

X62T-MPT Installation Guide

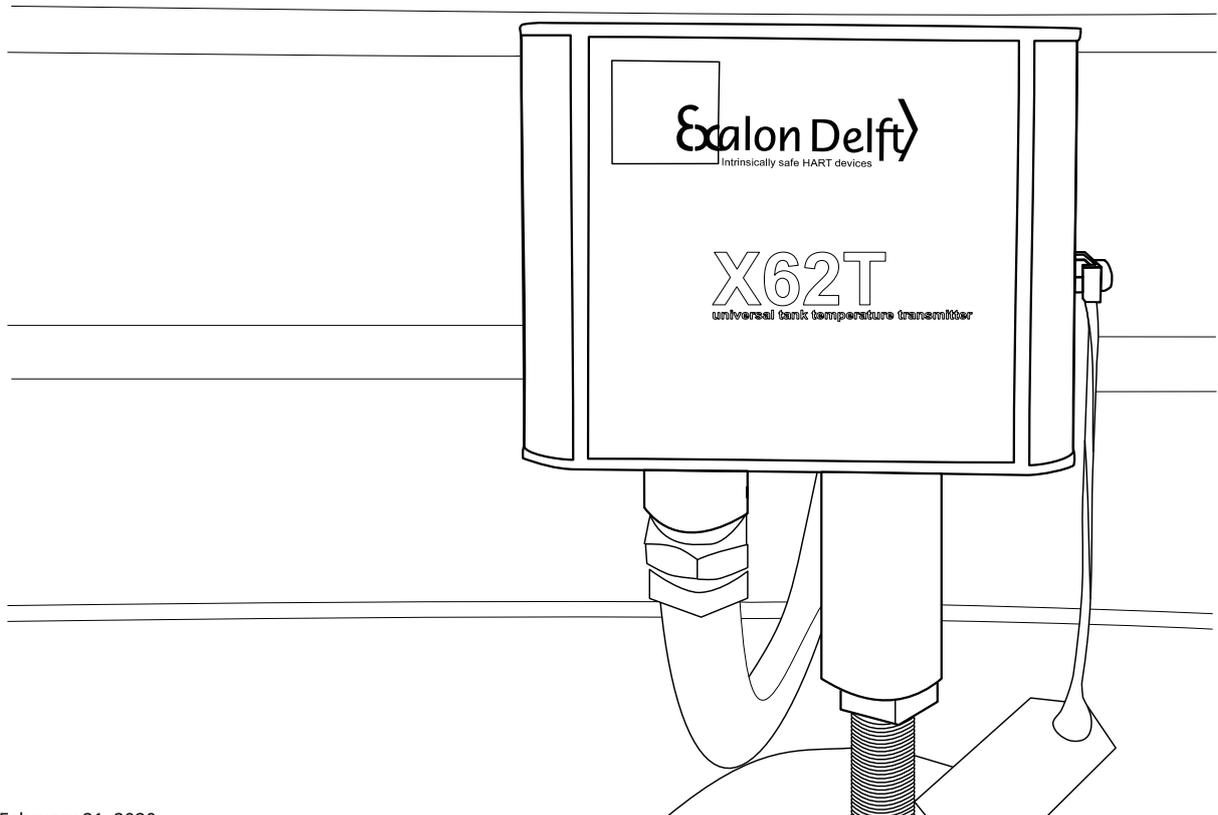


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1 Preface

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.

The information in this installation guide is the copyright property of Exalon Delft B.V., Netherlands. Exalon Delft B.V. disclaims any responsibility for personal injury or damage to equipment caused by:

- 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 EU 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-MPT?

The X62T-MPT is a Tank Thermometer transmitter based on the X62U multi-input HART transmitter. The X62T-MPT can be connected to Enraf servo gauges 854 ATG, 854 XTG, 873 radar gauge or 877 hydrostatic gauge that are fitted with MPU, HPU or OPU option boards (see Section 4.1).

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

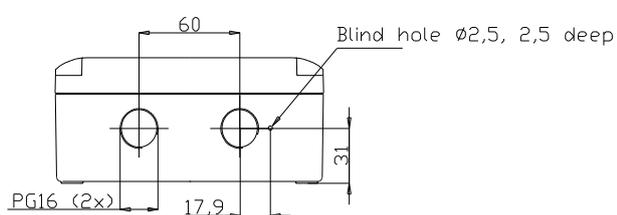
- The cable entry allows a PG16 cable gland or adapter to be used (not supplied).
- The MRT entry is also PG16 with positioning hole compatible to the original Enraf MTT G1/2-G1/2 adapter. If you are upgrading from a Enraf 862 MIR this adapter will already be glued on top of the 864 MRT. In a new installation 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-MPT enclosure can be selected: X62T-MPT/H and X62T-MPT/W:

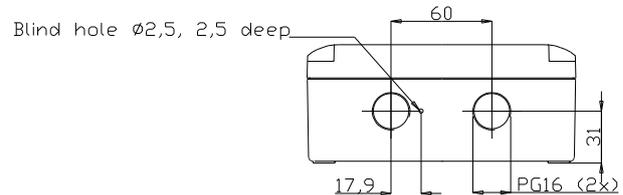
/H This is the default enclosure.

/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 MPT wires will cross the host connection wires.

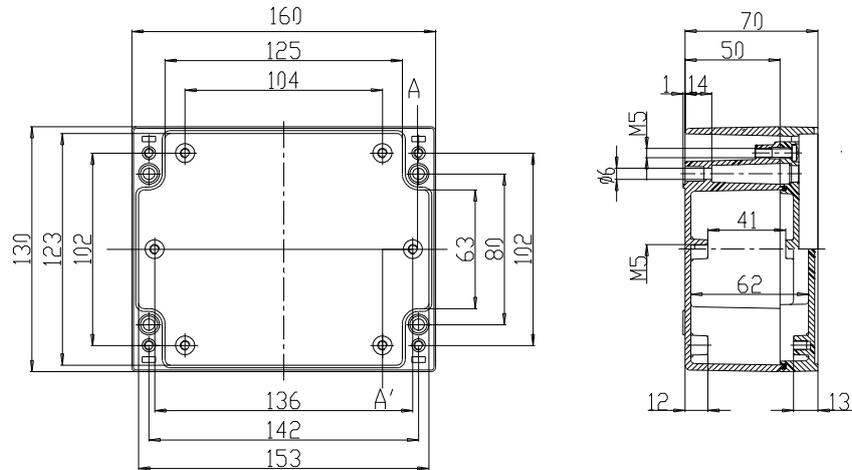
As the MPT wires and host wires are 2 different Intrinsically Safe circuits they MUST be kept isolated with a total of > 0.5mm solid isolation. An additional isolation sleeve (not supplied) may be needed to increase solid isolation.



X62T-MIT/H



X62T-MIT/W



Mounting holes

2.2 Other X62T variants

The X62T Host Interface and Probe Type are programmable. By supplying different firmware versions various combinations are supported to suite your application. See our Product Selection Guide at <https://www.exalondelft.nl/en/products/x62t/x62t-selection-guide> for a complete list.

3 Instructions for use in potentially explosive atmospheres

3.1 Explanation of the type identification code

Designation according to Directive 2014/34/EC:

CE₀₃₄₄ 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 | 12V @ 4mA (low current mode) 14V @ 15mA (high current mode) |
|---------------|--|

3.2.3 Ex i parameters

| Power supply / Output circuit / HART (CN1) | | Sensors / Input circuit (CN3) (circuits combined) | |
|--|-------|---|-------|
| U _i | 30V | U _o | 5.9V |
| I _i | 270mA | I _o | 62mA |
| P _i | 1.2W | P _o | 92mW |
| C _i | 5nF | C _o | 900uF |
| L _i | - | L _o | 30mA |

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 2: Connection of MPT probes) 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 C_o / L_o from the gauge:

$C_c \leq C_o - 5nF$, $L_c \leq L_o$.

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 X62T-MPT compatibility to Enraf gauge option boards

At this time the X62T-MPT can only be connected to MPU, HPU, OPU option boards that support MTT.

Note

Each option board also exists in a MIR version that supports MRT. These option boards are currently only supported by the X62T-MIR.

If unsure about which option board is installed in your Enraf gauge and a PET (Portable Enraf Terminal) is available the following procedure can be used:

- Make sure the gauge is certified as Ex d [ia] or Ex ed [ia] by examining the type plate and the documentation.
- Issue command software version: SV. This will return the installed option boards. At least an MPU, HPU or OPU option board needs to be present. For example 'MPUB3.0'. The 'B' indicates an MIT firmware version.
- Issue command number of temperature elements: MN, this will return the number of temperature elements, example MN=16.

Note

If the MTT or MPU/HPU/OPU option board is malfunctioning this problem can not be resolved by using a X62T-MPT.

5 Installation

5.1 Powering the X62T-MPT

The X62T can be configured to draw a constant current of either 4 mA or 15 mA. When programmed with X62T-MPT firmware the high current mode must be selected (SW1 BROWN in ON position).

The X62T-MPT requires a voltage between 14V and 24V on the terminals CN1. When connected to an Enraf MPU or HPU option board the supplied power will be sufficient.

Note

Issuing a reset command to the gauge (RS) will temporarily cut power and RESET the X62T.

5.2 Mechanical connection

The probe entry thread into the X62T-MPT is PG16 which is compatible to Enraf 862 enclosures.

When decommissioning an Enraf 864 the Enraf G1/2-G1/2 M/F adapter may be salvaged from the adjusting pipe¹ of the 864 MTT probe. This adapter will be compatible with the X62T enclosure and does not need to be replaced if the O-ring is in good condition.

Using the G1/2-G1/2 M/F adapter MPT probes with G1/2 threads can be installed².

- 1 In case the adapter is in bad condition a replacement Exalon Delft G1/2-G1/2 M/F adapter can be ordered separately.
- 2 MPT probes with other threads require additional adapters with the risk of obtaining an inferior pipe seal. Alternatively a custom adapter is required. Contact Exalon Delft for more information.

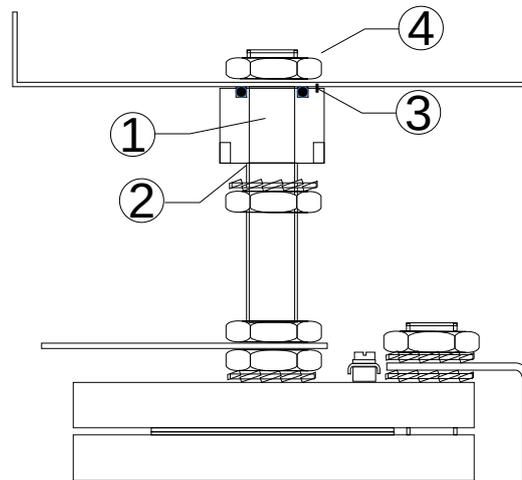


Figure 1: X62T-MPT installation

- 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 MPT wiring through the Exalon Delft G1/2-G1/2 M/F adapter (1).
- Apply a suitable thread locking pipe sealant on the first 25mm of the MPT 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 to probes

Connect the MPT probes according to Figure 2: Connection of MPT 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 MPT supports four kinds of PT100 measurements. The maximum number of spots that can be connected depends on the type of measurement.

| Type of measurement | Number of actual spots |
|----------------------------|--|
| 2-Wire | 16 ³ (<i>not recommended due to low accuracy</i>) |
| 3-Wire Common Sense | 16 |
| 3-Wire Individual Sense | 9 |
| 4-Wire | 6 |

Depending on the type of measurement to be performed the drawings in Figure Figure 2 shows how to connect the wires and how to set the switches of the X62 to select the type of measurement.

3 The X62 can measure up to 18 spots but the gauge only supports 16 spots.

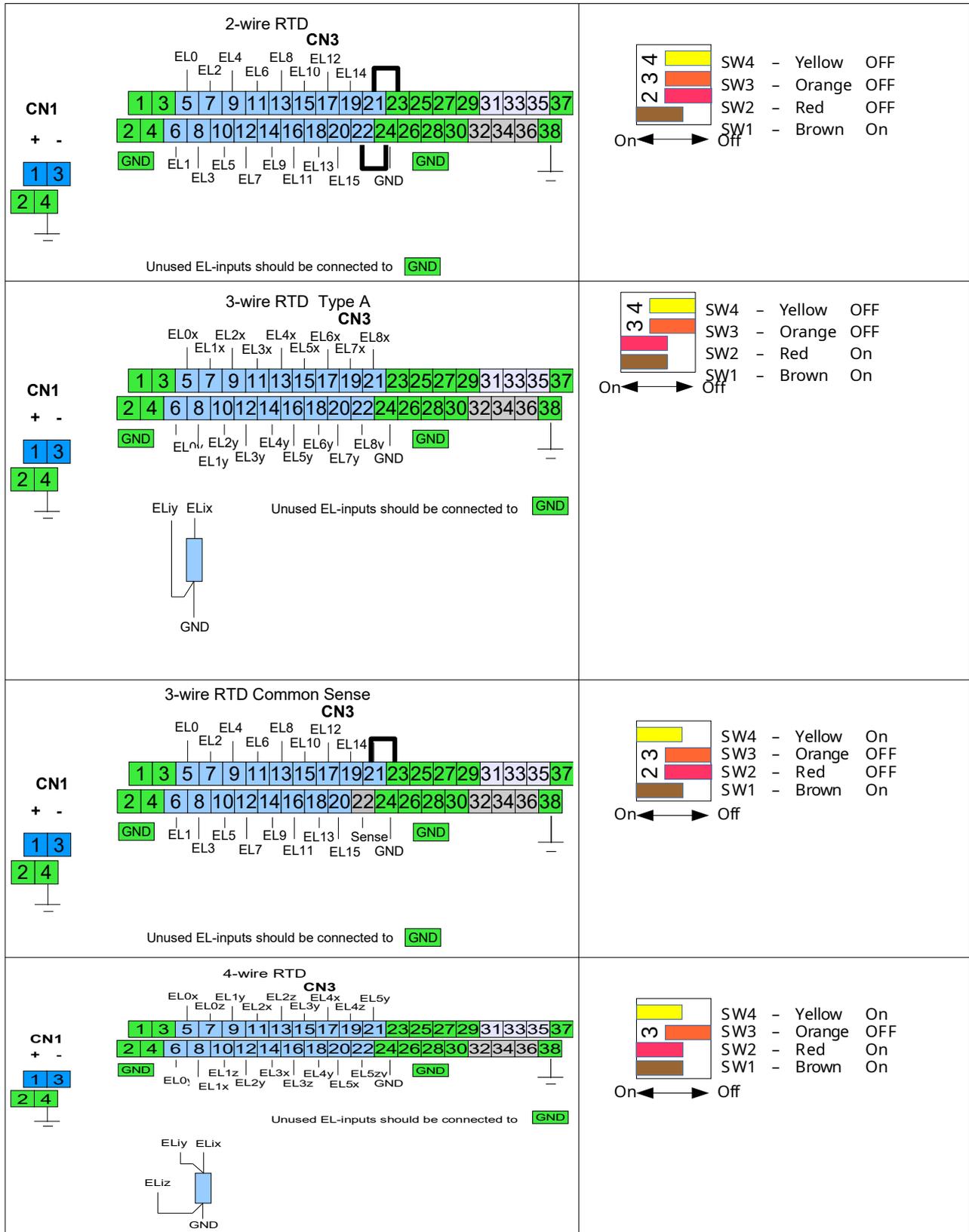


Figure 2: Connection of MPT probes

When the probe has less spots than the supported maximum the non-used terminals must be connected to ground. This allows the X62 to determine the real number of spots. See Figure Figure 3 where the terminals of the last element in a 4-wire configuration are connected to ground to have the X62 use 5 spots (instead of the maximum allowed 6). See Section 5.4 on how the X62T-MPT emulates 16 spots when less than 16 elements are connected.

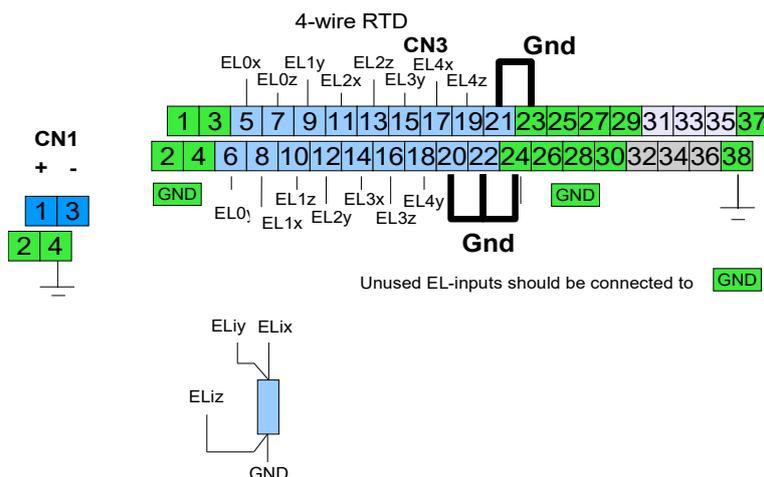


Figure 3: Grounded terminals indicating number of spots

5.3.1 Steps to setup the X62T-MPT for use with an RTD Probe

- Set switch SW1 BROWN in On position to enable high current mode.
- Set switch SW3 ORANGE in Off position to have the X62 start in Run Mode.
- Set switches SW2+SW3 in the correct position for the probe to be used. See Figure Figure 2.
- Turn power on.

After a few minutes temperature should be indicated on the display or the PET.

Example

The display indicates +023.97FL ---I1 meaning temperature has been detected but the gauge needs configuration.

Example

The PET item AP = IF@@@9999999 meaning temperature is not ready.

AP = C@@@+023.97 indicates correct temperature, with C = '0' - 'F' indicating the highest submerged spot element.

5.3.2 Setting the spot order in the Enraf gauge

The X62 outputs the values in the correct order to the MPU or HPU option board. It is not needed to have the MPU or HPU determine the order.

Instead a fixed order must be configured using the following item command:
 MW=0123456789ABCDEF

5.4 Number of spots and probe Length

The level gauge expects a probe with 16 spots evenly distributed over it's length. To support probes with less then 16 spots and still have accurate product temperature values the level gauge must be configured to have a probe of such a length that the upper real spot is located at the top of the tank.

For example with a tank of 25 meters high and a probe with 6 spots the configured length must be 75 meters. Explanation:

- An 864 MTT probe would have 16 spots which equals 15 segments (spot 0 at the bottom and spot 16 at the top).
- The MPT probe has 5 segments so each segment is $25/5=5\text{m}$. As the level gauge expects 15 segments the total length of the probe is to be set to $15*5=75\text{m}$.

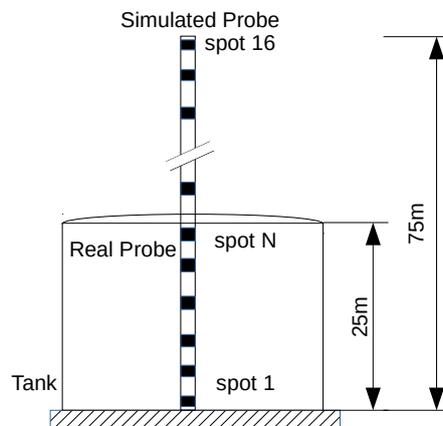


Figure 4: Probe Length for MPT

The unused spot inputs (those located above the roof) will get the same value as the top spot of the real probe.

This setup might cause a deviation of the Gas temperature (AG) but ensures an accurate product temperature (AP).

Two settings of the gauge determine the positions of the spots:

- Lowest spot element position: **MO**
- Temperature sensitive length: **MK**

In the example **MO** would be +000.000 (m) and **MK** would be +075.000 (m)

Note

The level gauge needs to have a valid value for the bottom spot since it uses this to compute the values of all other spots. Therefore in case of a failure of the bottom spot the X62 will copy the value of the lowest valid spot to the ones below it while the lowest valid spot is set to an out of range value. The result is that the level gauge shows the approximate average product temperature on the display with temperature unit (see Section 6.4).

5.5 The X62T Configuration Switches

The X62T has 4 switches (DIP switches) located at the top side. These switches can be shifted to their **On** or **Off** position. The **On** position is when the switch is shifted to the direction where the numbers are printed. The **Off** position is when the switch is shifted to the direction where the text "OFF" is printed.

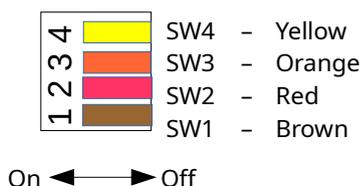


Figure 5: X62T Configuration Switches

Table 1: X62T Configuration Switch settings for the MPT

| Switch | Description |
|----------|---|
| 1 Brown | This switch configures the Current Mode of the X62T. For X62T-MPT this switch must always be in On position for High Current Mode . |
| 2 Red | For the X62T-MPT this switch in combination with switch 4 determines the sensor configuration used. See table below. |
| 3 Orange | This switch is reserved and must always be in Off position. |
| 4 Yellow | See switch 2. |

Table 2: Sensor Configuration using switch 2 and 4

| Sensor Configuration | 2 Red | 4 Yellow |
|-------------------------|-------|----------|
| 2-Wire RTD | Off | Off |
| 3-Wire RTD Type A | On | Off |
| 3-Wire RTD Common Sense | Off | On |
| 4-Wire RTD | On | On |

6 Commissioning MTT and VITO temperature

6.1 Commissioning

The following settings are intended to set up temperature measurement quickly, for settings customized to your local installation please consult your gauge manual or download the document *"Item documentation for Honeywell Enraf series 854 Level Gauges, 97x series SmartRadars Gauges and 877 Field Display & Interface"*, Part no.: 4416277 from <http://www.honeywellprocess.com>.

| Item | Name | Description |
|-----------|------------------------------------|--|
| W2 | Protection level 2 | Default W2=ENRAF2 |
| TD | Temperature dimension | Default TD=C (Celsius) |
| MT | Element type | MT=TPL |
| MR | Reference Resistance | +.22200000E+03 |
| MK | Sensitive length temperature probe | Use the value determined using section 5.4. Default MK=+030.0000 (m) |
| MO | Temperature element offset | Use the value from determined using section 5.4. Default MO=+000.0000 (m) |
| MI | Switch hysteresis | Default MI=+000.1000 (m) |
| MP | Product immersion depth | Default MP=+000.5000 (m) |
| MG | Gas immersion depth | Default MG=+000.5000 (m) for 854, 97x Default MG=+000.1000 (m) for 877 |
| MW | Temperature distribution | 0123456789ABCDEF Default MW=0000000000000000 |

Programs the order of the temperature sensors. As the X62T always sorts the sensors in the correct order the above values should always be used.

To disable the lowest element from the average temperature calculation (MPU B1.3 / OPU B1.1 / HPU B2.1 or higher) use F in stead of 0:
F123456789ABCDEF
This can be used to comply with API and ISO recommendations that the lowest element used for average temperature calculation is

| Item | Name | Description |
|-----------|-------------------------------|--|
| | | positioned 1m from the bottom of the tank. If the product level drops below 1m the lowest element will be used to calculate the average product temperature. The temperature status 'level below lowest element' will be set. |
| TU | Temperature status conversion | The character used to indicate a reduced accuracy for the temperature status caused by: <ul style="list-style-type: none"> • temperature out of range • temperature gradient out of range • last valid level used • manual level used • level below the lowest element Default TU=T |
| EX | Exit | |

6.2 Operation

If the gauge is equipped with a display, depending on the selected display format a correct temperature measurement will show the temperature followed by the selected unit of temperature 'C' or 'F' (example: +027.13°C ---I1). Incorrect temperature may show FL (example +023.97FL ---↓I1).

Without display, temperature related data may be retrieved using the PET.

| Item | Name | Description |
|----------------|---------------------------------|--|
| AP | Average product temperature | The temperature is preceded by 4 status bytes. The first byte indicates the highest submerged spot element ('0' ... 'F'). During startup it will be 'I'. Under normal operation the remaining three status bytes will be '@' |
| AG | Average gas temperature | Same as AP. |
| EM | Temperature system error | Last encountered error. If no errors after initialization will be: 2200 (MPU emulation) 2400 (HPU emulation) |
| MU | Value of the X62T test resistor | 166.5Ω ± 0.03% when EM shows no errors |
| U0 - UF | Relative spot position | As calculated by the gauge without adding item MO |

| Item | Name | Description |
|---------|------------------|--|
| V0 - VF | Spot temperature | Temperature of the spot (V0 is the lowest spot) preceded by the temperature status (same as AP). |

6.3 Troubleshooting

The X62T-MPT firmware measures all Pt100 elements independently from the MPU/HPU/OPU option board. Errors are detected in a much earlier stage than with the 862 MIT namely when calculating the resistance from the individual sub-measurements and before communicating the end result to the gauge.

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

- An X62T hardware failure purposely generates a large error shown in the value of the measured internal test resistor. The value is transmitted to the gauge to item MU and will cause a fatal error in the temperature measurement system.
- A non-fatal error in an probe element measurement is indicated generating a temperature out of range error for that element only.

| Step | Check | Description | Next ⁴ |
|------|---|---|-------------------|
| 1 | Check display unit C or F Check AP status=x@@@ | An invalid temperature on the display will not have the temperature unit and 'FL' may be shown. x indicates the highest submerged spot. @@@ indicates no errors or warnings. See Table 3 Temperature Status Byte 1 . | 3 |
| 2 | Check EM | | |
| | xx00 | No last error available. | 3 |
| | xx11 | No initial communication. | 4 |
| | xx92 | Communication interrupted. | |
| | xx70 | Subsystem error. | |
| | xx89 | One of spot 1-15 not connected (non fatal). | 5 |
| | xx80 | Rtest error, X62T-MIT signals a fatal error. | 6 |
| 3 | MU V0 - VF | Value of the X62T test resistor $166.5\Omega \pm 0.03\%$. Temperature of the spot (V0 is the lowest spot) preceded by the temperature status (as AP). | Stop |

4 If the Check condition is met, continue with the Step indicated under Next

| Step | Check | Description | Next |
|---|--------------------------|---|------|
| 4 | Check voltage on CN1 1-3 | > 14V. Set SW1 to high current or correct wiring. | End |
| 5 | Check MU | MU=+.1665ttt, with tt the terminal on CN3. ttt may need to be rounded to the nearest value. If tt equals 01 it probably means the ground wire of the spot is not connected. Example: +.1665199E+03 refers to terminal 20. If the wire can not be repaired disable the spot using item MW. | End |
| 6 | Check MU | Example: +.6399999E+02 rounded to the nearest integer value is 64. If MU < 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 Special values: 179 No available spots. When searching for the first available spot the X62T found none. <i>This can be caused by having the terminals of the first spot connected to ground.</i> 183 Ground Wire Disconnected 186 Common Sense Wire Disconnected | End |
| End Contact Exalon Delft or your local distributor for support | | | |

6.4 Display Examples

When all temperature measurements succeeded the display will show for example

```
+009.3121 m INN
+025.71°C ----I1
```

Then MU would be +.16650675E+03 and EM would be 2200.

When Spot 1 on T5 is disconnected the display will show for example

```
+009.3120 m INN
+025.74FL ----I1
```

where FL indicates 'General MPU/HPU fail'. Then MU would be +.166505000E+03 and EM would be 2289.

When the Common Ground wire is disconnected the display will show for example

```
+009.3120 m INN
+999.99FL ----I1
```

where FL indicates 'General MPU/HPU fail'. Then MU would be +.18300000E+03 and EM would be 2280.

Table 3: Temperature Status Byte 1

| | Spot element fail (one or more spots defect) | Level exceeds highest spot element | Level exceeds lowest spot element | Fail in average gas temperature | Fail in average product temperature | General temperature fail |
|---|--|------------------------------------|-----------------------------------|---------------------------------|-------------------------------------|--------------------------|
| @ | 0 | 0 | 0 | 0 | 0 | 0 |
| A | 0 | 0 | 0 | 0 | 0 | 1 |
| B | 0 | 0 | 0 | 0 | 1 | 0 |
| C | 0 | 0 | 0 | 0 | 1 | 1 |
| D | 0 | 0 | 0 | 1 | 0 | 0 |
| E | 0 | 0 | 0 | 1 | 0 | 1 |
| F | 0 | 0 | 0 | 1 | 1 | 0 |
| G | 0 | 0 | 0 | 1 | 1 | 1 |
| H | 0 | 0 | 1 | 0 | 0 | 0 |
| I | 0 | 0 | 1 | 0 | 0 | 1 |
| J | 0 | 0 | 1 | 0 | 1 | 0 |
| K | 0 | 0 | 1 | 0 | 1 | 1 |
| L | 0 | 0 | 1 | 1 | 0 | 0 |
| M | 0 | 0 | 1 | 1 | 0 | 1 |
| N | 0 | 0 | 1 | 1 | 1 | 0 |
| O | 0 | 0 | 1 | 1 | 1 | 1 |
| P | 0 | 1 | 0 | 0 | 0 | 0 |
| Q | 0 | 1 | 0 | 0 | 0 | 1 |
| R | 0 | 1 | 0 | 0 | 1 | 0 |
| S | 0 | 1 | 0 | 0 | 1 | 1 |
| T | 0 | 1 | 0 | 1 | 0 | 0 |
| U | 0 | 1 | 0 | 1 | 0 | 1 |
| V | 0 | 1 | 0 | 1 | 1 | 0 |
| W | 0 | 1 | 0 | 1 | 1 | 1 |
| X | 0 | 1 | 1 | 0 | 0 | 0 |
| Y | 0 | 1 | 1 | 0 | 0 | 1 |
| Z | 0 | 1 | 1 | 0 | 1 | 0 |
| [| 0 | 1 | 1 | 0 | 1 | 1 |
| \ | 0 | 1 | 1 | 1 | 0 | 0 |
|] | 0 | 1 | 1 | 1 | 0 | 1 |
| ^ | 0 | 1 | 1 | 1 | 1 | 0 |
| _ | 0 | 1 | 1 | 1 | 1 | 1 |
| ` | 1 | 0 | 0 | 0 | 0 | 0 |
| a | 1 | 0 | 0 | 0 | 0 | 1 |
| b | 1 | 0 | 0 | 0 | 1 | 0 |
| c | 1 | 0 | 0 | 0 | 1 | 1 |
| d | 1 | 0 | 0 | 1 | 0 | 0 |
| e | 1 | 0 | 0 | 1 | 0 | 1 |
| f | 1 | 0 | 0 | 1 | 1 | 0 |
| g | 1 | 0 | 0 | 1 | 1 | 1 |
| h | 1 | 0 | 1 | 0 | 0 | 0 |
| i | 1 | 0 | 1 | 0 | 0 | 1 |
| j | 1 | 0 | 1 | 0 | 1 | 0 |
| k | 1 | 0 | 1 | 0 | 1 | 1 |
| l | 1 | 0 | 1 | 1 | 0 | 0 |
| m | 1 | 0 | 1 | 1 | 0 | 1 |
| n | 1 | 0 | 1 | 1 | 1 | 0 |
| o | 1 | 0 | 1 | 1 | 1 | 1 |
| p | 1 | 1 | 0 | 0 | 0 | 0 |
| q | 1 | 1 | 0 | 0 | 0 | 1 |
| r | 1 | 1 | 0 | 0 | 1 | 0 |
| s | 1 | 1 | 0 | 0 | 1 | 1 |
| t | 1 | 1 | 0 | 1 | 0 | 0 |
| u | 1 | 1 | 0 | 1 | 0 | 1 |
| v | 1 | 1 | 0 | 1 | 1 | 0 |
| w | 1 | 1 | 0 | 1 | 1 | 1 |
| x | 1 | 1 | 1 | 0 | 0 | 0 |
| y | 1 | 1 | 1 | 0 | 0 | 1 |
| z | 1 | 1 | 1 | 0 | 1 | 0 |
| { | 1 | 1 | 1 | 0 | 1 | 1 |
| | 1 | 1 | 1 | 1 | 0 | 0 |
| } | 1 | 1 | 1 | 1 | 0 | 1 |
| ~ | 1 | 1 | 1 | 1 | 1 | 0 |
| | 1 | 1 | 1 | 1 | 1 | 1 |

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