ABB MEASUREMENT & ANALYTICS | SAFETY MANUAL

LMT Series

Safety manual for magnetostrictive level transmitter

K-TEK Level products

This document shall be read in conjunction with LMT series operating manual.

Measurement made Easy

1 Table of Contents

1 General

Introduction

This LMT-series is comprised of the LMT100, LMT200 and LMT300 models. The mounting between LMT100 and LMT200 is different. LMT100 is used for insertion mounting. LMT200 is used for external mounting, For LMT300 is used for sanitary applications and has polished surface. For all of them, the configuration, PCBA and firmware are same. This manual provides an overview of the safety aspects that must be observed for the installation and operation of the device.

Product description

The LMT-series of level transmitters is a modular range of field mounted, microprocessor-based electronic transmitters, utilizing multiple sensor technologies. Accurate and reliable measurement of liquid levels is provided in even the most difficult and hazardous industrial environments. The LMT-series can be configured to provide specific industrial output signals, including 4-20 mA with HART digital communication, FOUNDATION Fieldbus and Profibus communication. The LMT-series consists of three models: LMT100 (insertion-mounted), LMT200 (mounted on gauge (KM26) and LMT300 (insertion-mounted, sanitary).

General safety information

The device is constructed in accordance with international and local regulations and is deemed to be operationally safe. Additionally, the device is tested and shipped from the factory in perfect working condition. The information contained within this manual, as well as all applicable documentation and certification, must be observed and adhered to in order to maintain the factory-deployed condition throughout the LMT-series period of operation.

Full compliance with the general safety requirements must be observed during handling, installation, maintenance or operation of the device. In addition to providing general information, the individual sections within this manual contain descriptions, processes and / or procedural instructions with specific safety information for that corresponding action.

Only by observing all of the safety information can the user minimize the risk of hazards to personnel and / or the environment. The provided instructions are intended as an overview only and do not contain detailed information on all available models or every conceivable scenario that may arise during setup, operation and / or maintenance work. This document shall be used in conjunction with the operation/ instructions manual (3KX-L141000R4201 - OI LMT100200-EN).

For additional information, or in the event of specific issues not covered within these operating instructions, please contact the manufacturer. ABB declares the contents of this manual are not part of any prior or existing agreements, commitments or legal relationships and are not intended to amend those that are already in place.

In addition, the user must observe all relevant safety regulations regarding the installation and operation of electrical systems and the relevant standards, regulations and guidelines concerning explosion protection.

Information on WEEE2 Directive (Waste Electrical and Electronic Equipment)

Note : Starting from August 15th 2018, electrical and electronic equipment marked with the crossed-out wheeled bin symbol may not be disposed as unsorted municipal waste. Waste of electrical and electronic equipment (WEEE) shall be treated separately using the national collection framework available to customers for the return, recycling and treatment of WEEE.

Bear the following points in mind when disposing of them:

- As of 8/15/2018, this product will be under the open scope of the WEEE Directive 2012/19/EU and relevant national laws (for example, ElektroG - Electrical Equipment Act - in Germany).
- The product must be supplied to a specialist recycling company. Do not use municipal waste collection points. These may be used for privately used products only in accordance with WEEE Directive 2012/19/EU.

Pressure Equipment Directive (PED) (2014/68/EU)

This product conforms to the EU directives listed in the device-specific EU declaration of conformity. It is designed in accordance with safe engineering practices to meet state of the art safety requirements, has been tested and left the factory in a condition in which they are safe to operate.

Use of instruction

⚠ DANGER

Serious damage to health / risk to life

This symbol in conjunction with the signal word “DAN-GER” indicates an imminent electrical hazard. Failure to observe this safety information will result in death or severe injury.

⚠ WARNING

Bodily injury

This symbol in conjunction with the signal word “WARNING” indicates a potentially dangerous situation. Failure to observe this safety information may result in death or severe injury.

⚠ CAUTION

Minor Injuries

This symbol in conjunction with the signal word “CAU-TION” indicates a potentially dangerous situation. Failure to observe this safety information may result in minor or moderate injury. This symbol may also be used for property damage warnings.

NOTICE

Property Damage

This symbol indicates a potentially damaging situation. Failure to observe this safety information may result in damage to or destruction of the product and / or other system components.

IMPORTANT (NOTE)

This symbol indicates operator tips, particularly useful information or important information about the product or its further uses. The signal word “IMPORTANT (NOTE)” does not indicate a dangerous or harmful situation.

2 Installation in Hazardous Locations

Explosives atmospheres installation

For installation requirements in Explosives Atmospheres applications refer to IEC 60079-14 and any local Safety or Electric Code regulations mandatory in your area.
For specific conditions for safe use of the LMT100 / LMT200 & LMT300 refer to section “Specific conditions for use” of this manual.

⚠ WARNING

Bodily injury.

The device can be operated at high levels of pressure and with aggressive media. As a result, serious injury or significant property damage may occur if this device is operated incorrectly.

AVERTISSEMENT- Blessure corporelle.

L'appareil peut fonctionner à des niveaux de pression élevés et avec des fluides agressifs. Par conséquent, des blessures graves ou des dommages matériels importants peuvent se produire si cet appareil est utilisé de manière incorrecte.

⚠ CAUTION

Minor injuries.

Only qualified and authorized personnel are to be tasked with the installation, electrical connection, commissioning and maintenance of the transmitter. Qualified personnel are those individuals who have experience in the installation, electrical connection, commissioning and operation of the transmitter or similar devices and hold the necessary qualifications. These qualifications include:

— Training or instruction — C authorization to operate and maintain devices or systems according to safety engineering standards for electrical circuits, high pressures and aggressive media

— Training or instruction in accordance with safety engineering standards regarding maintenance and use of adequate safety systems.

For reasons of safety, ABB recommends that only sufficiently insulated tools, conforming to IEC EN 60900, be used.

Since the transmitter may form a link within a safety chain, it is recommended that the device be replaced immediately if defects are detected. In the event of use in a hazardous area, only non-sparking tools shall be used.

Safety information for electrical installation

⚠ WARNING

General risks.

Electrical connections may only be established by authorized personnel in accordance with the electrical circuit diagrams. The electrical connection information in the manual must be observed; otherwise, the application protection type may be affected. Ground the measurement system according to requirements.

AVERTISSEMENT - Risques généraux.

Les connexions électriques ne doivent être établies que par du personnel autorisé conformément aux schémas électriques. Les informations de connexion électrique dans le manuel doivent être respectées; Dans le cas contraire, le type de protection de l'application peut être affecté. Mettre à la terre le système de mesure en fonction des besoins.

Safety information for inspection and maintenance

Corrective maintenance work may be performed only by trained personnel.

- Before removing the device, depressurize the device and any adjacent lines or containers.
- Check whether hazardous materials have been used as measured materials before opening the device. Residual amounts of hazardous substances may still be present in the device and could escape when the device is open
- Within the scope of operator responsibility, check the following as part of a regular inspection:
  - Pressure-bearing walls / lining of the level device
  - Measurement-related function
  - Leak-tightness
  - Wear (corrosion)

Operator liability

In instances where corrosive and / or abrasive materials are being measured, the user must check the level of resistance of all parts that are coming into contact with these materials. ABB offers guidance in the selection of material but does not accept liability in performing this service. The user must strictly observe the applicable national regulations with regards to installing, functional testing, repairing and maintaining electrical devices.

Qualified personnel

Installing, commissioning and maintaining the device may be per-formed only by trained personnel who are authorized by the plant operator. These trained personnel must have read and under-stood this manual and must comply with its instructions.

Mounting

Read the following installation instructions carefully before proceeding. Failure to observe the warnings and instructions may cause a malfunction or personal hazard. Before installing the transmitter, ensure the device design meets the requirements of the measurement point from both a measure technology and safety point of view.
This applies in respect to:

- Explosion-protection certification
- Measuring range
- Pressure
- Temperature
- Operating voltage

Check the suitability of the materials in regards to their resistance to the media. This applies to the:

- Gasket
- Process connection and seals
- Float
- Probe
- End connection

In addition, the relevant directives, regulations, standards and accident prevention regulations must be observed. Measurement accuracy is largely dependent on the correct installation of the level transmitter and, if applicable, mounting arrangement. In instances where it is possible, the measuring setup should be free from critical ambient conditions such as large variations in temperature, vibrations or shocks.

Certification nameplates

Please refer to the section “Identification” of this manual for details.

Nameplate marking procedure (declaration of protection concept)

Before installing or the first time using the instrument, permanently indicate the protection concept associated with the hazardous area by marking the corresponding box on the product label.

Only one box shall be marked. The chosen protection concept cannot be altered and shall govern the use of the product until end of life. If more than one protection concept is marked, all the hazardous area classification becomes invalid, and the transmitter must be removed from the hazardous area immediately.

- If the instrument is not intended for use in any of the applicable hazardous areas classifications, mark the General Purpose box on the product label. (See figure 1)

IMPORTANT NOTE
Read this manual thoroughly before using this equipment.
If you do not understand the content of this manual, contact ABB service personnel.

Identification

The transmitter is identified by the name plates. (B) The certification plate contains the certification-related parameters for use in a hazardous area.

(A) The nameplate provides information (see figure 1) concerning the model number, probe length, sensor material, process connection type, process connection material, maximum pressure ratings, power supply, output signal, serial number, maximum processed temperature limits and Maximum ambient temperature limits.

Please refer to the serial number when speaking to ABB service department personnel.

IMPORTANT (NOTE)
The name plates shown here are only examples. The name plates attached to the devise may be different to what you see below.

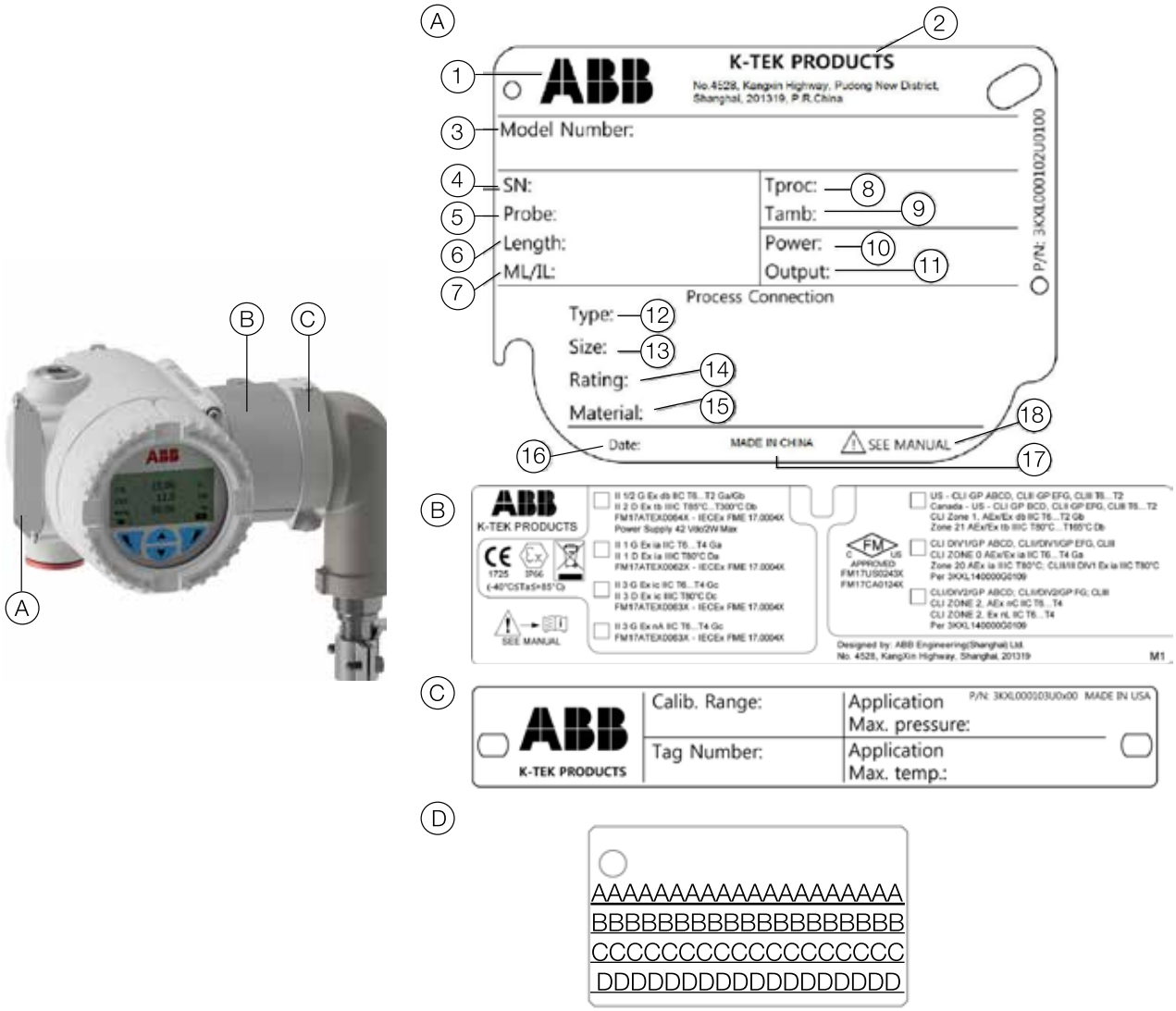


Figure 1 Name Plates

Ⓐ. Name plate Ⓑ. Specific data plate with Ex marking Ⓒ. Tag plate Ⓓ. Tag plate with customer specific data

①. Manufacturing Logo ②. Manufacturing Address ③. Model Number ④. Serial Number ⑤. Probe Material ⑥. Probe Length

⑦. ML = Measurement length (LMT200) / IL = Insertion Length (LMT100 / 300) ⑧. Limits of Measuring Process Temperature

⑨. Ambient Temperature Range ⑩. Power Supply ⑪. Current Output ⑫. Process Connection Type ⑬. Process Connection Size

⑭. Pressure Rating or maximum allowable pressure ⑮. Process Connection Material ⑯. Date of Production in yyyy/mm format

⑰. Country of Manufacture 18. Symbol: Read Instructions Before Use

IMPORTANT (NOTE)

The name plates shown here are only examples. The name plates attached to the devise may be different to what you see here.

IP Protection and designation

The housing for the LMT-series transmitters is certified as conforming to protection type IP66 (according to IEC 60529) or NEMA 4X (according to NEMA 250).

Cable connection

Depending on the design supplied, the electrical connection is established via a cable entry, M20 x 1.5 or ½-4 NPT thread.

IMPORTANT NOTE

With Category 3 transmitters for use in "Zone 2", a qualified cable gland for this type of protection must be installed by the customer (see the Hazardous Area Consideration section). M20 x 1.5 threads are located in the electronics housing for this purpose. For transmitters with a flame-proof enclosure (Exd type of protection, the housing cover must be secured using the locking screw. The screw plug that may have been supplied with the transmitter must be sealed at the plant using Molykote DX. The installer assumes responsibility for any other type of sealing medium used. Increased force is required to unscrew the housing cover after an interval of several weeks. This is not caused by the threads but is due to the type of gasket.

⚠ CAUTION

- The cable entry device shall comply with the requirements of EN 60079-0 and maintain IP 54 or better as required by the installation conditions.
- Field wiring should be rated at least 10°C above the maximum ambient temperature

⚠ WARNING

General risks. Cable, cable gland and unused port plug must be in accordance with the intended type of protection (for example, intrinsically safe and explosion-proof) and the degree of protection (for example, IP6x according to IEC EN 60529 or NEMA 4x). See also the addendum for Ex Safety Aspects and IP Protection. In particular, for explosion-proof installation, remove the red, temporary plastic cap and plug the unused opening with a plug certified for explosion containment.

ATTENTION

Risques généraux Le câble, le presse-étoupe et le bouchon d'orifice non utilisé doivent être conformes au type de protection prévu (par exemple, intrinsèquement sûr et antidéflagrant) et au degré de protection (par exemple IP6x selon IEC EN 60529 ou NEMA 4x). Voir aussi l'addendum pour les aspects de sécurité Ex et la protection de la propriété intellectuelle. En particulier, pour une installation antidéflagrante, retirez le capuchon en plastique rouge et branchez l'ouverture inutilisée avec une prise certifiée pour le confinement de l'explosion.

Remote version: Connection to remote mount design

The signal cable connects the measuring sensor to the transmitter. The cable is fixed to the transmitter, however, it can be separated as needed.

When laying the signal cable, observe the following points:

– Install the signal cable in the shortest path between the measuring sensor and the transmitter. Shorten the signal cable accordingly as needed.
– The maximum permissible signal cable length is 30 m (99 ft).
– Avoid installing the signal cable in the vicinity of electrical equipment or switching elements that can create stray fields, switching pulses and induction. If this is not possible, run the signal cable through a metal pipe and connect this to operational ground.
– Carry out all terminal connections carefully.
– Lay the wires in the terminal box in such a way that they are not affected by vibrations.

Remote version: Cutting the signal cable to length and terminating it

The signal cable is available in four standard lengths: 5 m (16.4 ft), 10 m (32.8 ft), 20 m (65.6 ft) and 30 m (98.4 ft).
The cable ends are already prepared for installation.

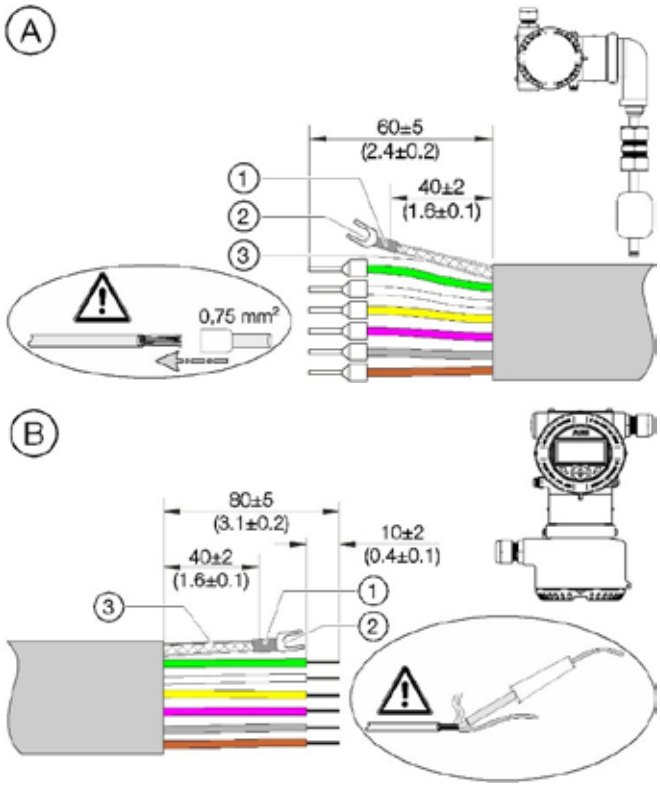


Figure 2 Signal cable dimensions in mm (inch)

Ⓐ Measuring sensor Ⓑ Transmitter

① Heat-shrink tube Ø 4 mm, 10 mm long ② Forked cable lug

③ Heat-shrink tube Ø 2.3 mm, 40 mm long (shielding)

The signal cable can also be cut to any length. Then the cable ends must be prepared as below.
– Twist the shield, shorten and insulate with heat-shrink tube 3. Crimp a matching forked cable lug 2 and insulate the crimping with a heat-shrink tube 1.
– Provide the wires on the measuring sensor side with wire-end ferrules (0.75 mm²).
– Twist the wires to the transmitter side and solder.

Remote version: Connecting the signal cable

⚠ DANGER

Danger of explosion if the device is operated with the transmitter housing or terminal box open!

Before opening the transmitter housing or the terminal box, note the following points:

– Check that a valid fire permit is available.

– Ensure that there is no risk of explosion.

– Switch off the power supply and wait for t > 2 minutes before opening.

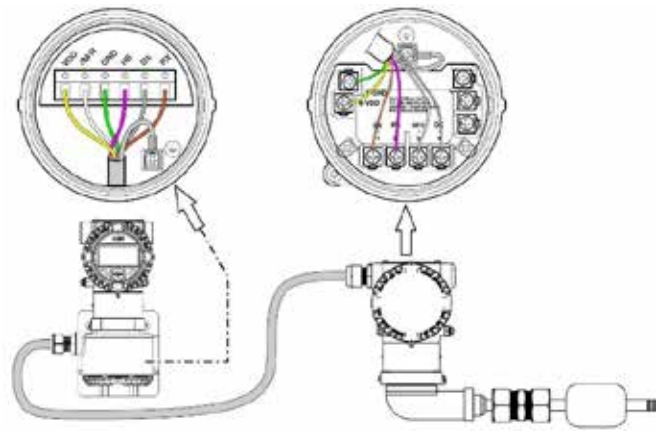


Figure 3 Remote version: connecting the signal cable

Terminal	Color / function
VDD	Yellow
/M/R	White
GND	Green
HS	Pink
DX	Gray
RX	Brown
⏚	Ground terminal (functional ground / shield)

Table 1

NOTE
The use of shielded cables in accordance to common engineering practices is recommended to minimize the impact of industrial electromagnetic noise.

1. Use the signal cable connected to the transmitter to make the electrical connection between the measuring sensor and the transmitter.
2. Unscrew the cover of the terminal boxes on the transmitter and the measuring sensor.
3. Tailor the signal cable in accordance with specification.
4. Insert the cable through the cable gland into the terminal box.
5. Tighten the cable gland.
6. Connect the wires to the corresponding terminals (refer figure 3).
7. Connect the shield of the signal cable to the forked cable lug to the ground terminal.
8. Screw on the cover of the terminal compartment on the transmitter and the measuring sensor and tighten by hand. Make sure the gaskets for the cover are seated properly.

Grounding

A terminal is available on both the outside of the housing and in the plug for grounding (PE) the transmitter. Both terminals are electrically connected to one another (see Figure 4).

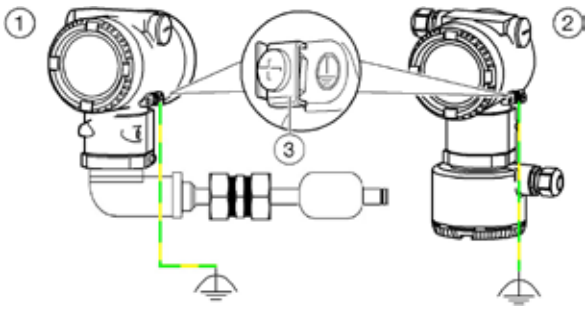


Figure 4 Ground connection on transmitter housing

(1) Integral mount design and sensor in remote design (2) Transmitter in remote mount design (3) Grounding terminal

Protective grounding

All transmitters are supplied with an external ground connection for protective grounding. Wire this ground connection to a suitable earth ground. For a transmitter measuring loop, an earth ground should maintain a resistance of 5 ohms or less. Use a heavy-duty conductor, at least 15 AWG / 1.6mm² Ø.

⚠ WARNING

General risks.

The LMT provides internal and external grounding terminals for use in installations in accordance to the applicable regional regulations governing electrical installations.

AVERTISSEMENT - Risques généraux.

Le LMT fournit des bornes de mise à la terre internes et externes à utiliser dans les installations conformément aux réglementations régionales applicables aux installations électriques.

General guidelines

⚠ WARNING

General risks.

Make sure all circuits are de-energized prior to installation

ATTENTION

Assurez-vous que tous les circuits sont hors tension avant l'installation

- The LMT-series has been evaluated as an Installation (Overvoltage) Category 1 / Pollution Degree 2 apparatus, per IEC 1010
- The maximum altitude of operation is 6560 feet (2000 meters).
- The LMT-series is designed with both internal and external protective earth (ground) terminals.
- All field wiring connected to the LMT-series transmitters must comply with National Electric Code or any other applicable regional electric codes.

Flame-proof / explosion-proof installations

Installation requirements

The LMT-series of level transmitters is designed for use in Division 1 or at the boundary of a Zone 0 and Zone 1 hazardous area.

⚠ CAUTION

The flameproof joints of the equipment are not intended to be repaired. Consult the manufacturer if repair of the flameproof joints is necessary.

Cable or conduit entries must be fitted with a suitably certified cable entry device, with or without the use of a suitably approved thread adaptor. Where conduit is used in the installation, an approved conduit seal or stopping box is required immediately after (ATEX/IECEx) or within 18 inches of (FM/FM-C/CSA) the end-user field wiring entrance. Unused cable entry holes shall be closed by a suitably approved Ex d blanking plug.

⚠ CAUTION

Internal temperatures of the LMT-series can reach up to 252°F (122°C) when operated at maximum process and maxi-mum ambient temperatures. The service temperature range of cable glands and field wiring shall be chosen accordingly.

Installation and use of apparatus in hazardous locations shall be in accordance with an IEC 60079-14 or applicable regional standards.

Temperature classification

Temperature classifications of the LMT-series are dependent on the process temperature of the coupled vessel. Use the table below to determine temperature class:

Flameproof / Explosion Proof		
Temperature	**Process**	**Ambient**
Class (Ex db)	**Temperature**	**Temperature**
T6	-196°C to +80°C	-40°C to +57.9°C
T5	-196°C to +95°C	-40°C to +67.4°C
T4	-196°C to +130°C	-40°C to +85°C
T4	-196°C to +195°C	-40°C to +85°C
T3	-196°C to +295°C	-40°C to +85°C
T2	-196°C to +420°C	-40°C to +85°C

Table 2

Flameproof marking

- ATEX/IECEx
  - II ½ G Ex db IIC T6..T2 Ga/Gb FM17ATEX0064X
  - IECEx FME 17.0004X Power Supply 42 Vdc/2W Max
- US & CA CLI Zone 1, AEx/Ex db IIC T6...T2 Gb
  - US - CLI GP ABCD, T6...T2
  - Canada - CLI GP BCD, T6...T2

Protection by enclosure installation

Installation requirements

Field wiring fittings such as cable glands and conduits must maintain the ingress protection rating of the enclosure (IP6X). Not suitable for use in uncontrolled dust environments.

Temperature classification

Temperature classifications of the LMT-series are dependent on the process temperature of the coupled vessel. Use the table below to determine temperature class:

Protection by Enclosure		
Temperature	**Process**	**Ambient**
Class (Ex db)	**Temperature**	**Temperature**
T85°C	-196°C to +80°C	-40°C to +57.9°C
T100°C	-196°C to +95°C	-40°C to +67.4°C
T135°C	-196°C to +130°C	-40°C to +85°C
T135°C	-196°C to +195°C	-40°C to +85°C
T165°C	-196°C to +295°C	-40°C to +85°C
T300°C	-196°C to +420°C	-40°C to +85°C

Table 3

Protection by enclosure marking

- ATEX/IECEx
  - II 2 D Ex tb IIIC T85°C...T300°C Db FM17ATEX0064X
  - IECEx FME 17.0004X Power Supply 42 Vdc/2W Max
- US & CA Zone 21 AEx/Ex tb IIIC T80°C...T165°C Db
  - US - CLII GP EFG, CLIII T6…T2
  - Canada - CLII GP EFG, CLIII T6…T2

Intrinsic safety / non-Incendive installation

Installation requirements

Refer to Installation and Control drawing in section “Intrinsic safety installation drawing” for details about the installation requirements.

Temperature classification

Refer to Installation and Control drawing in section “Intrinsic safety installation drawing” to determine the temperature classification.

Intrinsic / Non-Incendive marking

- ATEX/IECEx
  II 1 G Ex ia IIC T6…T4 Ga
  II 1 D Ex ia IIIC T80°C Da;
  FISCO Field Device,FF-16 (For FF/PA output) FM17ATEX0062X - IECEx FME 17.0004X
  II 3 G Ex ic IIC T6..T4 Gc
  II 3 D Ex ic IIIC T80°C Dc
  FISCO Field Device,FF-16 (For FF/PA output) II 3 G Ex nA IIC T6..T4 Gc
  FM17ATEX0063X - IECEx FME 17.0004X
  US & CA
- CLI DIV1/GP ABCD, CLII/DIV1/GP EFG, CLIII;
  CLI ZONE 0 AEx/Ex ia IIC T6…T4 Ga;
  Zone 20 AEx ia IIIC T80°C; CLII/III DIV1 Ex ia IIIC T80°C; FISCO Field Device,FF-16 (For FF/PA output)
  CLI/DIV2/GP ABCD; CLII/DIV2/GP FG; CLIII;
  CLI ZONE 2, AEx nC IIC T6…T4;
  CLI ZONE 2, Ex nL IIC T6…T4;
  per 3KXL140000G0109

EPL Ga installation requirements

When non-metallic, probe-covering materials are used (PVC, CPVC, and PVDF), there is a risk of ignition from electrostatic dis-charge due to the flow of non-conductive media (for example, in stirring vessels or pipes). The user must decide on the suitability of the material for the particular application. The LMT100 and LMT300 may be installed in EPL Ga applications, where only the outer surface of the probe and the wetted part of the process connection are facing the area requiring EPL Ga. Everything else including the internal volume of the instrument and the surrounding of the enclosure must be in area requiring EPL lower than Ga, in other words, the wall of the probe, which always exceeds 1mm thickness and the process connection of the instrument form a partition wall between the areas requiring EPL Ga and any other lower than EPL Ga. The material of the partition wall is determined by the probe and process connection material and are identified in the label of the instrument. The LMT200 is intended for installations attached to external chambers in areas requiring a lower EPL than Ga.

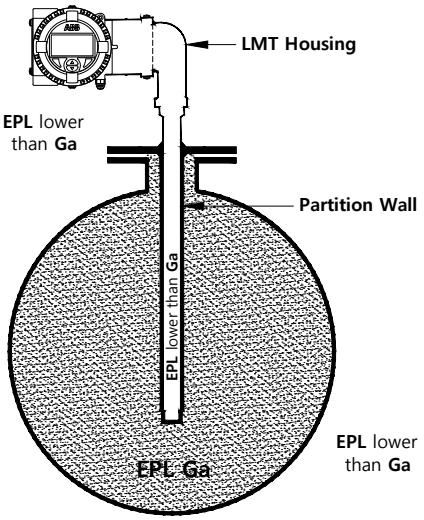


Figure 5

Applicable standards

US Approval

FM Class 3600 2011 - Electrical Equipment for Use in Hazardous (Classified) Locations General Requirements
FM Class 3615 2006 - Explosionproof Electrical Equipment
FM Class 3610 2015 - Intrinsically Safe Apparatus and Associated Apparatus for Use in Hazardous (Classified) Locations
FM Class 3611 2016 - Nonincendive Electrical Equipment for Use Hazardous (Classified) Locations
FM Class 3616 2011 - Dust-Ignitionproof Electrical Equipment
FM Class 3810 2005 - Electrical Equipment for Measurement, Control and Laboratory Use
ANSI/ISA 60079-0 2013 - Explosive atmospheres - Part 0: Equipment – General requirements
ANSI/UL 60079-1 2015 - Explosive atmospheres - Part 1: Equipment Protection by Flameproof Enclosures “d”
ANSI/ISA 60079-11 2014 - Explosive atmospheres - Part 11: Equipment protection by intrinsic safety “i”
ANSI/ISA 60079-15 2013 - Explosive atmospheres - Part 15: Equipment protection by type of protection “n”
ANSI/ISA 60079-31 2015 - Explosive atmospheres - Part 31:

Equipment dust ignition protection by enclosure “t”
ANSI/NEMA 250 2003 - Enclosures for Electrical Equipment (1000 Volts Maximum)
ANSI/IEC 60529 2004 - Degrees of Protection Provided by Enclosures (IP Code)

Canadian Approval
CSA-C22.2 No. 0.4 2004 - Bonding and Grounding of Electrical Equipment
CSA-C22.2 No. 0.5 1982 - Threaded Conduit Entries
CSA-C22.2 No. 25 1966 - Enclosures for Use in Class II Groups E, F, and G Hazardous Locations
CSA-C22.2 No. 30 1986 - Explosion-proof Enclosures for Use in Class I Hazardous Locations
CSA-C22.2 No. 94 1991 - Special Purpose Enclosures
CSA-C22.2 No. 157-M1992 - Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations
CSA-C22.2 No. 213-M1987 - Non-Incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations
CSA-C22.2 No. 60529 2005 - Degrees of Protection Provided by Enclosures (IP Code)
CAN/CSA-C22.2 No. 60079-0 2015 - Explosive atmospheres – Part 0: Equipment - General requirements
CAN/CSA-C22.2 No. 60079-1 2011 - Explosive atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”
CAN/CSA-C22.2 No. 60079-11 2014 - Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “i”
CAN/CSA-C22.2 No. 60079-15 2016 - Explosive atmospheres – Part 15: Equipment protection by type of protection “n”
CAN/CSA-C22.2 No. 60079-31 2015 - Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure “t”
CSA 61010-1 2012 - Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1, General Requirements

ATEX Certification
EN 60079-0 +A11 2012 2013 - Explosive atmospheres - Part 0: Equipment - General Requirements
EN 60079-1 2014 - Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures “d”
EN 60079-11: 2012 - Explosive atmospheres - Part 11: Equipment protection by intrinsic safety “i”
EN 60079-15: 2010 - Explosive atmospheres - Part 15: Equipment protection by type of protection “n”
EN 60079-26 2015 - Explosive atmospheres - Part 26: Equipment with equipment protection level (EPL) Ga
EN 60079-31 2014 - Explosive atmospheres - Part 31: Equipment dust ignition protection by enclosure “t”
EN 60529 +A2 1991 2013 - Degrees of protection provided by enclosures (IP code)

IECEx Certification
IEC 60079-0: 2011 Edition: 6.0 - Explosive atmospheres - Part 0: General requirements
IEC 60079-1: 2014-06 Edition: 7.0 - Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures “d”
IEC 60079-11: 2011 Edition: 6.0 - Explosive atmospheres - Part 11: Equipment protection by intrinsic safety “i”
IEC 60079-15: 2010 Edition: 4 - Explosive atmospheres - Part 15: Equipment protection by type of protection “n”
IEC 60079-26: 2014-10 Edition: 3.0 - Explosive atmospheres - Part 26: Equipment with Equipment Protection Level (EPL) Ga
IEC 60079-31: 2013 Edition: 2 - Explosive atmospheres - Part 31: Equipment dust ignition protection by enclosure “t”
IEC 60529:1989/AMD2:2013 - Degrees of protection provided by enclosures (IP code)

Technical limit values

The device is designed for use exclusively within the values stated on the name plate and within the technical limit values specified on the data sheets.

The following technical limit values must be observed:
- The maximum working pressure must not be exceeded.
- The maximum ambient operating temperature must not be exceeded.
- The maximum process temperature must not be exceeded.
- The housing protection type must be observed.

⚠ DANGER

Serious damage to health / risk to life

Explosion hazard. Do not open or disconnect equipment when a flammable or combustible atmosphere is present.

NOTICE

Property damage

Do not break thread sealant or conduit seal in order to maintain enclosure Type 4X and IP66/IP67 rating

Specific conditions for use

⚠ CAUTION

- Where EPL Da (1D) is required, the equipment housing shall not be subjected to uncontrolled dust layers.
- When EPL Ga or Da (1G or 1D) is required (for example in Zone 0 or Zone 20 hazardous areas), parts of the equipment containing light metals (Aluminum, Magnesium, Titanium and Zirconium) shall be protected from impact so that impact of friction sparks cannot occur, taking into account rare malfunction.
- When non-metallic, probe-covering materials are used (PFA, FEP, PVC, CPVC, and PVDF), there is a risk of ignition from electro-static discharge due to the flow of non-conductive media (for example, in stirring vessels or pipes). The user must decide on the suitability of the material for the particular application.
- If additional non-conductive paint/coatings are applied to the process connection flange or instrument housing (for

example, to provide additional corrosion resistance) there may exist a risk of electrostatic discharge due to charge build-up on the non-conductive paint/coating layer. The user shall take appropriate mitigations measures in accordance with their own risk assessment.

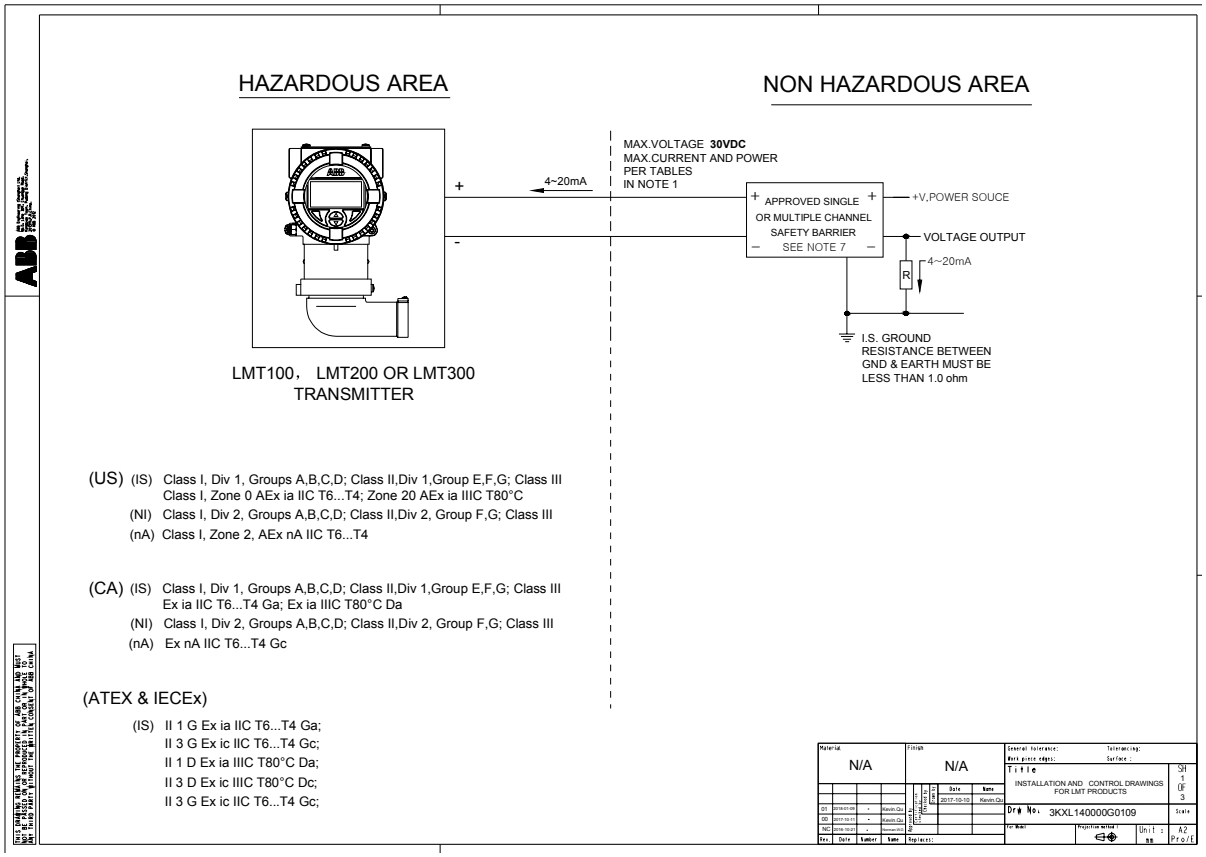
- The flameproof joints of the equipment are not intended to be repaired. Consult the manufacturer if repair of the flameproof joints is necessary.
- For EPL Ga installations - The LMT main electronics enclosure option j = D1 or D2 contains aluminum and is considered to present a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact or friction.
- When EPL Ga or Da is required (for example in Zone 0 or Zone 20 hazardous areas), parts of the equipment containing light metals (Aluminum, Titanium, Zirconium or Magnesium) shall be protected from impact so that impact or friction sparks cannot occur, taking into account rare malfunction. Measures to prevent impact or friction sparks when using the equipment containing light metals include but are not limited to:
  - Mounting the probe vertically
  - No mechanical agitation shall be used
  - Use of stilling wells to mitigate effect of agitation.
  - Limit rate of change of level to values such that friction sparks cannot occur
- The user shall take the appropriate mitigation measures in accordance with their own risk assessment to prevent any other conditions capable of producing impact or friction sparks.
- When the manufacturer of the equipment has not identified the type of protection on the label, the user shall, on installation, mark the label with the type of protection used.

IMPORTANT
For cable glands, please refer to your supplier's data sheet for proper installation.

NOTICE

It is the customer's responsibility to use appropriate cable gland, screw plug, lube and/or sealant for the cable entry ports. The installer assumes responsibility for any other type of sealing medium used. At this point, we wish to draw your attention to the fact that increased force will be required to unscrew the housing cover after an interval of several weeks. This is not caused by the threads, but instead is solely due to the type of gasket.

Intrinsic safety installation drawing



(US) (IS) Class I, Div 1, Groups A,B,C,D; Class II,Div 1,Group E,F,G; Class III
Class I, Zone 0 AEx ia IIC T6...T4; Zone 20 AEx ia IIIC T80°C
(NI) Class I, Div 2, Groups A,B,C,D; Class II,Div 2, Group F,G; Class III
(nA) Class I, Zone 2, AEx nA IIC T6...T4

(CA) (IS) Class I, Div 1, Groups A,B,C,D; Class II,Div 1,Group E,F,G; Class III
Ex ia IIC T6...T4 Ga; Ex ia IIIC T80°C Da
(NI) Class I, Div 2, Groups A,B,C,D; Class II,Div 2, Group F,G; Class III
(nA) Ex nA IIC T6...T4 Gc

(ATEX & IECEx)

(IS) II 1 G Ex ia IIC T6...T4 Ga;
II 3 G Ex ic IIC T6...T4 Gc;
II 1 D Ex ia IIIC T80°C Da;
II 3 D Ex ic IIIC T80°C Dc;
II 3 G Ex ic IIC T6...T4 Gc;

Material	Finish	General tolerance:	Tolerancing:
N/A	N/A	Work piece edges:	Surface :

Title: INSTALLATION AND CONTROL DRAWINGS FOR LMT PRODUCTS — SH 1 OF 3

Dr# No. 3KXL140000G0109 — Scale

Projection method | Unit : mm | A2 Pro/E

NOTES:

1. For HART OUTPUT:
INPUT PARAMETERS FOR L1 DISPLAY OPTION

TEMPERATURE CLASS- GAS	TEMPERATURE CLASS- DUST	MINIMUM AMBIENT(°C)	MAXIMUM AMBIENT(°C)	MAXIMUM INPUT-CURRENT Imax(mA)	POWER (W)
T4	T135°C	-40°C	+85°C	100	0.75
T4	T135°C	-40°C	+70°C	160	1
T5	T100°C	-40°C	+40°C	100	1.4
T6	T85°C	-40°C	+40°C	50	0.4

INPUT PARAMETERS FOR L2 DISPLAY OPTION

TEMPERATURE CLASS- GAS	TEMPERATURE CLASS- DUST	MINIMUM AMBIENT(°C)	MAXIMUM AMBIENT(°C)	MAXIMUM INPUT-CURRENT Imax(mA)	POWER (W)
T4	T135°C	-40°C	+60°C	100	0.75
T4	T135°C	-40°C	+60°C	160	1
T5	T100°C	-40°C	+56°C	100	1.4
T6	T85°C	-40°C	+44°C	50	0.4

2. For FF OUTPUT:

TEMPERATURE CLASS- GAS	AMIENT TMPERATURE LIMITATION	MAXIMUM FLUID TEMPERATURE
T6	57.9°C	80°C
T5	67.4°C	95°C
T4	85°C	130°C
T4	85°C	195°C

Ui = 24V
Ii = 250mA
Pi = 1.2W
Ci ≤ 5nF
Li ≤ 10μH

When FISCO: Ui = 17.5Vdc
Ii = 380mA
Pi = 5.32W
Ci ≤ 5nF
Li ≤ 20μH

INPUT PARAMETERS FOR 'ic" ARE:

FISCO:
Ui = 17.5Vdc
Ii = 380mA
Pi = 5.32W
Ci < 5nF
Li <10μH

FF-816：
Ui = 32Vdc
Ii = 250mA
Pi = 1.2 W
Ci < 5nF
Li < 10μH

3. For PA OUTPUT:

TEMPERATURE CLASS- GAS	AMIENT TMPERATURE LIMITATION	MAXIMUM FLUID TEMPERATURE
T6	57.9°C	80°C
T5	67.4°C	95°C
T4	85°C	130°C
T4	85°C	195°C

Ui = 24Vdc - Linear output
Ii = 250mA
Pi = 1.2W
Ci ≤ 5nF
Li ≤ 20μH

When FISCO: Ui = 17.5Vdc
Ii = 360mA
Pi = 2.52W
Ci ≤ 5nF
Li ≤ 10μH

INPUT PARAMETERS FOR 'ic" ARE:

FISCO:
Ui = 17.5Vdc
Ii = 380mA
Pi = 5.32W
Ci < 5nF
Li <10μH

FF-816：
Ui = 32Vdc
Ii = 250mA
Pi = 1.2 W
Ci < 5nF
Li < 10μH

4. DUST-TIGHT CONDUIT SEAL MUST BE USED WHEN INSTALLED IN CLASS II & CLASS III ENVIRONMENTS.
5. CONTROL EQUIPMENT CONNECTED TO BARRIER MUST NOT USE OR GENERATE MORE THAN 250V.
6. FOR ENTITY MODEL SAFETY BARRIER MUST MEET THE FOLLOWING REQUIREMENTS:
V(OC) or V(T)<V(Max),I(SC) or I(T)<I(Max),C(A)>(C(I)+C(Cable)),L(A)>(L(I)+L(Cable)).
7. FOR DIV 2 APPLICATIONS,THE TRANSMITTER MUST EITHER BE INSTALLED IN ACCORDANCE WITH NATIONAL ELETRICAL CODE FOR DIVISION 2 WIRING METHODS OR CONNECT TO AN FM APPROVED BARRIER.
8. ASSOCIATED EQUIPMENT MUST BE FM APPROVED.
9. INSTALLATION SHALL BE IN ACCORDANCE WITH ANSI/ISA RP12.06.01(EXCEPT CHAPTER 5 FOR FISCO INSTALLATIONS) "INSTALLATION OF THE INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS(CLASSIFIED) LOCATIONS"AND THE NATIONAL ELECTRICAL CODE ® (ANSI/NFPA 70) SECTIONS 504,505 AND 506.
10. SYSTEM CALCULATIONS:ADD CABLE CAPACITANCE & INDUCTANCE TO TRANSMITTER ENTITY PARAMETERS(I.E. ALL FIELD INSTALLED CAPACITANCE AND INDUCTANCE MUST BE CONSIDERED) IF CABLE PARAMETERS ARE NOT KNOWN,60pF/FT& 0.2uH/ft SHALL BE USED.
11. WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR USE IN HAZARDOUS LOCATIONS.
12.INSTALLATION IN CANADA SHALL BE IN ACCORDANCE WITH C22.1 CANADIAN ELECTRICAL CODE, Part I.

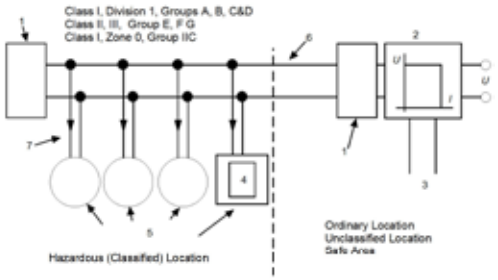
Material	Finish	General tolerance:	Tolerancing:
N/A	N/A	Work piece edges:	Surface :

Title: INSTALLATION AND CONTROL DRAWINGS FOR LMT PRODUCTS — SH 2 OF 3

Dr# No. 3KXL140000G0109 — Scale

Projection method | Unit : mm | A2 Pro/E

EXAMPLE OF FISCO CONTROL DRAWING



1. Terminator
2. Power supply
3. Data
4. Hand held terminal
5. Field devices
6. Trunk
7. Spur

FISCO CONCEPT

The Fieldbus Intrinsically Safe Concept (FISCO) allows the interconnection one FISCO certified power supply, an unlimited number of FISCO certified intrinsically safe field apparatus, and two FISCO certified terminators, one of each end of the trunk cable. (Note: The FISCO Terminator at the supply end is usually incorporated in to the FISCO Power Supply.)

Each piece of apparatus will be marked with the word "FISCO" followed by the indication of its function, i.e. "Power Supply", "Field Device" or "Terminator".

The criterion for such interconnection is Division or Zone and Group Dependent. Therefore, all apparatus shall be labeled for the same applicable Division or Zone and Group(s).

The FISCO power supply shall be located not more than 30m from one end of the trunk. Where the power supply is connected via a spur, then that spur is restricted to a length of 30 m.

The cable used to interconnect the devices needs to comply with the following parameters:

Loop resistance Rc: 15 Ω/km to150 Ω/km
Inductance per unit length Lc: 0.4mH/km to 1mH/km
Capacitance per unit length Cc: 45nF/km to 200nF/km
Maximum Length of spur Cable: 60m for IIC
Maximum length of each trunk cable, including the length of all spurs, 1 km in IIC and 5 km in I, IIB and IIIC.

Terminators
At each end of the trunk cable a line terminator with the following parameters is suitable:
R= 90Ω to 102Ω
C = 0 to 2.2μF

1. No revision to drawing without prior FM Approval.
2. The FISCO Supply, FISCO Field Device(s) and FISCO Terminators shall be FM Approved for installations in the U.S.
3. The FISCO Supply, FISCO Field Device(s) and FISCO Terminators shall be Canadian Approved for Installations in Canada.
4. The FISCO Supply, FISCO Field Device(s) and FISCO Terminators shall be ATEX Certified for Installations in Europe.
5. The FISCO Supply, FISCO Field Device(s) and FISCO Terminators shall be IECEx Certified for IECEx installations.
6. FISCO Supply manufacturer's installation drawing shall be followed when installing this equipment.
7. The control room equipment connected to FISCO Supply must not generate more than 250 Vrms or Vdc, or the marked Um on the associated apparatus.
8. Installations in the U.S. shall be in accordance with ANSI/ISA RP12.06.01 "installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the latest edition of the National Electrical Code (ANSI/NFPA 70)
9. Resistance between Intrinsically Safe Ground and earth ground shall be less than 1.0 Ohm.
10. Installation in Canada shall be in accordance with C22.1 Canadian Electrical Code, Part I.
11. Installations in Europe shall comply with the relevant requirements of EN60079-14 and applicable National regulations.
12. Installations for IECEx certification shall be in accordance with IEC 60079-14 and the wiring practices for the country of origin.
13. For remote version, the barriers shall be GALVANICALLY ISOLATING BARRIERS.The code for remote version is R1,R2,R3 or R4 from housing option

Material: N/A				Finish: N/A				General tolerance:	Tolerancing:	
								Work piece edges:	Surface :	
								Title: INSTALLATION AND CONTROL DRAWINGS FOR LMT PRODUCTS		SH 3 OF 3
								Dr# No.: 3KXL140000G0109		Scale
01	2018-01-04	-	Kevin.Qu					To Next	Projection method:	Unit : mm / A2 Pro/E
00	2017-10-13	-	Kevin.Qu							
NC	2016-10-21	-	Vanessa.Hi							
Rev.	Date	Number	Name	Replaces:						

3 Functional safety (for HART version)

SIL General Information

NOTE

This functional safety is valid for Magnetostrictive level transmitter LMT100/200/300 with Hart output signal (H1 — Single 4 ... 20 mA + HART") and"SIL2 for HFT=0, SIL3 for HFT=1 --- certified acc. to IEC 61508".

Each device design has a specific type designation. The parts of the model number relating to the SIL approval are listed in the table of device data sheet. The complete key to model numbers is described in the device data sheet. The type designation is located on the name plate of the device.

⚠ CAUTION

The HART protocol is non-safety related, which is only used for setup, calibration, and diagnostic purposes, not during operation.

The HART protocol shall never be used in safety related applications.

- **LMT Sensor**

The sensor used in this transmitter is based on the magnetostriction principle. Sensor includes a magnetostrictive wire through which current pass to generate a magnet field, the magnets within the float generate orthotropic magnet field. The interaction between these two orthotropic magnet fields produces a torsion on the sensor wire.
LMT series includes the following types: LMT100 LMT200, LMT300.
The mounting between LMT100 and LMT200 is different. LMT100 is intended for insertion mounting. LMT200 is intended for external mounting, For LMT300 is used in sanitary application and has polished surface. For all of them, the configuration, PCBA and firmware are the same.

- **Reference Documents**

– TüV Report and Certificate
– FMEDA Report

- **Acronyms and abbreviations**

Abbreviation	Designation	Description
HFT	Hardware Fault Tolerance	Hardware fault tolerance of the unit. Ability of a functional unit (hardware) to continue to perform a required function when faults or errors are prevailing.
MTBF	Mean Time Between Failures	Mean time between failures.
MTTR	Mean Time To Restoration	Mean time between the occurrence of an error in a unit or in a system and its repair.
PFD	Probability of Dangerous Failure on Demand	Probability of hazardous failures for a safety function on demand.
PFD_{AVG}	Average Probability of Dangerous Failure on Demand	Average probability of hazardous failures for a safety function on demand.
SIL	Safety Integrity Level	The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL 1 to SIL 4). Each level corresponds to a range of probability for the failure of a safety function. The higher the Safety Integrity Level of the safety-related systems, the lower the probability that they will not perform the required safety function.
SIF	Safety Instrumented Function	A set of equipment intended to reduce the risk due to a specific hazard (a safety loop), Safety instrumented control/protection function.
SIS	Safety Instrumented System	Implementation system of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s).
SFF	Safe Failure Fraction	Proportion of non-hazardous failures; in other words, the proportion of failures without the potential to put the safety-related system in a hazardous or impermissible state.
Low Demand Mode	Low Demand Mode of operation	Measurement type with low request rate. Measurement type for which the request rate for the safety-related system is not more than once a year and not greater than twice the frequency of the retest.
DCS	Distributed Control System	Control system used in industrial applications to monitor and control decentralized units.
HMI	Human Machine Interface	In this case, the HMI is a combined module consisting of an LCD display with or without a local keyboard.
DTM	Device Type Manager	A DTM is a software module that supports specific functions for accessing device parameters, the setup and the operation of devices, and diagnostics. The DTM is not executable software. It requires an FDT container program in order to be activated.
LRV	Device Configuration	Lower Range Value of the measurement range
URV	Device Configuration	Upper Range Value of the measurement range
Multidrop	Multidrop Mode	In Multidrop Mode, up to 15 field devices are connected in parallel to a single wire pair. The analog current signal simply serves to supply power to the devices in two-wire technology with a fixed current of ≤ 4 mA.
SELV	Safety Extra Low Voltage	electrical circuit with the following characteristics: • the voltage does not exceed ELV; • protective separation from circuits other than SELV or PELV; • no provisions for earthing of the SELV circuit, or its accessible conductive parts; • basic insulation of the SELV circuit from earth and from PELV circuits
PELV	Protective Extra Low Voltage	electrical circuit with the following characteristics: • the voltage does not continuously exceed ELV under single fault as well as normal conditions; • protective separation from circuits other than PELV or SELV; • provisions for earthing of the PELV circuit, or its accessible conductive parts, or both

Table 4 Terms and Abbreviations

SIL Standards and definitions of terms

LMT Transmitter related standards

- Standard IEC 61508 (2010) (Edition 2), Part 1 to 7

– *English*
Functional safety of electrical / electronic / programmable electronic safety-related systems (Target group: Manufacturers and Suppliers of Devices).

– *German*
Funktionale Sicherheit sicherheitsbezogener elektrischer / elektronischer / programmierbarer elektronischer Systeme (Zielgruppe: Hersteller und Lieferanten von Geräten).

LMT Sensor related standards

- IEC 61508 Parts 1-2 and 4-7:2010 Functional safety of electrical/electronic/ programmable electronic safety-related systems
- IEC 61511 Parts 1-3:2016 Functional safety - Safety instrumented systems for the process industry sector

Dangerous failure
A failure that has the potential to place the safety-related system in a dangerous state or render the system inoperative.

Safety-related system
A safety-related system performs the safety functions that are required to achieve or maintain a safe condition, e.g., in a plant. Example: pressure meter, logics unit (e.g., limit signal generator) and valve form a safety-related system.

Safety function
A specified function that is performed by a safety-related system with the goal, under consideration of a defined hazardous incident, of achieving or maintaining a safe condition for the plant.
Example: limit pressure monitoring

Determine the Safety Integrity Level (SIL)

The transmitter produces an analog signal (4 ... 20 mA) proportional to the level value. The total valid range of the output signal shall be configured to a minimum of 3.8 mA and a maximum of 20.5 mA (Factory Default).
The safety related function of the transmitter is the safe monitoring of the level value within a range of ±2 % of span (±2 % of 16 mA).
The safety state is that the output current is <= 3.6 mA or >= 21 mA.

Alarm response and current output
In case of detected critical faults the configured alarm current will be produced - this is fed to a subsequent logic unit, e. g. a DCS and monitored for violation of a defined maximum value.

There are two selectable modes for this alarm current:
– HIGH (Max Alarm current)
– LOW (Min Alarm current) which is the factory default setting.

The low alarm current value is configurable from 3.5 to 3.6 mA with a factory default setting to 3.55 mA.
The high alarm current value is configurable from 21.0 mA to 22.6 mA with a factory default setting at 21.0 mA.
The current output during power up is 3.5 mA.
The reaction time after the occurrence of a critical error until the output of the alarm current amounts to ≤ 15 min.

General failures will be immediately signaled with LOW or HIGH depending of the configured value (Factory Default Alarm Failure Mode = LOW).
CPU internal faults will always result in LOW alarm independently of the selected Alarm Failure Mode.
If a current drift failure (mismatch between actual and intended current output) id detected the alarm will be triggered according below rules:
– The detected current drift exceeds the expected value by more than 0.32mA, in this case High alarm will be triggered independently of the selected Alarm Failure Mode.
– The detected current drift falls behind the expected value by more than 0.32mA, in this case Low alarm will be triggered independently of the selected Alarm Failure Mode.

NOTE

For a safe fault monitoring the following conditions must be fulfilled:

– The LOW ALARM must be configured with a value <= 3.6 mA.

– The HIGH ALARM must be configured with a value >= 21 mA.

– The DCS must be capable of recognizing the configured High Alarms or Low Alarms as a malfunction detection.

– For a safe current output operation the terminal voltage at the device must be given from 12 ... 42 V.

Note: SELV/PELV is requirement for external power supply.

The DCS loop must be capable to provide the required voltage level even if the current output operates on the configured HIGH alarm.

The device is not safety compliant during the following conditions:
– During Configuration
– If the HART Multidrop mode is activated
– During Simulation
– During Test of the safety function
– During Device software updates/hardware change

The fraction of failures without the potential to put the device into a dangerous function status is given by the SFF value shown in chapter “Device specific data related to functional safety”.

Overall safety accuracy

The defined value for the "Total Safety Accuracy" of the safety function of this device is: ±2 % of span (±2 % of 16 mA).

LMT sensor functional Safety relevant specifications

LMT sensor safety function

LMT Float/Magnets are considered part of the safety function because they determine the level/position measured by the instrument. When located at the target position will generate a torsional wave that propagates along the magnetostrictive sensor wire with a speed of approximately 2822 m/s. The piezoelectric sensor detect the torsional wave and convert it into electrical signal. Finally, the built-in electronics measures the propagation time, typically between 150us-8100us, from which the level/position is calculated.

LMT sensor environmental limits

The designer of a SIF must verify that the device is rated for use within the expected environmental limits.

Environment items	Limits
Operation ambient temperature	-40~85°C
Storage ambient temperature	-50~85°C
Humidity	0 to 95% relative non-condensing
Altitude	<2000m
Polluting Grade	III

Table 5 LMT sensor environment limits

LMT sensor application limits

The designer of a SIF must verify that the device is rated for use within the expected application limits. For usage in safety-related applications, the compatibility of the operating medium with the materials of construction must be verified in accordance with the manufacturer.

Product limitations items	Limits
Suitable Transmitter	Designed for LMT series transmitter.
Application Accuracy	0.01% of full scale or +/-1.27mm for nonsafety use. 2% of full scale for safety use.
Process pressure	Min bar: -1.0 bar Max bar: 165.7 bar
Probe length	304.8mm to 9.14m for Standard version and 22.86m maximum for flexible probe
Process temperature	-40°C to 121.1°C for standard version -195°C to 427°C with options
Ingress protection	IP66 , NEMA 4X
Main media	Emulsion, layers fluid surface, Hydrocarbons and industrial control
Main used application	Water process; Oil factory

Table 6 LMT sensor application limits

LMT sensor design verification

Failure Mode and Effects Analysis for the device has been carried out to define what kind of failures are safe or dangerous ones. This document presents failure modes in function of the tested device (see FMEDA report). Furthermore, the suitability of the design can be confirmed by the positive result of a type test and an endurance test and the sufficient field feedback of the device (see test report).

LMT sensor SIL Capability

The device is suitable for use in a safety instrumented system up to SIL 2, HFT==0, Under consideration of the minimum required hardware fault tolerance HFT=1 the devices may be used in a redundant structure up to SIL 3 (see test report).
The achieved Safety Integrity Level (SIL) of an entire Safety Instrumented Function (SIF) design must be verified by the designer via a calculation of PFDavg considering architecture, proof test interval and , proof test effectiveness, any automatic diagnostics, average repair time and the specific failure rates of all components included in the SIF. Each subsystem must be checked to assure compliance with minimum hardware fault tolerance (HFT) requirements.

Sensor version		1.0	
Route of Assessment		2H / 1S	
Type of Sub-system		Type A	
Mode of Operation		Low Demand Mode	
Hardware Fault Tolerance	HFT	HFT of 0 is for SIL2, HFT of 1 is for SIL 3	
Lambda Dangerous confidence level of calculation 1-α = 95 %	λD	1.85 E- 07 / h	185 FIT
Lambda Dangerous Undetected assumed Diagnostic Coverage DC = 0 %	λDU	1.85 E- 08 / h	18.5 FIT
Mean Time To Dangerous Failure	MTTFD	5.41 E+07 h	618 a
Average Probability of Failure on Demand 1oo1 assumed Proof Test Interval T1 = 2 year	PFDavg (T1)	1.62 E-04	
Average Probability of Failure on Demand 1oo1 assumed Proof Test Interval T1 = 5 year	PFDavg (T1)	4.05 E-04	

Table 7 LMT sensor specific parameters

Requirements of other components

In order to determine whether tested device is suitable for use in a certain safety-related system, it is necessary to determine the PFDavg value of the overall system. Usually it is presumed that a final element (valve + actuator) uses up to 50 % of the total available PFDavg value.

Role and responsibilities

All the people, departments and organizations involved in the lifecycle phases, which are responsible for carrying out and reviewing the applicable overall, E/E/PES (Electrical/

Electronic/ Programmable Electronic System) or software safety lifecycle phases of a Safety Instrumented System shall be identified. All those specified as responsible for management of functional safety activities shall be informed of the responsibilities assigned to them. All persons involved in any overall, E/E/PES or software safety lifecycle activity, including management activities, should have the appropriate training, technical knowledge, experience and qualifications relevant to the specific duties they have to perform.
The safety of design and operation of a safety-related system, in which the device is implemented, must be ensured by manufacturer and operator.

Responsibility of manufacturer
- Safe design of the device
- Providing of all safety-related information to the operator of the overall system
- Compliance to all regulations and guidelines that allow a safe commissioning

Responsibility of operator
- Instructing of personnel working on the overall system
- Maintaining the safe operation of the overall system
- Compliance to all regulations and guidelines regarding occupational safety
- Ensuring of periodic test of the overall system by qualified employees

The Level meter as part of the safety function system

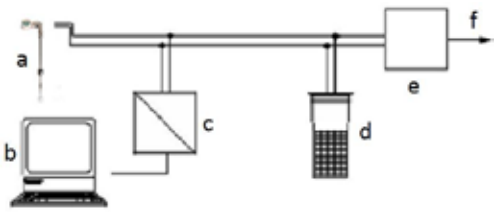


Figure 6 Safety function (e.g. min / max Level value monitoring) with Level meter as a sub-system

A Level meter b Notebook with configuration Tool such as SMART VISION c FSKModem d Handheld-Terminal e Automation System, Logic-Unit, PLC, limit signal generator, etc. f Actuator

The Level meter transmitter generates an analog signal (4 ... 20 mA) proportional to the level value. The analog signal is fed to a downstream logics unit such as a PLC or a limit signal generator, and is monitored for exceeding a specified maximum or minimum value.

NOTE

The safety-related signal is the 4 ... 20 mA analog output signal of the level meter transmitter.

All safety functions refer exclusively to this analog output.

Device specific data related to functional safety

Characteristic as per IEC 61508	Value
Valid frontend board software version	02.00.00
Valid communication board software version	02.00.00
Valid frontend board hardware version	01.01.00
Valid communication board hardware version	01.00.00
Type of assessment	Full IEC 61508 assessment
SIL	2
Systematic capability	3
HFT	For SIL2, HFT=0 For SIL3, HFT=1
Component Type	B
Measuring mode	Low demand mode & High demand mode
DTI (Diagnosis Testing Interval)	<= 15 minutes
Response time	1200ms + Damping Time[1)]
Fault reaction time	< 15 minute
High demand rate	<= 100 * DTI
MTTR	8
PFH (With mechanical part)	2.23E-07
λ_s [2)]= λ_{sd} [2)] + λ_{su} [2)]	2.75E-06
λ_{dd} [2)]	1.55E-06
λ_{du} [2)]	2.23E-07

Table 8 device basic data related to functional safety

1) The damping time is selectable constant between 0-60 S
2) Calculated at ambient temperatures 100 °C based on Siemens SN2950

Temperature	SFF	Recommend PTI (Proof Testing Interval)	PFDavg	Percentage in system of SIL2
50	96.04%	2	3.84E-4	3.9%
		5	9.60E-4	9.6%
		7	1.34E-3	13.5%
60	95.86%	2	5.07E-4	5.1%
		5	1.27E-3	12.7%
		7	1.77E-3	17.8%
100	95.29%	2	1.82E-3	18.2%
		3	2.73E-3	27.3%

Table 9 Specific data to functional safety of device without mechanical

Temperature	SFF	Recommend PTI (Proof Testing Interval)	PFDavg	Percentage in system of SIL2
50	95.16%	2	5.46E-4	5.5%
		5	1.36E-3	13.7%
		7	1.91E-3	19.2%
60	95.17%	2	6.69E-4	6.7%
		5	1.67E-3	16.8%
		7	2.34E-3	23.5%
100	95.07%	2	1.98E-03	19.9%
		3	2.97E-03	29.8%

Table 10 Specific data to functional safety of device with mechanical

Wiring

⚠ CAUTION

The device signal cables shall be permanently connected (fixed) and protected against external damage, e.g. by:

- cable conduit, or
- armoring, or
- using separate multi-core cables, or
- within an electrical enclosure, or
- individually shielded with earth connection

Installation

For LMT transmitter

LMT level transmitters have been designed to operate in a wide range of environmental conditions typical of industrial field and in hazardous environments. The environmental conditions under which the measuring equipment is designed to operate within its specified accuracy limits and without impairment of its operating characteristics. SIF designer must check that LMT level Transmitters certified according to IEC61508:2010 are used within the expected environmental limits as indicated in this safety manual. Also need to comply the notification of installation described in operation instructions of transmitter.

For LMT sensor

LMT sensor installation

The LMT sensor must assembled in transmitter to use in field. Below is the rules for mounting:

- Only qualified and authorized personnel are to be tasked with the installation and commissioning
- Make sure transmitter are de-energized prior to installation.
- Don't use LMT sensor as a support when mounting.
- Over-tightening the compression tube fitting can cause the tubing to kink or flare and cause the inside wire to dampen the return signal.
- When installing LMT, depending on the height, the user needs to ensure that the float does not drop down on the float stop or probe end connection.

LMT sensor as the part of LMT transmitter, the operating and regulation is follow transmitter's rules. Configure parameter through HMI/HART, reading level value from 4-20mA, HART and HMI.

Normally LMT is a digital transmitter with no routine calibration or reconfiguration required. But if a recalibration is required, this can be done using HART signal (via DTM, EDDL) or with the menu driven HMI display.

LMT sensor location and placement

The sensor must be accessible for physical inspection and maintenance purpose.

Mechanic connections

For Floats connection, during installation, it may be necessary to remove the float and spacer (if included) from the sensor tube. For proper operation, the float must be reinstalled using the proper orientation. Floats may be marked with 'Top for SPM' or 'Top for LMT'. These ends of the float must face the transmitter head. Other floats may be marked with an arrow indicating the proper orientation. If a float is etched with information but does not indicate a proper orientation, it will be bidirectional and can be installed in either direction.

NOTE:

If the float is removed during installation, it must be slid back onto the probe tube with correct orientation.

Maintenance

LMT transmitter maintenance

If the LMT transmitters is being used as part of a SIS, periodic testing is required to proof the transmitter and detect any potential failure, which is defined as dangerous-undetectable in normal operation.

- This testing must be performed at PTI (Proof Testing Interval), and the results of this testing must be documented.
- Should the transmitter exhibit a fault during normal operation, it's necessary to perform the proof testing, regardless of the schedule.
- In the event a Magnetostrictive transmitter has suffered a failure in any component which is exposed to the process, any other Magnetostrictive transmitter installed in the same or similar process should be inspected for the same failure, regardless of its maintenance schedule.

LMT sensor maintenance

- Maintenance interval shall be at the user's calculated requirement. If a user calculation is not performed, the manufacturer recommends 5 years.

In the event a Magnetostrictive transmitter has suffered a failure in any component which is exposed to the process, any other Magnetostrictive transmitter installed in the same or similar process should be inspected for the same failure, regardless of its maintenance schedule. For LMT sensor these common cause failure include:
(1), float collapse due to over pressure;

(2), damage due to material incompatibility;

(3), damage of the sensor due to improper installation.

Float inspection:
The LMT will detect and report the position of the float on its sensor tube (or magnetic level gauge) as a level of fluid in the process. In order to measure the fluid in the process properly, the float must move freely up and down the sensor tube (or magnetic level gauge) partially submerged in the liquid level. If the float were to become damaged or stuck on the sensor tube (or magnetic level gauge), the transmitter will still report the float position regardless of the actual process fluid level. This by definition is a dangerous undetectable failure. To prevent this failure the float will need to be inspected for integrity and movement.
(1), move the float up and down the length of the sensor tube (or magnetic level gauge). It should move freely all over the moving space, for LMT 100 is from the bottom of the sensor tube to the process connection and for LMT200 is the entire moving space in magnetic level gauge.

(2), remove the float from the sensor tube by removing the retaining clip or bolt from the end of the transmitter (or from magnetic level gauge). Inspect the float for signs of excessive wear of damage.

(3), submerge the float in a container of water to check for leaks as air bubbles escaping from the float. The float is a sealed unit and any holes in the shell of the float could allow process fluid to seep inside. Upon completion of float inspection, place the float back on the sensor tube (or magnetic level gauge) paying careful attention to float orientation. Some LMT transmitters will be equipped with float spacers designed to keep the float positioned in the measurable range of the sensor tube. It's important that the spacer be replaced when the transmitter is reassembled.

Sensor inspection:
The sensor of the LMT consists of a metal tube containing several wires. The sensor tube will measure the float location properly if the tube is straight and the float can travel freely up and down its length. Perform a visual inspection on the sensor tube to make sure it is straight, free from pits or gouges, and does not show excessive wear patterns.

Application

Descriptions of application requirements

Ambient temperature	-40C to 85C
Storage temperature	-50C to 85C
Relative humidity	0 to 95% relative non-condensing
Supply voltage	12 ~ 42 VDC for normal condition; 12 ~ 30 VDC for Exia condition;
Over voltage category	III
Operating altitude	<2000m
IP protection level	IP66
Pollution degree	III

Table 11 device application requirements

SIL 2 Application
The following assumptions have been made during the FMEA analysis:

- The PFD_{AVG} /PFH of the device shall claim only amount less than 23% of the complete safety loop (SIL 2).
- For a SIL2 application operating in Low Demand Mode the total PFD_{AVG} value of the SIF (Safety Instrumented Function) shall be smaller than 10E-2, hence the maximum allowable PFDAVG value would then be 2.3E-03.
- For a SIL2 application operating in High Demand Mode of operation the total PFH value of the SIF shall be smaller than 10E-6 per hour, hence the maximum allowable PFH value would then be 2.3E-7 per hour.
- Failure rate based on the Siemens SN29500 data base.
- Failure rates are constant, wear out mechanisms are not included.
- External power supply failure rates are not included.
- The safety-related device is considered to be of type B components with a Hardware Fault Tolerance of 0.
- Since the circuit has a Hardware Fault Tolerance of 0 and it is a type B component, the SFF must be ≥ 90% according to table 2 of IEC 61508-2 for SIL2.
- The HART protocol is only used for setup, calibration, and diagnostic purposes, not during operation, and it is not safety related function.
- Electromagnetic compatibility

Electrostatic discharge	+/-6 kV/+/-8 kV contact/air
Electromagnetic Field	20 V/m (80 MHz to 1 GHz) 10 V/m (1,4 GHz to 2 GHZ) 3 V/m (2,0 GHz to 6 GHz)
Conducted RF	10 V (150 kHz to 80 MHz)
Electrical Fast Transient	3 kV (5/50 ns, 5 kHz)
Surge immunity	2 kV /4 kV
Voltage dips	40 % UT for 10 ms
Short interruptions	0% UT for 20 ms

Table 12 IEC61326-3-1:2017 Performance Criterion FS

SIL 3 Application

⚠ CAUTION

If the user would like to achieve SIL 3 safety related application by using two pieces (dual redundant configuration, HFT=1) of isolated barriers LMT types, the following Common Cause Failure (CCF) factors acc. to IEC 61508-6 must be considered:

- β = βD = 5%

Commissioning

Commissioning

The activities to validate the required safety functionality of the system together with the level transmitter according to the safety requirement specification are the following:

1 Enable write protection (See chapter “Enabling/Disabling the write protection”)

2 Power-on the transmitter: the transmitter performs automatically a self-test that consists in the operations below:

– ROM test
– RAM test
– Instruction Test
– Nonvolatile memory test

Proof Test

In accordance with IEC 61508, the safety function of the measuring device must be checked at appropriate time intervals. The operator must determine the checking interval and take this into account when determining the probability of failure PFDavg of the Level meter.
The test must be carried out in such a way that it verifies correct operation of the device.

Test of the LMT transmitter

For check the safety function of the device proceed as follows:

1 Bridge the safety DCS or take other appropriate measures to prevent inadvertent triggering of alarms.

2 Deactivate the write lock (see Chapter “Configuration” on page 9).

3 Set the current output of the transmitter to 12mA by means of the push buttons of the LCD-display, HART communication by using a DTM in combination with DAT200 (Asset vision basic) or with the Field Information Manager (FIM-Tool) using simulation function (Menu: Diagnostics / Simulation Mode / Current Out).

4 Check the current output accuracy is comply with requirement of safety function.

5 Set the current output of the transmitter to a HIGH ALARM value by means of the push buttons of the LCD-display, HART communication by using a DTM in combination with DAT200 (Asset vision basic) or with the Field Information Manager (FIM-Tool) using simulation function (Menu: Diagnostics / Simulation Mode / Current Out).

6 Check whether the current output signal reaches this value.

7 Set the current output of the transmitter to a LOW ALARM value by means of the push buttons of the LCD-display, HART communication by using a DTM in combination with DAT200 (Asset vision basic) or with the Field Information Manager (FIM-Tool) using simulation function (Menu: Diagnostics / Simulation Mode / Current Out).

8 Check whether the current output signal reaches this value.

9 Terminate the simulation mode after finishing the output simulation!

10 Activate the write lock (see Chapter “Configuration” on page 9) and wait 10 seconds.

11 Restart the device by power down.

12 **Check at 3 to 5 measuring points** by adjust the level in the vessel and record the measured values at distances for the reference which can be verified. Perform a calculation to determine if the error is within the acceptable error specified in this safety manual

13 Remove the bridging of the safety DCS or restore normal operation in another way.

14 After the test has been performed, the results must be documented and stored in a suitable manner.

NOTE

By using this test method of dangerous, undetected failures are detected. The influence of systematic errors like e.g. medium properties, operating conditions, build-up or corrosion on the safety function is not fully covered by the test.

- If one of the test criteria from the test procedure described above is not fulfilled, the device may no longer be used as part of a protective system.
- Take measures to reduce systematic errors.

Test of LMT sensor

The objective of proof testing is to detect failures within the device that are not detected by any automatic diagnostics of the system. Of main concern are undetected failures that prevent the SIF from performing its intended safety function. The frequency of proof testing, or the proof test interval, is to be determined in reliability calculations for the SIF for which a device is applied. The proof tests must be performed at least as frequently as specified in the calculation in order to maintain the required safety integrity of the SIF. Recommended PTI (years) refer table 9 and table 10: Specific data to functional safety of device’.
Proof Test Coverage Factor PTC names how many of the

dangerous undetected failures can be detected by a proof test. It has been determined within a FMEA.
The suggested proof test consists of a full stroke of the device, as described in the table below.

Failure	
Dangerous undetected	14
Detectable during proof test	12
Proof test coverage (PTC)	86 %

Table 13 Proof test coverage (PTC)

Step	Action
1	Bypass the safety function and take appropriate action to avoid a false trip
2	Interrupt the supply to the transmitter to inspect the device and the other final element components for any leaks, visible damage or contamination.
3	Restore the supply to the transmitter and confirm that the normal operating state was achieved.
4	Remove the float from the transmitter to trigger the Fail-Safe state and confirm that the Safe State was achieved within the correct time.
5	Record the test results and any failures in your company's SIF inspection database
6	Remove the bypass and restore normal operation

Table 14 Proof test

Configuration

⚠ CAUTION

The configuration software is non-safety related, which is only used for setup, calibration, and diagnostic purposes, not during operation. The configuration shall never be used in safety related applications.

This device is configured and tested as specified by the customer order. Nevertheless this device can be configured by the local HMI or DTM via HART® Interface. Other configuration tools like Handheld Terminals are not described in this manual. During this configuration a safe operation of the device shall not be granted.

Checklist before safety operation

Here lists important checks before safety operation:

- Before the first start-up of the device as a part of a safety function check that the device configuration fulfills the safety function of the system.
- Check if the device is installed correctly.
- When changing the settings of the device working as a part of a safety function, such as change the installation position or configuration, the device shall be out of service as safety function part and the safety function of the device shall be checked.
- After the safety function has been checked, the operation of the device must be locked because a change to the measuring system or parameters can compromise the safety function.

The write protection shall be enabled before power up when going into safe operation. The device provides two method for write protection: The hardware write protection (external push button) and the software write protection. In case one of 2 protections is enabled, the write protection is enabled.

Enabling/Disabling the write protection

The device must be write-protected for the safety operation. This could be realized in the following steps:

1 Enable write protection via external push button:

- Remove the identification plate by loosening the retaining screw that is situated on the bottom left corner.
- Use a suitable screwdriver to fully press the switch down.
- Turn the switch clockwise by 90°.

2 Enable write protection via device software:

- Use HART command 128 to change the SW write protection to be enabled.
- There is another way to enable SW write protection:
- Enter menu in HMI:
- Device Setup → Write Protect → Software WP
- Change it to ON.

3 Disable write protection via external push button:

- Remove the identification plate by loosening the retaining screw that is situated on the bottom left corner.
- Use a suitable screwdriver to fully press the switch down.
- Turn the switch counterclockwise by 90°.

4 Disable write protection via device software:

- Use HART command 128 to change the SW write protection to be disabled.
- There is another way to enable SW write protection:
- Enter menu in HMI:
- Device Setup → Write Protect → Software WP
- Change it to OFF.

High/Low alarm configuration

The Level meter LMT100/200/300 have two methods to configure the alarm state. Hardware dip-switch (SW4) decides which method is used for the configuration (see chapter “DIP switch on communication board”).

- If SW4 is configured as “ON” state, then alarm state is decided by SW5.
- If SW4 is switched to “OFF”, then alarm state is decided by software.
  - Set “alarmSelection” with HART command 165 as “High” or “Low” alarm mode. This parameter is stored in non-volatile memory.
  - Or Set “alarmSelection” “High” or “Low” alarm mode via HMI. Enter menu in HMI: Process Alarm → Alarm mode, Select “High Alarm Current” or “Low Alarm Current”.

Reconfiguration device

If the end user want to reconfigure the device which is

configured for safety operation, this could be realized in the following steps:

1 Disable write protection

2 Change parameters configuration.

3 User must double confirm the parameters and take related responsibility fulfill steps listed in chapter checklist before safety operation and enabling the write protection.

DIP switch on communication board

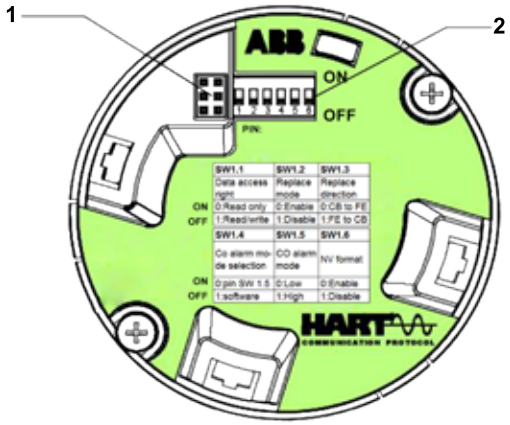


Figure 7 Communication board

① Interface for LCD indicator and service port ② DIP switches

The communication board is located behind the front housing cover. The LCD indicator may have to be removed to provide access to the DIP switches.
The DIP switches are used to configure specific hardware functions. The power supply to the transmitter must be briefly interrupted in order for the modified setting to take effect. The interface for the LCD indicator is also used as the service port for device configuration.

DIP switch	Function
SW 1.4	Current out alarm mode selection source: On: Current out alarm mode selected by pin SW1.5. Off: Current out alarm mode selected by software
SW 1.5	Current out alarm mode selection. On: Low alarm mode. Off: High alarm mode.

Table 15 DIP switch

• Write protection switch
When write protection is activated, device parameters cannot be changed via HART or the LCD indicator. Activating and sealing the write protection switch protects the device against tampering

• Status of the current output
DIP switches SW 1.4 and SW 1.5 can be used to configure the status of the current output in the event of an alarm / error. If the current in the event of an alarm is selected via DIP switch SW 1.5, the setting can no longer be changed using HART or the LCD indicator.

Safety critical parameters

Safety critical parameters	Range
PV	Level, Interface Level, Linearization Level, Linearization interface Level, Ullage.
PV Unit	–mm, cm, m, in, ft
PV LRV	PV LRV Range varies according to current PV selection. For different measuring object, a dedicate range is provided.
PV URV	PV LRV Range varies according to current PV selection. For different measuring object, a dedicate range is provided.
PV Damping Time	0 – 60 seconds
Level Unit (Level)	–mm, cm, m, in, ft
Lower Range (Level)	• Non linearized – Minus 20% to 120% of probe length • Linearized –999999999 to 999999999
Upper Range (Level)	• Non linearized – Minus 20% to 120% of probe length • Linearized –999999999 to 999999999
Level Offset (Level)	+/- 50% of probe length
Linearization minimum	–999999999 to 999999999
Linearization maximum	–999999999 to 999999999
Probe Length	1 – 75 ft
Failure Mode	High, Low
Low Alarm Current	3.5 – 3.8 mA
High Alarm Current	20.5 – 22 mA
Alarm Delay	0 – 99 seconds
Low Saturation	3.8 – 4.0 mA
High Saturation	20 – 21 mA

Table 16 Safety critical parameters

1) For safety mapping

Possible error messages

The error messages are divided into four groups in accordance with the NAMUR classification scheme.

Errors

Error no. / Range	Text on the LCD display	Cause	Remedy	Current Out state
F218.023	Electronics NV Failure	Electronics memory is corrupted	The electronics must be replaced	Safe state. Current out shall output High/Low alarm according to alarm selection.
F226.044	Current Output Failure	The output circuit could be broken or not correctly calibrated	Current out trimming shall be performed and if the error still exist the communication board must be replaced	Safe state. Current out shall output High/Low alarm according to alarm selection.
F228.039	Primary Current Uncertain	The device is not properly configured	The measurement setting is not configured properly, that would cause the output value exceed the hardware output limits. The device configuration shall be checked	Safe state. Current out shall output High/Low alarm according to alarm selection.
F244.003	Safety Function Flow Failure	Calculation of safety function did not occur in the proper sequence	Restart the device. If the condition persists contact ABB service.	Safe state. Current out shall output High/Low alarm according to alarm selection.
F246.041	Electronics RAM Failure	Electronics memory test failed or Process data memory check failed (dynamic duplicated error)	Restart the device. If the condition persists contact ABB service.	Safe state. Current out shall output High/Low alarm according to alarm selection.
F247.040	Electronics ROM Failure	Program memory test failed	Restart the device. If the condition persists contact ABB service.	Safe state. Current out shall output High/Low alarm according to alarm selection.
F248.006	Self-test failure		Restart the device. If the condition persists contact ABB service.	Safe state. Current out shall output High/Low alarm according to alarm selection.
F210.042	NV Replace Error	The Electronics or the Sensor have been changed but the replacement operation has not been executed.	1, The replacement operation must be executed. Set the SW 1 of the electronics to position 1 to enable the replace mode. Set SW 2 accordingly depending on which component (Electronics or Sensor) has been replaced. Power cycle the device. Move the SW 1 of the electronics to position 0. 2, The data replacement operation must be executed. Only the data of the electronics can be copied to the sensor. Set the SW 1 of the electronics to position 1 to enable the replace mode. Set SW 2 to New Sensor position 1. Power cycle the device. Move the SW 1 of the electronics to position 0.	Safe state. Current out shall output High/Low alarm according to alarm selection.
		The Electronics or the Sensor have been changed. The replacement has been enabled but with the wrong direction. (SW 2 = 0)	Change the replacement direction (if possible). The SW 1 is already set to Enable replace mode. Set SW 2 to New Sensor (1). Power cycle the device. Move the SW 1 of the electronics to position 0.	

F215.004	Level Sensor Out of Limits	Result of Level measurement is outside of the valid and expected range	Using a HART configurator (DTM -Hand held) or the local HMI, navigate to the Diagnostics -> Waveform display and confirm the quality of the signal. The signal peak should visibly cross the threshold line and should measure approximately 2 Volts. Contact ABB service for additional support or a replacement if the condition persists.	Safe state. Current out shall output High/Low alarm according to alarm selection.
F098.001	Temperature Sensor Failure	A temperature measurement has resulted in a value outside of the operating range.	Restart the device. If the condition persists contact ABB service.	Safe state. Current out shall output High/Low alarm according to alarm selection.
F194.031	Sensor Board Fault	An error occurred in the sensor module. Possible causes could be a failed component in the sensor electronics, a configuration error, or the sensor assembly.	Using a HART configurator (DTM -Hand held) or the local HMI, navigate to the Diagnostics -> Waveform display and confirm the quality of the signal. The signal peak should visibly cross the threshold line and should measure approximately 2 Volts. Contact ABB service for additional support or a replacement if the condition persists.	Safe state. Current out shall output High/Low alarm according to alarm selection.
F196.020	Sensor Communication Failure	An error occurred in the communication between the sensor and electronics modules.	Restart the device. If the condition persists contact ABB service.	Safe state. Current out shall output High/Low alarm according to alarm selection.
F198.000	Level Sensor Failure	An error occurred in the sensor module. Possible causes could be a failed component in the sensor electronics or an error changing the configuration.	Restart the device. If the condition persists contact ABB service.	Safe state. Current out shall output High/Low alarm according to alarm selection.
F212.017	Sensor Board Memory Failure	Writing to the sensor non-volatile memory was not successful.	The sensor board should be replaced as soon as possible.	Safe state. Current out shall output High/Low alarm according to alarm selection.

Table 17 Errors

NOTE

CPU internal faults will result in the LOW alarm independent from the configured alarm current, and will not be shown on LCD display.

Repair

To ensure the safety related function, repairs have to be Performed by ABB.

Replacing modular components by original ABB spare parts is permitted if personnel was trained by ABB for this purpose. The “Declaration of contamination and cleaning” must be enclosed when returning the defective device. Refer to instruction manual for further details.

Manufacturer Notification

All faults must be reported to manufacturer for recording purposes, by contacting the Quality Department at address below. All defective devices must be returned to manufacturer for investigation and rectification.

Address:

ABB Engineering (Shanghai) Ltd.

Process Automation
No. 4528, Kangxin Highway, Pudong New District
Shanghai, 201319, P.R. China
Tel: +86(0) 21 6105 6666
Fax: +86(0) 21 6105 6677

ABB Inc.

Process Automation
125 E. County Line Road
Warminster, PA 18974 USA
Tel: +1 215 674 6000
Fax: +1 215 674 7183

Appendix

SIL2 for HFT=0, SIL3 for HFT=1 certificate

Certificate

Functional Safety

TÜVRheinland CERTIFIED

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No.: 968/FSP 1559.00/18

Product tested	Magnetostrictive Liquid Level Transmitter	**Certificate holder**	ABB Engineering (Shanghai) Ltd. No. 4528, Kangxin Highway Pudong New District Shanghai, 201319 P.R. China
Type designation	LMT100, LMT200, LMT300		
Codes and standards	IEC 61508 Parts 1-7:2010		
Intended application	The magnetostrictive liquid level transmitters comply with the requirements of the relevant standards (Safety integrity Level 2 (SIL 2) and Systematic Capability 3 (SC 3) acc. to IEC 61508) and can be used in applications up to SIL 2 (HFT=0) resp. SIL 3 (HFT=1). The product can be used in the application area of IEC 61511-1 up to SIL 2 (HFT=0) / SIL 3 (HFT=1). Further details see page 2 of certificate.		
Specific requirements	The instructions of the associated Safety Manual shall be considered.		

Valid until 2023-01-24

The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/FSP 1559.00/18 dated 2018-01-24.
This certificate is valid only for products which are identical with the product tested.

Köln, 2018-01-24

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit
Am Grauen Stein, 51105 Köln
Certification Body Safety & Security for Automation & Grid

Dipl.-Ing. Thomas Steffens

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Precisely Right.

TÜV Rheinland Industrie Service GmbH, Am Grauen Stein, 51105 Köln / Germany
Tel.: +49 221 806-1790, Fax: +49 221 806-1539, E-Mail: industrie-service@de.tuv.com

Page 2 of Certificate No. 968/FSP 1559.00/18

TÜVRheinland®
Precisely Right.

Manufacturing plants:

1. **ABB Engineering (Shanghai) Ltd.**
   No. 4528, Kangxin Highway
   Pudong New District
   Shanghai, 201319
   P.R. China

2. **ABB Limited**
   125 East County Line Road, Warminster, PA 18974

Characteristics as per IEC 61508

Safety architecture	1oo1
Hardware Fault Tolerance (HFT)	0
Hardware Safety Integrity Level (SIL)	SIL 2
Systematic Capability (SC)	SC 3
Device type of E/E/PE parts	TYPE B
Device type of mechanical level sensor parts	TYPE A
Safe Failure Fraction (SFF) of each element	> 90%
*Safe failure rate λ_S	2.756E-06 (2756FIT)
*Detected dangerous failure rate λ_{DD}	1.552E-06 (1552FIT)
*Undetected dangerous failure rate λ_{DU}	2.23E-07 (223 FIT)
Mean Time To Repair (MTTR)	8h
Mean Repair Time (MTTR)	8h
*PFDavg	9.92E-04 (9.9% of SIL 2, at PTI=1 year) 1.98E-03 (19.8% of SIL 2, at PTI=2 years)
*PFH	2.23E-07 (22.3% of SIL 2)
Notes: - *: Those safety related parameters include both E/E/PE parts and mechanical level sensor parts - If the user would like to achieve SIL 3 safety application by using two sets of Level Transmitters (HFT=1), the following Common Cause Failure (CCF) factors must be considered as required within the Safety Manual: $\beta = \beta_D = 5\%$	

1 FIT = 1 E-09 1/h

Remark: Failure rates of the electronic components as per Siemens SN 29500, calculated based upon an ambient temperature of 100 °C.

Return form
Statement on the contamination of devices and components

Repair and / or maintenance work will only be performed on devices and components if a statement form has been completed and submitted.
Otherwise, the device / component returned may be rejected. This statement form may only be completed and signed by authorized specialist personnel employed by the operator.

Customer details:

Company:	
Address:	
Contact person:	Telephone:
Fax:	E-Mail:
Device details: Typ:	Serial no.:
Reason for the return/description of the defect:	

Was this device used in conjunction with substances which pose a threat or risk to health?

☐ Yes ☐ No

If yes, which type of contamination (please place an X next to the applicable items)?

Biological	☐	Corrosive / irritating	☐	Combustible (highly / extremely combustible)	☐
Toxic	☐	Explosive	☐	Other toxic substances	☐
Radioactive	☐				

Which substances have come into contact with the device?

1.

2.

3.

We hereby state that the devices / components shipped have been cleaned and are free from any dangerous or poisonous substances.

Town/city, date

Signature and company stamp

Notes

Notes

Notes

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