicates a wiring error The value 5xx.0 indicates a shorted wire error on terminal xx. (CN3)	End
4	Check Element temperature of indicated element. See table below for error to element mapping.	4xx.0 indicates an open connection on terminal xx 5xx.0 indicates a grounded connection on terminal xx See Figure 5, Figure 6, Figure 9 and Table 19 for terminal numbers and wiring.	
5	Check voltage on CN1 1-3	> 14V. See 5.1 Powering the X62T-NMT. Set SW1 to low current or correct wiring to HCU/HPI.	End
End	Contact Exalon Delft or its representative for support		

The ‘Operating Instructions Micropilot NMR81’ document lists additional error codes, see chapter 11 ‘Diagnostics and troubleshooting’.

Table 21: NMT Diagnostic codes

NMT Diagnostic Error code	Indication
1	Common Line not connected
3 or 4	Element 1 not connected or short to ground
5 or 6	Element 2 not connected or short to ground
7 or 8	Element 3 not connected or short to ground
9 or 10	Element 4 not connected or short to ground
11 or 12	Element 5 not connected or short to ground
13 or 14	Element 6 not connected or short to ground
15 or 16	Element 7 not connected or short to ground
17 or 18	Element 8 not connected or short to ground
19 or 20	Element 9 not connected or short to ground
21 or 22	Element 10 not connected or short to ground
25 or 26	Element 11 not connected or short to ground
27 or 28	Element 12 not connected or short to ground
29	Level < bottom point
33 or 34	Element 13 not connected or short to ground
35 or 36	Element 14 not connected or short to ground
37 or 38	Element 15 not connected or short to ground
39 or 40	Element 16 not connected or short to ground

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