delta-mobrey

**Reference Manual**
IP2020, Rev. C
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# Delta Mobrey MLT100

## Intelligent Displacer Level Transmitter

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# Delta Mobrey MLT100
# Intelligent Displacer Level Transmitter

**⚠ WARNING**

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

- Do not drop the transmitter. Handle with care
- Do not use liquids incompatible with materials of construction
- Do not operate the transmitter above its rated pressure
- Do not pressure test above the specified test pressure
- Do not expose the transmitter to excessive vibration
- Ensure all explosive atmosphere requirements are applied
- Ensure the transmitter and associated pipework are pressure tested to $1^1/_2$ times the maximum operating pressure after installation

**⚠ CAUTION**

The products described in this document are NOT designed for nuclear-qualified applications. Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Delta Mobrey nuclear-qualified products, contact your local Delta Mobrey Process Management Sales Representative.

- Refer to ATEX safety instructions:
  MLT100 Ex d: See product document IP2020/SI Exd

## ⚠ WARNING

**Failure to follow these installation guidelines could result in death or serious injury**

- The Delta Mobrey MLT100 is a *wired liquid displacer level transmitter*. It must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment
- Prior to energizing, always ensure that cover locking safety grub screw is tightened

**Explosions could result in death or serious injury**

- Installation of the level transmitter in a hazardous environment must be in accordance with the appropriate local, national, and international standards, codes, and practices.

Please review the approvals section in this reference manual for any restrictions associated with an installation

- Before connecting a Field Communicator in an explosive atmosphere, ensure the installation is in accordance with intrinsically safe or non-incendive field wiring practices
- Verify that the operating atmosphere of the level transmitter is consistent with the appropriate hazardous locations certifications

**External Surface may be hot**

- Care must be taken to avoid possible burns

**Process leaks could result in death or serious injury**

- Install and tighten process connectors before applying pressure
- Do not attempt to loosen or remove process connectors while the level transmitter is in service

**Electrical shock could cause death or serious injury**

- If the level transmitter is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the level transmitter is off while making connections

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# Section 1 Overview



## 1.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol ( ⚠ ). Please refer to the following safety messages before performing an operation preceded by this symbol.

### 1.1.1 Warnings

**⚠ WARNING**

**Failure to follow these installation guidelines could result in death or serious injury**

- The MLT100 is a *wired displacer level transmitter*. It must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment
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**External surface may be hot**

- Care must be taken to avoid possible burns

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- Install and tighten process connectors before applying pressure
- Do not attempt to loosen or remove process connectors while the level transmitter is in service

**Electrical shock could cause death or serious injury**

- If the level transmitter is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals. Make sure that power to the level transmitter is off while making connections

# 1.2 Overview

## 1.2.1 Use of the MLT100 Displacer Level Transmitter

The Delta Mobrey MLT100 Displacer Level Transmitter transmits a 4–20mA signal proportional to the *liquid level* or *interface position* over a simple 2-wire 24 vdc power loop. The MLT100 is installed either directly on the top of a vessel or in an external chamber, and then valved to the main vessel such that the displacer element is immersed in the liquid.

The MLT100 may be installed in a hazardous area. The design of the MLT100 is Flameproof/Explosion-proof and suitable for connection to suitable stopper glands and conduit. Always refer to the accompanying safety instructions IP2020/SI Ex, or IP2020/SI Exd.

An MLT100 may be used in a non-hazardous area, where any local wiring requirements apply.

## 1.2.2 Basic operation

The displacer, which is normally partially-immersed in the process fluid, is suspended from an extension spring. The effective weight on this spring changes as the level of the process liquid rises and falls on the displacer. This is predictable, and depends upon the density of the liquid and the diameter of the displacer. In turn, the extension of the suspension spring will change as the weight suspended from it changes. The core of an LVDT (Linear Variable Differential Transformer) is attached to the moving parts suspended from the spring, and moves up and down in the pressure tube of the transmitter enclosure. An LVDT is positioned on the pressure tube in the enclosure. The positional changes of the core in relation to the LVDT will cause electrical changes which are interpreted by the transmitter electronics as changes of liquid level.

## 1.2.3 Calibration

Each MLT100 is factory calibrated to give optimum performance in the application conditions advised at the time of order. Provided these conditions have not changed, the instrument will give accurate readings of level at operating pressure, temperature and specific gravity (SG).

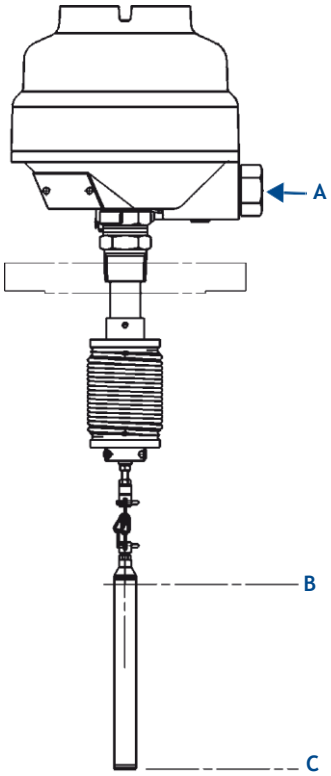
Refer to Section 4: Commissioning and Section 5: Fault finding and error messages for details of re-calibration, if this is necessary.

## 1.2.4 Take care!

The MLT100 is an instrument, and should be handled with due care and attention at all times. Mounting flanges can be heavy and difficult to handle.

It is particularly important that the MLT100 is not damaged when installing on the vessel or chamber, and that the Installation instructions in are carefully followed.

Figure 1-1. The Delta Mobrey MLT100 Displacer Level Transmitter




A. Caliplug
B. 20 mA Point
C. 4 mA Point

## 1.3 Service support

Please contact Delta Mobrey (see back page) in the event of any difficulty in the installation, operation, or maintenance of the product.

To expedite a return process, contact Delta Mobrey Ltd

**⚠ CAUTION**

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of, and understand, the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet for each hazardous substance identified must be included with the returned goods.

## 1.4 Product recycling/disposal

Recycling of equipment and packaging should be taken into consideration. The product and packaging should be disposed of in accordance with local and national legislation.

# Section 2 Unpacking and Installation



## 2.1 Unpacking

The MLT100 may be pre-assembled or supplied in three parts requiring assembly.

If assembly is required, it typically arrives in two packages. The *larger* package contains the control head and spring/rod assembly. A *second* package contains the displacement element.

**Note**
Any mounting flange or chamber is packaged separately.

After unpacking the control head, check that the model code/Tag Number is the one expected for this application (see "Ordering information" on page 2 for model code explanation).

The control head, the spring/rod assembly, and the displacer element are a *matched set*. These components must not be used on other MLT100 transmitters. Each component is marked with the unique transmitter's Final Assembly Number for identification.

**Note**
If there are any queries, please contact your local Delta Mobrey representative or Delta Mobrey directly, quoting the transmitter Final Assembly Number and the order reference.

## 2.2 Mounting arrangements

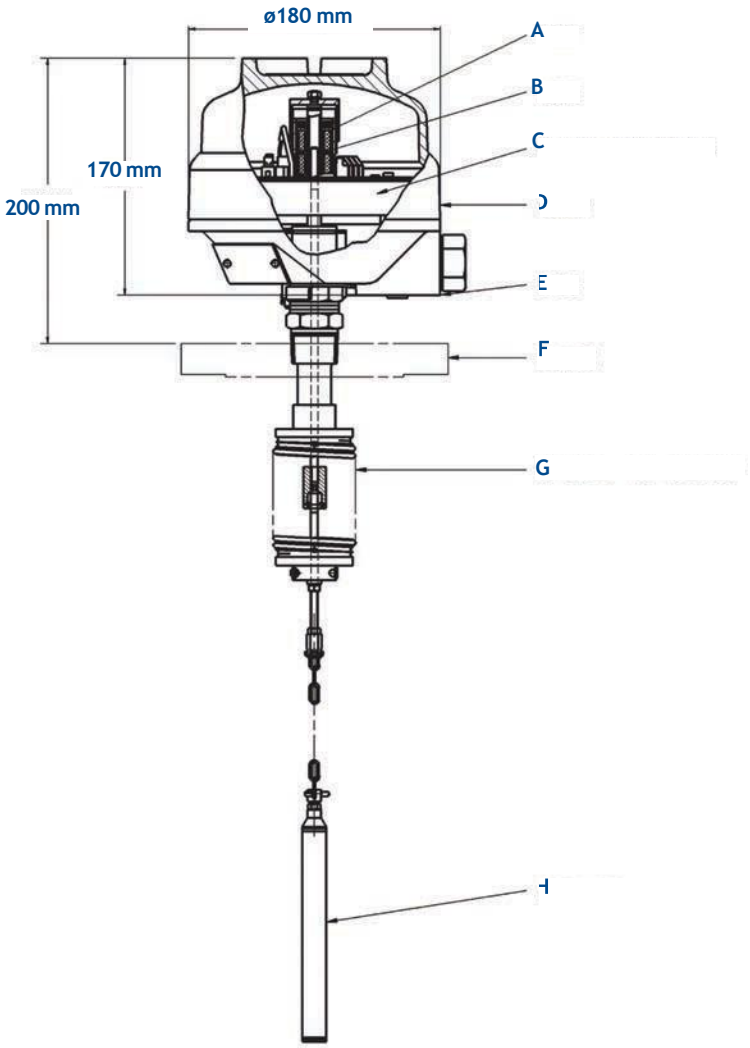
**Note**
See accompanying safety instructions

### 2.2.1 External chamber mounting transmitters

If a chamber has been supplied, unpack and remove any packing or tie strings. Ensure that the chamber is completely clean and fit to the mating vessel connections. The chamber should be mounted within $1^1/_2$ degree to the vertical, and the top flange should be checked with a spirit level to see it is horizontal.

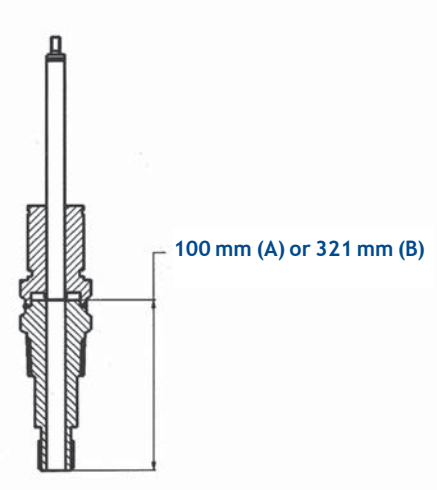
Sometimes, when the MLT100 is used on a chamber, there is not enough space above the upper liquid level for its moving parts. In these situations an extension in the form of a stand pipe will have been supplied, and this should now be fitted to the chamber using a suitable gasket or seal, ensuring once again that the top flange is horizontal. The chamber should be mounted as close to the vessel as possible with minimum pipe length.

## Figure 2-1. MLT100 main components




A. LVDT (Linear Variable Differential Transformer)
B. Core
C. Potted electronics
D. Cover
E. Base
F. Flange (If Fitted), otherwise threaded process connection
G. Spring and Rod Assembly
H. Displacer

**Figure 2-2. Pressure tube assembly**




A. Standard temperature MLT100
B. High temperature MLT100

## 2.2.2 Direct mounting transmitters

### Stilling tubes

If there is a high degree of agitation in the vessel, such that the displacer element could be caused to swing or bounce, then a stilling tube should be installed in the vessel. Ensure that the stilling tube has an internal diameter large enough to allow free movement of the displacer element, and that a vent hole is drilled at the top to prevent air-locks. The tube must be installed vertically so that the displacer element does not touch the tube at any point.

### Stand-off

Sometimes, when the MLT100 is used on a vessel, there is not enough space above the upper liquid level for its moving parts. In these situations an extension in the form of a stand pipe will have been supplied, and this should now be fitted to the vessel using a suitable gasket or seal, ensuring that the top flange is horizontal.

## 2.2.3 Level transmitter assembly

**Important notes**
It is strongly recommended that two people work together at this stage, particularly when installing the instrument on the vessel.
Take great care not to bend the rod or stretch the spring at any stage of installation. A bent rod or stretched spring will prevent your MLT100 from working.
Do not slacken any of the lock nuts on the rod assembly; these have all been preset for your application.

When unpacked, the enclosure will be free to rotate on the pressure tube assembly. This is to allow correct orientation of the enclosure, conduit entry and display (if fitted) after installation. High pressure transmitters will have been supplied with the head factory-fitted and secured in the mounting flange. If a flange is supplied separately, you should now screw the head into the mounting flange using a suitable thread sealant, using the hexagon to tighten and effect the pressure seal. The thread is a 1-in. NPT taper.

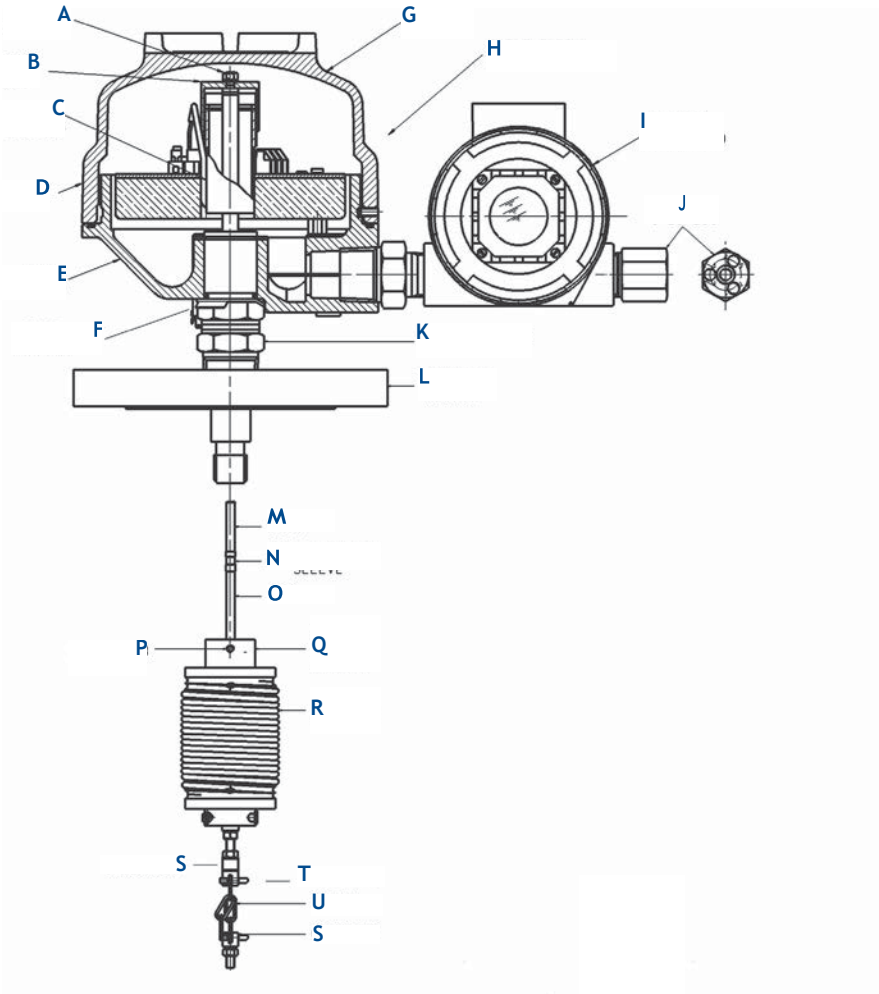
Next, fit the spring and rod assembly to the head. Make sure that the core, rod, and anti-friction sleeve are free from any dirt or pieces of packing material. Remove any seal from the bottom of the pressure tube assembly and gently pass the core into the pressure tube assembly. Carefully feed the rod into the tube, avoiding the step reduction in diameter of the internal bore of the tube. (See Figure 2-2 on page 3).

Once inserted, check that the rod moves freely in the pressure tube, then screw the top of the upper spring carrier onto the thread at the foot of the pressure tube. Assemble finger tight, then lock in position by tightening the 3 mm grub screw using a 1.5 mm hexagonal key (see Figure 2-3 on page 5).

The head assembly is now complete and no other adjustments need be made at this stage.

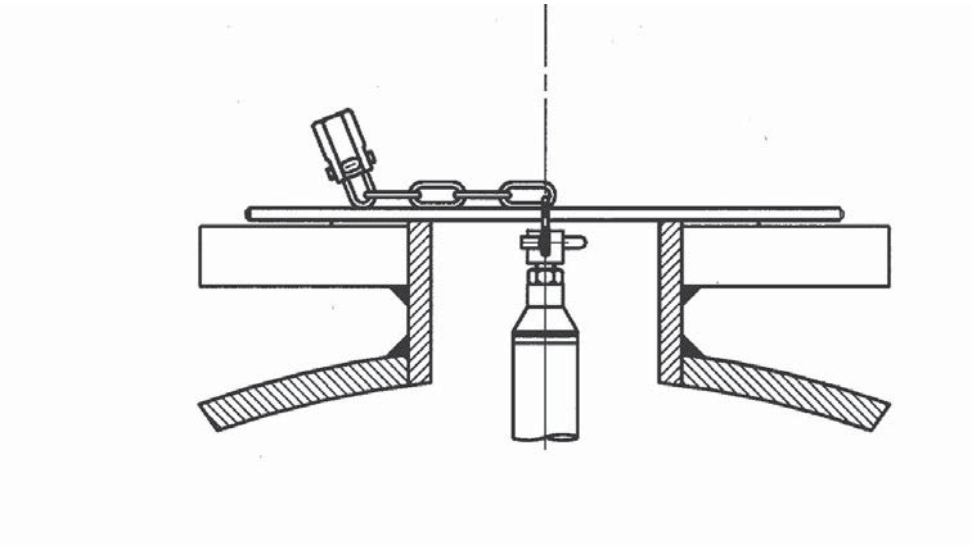
Your Delta Mobrey transmitter has already been factory calibrated for use at the operating conditions stated at the time of order. Decide now if you wish to bench check the calibration of your transmitter at 20 °C, in which case refer to Appendix C: Bench Checking – LDVT Setting 20 °C. If you want to mount your transmitter on the vessel and check calibration at operating conditions, please read on.

**Figure 2-3. Level transmitter components**




| | | |
|---|---|---|
| A. LVDT Locknut | H. Cable Entry Is At Back | O. Rod |
| B, LVDT Cap | I. Display (Optional) | P. 3 mm Grub Screw |
| C. Coil Housing | J. Caliplug) | Q Upper Spring Carrier |
| D. Cover | K. Pressure Tube Assembly | R. Spring Assembly |
| E. Base Casting | L. Mounting Flange (If Ordered) | S. Coupling |
| F. M5 Grub Screws (x2) | M. Core | T. Split Pin |
| G. Control Head | N. Anti-friction Sleeve | U. Chain |

**Figure 2-4. Supporting the displacer element before mounting the head assembly**



## 2.2.4 Check the transmitter range position

**Note**
This section is for normal liquid applications, and not interface applications.

Before you mount the transmitter assembly into the vessel, you may wish to check that the displacer element is hanging at the correct level below the transmitter head.

Attach the chain at the top of the displacer element (See Figure 2-3 on page 5) to the end of the spring rod using the coupling provided.

With the displacer element hanging in free air at 20 °C and the spring extended by the weight of the displacer, measure the distance from the sealing face of the mounting flange to the bottom of the displacer, which is called the “free hanging distance”. Include the thickness of any seals or gaskets.

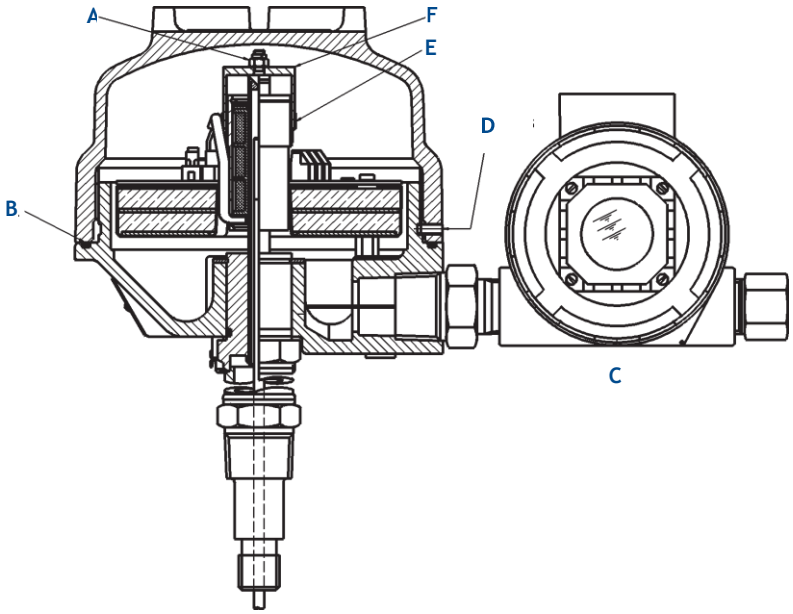
This is the approximate distance below the sealing face of the flange which is factory calibrated to give a 4 mA output from the transmitter in a normal level application, unless you requested otherwise at the time of order. You can re-range later if required (Section 4: Commissioning). For interface applications it is not possible to check the 4mA point without the upper liquid present.

Check that this dimension is correct to your requirements, ±6mm, particularly if you are mounting the transmitter on a chamber. In this case, the dimension should be equal to the dimension from the chamber mounting flange sealing face to the centre line of the bottom process connection bore, or around 30mm from the bottom of the chamber for a side/bottom connection chamber.

There is some mechanical adjustment possible of the position of the displacer element below the top flange: ±25 mm. If the error is within this band, locate the small length (typically five links) of chain on which the displacer element is suspended and adjust the number of links to

correct the error. Do not cut any surplus links from the chain. If the error is greater than±25 mm, contact Delta Mobrey for help.

**Figure 2-5. Securing The LVDT Cap**




A. LVDT Locknut
B. Cover Seal
C. Display (Optional)
D. Cover Locking Safety Grub Screw
E. Transit Tape
F. LVDT Cap

## 2.2.5 Mounting the transmitter on the vessel or chamber

If you attached the displacer to the head as above, it is best to now disconnect the displacer from the rod, leaving the chain attached to the displacer. Ensure that the chain is securely fixed to the displacer, checking that the locknut is tight.

Slip the 5 mm diameter support rod through the lowest link of the chain, and then carefully lower the displacer into the vessel so that the weight of the displacer is taken by the rod and the vessel mounting flange (see Figure 2-4 on page 6).

Remember that the enclosure is still free to rotate on the pressure tube at this stage.

Ensure a suitable gasket or seal is fitted to the mating flange and, holding the head vertical, attach the bottom of the rod to the chain coupling. Tighten the lock nut against the coupling. Taking the weight of the displacer by hand, carefully withdraw the support rod and allow the displacer element to extend the spring, lowering the element into the vessel. Do not allow the displacer weight to fall freely and damage the spring.

Check that the displacer element does not foul on any part of the chamber or vessel.

Locate the transmitter flange on the mating flange so that the cable entry and display (if fitted) are facing the way you require.

Fit the flange bolts and tighten to the recommended torque (see Appendix B: Bolting Torque Details (Carbon Steel Bolts Only)) to achieve a pressure seal. Check that the pressure tube is sufficiently tightened into the top flange, using the hexagons on the pressure tube.

Rotate the enclosure to the exact position required and tighten the 2 off M5 grub screws (see Figure 2-3 on page 5) under the enclosure base onto the hexagon flats of the pressure tube to prevent further rotation of the enclosure on the pressure tube.

## 2.2.6 Securing the LVDT cap

The LVDT cap inside the enclosure leaves the factory free to rotate on the pressure tube so that movement in transit and during installation is not transmitted to the LVDT. The LVDT cap must now be secured in position (see Figure 2-5 on page 7).

If the cover is in place, locate and unscrew the cover locking safety grub screw and unscrew the cover from the base.

Locate and tighten the LVDT locknut (at the top of the pressure tube) against the top of the LVDT cap so that it can no longer rotate on the LVDT. Remove the transit tape from the LVDT.

Refer now to the wiring section or, if the transmitter is to be left in this condition for a period, check that the cover seal is in good condition and re-fit the cover, then secure cover locking screw. Check any conduits are suitably sealed against ingress of moisture.

# Section 3 Electrical Connections



## 3.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol ( ⚠ ). Please refer to the following safety messages before performing an operation preceded by this symbol.

**⚠ WARNING**

**Failure to follow these installation guidelines could result in death or serious injury**

- The MLT100 is a *wired displacer level transmitter*. It must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment
- Prior to energizing, always ensure that cover locking safety grub screw is tightened

**Explosions could result in death or serious injury**

- Installation of the level transmitter in a hazardous environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of this reference manual for any restrictions associated with an installation
- Before connecting a Field Communicator in an explosive atmosphere, ensure the installation is in accordance with intrinsically safe or non-incendive field wiring practices
- Verify that the operating atmosphere of the level transmitter is consistent with the appropriate hazardous locations certifications

**External surface may be hot**

- Care must be taken to avoid possible burns

**Process leaks could result in death or serious injury**

- Install and tighten process connectors before applying pressure
- Do not attempt to loosen or remove process connectors while the level transmitter is in service

**⚠ WARNING**

**Electrical shock could cause death or serious injury**

- If the level transmitter is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the level transmitter is off while making connections

## 3.2 Overview of the electrical connections

The MLT100 is a two-wire, loop-powered transmitter and requires a 24 Vdc nominal supply. It provides a 4–20 mA output of the level measurement and supports HART communications.

### General considerations

- When installing in a hazardous area, refer also to the safety instructions booklet: MLT100 Ex d: See product document IP2020/SI Exd
- To minimize the electrical shock hazard, before energizing it is essential that the equipment is connected to a protective ground using the terminals supplied
- It is the responsibility of the installer to observe all local regulations and approval requirements, and to use materials to suit the environmental conditions of the particular application. Check and obtain any hazardous area work permits before applying power to the MLT100
- If your MLT100 has been supplied with a Display module, note that you do not need to remove the Display module cover for wiring. All field wiring is connected in the main head enclosure
- In multi-drop HART installations, the 4–20mA output of the level measurement is not available (see "Multi-drop installations (MLT100 in HART digital mode)" on page 3-5).

### 3.2.1 Opening the head cover

To remove the head cover, unscrew the cover locking safety grub screw (Figure 2-5 on page 2-7) and unscrew the cover from the base.

Figure 3-1 shows the layout inside the transmitter with the cover removed.

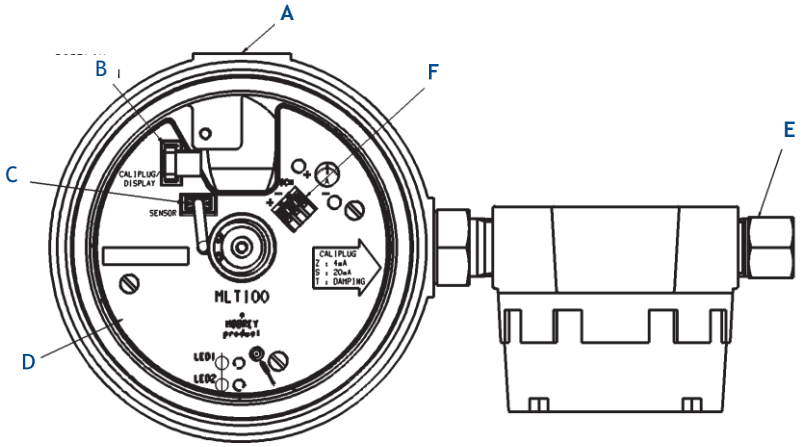
A terminal block is provided for the power supply and cable screen connections, together with a pair of 2 mm sockets for connection of an ammeter to monitor the loop current.

There are two small sockets integrated into the terminal block for convenient connection of a Field Communicator if required. (Use only an Intrinsically Safe approved field communicator if installing the MLT100 in a Hazardous area).

The small target and LED's are used for bench calibration of the transmitter if required. See Section 4: Commissioning for bench calibration details.

Whilst the cover is removed, ensure that the two multi-way plugs are not disturbed in their sockets. (The plugs have been secured in their sockets at the factory with a sealing compound).

**Figure 3-1. Transmitter head with cover removed**




A. Cable Entry 1-in. NPT
B. Display Connection
C. LVDT Connection
D. Cover Plate
E. Caliplug (Connected To Optional Display)
F. Power Supply Terminals

## 3.2.2 Cable considerations

The cable should be single twisted pair shielded or multiple twisted pair with each pair shielded and an overall shield to BS5308 or equivalent.

The terminal block will accept wire size up to 2.5 $mm^2$ (16SWG, 14AWG). It is recommended that the minimum conductor size should be 1 $mm^2$ up to 5000 ft. total length and 20 AWG above 5000 ft., but always ensure that the voltage at the terminals is a minimum of 12 Vdc.

### Cable capacitance in intrinsically safe circuits

When used in Hazardous areas in an Intrinsically Safe circuit, refer to the Safety Instructions booklet (IP2020/SI Ex, IP2020/SI Exd, or IP2020/SI Exg) supplied with the transmitter, and local and national codes of practice, to determine the maximum cable capacitance allowed.

### Multi-core cables

In multi-pair installations, it is important that the other pairs do not interfere with the HART signalling. The other pairs should only be used for other HART loops or for purely analogue signals.

It is recommended that HART signal cables are not run alongside power cables.

### Cable gland

The cable gland entry thread is 1-in. NPT female; the enclosure is rated IP66 and so a suitable combination of gland and cable should be selected. When used in a hazardous area, glands must comply with the relevant Intrinsically Safe or Flameproof/Explosion-proof requirements. Refer also to the Safety Instructions booklet (IP2020/SI, IP2020/SI Exd, or IP2020/SI Exg) supplied with the transmitter.

# 3.3 Terminal connections

Connection of the cable is to the + and – terminals with the cable screen being connected to the 'scn' terminal. The cable screen should normally be earthed at the power supply end. An internal and external earth point is also provided.

## 3.3.1 Power supply requirements

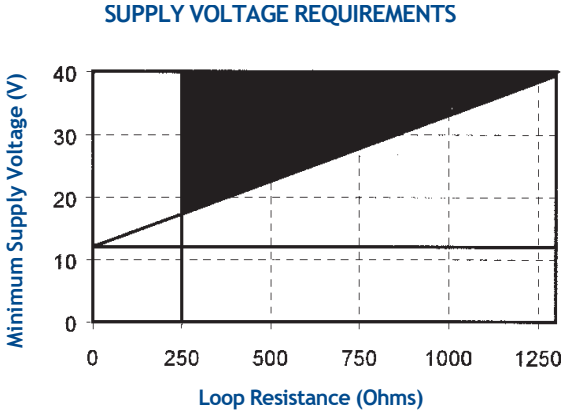
### Operating voltage

The MLT100 will work satisfactorily provided the voltage at the transmitter terminals remains between 12 and 40 Vdc.

In considering the voltage of the power supply, allowance must be made for the voltage drop across any load in series with the transmitter such as an indicator, safety barrier, or the cable itself. The largest voltage drop will occur at the maximum current which is 21 mA under alarm conditions.

See Figure 3-2 for a Load versus Voltage graph, which defines the acceptable range of power supply voltages for any given installation.

**Figure 3-2. Load Versus Voltage**




## 3.3.2 HART® communications

If the HART communications is to be used at the time of installation or during its future working life, then it is essential that a resistive load of at least 250 Ohms is connected in the supply cable. This resistance may be provided by other devices in the loop (chart recorder, meter, etc.) or more usually by installing a standard 270 Ohm, 0.25 W resistor in series. In this way, the HART Master device is able to signal to the transmitter without the power supply short-circuiting the data.

## 3.4 Lightning protection

If local conditions dictate, it is recommended that a lightning suppressor is fitted. A typical manufacturer is Telematic who can supply products suitable for IS as well as non-IS installations.

## 3.5 Multi-drop installations (MLT100 in HART digital mode)

Up to 15 transmitters (unless in an IS loop – see below) may be connected in parallel with each other, and each must be set to a different HART address between 1 and 15 (see Appendix D: Field Communicator Data Map).

When HART transmitters are connected in multi-drop mode, each transmitter draws a fixed current of 4 mA, and allowance must be made for the total maximum current that could be drawn (i.e. 15 x 4 mA = 60 mA).

In HART digital mode, the 4–20mA output of the level measurement is not available.

### 3.5.1 Intrinsically safe installations

In multi-drop IS installations, typically a maximum of five transmitters may be connected to the loop in parallel, thus limiting the current in the loop.

### 3.5.2 Field communicators

A field communicator may be connected across the network (downstream of the minimum 250 Ohm loop resistance) to configure or interrogate a HART transmitter.

Some field communicators support only a subset of a transmitter's functions, and will only access the transmitters Universal and Common Practice commands. However, the MLT100 is fully supported by the Delta Mobrey 375/475 Field Communicator if it is loaded with the transmitter's Device Description.

## 3.6 Final checks

When all wiring is complete, check that the two multi-way plugs remain securely in their respective sockets.

Check that the cable gland is tightened into the conduit and a good seal is formed.
If the transmitter is to be commissioned at this point, refer now to Section 4: Commissioning.
If not, check that the cover seal is in good condition, then replace the cover and screw down fully to ensure the weatherproof rating of the enclosure is maintained. (Do not attempt to overtighten as the torque you apply to the cover will be transmitted to the pressure tube union and locking screws; these must not be loosened by overtightening of the cover).

Finally, prior to energizing, tighten the cover locking safety grub screw.

# Section 4 Commissioning



## 4.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

### 4.1.1 Warnings

**⚠ WARNING**

**Failure to follow these installation guidelines could result in death or serious injury**

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- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment
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- Installation of the level transmitter in a hazardous environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of this reference manual for any restrictions associated with an installation
- Before connecting a Field Communicator in an explosive atmosphere, ensure the installation is in accordance with intrinsically safe or non-incendive field wiring practices
- Verify that the operating atmosphere of the level transmitter is consistent with the appropriate hazardous locations certifications

**External surface may be hot**

- Care must be taken to avoid possible burns

**Process leaks could result in death or serious injury**

- Install and tighten process connectors before applying pressure
- Do not attempt to loosen or remove process connectors while the level transmitter is in service

**Electrical shock could cause death or serious injury**

- If the level transmitter is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the level transmitter is off while making connections

# 4.2 In-situ commissioning

The MLT100 transmitter has been supplied calibrated to the requirements of the specific application advised at the time of ordering. Refer to the Set-up Certificate supplied with the transmitter to check that this data is still valid. If you wish to carry out some bench calibration or testing, refer now to Appendix C: Bench Checking – LDVT Setting 20 °C.

**Important**

- Some of the adjustments described below require the MLT100 cover to be removed with power on. Check and obtain any hazardous area work permits required before removing the cover.
- Prior to energizing, ensure that the cover locking safety grub screw is tightened

## 4.2.1 Initial power-up

Turn on the power and check that the "Heartbeat" LED in the Caliplug beats at about once every 3 seconds.

If the transmitter is fitted with a display module, the display will show the software revision number (in the format *.*), and then change to show the measured value.

With the displacer element hanging on the spring and rod assembly, the displacer spring is extended due to the weight of the element hanging on it.

The transmitter has been calibrated to give an accurate 4–20 mA output proportional to level at a specific set of operating conditions: specific gravity (SG), pressure, and temperature. Consequently, the level measurement at 20 °C may not be as you expect.

After operating conditions are reached, the spring will relax and the core will drop, giving an output of 4 mA with the vessel empty.

## 4.2.2 Local calibration adjustments at operating conditions

After the vessel has reached process operating conditions, the following can be checked and adjusted if required:

- If you wish to fine tune the 4 and 20 mA points or to re-range the transmitter to give the 4–20 mA output over a different span, this can now be done.

**Note**

To maintain accuracy, it is recommended the maximum turndown used is 3:1.

### Zero level (4 mA point)

With no liquid in the vessel, the output should be 4 mA.

If the output is within 3.9 and 4.1 mA, refer to "Local calibration using the MMS and the caliplug" on page 4-3 to fine tune to exactly 4 mA.

If the output with the vessel empty and at operating conditions is outside of these limits, it is likely that the position of the LVDT in the transmitter head needs to be adjusted. Refer to Appendix C: Bench Checking – LDVT Setting 20 °C before making any further adjustments.

## High level (20 mA point)

This occurs with the displacer element almost fully covered with liquid (to within 10 to 15 mm of the top of the parallel portion of the element), and the output should be 20 mA.

These adjustments may be made locally with:

- a Mobrey Magnetic Scroller (MMS)
- a Caliplug on the transmitter
  (see "Local calibration using the MMS and the caliplug" on page 4-3)
- a Field Communicator connected across the two-wire loop
- a PC running AMS Suite: Intelligence Device Manager software

**Note**
See Section 7 for adjustments using a Field Communicator or AMS.

# 4.2.3 Local calibration using the MMS and the caliplug

This section describes how to locally calibrate using the Delta Mobrey Magnetic Scroller (MMS) and the Caliplug when the transmitter is at operating pressure, temperature, and SG).

**Note**
The 4 mA point can be positioned above the 20 mA point to reverse the operation of the transmitter, thus giving a falling current output with rising liquid level.

## 4 mA Point

With the vessel empty or the liquid at the level required for 4mA output, insert the magnetic tip of the MMS into the Caliplug port marked "Z". Hold in until acceptance of the new setting is given by the Caliplug LED flashing at an increased rate of twice per second.

## 20 mA Point

With the liquid at the level required for 20 mA output, insert the magnetic tip of the MMS into the Caliplug port marked "S". Hold in until acceptance of the new setting is given by the Caliplug LED flashing at an increased rate of twice per second.

## Ranging with a partially full vessel

If it is not possible to fill the vessel to the required level for a 20 mA output, the transmitter can be ranged in a partially full vessel.

With liquid in the vessel at a level above the 4 mA level, the current output can be incremented to a value that represents this level. For example, with the vessel ¾ full, the current would be set at a value of 16 mA.

Connect a milliammeter to the two sockets inside the enclosure.

To enter the ranging mode, hold the MMS on the small target icon on the internal nameplate for about 3 seconds. One (or both) of the 2 LED's adjacent to the target icon will start to flash. Insert the magnetic tip of the MMS into the "S" port of the Caliplug to increase the current out as

shown on the milliammeter, or the "Z" port to decrease the current at this level. Withdraw the MMS once the current level has been set to the required level.

Hold the MMS on the target again to deactivate the LED's and exit the ranging mode.
Note, the instrument will automatically exit the ranging mode if left for longer than 5 minutes.

### Damping

The damping of the transmitter level measurement may be adjusted using the MMS and the Caliplug. The damping value entered is actually a time constant in seconds which is applied as smoothing to the level reading and the output current. A new value may be entered up to a value of 100 seconds. A large value will have the effect of smoothing out rapid changes of level and will also smooth out the effects of turbulence. (It would be highly unusual to select a value greater than 30 seconds).

Insert the magnetic tip of the MMS into the "T" port of the Caliplug and hold in place for a number of seconds equivalent to the damping that you require, noting that the LED flash rate increases to once per second during setting of damping. After the MMS is removed, the new damping value is set.

Your MLT100 is now ready to operate.

Finally, check all seals and conduits are in good condition and replace the transmitter head cover and secure with the locking grub screw.

If you experience any unusual output or apparently faulty operation of your MLT100, refer to the Adjustments for changing process conditions and Section 5.

## 4.2.4 Adjustments for changing process conditions

It may be that actual process conditions are a little different to those envisaged at time of order and used to set-up your MLT100.

The MLT100 has been factory set to give you the correct output under the operating conditions which you quoted in your enquiry/order. If you intend to operate outside the parameters for which the MLT100 has been factory set, please read the notes below. These describe a variety of deviations and their implications. Typical deviations are:

- More dense process (lower) liquid
- Less dense process (lower) liquid
- More dense upper liquid/gas
- Less dense upper liquid/gas
- Higher process temperature
- Lower process temperature
- The range is in the wrong place

The electronics can be re-configured to accommodate different operating conditions, but your working range may be affected. The transmitter output can be re-ranged, giving the 4–20 mA output over the correct liquid level excursion, but this is achieved electronically by changing the values of pre-programmed parameters. The base process value (PV) will still show as the true measured value of the liquid level. Transmitter accuracy is little affected provided the process condition changes are within the limits stated in each case.

**Note**
See Appendix D: Field Communicator Data Map for adjustments using a Field Communicator or AMS.

## Adjustments using the MMS to re-range the MLT100

Sometimes the effects of changed process operating conditions, provided that they are within the limits stated in each case below, are minimal and simple re-ranging using the Delta Mobrey Magnetic Scroller (MMS) tool to set new Zero and Span levels is adequate.

Refer now to the various conditions below:

### More dense process (lower) liquid

Because the lift from the process liquid is increased, the MLT100 output will show 100% (top level) when the level in the vessel is below what you expect.

We recommend that you accept this; re-ranging the MLT100 to give 20 mA at full vessel conditions is not recommended as this may cause the LVDT to operate outside of its calibrated range. At the low level (0%), the MLT100 output will correctly correspond with the level in the vessel.

### Less dense process (lower) liquid

The lift from the process liquid is reduced and the MLT100 output will never reach 100% (top level). The process liquid reaches the top of the Displacer without providing the upthrust expected. The range will thus be reduced at its top end.

It is possible to re-range the MLT100 to output 20 mA with the displacer element fully covered in this less dense liquid. Refer to “Local calibration adjustments at operating conditions” on page 4-2 for re-ranging. At the low level (0%), the MLT100 output will correctly correspond with the level in the vessel.

### More dense upper liquid/gas

The effect can be significant with an interface liquid, or where the gas above the process liquid is at a very high pressure. The displacer will be covered by the process liquid at high level (100%) and at this point the MLT100 output will correspond with the level in the vessel.

At the other extreme, when the displacer is entirely in the upper liquid/gas, the extra lift will cause the MLT100 output to have a value higher than the 0% that you would expect from the level in the vessel. For example, when the interface reaches the bottom of the displacer, the MLT100 output might be 2%. If the interface falls further, no change in MLT100 output can occur.

It is possible to re-range the MLT100 to output 4 mA (0%) when the displacer element is covered with the more dense upper liquid or gas. Refer to “Local calibration adjustments at operating conditions” on page 4-2 for re-ranging.

### Less dense upper liquid/gas

The displacer will be covered by the process liquid at high level (100%) and at this point the MLT100 output will correspond with the level in the vessel.

At the other extreme, when the displacer is entirely in the upper liquid/gas, the reduced lift will cause the MLT100 output to give a value of 0% whilst the element is still partially immersed in the lower liquid.

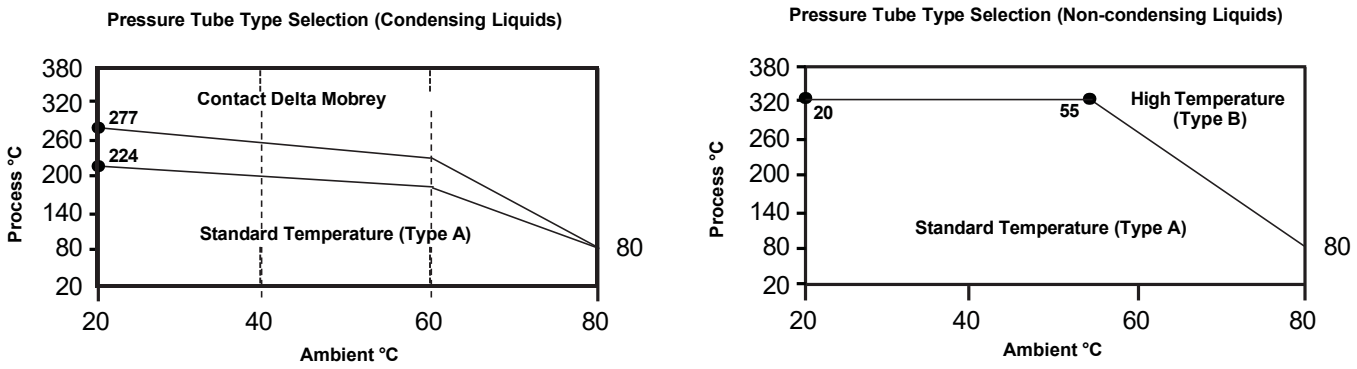
We recommend that you accept this; re-ranging the MLT100 to give 4 mA (0%) when the displacer element is covered by the less dense upper liquid or gas is not recommended as this may cause the LVDT to operate outside of its calibrated range.

## Higher process temperature

The spring rate will be lower and, therefore, the displacer hangs lower than it was designed to. The MLT100 output will indicate a lower level in the vessel than that which actually exists. This deviation will be greater at low level than at high level.

You should check from the graphs in Figure 4-1, that the new process temperature does not require a longer pressure tube assembly. If it does, talk to Delta Mobrey about what is best to be done, otherwise the electronics will be damaged by excessive temperature.

**Figure 4-1. Temperature graphs for selecting pressure tube type A or B**




## Lower process temperature

The spring rate will be higher so the displacer will hang higher than it was designed to. The MLT100 output will indicate a higher level in the vessel than that which actually exists. This deviation will be greater at low level than at high level.

Use the MMS to set zero at this point (see “Adjustments for changing process conditions” on page 4-4). However, if the change in process temperature from that quoted at time of order is greater than ±50 °C, the LVDT may operate outside of its calibrated range at higher liquid levels.

## The range is in the wrong place

Lengthening or shortening the suspension chain will put this right. Where the chain would need to be shorter than one link, the only possibility is to fit a stand-off to the vessel/chamber. Delta Mobrey can help with this. Delta Mobrey can also supply chain and matching split pins to replace the chain supplied if you need a greater length.



Temperature (Type B)

# Section 5 Fault finding and error messages



## 5.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol ( ⚠ ). Please refer to the following safety messages before performing an operation preceded by this symbol.

### 5.1.1 Warnings

**⚠ WARNING**

**Failure to follow these installation guidelines could result in death or serious injury**

- The MLT100 is a *wired displacer level transmitter*. It must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment
- Prior to energizing, always ensure that cover locking safety grub screw is tightened

**Explosions could result in death or serious injury**

- Installation of the level transmitter in a hazardous environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of this reference manual for any restrictions associated with an installation
- Before connecting a Field Communicator in an explosive atmosphere, ensure the installation is in accordance with intrinsically safe or non-incendive field wiring practices
- Verify that the operating atmosphere of the level transmitter is consistent with the appropriate hazardous locations certifications

**External Surface may be hot**

- Care must be taken to avoid possible burns

**Process leaks could result in death or serious injury**

- Install and tighten process connectors before applying pressure
- Do not attempt to loosen or remove process connectors while the level transmitter is in service

**Electrical shock could cause death or serious injury**

- If the level transmitter is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals. Make sure that power to the level transmitter is off while making connections

# 5.2 Fault finding

## 5.2.1 Finding out why there is no output

When there is no output:

- Check the voltage at the transmitter terminals is greater than 12 Vdc
- Check that the polarity of the power applied is correct.
(The MLT100 is reverse polarity protected)
- If the above is correct, check that the Caliplug LED is flashing at a frequency of about once every 3 seconds
- Check that the Caliplug connection lead is secure in its socket
- If a display is fitted, check that the display lead is secure in its socket and that the display is showing a reading
- If there is no Display or Caliplug LED activity, the MLT100 should be returned to Delta Mobrey or your local agent for repair or replacement

## 5.2.2 Finding out why there is an incorrect output

If your MLT100 does not have a display module fitted, but you are seeing an incorrect current output for a known level in the tank, check the following:

- Check that the correct displacer and spring/rod assembly have been fitted to the transmitter head. Each item will be marked with the same Final Assembly Number (FAN). The instrument FAN is on the Set-up Certificate supplied with each MLT100
- Check that the displacer element is hanging at the correct level below the transmitter mounting flange. Refer to “Check the transmitter range position” on page 2-6
- Check that the rod and core move freely in the pressure tube. A bent or damaged rod could result in sluggish or incorrect output
- Check that the spring is not damaged. Any permanent deformation by over-extension will cause incorrect readings
- Check that the liquid SG, operating pressure and temperature at the MLT100 are all as given on the Set-up certificate. Some site adjustments are possible.
Refer to “Local calibration adjustments at operating conditions” on page 4-2
- If the MLT100 is assembled correctly and all components move freely, carry out a bench check as detailed in Appendix C: Bench Checking – LDVT Setting 20 °C to ensure that the LVDT is positioned correctly
- Check the spring and rod assembly is fully screwed onto the head (lower end of the pressure tube) and locked in place with the grub screw

# 5.3 Error messages

## 5.3.1 Error messages indicated on the display module

The MLT100 transmitter monitors its performance and reacts to any problems. If a display module is fitted, description of the condition will be displayed on there.

Only one alarm condition is displayed at any one time. Therefore, each alarm is allocated a priority (see Table 5-1). Additionally, for certain conditions, the current output will take the value of parameter P22 after a delay specified by parameter P21.

**Table 5-1. Alarm Condition Priorities**

| Priority | Description of Error Message | Error Message Displayed | Current Output Affected? |
|---|---|---|---|
| 1 | ROM Checksum Error | ROM | Y |
| 2 | RAM Error | ROM | Y |
| 3 | EEPROM Checksum Error | E'PROM | Y |
| 4 | ADC reference too high | ADC H | Y |
| 5 | ADC reference too low | ADC L | Y |
| 6 | Sensor output too high | SO H | N |
| 7 | Sensor output too low | SO L | N |
| 8 | PV out of limits | PV OL | N |
| 9 | Temperature out of limits | °C OL | N |
| 10 | Current Saturated | SAT | N |

### Messages and required actions

#### ROM, RAM, E'PROM, ADC H, and ADC L

These errors are generated when internal self-checking reveals a fault. The MLT100 should be returned to Delta Mobrey or your local agent for repair or replacement.

#### SO H

This means that the core has travelled too high in the pressure tube and that the LVDT output is therefore too high.

Required actions:

1. Check that the displacer element is the correct element for this MLT100.
2. Do a bench calibration to check that the LVDT is in the correct position.
3. If the message only appears when there is liquid in the vessel, check that the liquid/gas specific gravity (SG) is as expected, and not too high.

## SO L

This means that the core is too low in the pressure tube and that the LVDT output is therefore too low.

Required actions:

1. Check that the displacer element is the correct element for this MLT100.
2. Check the spring is not damaged.
3. Check the spring and rod assembly is fully screwed onto the head (lower end of the pressure tube) and locked in place with the grub screw.
4. Do a bench calibration to check that the LVDT is in the correct position.
5. If the message only appears when there is liquid in the vessel, check that the liquid/gas specific gravity (SG) is as expected, and not too high.

## PV OL

Carry out the same checks described by SO H and SO L above.

## °C OL

This indicates that the process temperature or a combination of the process and ambient temperatures have resulted in the electronics becoming too hot or too cold.

Required action:

1. Using a Field Communicator or AMS, check parameters P46 and P47 to see the *maximum* and *minimum* temperatures recorded.

   The electronics may have been permanently damaged if the MLT100 electronics has recorded a temperature above 85 °C. The MLT100 should be returned to Delta Mobrey or your local agent for repair or replacement.

## SAT

This means the current output is saturated (outside the limits 3.8 to 20.5 mA).

Required action:

1. Reset the 4 and 20mA points using the Delta Mobrey Magnetic Scroller (see Section 4: Commissioning), or Field Communicator or AMS (see Appendix D: Field Communicator Data Map).

# Section 6 Maintenance



## 6.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol ( ⚠ ). Please refer to the following safety messages before performing an operation preceded by this symbol.

### 6.1.1 Warnings

**⚠ WARNING**

**Failure to follow these installation guidelines could result in death or serious injury**

- The MLT100 is a *wired displacer level transmitter*. It must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment
- Prior to energizing, always ensure that cover locking safety grub screw is tightened

**Explosions could result in death or serious injury**

- Installation of the level transmitter in a hazardous environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of this reference manual for any restrictions associated with an installation
- Before connecting a Field Communicator in an explosive atmosphere, ensure the installation is in accordance with intrinsically safe or non-incendive field wiring practices
- Verify that the operating atmosphere of the level transmitter is consistent with the appropriate hazardous locations certifications

**External Surface may be hot**

- Care must be taken to avoid possible burns

**Process leaks could result in death or serious injury**

- Install and tighten process connectors before applying pressure
- Do not attempt to loosen or remove process connectors while the level transmitter is in service

**Electrical shock could cause death or serious inju7ry**

- If the level transmitter is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals. Make sure that power to the level transmitter is off while making connections

## 6.2 Routine maintenance

There is very little maintenance required on the Delta Mobrey MLT100.

Take great care when removing the instrument from any vessel. This is a two-person operation. The assembly must be kept vertical when removing from the vessel to prevent damage to the spring and rod assembly.

All that need be checked during routine strip down is that the spring rod remains free to move in the pressure tube and that any chamber or stilling tube is free of debris or build-up.

Refer to "Mounting the transmitter on the vessel or chamber" on page 2-7 when re-installing the MLT100 into a vessel or chamber.

## 6.3 Spares

The MLT100 is a factory built instrument and there are no spare parts that can be fitted in the field. If the MLT100 requires any repair or replacement parts, it must be returned to Delta Mobrey for action.

# Section 7 HART Communications using a Field Communicator and AMS



## 7.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol ( ⚠ ). Please refer to the following safety messages before performing an operation preceded by this symbol.

### 7.1.1 Warnings

**⚠ WARNING**

**Failure to follow these installation guidelines could result in death or serious injury**

- The MLT100 is a *wired displacer level transmitter*. It must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment
- Prior to energizing, always ensure that cover locking safety grub screw is tightened

**Explosions could result in death or serious injury**

- Installation of the level transmitter in a hazardous environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of this reference manual for any restrictions associated with an installation
- Before connecting a Field Communicator in an explosive atmosphere, ensure the installation is in accordance with intrinsically safe or non-incendive field wiring practices
- Verify that the operating atmosphere of the level transmitter is consistent with the appropriate hazardous locations certifications

**External surface may be hot**

- Care must be taken to avoid possible burns

**Process leaks could result in death or serious injury**

- Install and tighten process connectors before applying pressure
- Do not attempt to loosen or remove process connectors while the level transmitter is in service

**⚠ WARNING**

**Electrical shock could cause death or serious injury**

- If the level transmitter is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the level transmitter is off while making connections

# 7.2 Using a field communicator and AMS

The MLT100 supports HART communications, which may be used to program or interrogate the transmitter from any point on the two-wire loop.

By connecting the Field Communicator across the two-wire loop at any point downstream of the minimum 250 Ohm loop resistance, communication can be established. The terminal block of the MLT100 has integral 2 mm sockets provided for this purpose.

Ensure that the MLT100 Device Description (DD) is correctly loaded or compiled to gain access to all of the MLT100 parameters. If you do not have the MLT100 DD loaded, you will only be able to access the Universal and Common Practice commands. Contact Delta Mobrey or any other HART Host Subscriber to update your communication device with the latest MLT100 DD.

This section contains information on configuring the transmitters using a Field Communicator, or a PC with AMS.

## Field Communicator and AMS

For convenience, Field Communicator fast key sequences are labeled “Fast Keys” for each software function below the appropriate headings.

## Example Software Function

| Fast Keys | 1, 2, 3, etc. |
|---|---|

When using a Field Communicator, some configuration changes are sent to the transmitter by pressing “SEND”. AMS configuration changes are implemented when the “Apply” button is clicked.

Connect the Field Communicator leads to the transmitter, and turn on the Field Communicator by pressing the ON/OFF key. The Field Communicator will search for a HART-compatible device and indicate when the connection is made. If the Field Communicator fails to connect, it indicates that no device was found. If this occurs, check the lead connections and re-try.

**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

# 7.3 Concepts to understand before configuring

## Parameters

The MLT100 stores a wide range of parameters, enabling it to perform more functions than a simple 4 to 20 mA level transmitter. Some parameters are required to comply with the HART protocol whilst others, for example, enable the transmitter to calculate and display the contents of a non-linear tank in true volumetric units.

**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## Display module

The display module, if fitted, can be programmed to show specific information. This digital display alternates between indicating the values for "display 1" (set by parameter P23) and "display 2" (set by parameter P24).

A typical configuration might be to alternate the *measured level* and the *mA current output*, which is useful during commissioning. After the setting-up is completed, the display may be changed back to show the *measured level* or, if more useful, *the percentage level*.

**Note**
See pages 7-24 and 7-24 for a full description of parameters P23 and P24.

## Units of operation and display

The measurement units on the display module (if fitted), Field Communicator, or AMS can be changed from the default metres (meters) using parameter P12.

It is important to know that the numerical value of the Process Value (PV) - level in metres - does not automatically get converted when the display units are changed by P12. To convert the PV to other measurement units, use parameter P13 to set the conversion factor.

**Note**
See pages 7-15 and 7-16 for a full description of parameters P12 and P13.

## Standing value

If there is still liquid in the tank when the displacer element is fully uncovered, the reading can be adjusted to show this by adding the amount of the liquid remaining to the measured value. The liquid PV, in the units defined by P12 and P13, is entered into parameter P14 (see page 7-17).

## Linear and non-linear profiling

Unless factory calibrated to specific instructions, the MLT100 gives a 4-20 mA output proportional to level over the full displacer length, with 4 mA representing a level of 0 m at the end of the displacer element. The MLT100 can be re-ranged on-site if necessary (See "Local calibration adjustments at operating conditions" on page 4-2).

For applications where the relationship between height and contents is not linear e.g. a spherical tank, the MLT100 may be programmed with a look-up table so that the microprocessor can convert height-to-contents, or height-to-flow.

The MLT100 has a library of popular tank shapes that may be selected using parameter P11, or the data for a custom look-up table can be entered into parameters P30 to P39.

**Note**
See pages 7-9 and 7-15 for a full description of P11 and P30 through P39.

# 7.4 Adjustments for process changes

## Adjustments for process temperature changes

Changes in process temperature cause the wetside assembly to hang at a different level than that planned. The effect of the new temperature on the spring rate can be corrected by entering the new process temperature into parameter P25 (see page 7-25). This new value is then used compensate the level measurement for temperature effects.

## Adjustments for specific gravity differences

The effects of a changing liquid specific gravity (SG) can be corrected by entering the new specific gravities into parameters P26 (Lower fluid SG, page 7-26) and P27 (Upper fluid SG, page 7-26).

The process change of a lower-liquid specific gravity (SG) to one greater than originally programmed, causes the 20 mA output to occur before the displacer element is fully covered. Entering the new SG corrects this so that the correct current output is given. However, if the lower-liquid SG changes from that used to factory calibrate the instrument by greater than 10%, the output may become non-linear if the core operates outside of the calibrated range of the LVDT.

Conversely, if the operating SG of the lower-liquid is lower than the SG originally programmed at the factory, the core will not travel high enough to give a full 20 mA output. Entering a new operating SG corrects this, effectively re-scaling the output to be correct. There is no danger in this instance of a non-linear output.

**Note**
Changes in the upper-liquid SG has the opposite effect.
See page 7-26 for a full description of parameters P26 and P27.

# 7.5 Configuration parameters

The MLT100 "Program" parameters each have default values which are loaded into the transmitter's memory when first manufactured. Some of these values are adjusted at the factory to suit the customer's application.

Several of the parameters have upper and lower limits outside of which they should not be set. Certain parameters, when changed, can cause a step change in the output. In these cases the Field Communicator (or AMS) prompts for confirmation before making the change. This gives the user the opportunity to put a plant's control loop into manual and then restore it to automatic later.

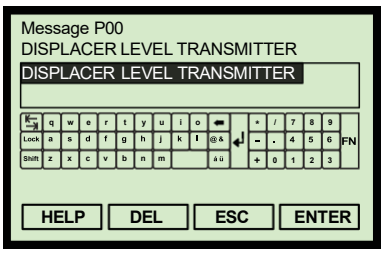
This section of the manual details the function of each parameter in numerical order, together with its default value and limits if applicable. A typical screen from the Field Communicator is shown for each parameter.

**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.5.1 Message (P00)

| Fast Keys | 1, 2, 1, - |
|---|---|

This allows a general 32-character message to be edited. It can be used for any purpose, such as recording the initials of the person who programmed it, a support contact number, details of last programming change, etc.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

To view or change the message:

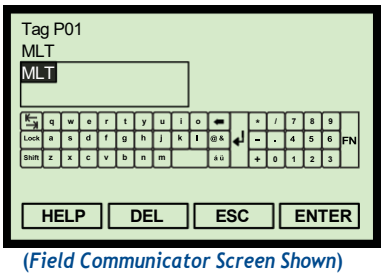
1. From the *Home* screen, select 1: Configure/Setup.
2. Select 2: Device Configuration.
3. Select 1: Identity.
4. Scroll down and select Message P00.
5. If required:
   (a) Input a new message, and then press "ENTER" to save it.
   (b) Press "SEND" to update the transmitter.

**Note**
Parameter P00 is also at Fast Key sequence 3, 4. (Scroll down to see P00)

## 7.5.2 Tag (P01)

| Fast Keys | 1, 2, 1, 1 |
|---|---|

This is for editing an electronic 'label' of up to 8 characters for the transmitter. The tag is typically a reference number, but it can also be used to identify the location or duty of the transmitter in plant item terms.



*(Field Communicator Screen Shown)*

**Note**
This tag helps identify the transmitter being interrogated when using a HART Master Device such as a Field Communicator or a PC running AMS.

### Field Communicator or AMS

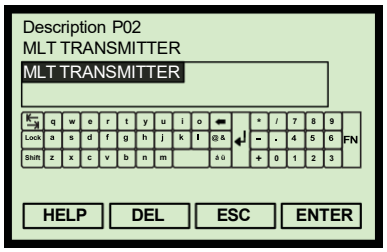
To view or change the tag:

1. From the *Home* screen, select 1: Configure/Setup.
2. Select 2: Device Configuration, and then select 1: Identity.
3. Select 1: Tag P01.
4. If required:
   (a) Input the new tag, and then press "ENTER" to save it.
   (b) Press "SEND" to update the transmitter.

## 7.5.3 Description (P02)

| Fast Keys | 1, 2, 1, - |
|---|---|

This is for editing up to 16 characters, and can be used for any purpose e.g. to expand on Tag (page 7-6) if needed.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

To view or change the descriptor:

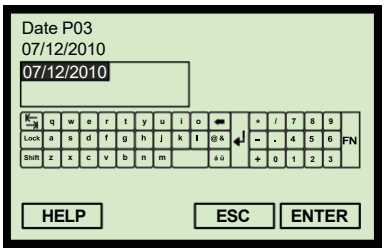
1. From the *Home* screen, select 1: Configure/Setup.
2. Select 2: Device Configuration.
3. Select 1: Identity.
4. Scroll down and select Description P02.
5. If required:
   (a) Input a new description, and then press "ENTER" to save it.
   (b) Press "SEND" to update the transmitter.

**Note**
Parameter P02 is also at Fast Key sequence 3, 4, 9.

## 7.5.4 Date (P03)

| Fast Keys | 1, 2, 1, 9 |
|---|---|

This can be used to store the date when the last changes were made to the transmitter's configuration. The Field Communicator (or AMS) automatically loads the correct date if it makes any such changes.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

To view the date:

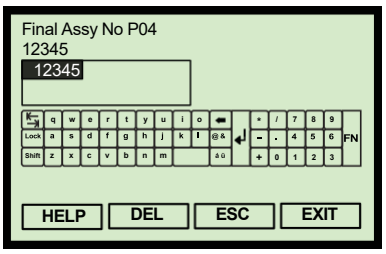
1. From the *Home* screen, select 1: Configure/Setup.
2. Select 2: Device Configuration.
3. Select 1: Identity.
4. Select 9: Date P03.

**Note**
Parameter P03 is also at Fast Key sequence 3, 4, 8.
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.5.5 Final Assembly Number (P04)

| Fast Keys | 1, 2, 1, 7 |
|---|---|

This is a read-only, factory-set parameter showing the hardware assembly number. It can be used by the factory to track the manufacturing history of an individual MLT100.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

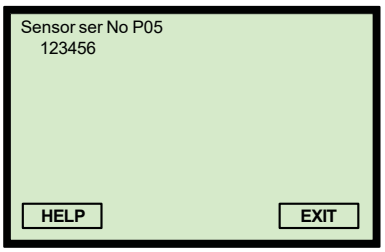
To view the final assembly number:

1. From the *Home* screen, select 1: Configure/Setup.
2. Select 2: Device Configuration.
3. Select 1: Identity.
4. Select 7: Final Assy No P04.
5. Press "EXIT" to exit to the previous menu.

**Note**
Parameter P04 is also at Fast Key sequence 3, 4, 6.
See Appendix A: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.5.6 Sensor Serial Number (P05)

| Fast Keys | 1, 2, 1, 6 |
|---|---|



*(Field Communicator Screen Shown)*

This is a read-only, factory-set parameter showing the sensor serial number. It is used by the factory to identify an individual LVDT, which provides the level input signal to the electronics.

### Field Communicator or AMS

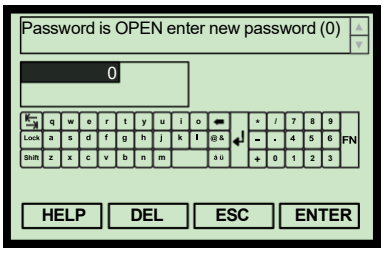
To view the sensor serial number:

1. From the *Home* screen, select 1: Configure/Setup.
2. Select 2: Device Configuration.
3. Select 1: Identity.
4. Select 6: Sensor ser No P05.
5. Press "EXIT" to exit to the previous menu.

**Note**
Parameter P05 is also at Fast Key sequence 3, 4, 5.
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.5.7 Password (P06)

| Fast Keys | 1, 2, 1, 5 |
|---|---|



*(Field Communicator Screen Shown)*

This three-tier password system controls changes to the parameters within the MLT100 transmitter.

There are three password levels:

"CLOSED"
– this control prevents any changes to parameter settings

"OPEN"
– this control allows configuration of the transmitter to suit the application

"OPEN*"
– this control allows access to the "protected" parameters which relate to the calibration of the transmitter. The "*" in this control is a secret character. Protected parameters should not be adjusted without contacting Delta Mobrey.

The default password level is "OPEN".

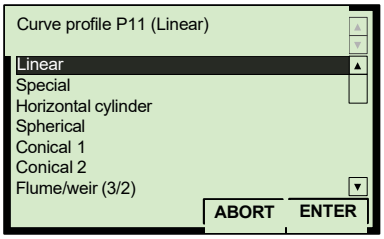
## Field Communicator or AMS

To enter a password:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 2: Device Configuration.
3. Select 1: Identity.
4. Select 5: Password P06.
5. To change password level, input one of the three-tier passwords and then press "ENTER".

# 7.5.8 Curve Profile (P11)

| Fast Keys | 1, 3, 1, 3 |
|---|---|




*(Field Communicator Screen Shown)*

Parameter P11 selects the shape of a tank, and establishes the *linear* or *non-linear* relationship between the live liquid level (height) and the output process value (PV) derived from that level.

The transmitter is pre-programmed with popular profiles that convert a level reading to a flow or volumetric process value (PV). The Current Output is then driven by the flow or volumetric process value (PV).

**Note**
The process value (PV) is indicated by Process Value P10 (page 7-40).

The allowed selections for parameter P11 are "Linear", and then seven non-linear functions – "Special", "Horizontal cylinder", "Spherical", "Conical 1", "Conical 2", "Flumeweir (3/2)" and "Vnotchweir (5/2)".

The default setting for P11 is: "Linear"

**Note**
The displayed measurement units for the process value (PV) are set using the parameter PV Units P12 (page 7-15). Changing these units does not automatically convert the process value PV value to alternative units.

The profile options are described in the following sections:

- "Contents (Volume) Measurement" on page 7-10
- "Flow Measurement" on page 4-28

## Field Communicator or AMS

To change the curve profile:

1. From the *Home* screen, select 1: Configure/Setup.
2. Select 3: Variables Configuration.
3. Select 1: Scaled Variable.
4. Select 3: Set Curve Profile.
5. Select a new profile, and then press “ENTER” to save the selection.
6. Press “SEND” to update the transmitter.

**Note**
When messages appear, take appropriate action if needed and press “OK”.
The chosen profile can be viewed by Fast Key sequences 1, 3, 1, 4 or 3, 3, 2.

# 7.5.9 Contents (Volume) Measurement

There are five profile options available to select, including:

- Curve Profile P011 = “Linear” (see page 7-10)
- Curve Profile P011 = “Special” (see page 7-10)
- Curve Profile P011 = “Cylinder” (see page 7-12)
- Curve Profile P011 = “Spherical” (see page 7-12)
- Curve Profile P011 = “Conical 1” (see page 7-13)
- Curve Profile P011 = “Conical 2” (see page 7-13)

## Curve Profile P011 = “Linear”

This setting is for level or volume (content) measurements involving a tank with a constant cross-section. When “Linear” is selected, the level or volume is the liquid height above the zero level multiplied by a scaling factor.

The volume of the contents is calculated by entering the maximum tank volume into the parameter Scale Factor P13 (page 7-16). The units of measurement e.g. gallons, liters, etc. are then set by parameter PV Units P12 (page 7-15).

If volume is not required, the parameter Scale Factor P13 (page 7-16) is set to 1.0 unless other measurement units for the output PV are required.

## Curve Profile P011 = “Special”

When selecting “Special”, parameters P30 to P39 (page 7-15) can be edited to plot the unique profile of an irregular shaped tank.

To derive the 10 profile points, it is necessary to have tabulated or graphical data to relate the process value (PV) to the live liquid height over the span set by P17 and P18. Figure 7-1 on page 7-11 shows an example graph of PV versus Liquid Height. In the example, 60% of the

maximum height on the X-axis relates to a percentage of the maximum PV on the Y-axis. The related percentage, say 55%, is entered into parameter P35 (profile point 6).

The transmitter interpolates linearly between the plotted points to give an accurate curve fit, which will determine the output process value (PV) from the live level (height) measurement.

Each live level measurement is converted into a percentage (0 to 100%), which is proportional to the maximum height. In graph terms, the converted percentage corresponds to an X ordinate on the X-axis. Using this X ordinate, the Y ordinate is then calculated to get a percentage proportional to the maximum PV. This percentage is multiplied by the maximum height to get the output process value (PV).

Setting-up Procedure for "Special" Option:

1. Select the displayed (reported) units for the output PV (see page 7-15).
2. Draw a graph of PV versus Liquid Height, and note the maximum points.
3. Enter the maximum volume into PV Scale Factor P13 (see page 7-16).
4. Use parameters profile point 1 (P30) to profile point 10 (P39) to enter the percentage values that relate to the X-axis fixed percentages.

**Note**

- The origin (0,0) is always used as the start point. It is not a parameter.
- Profile point 10 occurs at the height used as the maximum level, normally the displacer top unless re-positioned by P17 (page 7-45).
- It is possible the process value (PV) at the maximum height is less than 100% of the maximum volume or flow. (See Figure 7-2 on page 7-12).

**Figure 7-1. Graph 1 of PV versus Height**

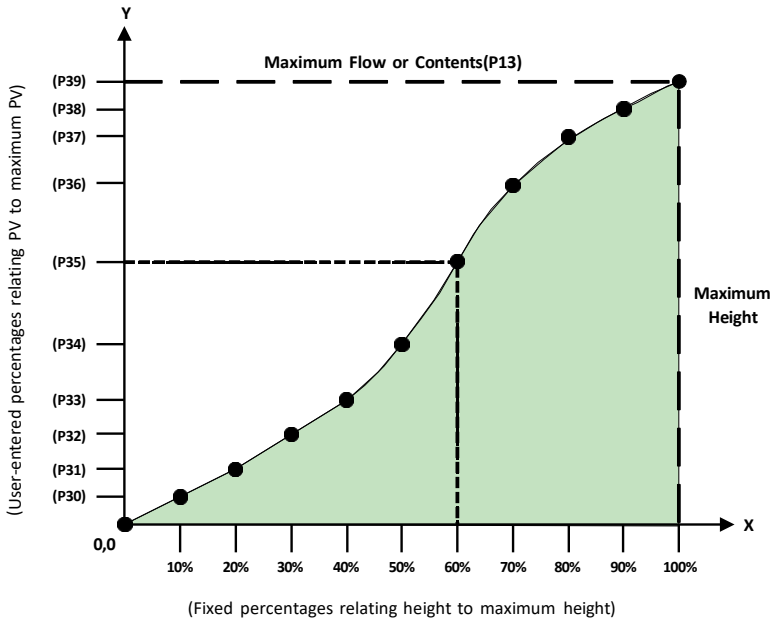
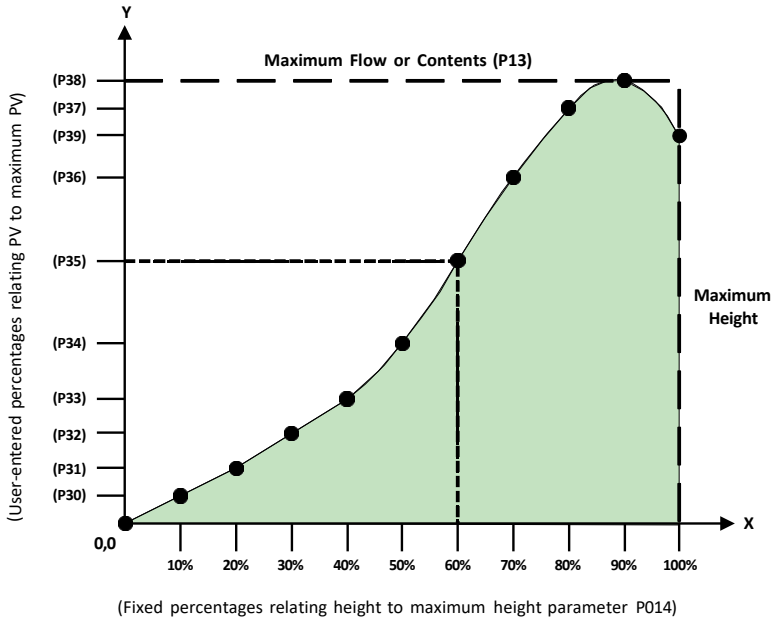


Figure 7-2. Graph 2 of PV versus Height




## Curve Profile P011 = “Cylinder”

This “Cylinder” setting is applicable when volume measurements are needed from a horizontally-oriented cylindrical tank with a constant diameter and flat ends (see Figure 7-3 on page 7-13 for a cross-sectional view).

The volume is calculated from the live level measurement, the full volume of an ideal cylindrical tank, and the diameter of that tank.

Setting-up Procedure for “Cylinder”:

1. Use the Curve Profile P011 parameter to select the option “Cylinder”.
2. Enter the full volume into the PV Scale Factor P13 parameter (page 7-16).
3. Enter the tank diameter into the Standing Value P14 parameter (page 7-17).

## Curve Profile P011 = “Spherical”

This setting is applicable when volume measurements are needed from a spherical tank with a constant diameter (see Figure 7-3 on page 7-13 for a cross-sectional view).

The volume is calculated from the liquid level measurement and the full volume of the ideal spherical tank.

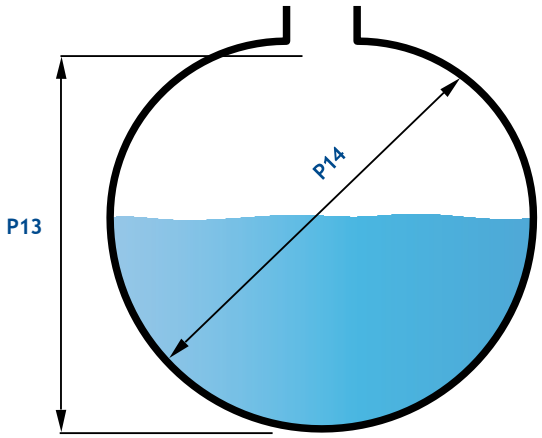
Setting-up Procedure for “Spherical”:

1. Use the Curve Profile P011 parameter to select “Spherical”.
2. Enter the full volume into the PV Scale Factor P13 parameter (page 7-16).

3. Enter the tank diameter into the Standing Value P14 parameter (page 7-17).

To provide the PV output as volume contents in a spherical tank, this curve is selected. The equivalent ideal spherical tank dimensions are entered in the parameters 10-14 as shown in D. If the actual tank measurement range is limited by transducer positioning or tank shape to part of a sphere, the ideal full sphere dimensions must be used. The 4-20mA output can then be restricted to operation over a smaller volume span if required.

**Figure 7-3. Cylindrical or spherical tank cross-section**




**Note**
For rectangular or cylindrical tanks with a conical bottom, two patterns are provided to suit different tank aspect ratios: CONICAL 1 and CONICAL 2.

## Curve Profile P011 = “Conical 1”

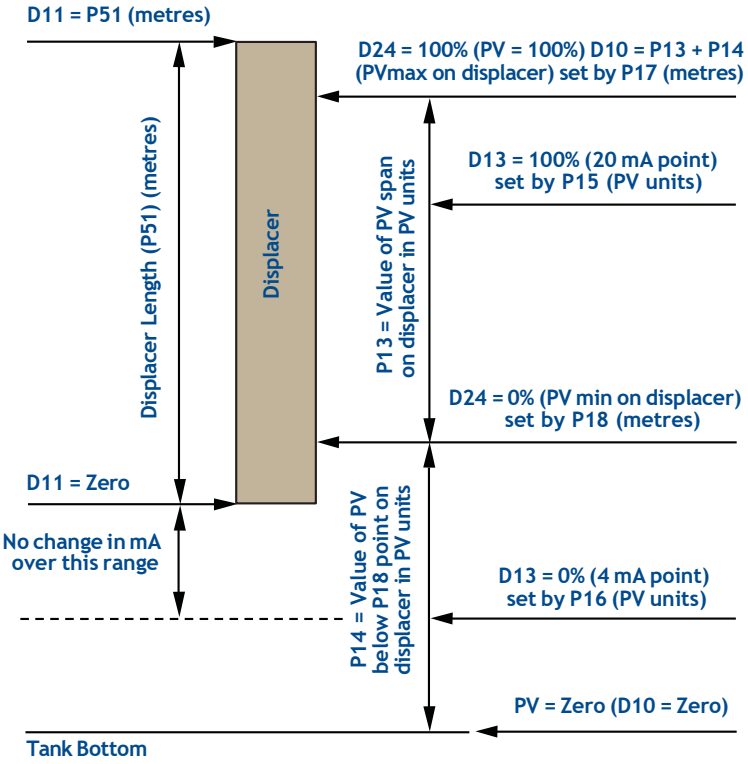
This is for tanks where the major part of the tank height is taken up with the cone. The profile creates an imaginary tank where the linear section is the same height as the conical section, and P13 and P14 are entered for this imaginary tank. This profile is applicable on all tanks where the maximum height to be measured is less than twice the conical section height, H.

**Note**
The zero reference distance and the conical height is measured from the cone’s apex – where it would be without considering discharge pipework, etc.

## Curve Profile P011 = “Conical 2”

This is used for tanks which have a much smaller proportion of the height as a cone. It is applicable for tanks where the maximum measurement is up to 5 times the conical section height above the apex of the cone. For higher tanks the non-linearity introduced by the conical section becomes insignificant, and a LINEAR profile should be used.

Figure 7-4. Linear vessel or sump




## Notes for Figure 7-4

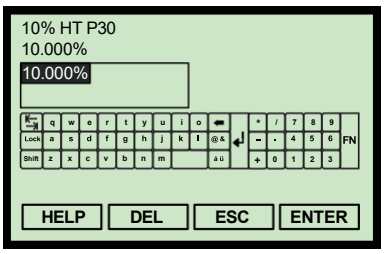
1. P12 = PV units
   (This is the units that PV, P13, P14, P15, and P16 are displayed in).

2. The Non-Linear Profile is only calculated over the P13 range.

3. P13, P15, P17 = Auto = P51 (Displacer Length).

## 7.5.10 Non-linear Profile Points 1 to 10 (P30 to P39)

| Fast Keys | 1, 3, 1, 3 |
|---|---|




*(Field Communicator Screen Shown)*

When a non-linear profile has been selected by P11, the profile is plotted using parameters P30 to P39. Each plot point represents the percentage of maximum PV corresponding to 10% increments in level. The range of this level is defined by P17 and P18 relative to the bottom end of the displacer.

The default values provide a linear output

**Note**
For further details, see "Curve Profile (P11)" on page 7-9.

### Field Communicator or AMS

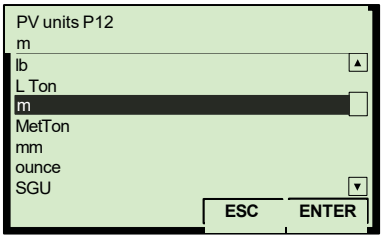
To view or change the profile point:

1. From the *Home* screen, select 1: Configure/Setup.
2. Select 3: Variables Configuration.
3. Select 1: Scaled Variable.
4. Select 3: Set Curve profile.
5. Select a profile point e.g. P30.
6. Input a new value, and then select "ENTER" to save it.
7. Press "SEND" to update the transmitter.

**Note**
The profile point parameters are only accessible on a Field Communicator if they are required for a selected Curved Profile (see page 7-9). The points can be changed only if the "Special" profile has been selected.

## 7.5.11 PV Units (P12)

| Fast Keys | 1, 3, 1, 2 |
|---|---|




*(Field Communicator Screen Shown)*

The process value (PV) may be configured to display a wide range of variables from levels to volumes. Parameter P12 is used to associate appropriate measurement units to the calculated process value, and these units are then displayed on the optional integral display, and the Field Communicator and AMS.

The default value is: "m" (metres)

**Note**
Selecting alternative display units does not automatically re-scale the PV value. Use the parameter PV Scale Factor to manually re-scale the value.

## Field Communicator or AMS

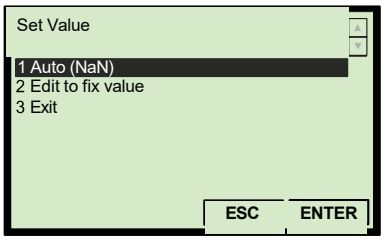
To view or change the displayed units for the process value (PV):

1. From the *Home* screen, select 1: Configure/Setup.
2. Select 3: Variables Configuration.
3. Select 1: Scaled Variable.
4. Select 2: PV units P12.
5. If required, select alternative display units and then press “ENTER” to save the selection.
6. Press “SEND” to update the transmitter.

**Note**
If the process value (PV) has no units, select and confirm the “None” option.

# 7.5.12 PV Scale Factor (P13)

| Fast Keys | 1, 3, 1, 5 |
|---|---|



*(Field Communicator Screen Shown)*

The PV Scale Factor enables the transmitter to provide an answer in the customer’s preferred units (see Appendix E: Data Processing Flow Chart for when it is applied). Typically, it may be used to give an answer of volume in cubic metres.

The value of P13 is normally the PV span value on the displacer (see Figure 7-4 on page 7-14). If the value is set to automatic, the MLT100 takes the displacer length (or the span defined by P17 and P18) as its full-scale range and adjusts the output accordingly.

The default value is: “NaN” (Automatic)

## Field Communicator or AMS

To view or change the scale factor:

1. From the *Home* screen, select 1: Configure/Setup.
2. Select 3: Variables Configuration.
3. Select 1: Scaled Variable.
4. Select 5: Set PV scale factor.

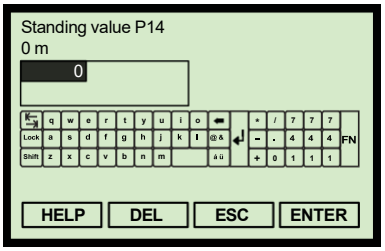
5. Select 1: Auto (NaN) for Automatic (and exit to previous menu),
   Select 2: Edit to fix value, or
   Select 3: Exit to exit to the previous menu without making changes.

6. If requiring a fixed value:
   (a) Input the value and press "ENTER" to save it.
   (b) Press "SEND" to update the transmitter.

**Note**
Parameter P13 can be viewed at Fast Key sequences 1, 3, 1, 6 or 3, 3, 3.
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.5.13 Standing Value (P14)

| Fast Keys | 1, 3, 1, 7 |
|---|---|



*(Field Communicator Screen Shown)*

A displacer level transmitter can only give a meaningful output over the length of its displacer. If, however, the vessel still has some contents when the level is at the bottom of the displacer then this value may be added to the process value (PV) by entering the difference value into P14.

The default value is: 0.0 (*P14 may be positive or negative*)

### Field Communicator or AMS

To view or change the standing value:

1. From the *Home* screen, select 1: Configure/Setup.
2. Select 3: Variables Configuration.
3. Select 1: Scaled Variable.
4. Select 7: Standing Value P14.
5. If required, input the new value and press "ENTER" to save it.
6. Press "SEND" to update the transmitter.

**Note**
Parameter P14 is also at Fast Key sequence 3, 3, 4.
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

### Standing Level Examples

If the displacer element does not cover the full depth of the tank, there is provision to add a standing level to the calculations. Simply enter the level, in metres, into parameter Standing Level P14 (page 7-17), and the MLT100 gives a proportional output over the length of the

displacer. Note that the output will now never reach 4 mA, as the displacer length is now only a part of the full output range.

## Example One

Displacer length 1.50 m:P17 = 1.50 / P18 = 0 m / P14 = 0 m

To allow for a standing level of 0,5 m:P17 = 1.50 m / P18 = 0m / P14 = 0.5 m

Resulting output signal:8mA at 0.5m and below, 20 mA at 2.0 m.

To operate in units other than metres, the "PV Scale factor" P13 can be used
(See "PV Scale Factor (P13)" on page 7-16).

## Example Two

To operate in feet, set P13 to the maximum value of the PV. For a displacer length of 1.5 m, where PV max is 1.5 m, set P13 (1.5 x 3.2808) = 4.9212

If you wish to re-range the transmitter, you can reset P17 and/or P18 so that the transmitter output is proportional to level over this new range. Note, P17 and P18 are ALWAYS entered in metres.

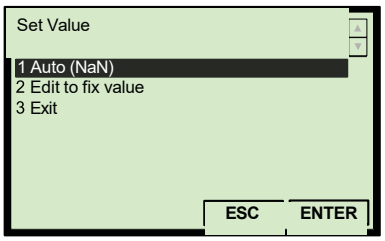
To operate in liters, set P13 to the volume in liters equivalent to the length of the displacer element. For an element of length of 1.5 m in a vessel of diameter 2 m, set P13 to:

$1^1/_2 \times ((\pi \xi 2.0^2) / 4) \times 1000 = 4712$ liters

If there is a standing level (or volume) to be taken into account, this is entered on P14 as previously described, but note that the units MUST BE entered in the same units as the readout. i.e. feet or liters in the above examples. Whatever units are chosen for the readout, the display, Field Communicator, or AMS can be configured to suit using P12.

## 7.5.14 Calibration Max (P15)

| Fast Keys | 1, 1, 1, 2 |
|---|---|



*(Field Communicator Screen Shown)*

This defines the process value (PV) represented by a 20 mA output current from the MLT100 transmitter.

The factory default value is "NaN" (Automatic), and this means that the 20 mA calibration point value is automatically set to the *maximum transmitter range*. For example, a transmitter with a range of 60 cm leaves the factory with the 20mA (max) calibration point set to 0.6 m.

### Field Communicator

To change the 20 mA (max) calibration point:

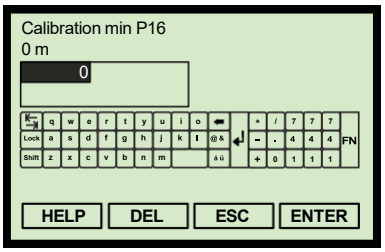
1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 1: Basic Setup.
3. Select 1: Basic Setup, and then select 2: Set Calibrate max.
4. Select 1: Auto (NaN) for Automatic (and exit to previous menu),
   Select 2: Edit to fix value, or
   Select 3: Exit to exit to the previous menu without making changes.
5. If editing a fixed value:
   (a) Input the value and press "ENTER" to save it.
   (b) Press "SEND" to update the transmitter.

**Note**
When messages appear, take appropriate action if needed and press "OK".

**Note**
Parameter P15 can be viewed at Fast Key sequences 1, 1, 1, 3
or 3, 1, 2, 1 (*P15 = NaN*) or 3, 2, 2, 1 (*P15 not = NaN*).
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.5.15 Calibration Min (P16)

| Fast Keys | 1, 1, 1, 4 |
|---|---|



*(Field Communicator Screen Shown)*

This defines the process value (PV) represented by a 4 mA output current from the MLT100 transmitter.

The span of the 4–20 mA current output is defined by Calibration Max P15 and Calibration Min P15 parameters.

The Calibration Min P15 value can be greater than the Calibration Max P15 value, in which case the output current decreases for an increasing process value (PV).

### Field Communicator

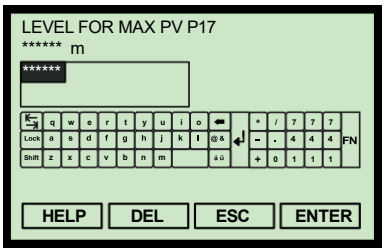
To view or change the 4mA (min) calibration point:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 1: Basic Setup.
3. Select 1: Basic Setup, and then select 4: Calibration min P16.
4. If required, input a 4mA point value and then press “ENTER” to save it.
5. Press “SEND” to update the transmitter.

**Note**
When messages appear, take appropriate action if needed and press “OK”.

## 7.5.16 Level For Max PV (P17)

| Fast Keys | 1, 4, 2, 1 |
|---|---|



*(Field Communicator Screen Shown)*

The top end of the displacer is not necessarily the level which is required to represent the maximum process value (PV). Parameter P17 can be used to specify another level for this purpose and subsequent *answers* are then be based upon this revised point (see Appendix E: Data Processing Flow Chart).

The default value is: Automatic (*maximum PV is at the top of the displacer*).

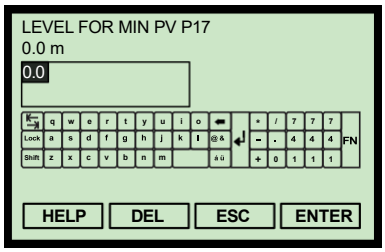
### Field Communicator or AMS

To view or change the level for maximum PV:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 4: Calibration Configuration, and then select 2: Ref Calibrate.
3. Select 1: Sensor rerange
4. Select 1: Maximum level, and set a value accordingly.

## 7.5.17 Level For Min PV (P18)

| Fast Keys | 1, 4, 2, 2 |
|---|---|



*(Field Communicator Screen Shown)*

The displacer bottom end is not necessarily the level which is required to represent zero process value (PV). Parameter P18 can be used to specify another level for this purpose and subsequent *answers* are then based upon this revised point (see Appendix E: Data Processing Flow Chart).

The default value is: 0.0

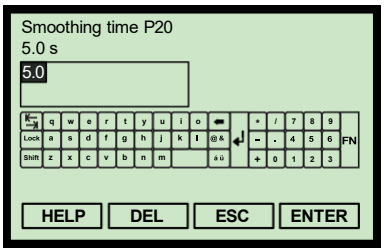
### Field Communicator or AMS

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 4: Calibration Configuration, and then select 2: Ref Calibrate.
3. Select 1: Sensor rerange
4. Select 2: Minimum level, and set a value accordingly.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

# 7.5.18 Smoothing Time / Damping (P20)

| Fast Keys | 1, 1, 1, 5 |
|---|---|




*(Field Communicator Screen Shown)*

Where the level is unstable, it may be beneficial to adjust the amount of damping applied to the level reading and output current.

The damping value is a time constant in seconds. A larger value will have the effect of smoothing out rapid changes of level, and smooth out the effects of turbulence and ripples on the liquid surface.

A value of zero can be edited, in which case no smoothing is applied and transmitter readings immediately change the output.

The default damping is 5 seconds.

## Field Communicator or AMS

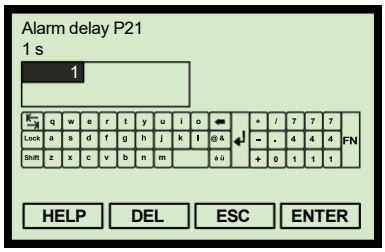
To view or change the damping:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 1: Basic Setup.
3. Select 1: Basic Setup.
4. Select 5: Smoothing time P20.
5. If required:
   (a) Input a new value and then select “ENTER” to save it.
   (b) Press “SEND” to update the transmitter.

**Note**
When messages appear, take appropriate action if needed and press “OK”.
Parameter P20 can also be viewed at Fast Key sequences 3, 1, 3 or 3, 2, 3.
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.19 Alarm Delay (P21)

| Fast Keys | 1, 3, 4, 1 |
|---|---|




*(Field Communicator Screen Shown)*

The MLT100 continuously monitors its performance, and signals an alarm if certain parameters go outside of pre-determined limits. Under these circumstances, the MLT100 signals that an alarm condition exists using the method selected by parameter Alarm Action P22 (page 7-23).

Parameter P21 sets the delay between an alarm condition occurring and the transmitter signalling the alarm.

The default value is: 1 second

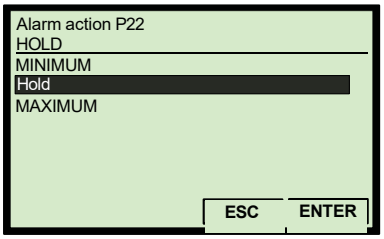
### Field Communicator or AMS

To view or change the alarm delay:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 3: Variables Configuration.
3. Select 4: Engineering Setup, and then select 1: Alarm delay P21.
4. If required:
   (a) Input a new value and then press "ENTER" to save it.
   (b) Press "SEND" to update the transmitter.

## 7.5.20 Alarm Action (P22)

| Fast Keys | 1, 3, 4, 2 |
|---|---|




*(Field Communicator Screen Shown)*

The MLT100 continuously monitors its performance and signals an alarm if certain parameters go outside of pre-determined limits.

An alarm condition is signalled by:

- Setting an Alarm bit in every HART message
- Flashing an Alarm message on the display (if fitted)
- Setting the output current to a user-defined state set by P22.

The options for P22 are to set the current to 3.6 mA, 21 mA or to hold the last reading. The default value is: Hold

**Note**
See "Error messages" on page 5-3 for possible alarm conditions.
See also parameter Alarm Delay P21 (page 7-23).

## Field Communicator or AMS

To view or change the alarm action:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 3: Variables Configuration.
3. Select 4: Engineering Setup, and then select 2: Alarm delay P21.
4. If required:
   (a) Select a new action and then press "ENTER" to save it.
   (b) Press "SEND" to update the transmitter.

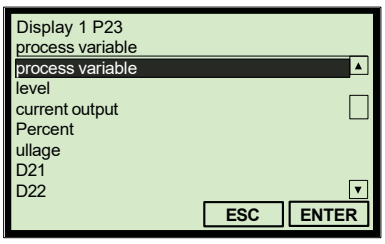
**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

# 7.5.21 Display 1 (P23)

| Fast Keys | 1, 2, 3, 1 |
|---|---|

The optional display module can be programmed to display any one or two parameters from a selection of parameters.

P23 is used to define Display 1. The choice is Process Value, Level, Current Output, Percent, Ullage, Sensor Outputs (D21 to D23), Percent of PV Range (D24), and Temperature (D25)



*(Field Communicator Screen Shown)*

## Field Communicator or AMS

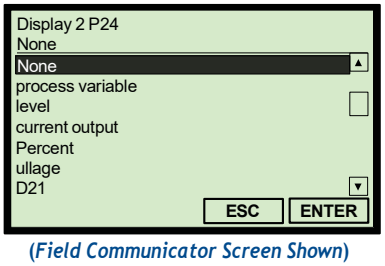
To view or change Display 1:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 2: Device Configuration.
3. Select 3: LCD, and then select 1: Display 1 P23.
4. If required:
   (a) Select new option, and then press "ENTER" to save the selection.
   (b) Press "SEND" to update the transmitter.

# 7.5.22 Display 2 (P24)

| Fast Keys | 1, 2, 3, 2 |
|---|---|

Parameter P24 can be used to define a second display which will flash alternately with Display 1 P23 (page 7-24) on the display module. It has the same choice as for Display 1 P23 except for the addition of "None" if a second variable display is not required.



*(Field Communicator Screen Shown)*

When flashing, the two displays are distinguished by the Display 1 and Display 2 being accompanied by up and down arrows respectively.

The default option is: none.

## Field Communicator or AMS

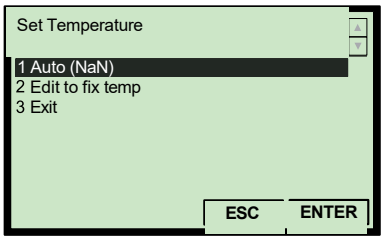
To view or change Display 2:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 2: Device Configuration.
3. Select 3: LCD, and then select 2: Display 2 P24.
4. If required:
   (a) Select new option, and then press "ENTER" to save the selection.
   (b) Press "SEND" to update the transmitter.

**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

# 7.5.23 Process Temperature (P25)

| Fast Keys | 1, 3, 2, 1 |
|---|---|



*(Field Communicator Screen Shown)*

The process temperature has an effect on the transmitter performance. This effect has been accounted for already by the factory calibration. If, however, the temperature is significantly different from that originally specified, it may be compensated for by entering a revised value into P25. If set to "NaN" (Automatic), the value from the temperature sensor on the PCB assembly is used.

The default value is: "NaN" (Automatic)

## Field Communicator or AMS

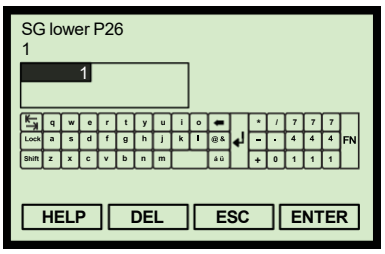
To view or change the process temperature setting:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 3: Variables Configuration.
3. Select 2: Process Properties.
4. Select 1: Set Process Temp.
5. Select 1: Set to Auto (NaN) for automatic (dynamic) corrections.
6. Alternatively, select 2: Edit to fix temp, input a fixed process temperature, and then save it by pressing "ENTER".

**Note**
When messages appear, take appropriate action if needed and press "OK". Parameter P25 can be viewed with Fast Key sequence 1, 3, 2, 2.
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.5.24 SG Lower (P26)

| Fast Keys | 1, 3, 2, 4 |
|---|---|



*(Field Communicator Screen Shown)*

The performance of a Displacer Level Transmitter is dependent on the specific gravities of the *lower* and *upper* fluids in a vessel.

The MLT100 is already calibrated at the factory for certain specific gravities but subject to certain limitations.

Revised values may be entered into parameters SG lower P26 and SG upper P27 for actual process conditions.

The default value is: 1.0

### Field Communicator or AMS

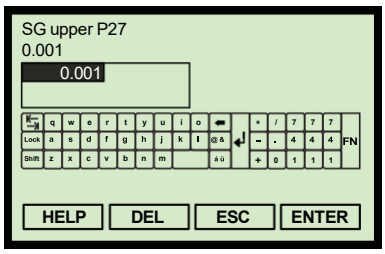
To view or change the specific gravity (*lower fluid*) setting:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 3: Variables Configuration.
3. Select 2: Process Properties.
4. Select 4: SG lower P26.
5. If required:
   (a) Input the new value, and then press "ENTER" to save it.
   (b) Press "SEND" to update the transmitter.

**Note**
When messages appear, take appropriate action if needed and press "OK".

## 7.5.25 SG Upper (P27)

| Fast Keys | 1, 3, 2, 5 |
|---|---|



*(Field Communicator Screen Shown)*

See also P26 above. At the factory, the MLT100 has already been calibrated for certain process conditions. The specific gravity (SG) of the *upper* fluid in a vessel is stored in parameters SG Lower P27 and P59. The value in P59 should not be changed but P27 may be adjusted to match revised process conditions.

The default value is: 0.0

## Field Communicator or AMS

To view or change the upper specific gravity setting:

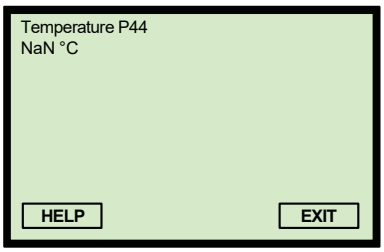
1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 3: Variables Configuration.
3. Select 2: Process Properties.
4. Select 5: SG upper P27.
5. If required:
   (a) Input the new value, and then press "ENTER" to save it.
   (b) Press "SEND" to update the transmitter.

**Note**
When messages appear, take appropriate action if needed and press "OK".

**Note**
Parameters P44 to P69 are vital to the MLT100 calibration, and should not be adjusted without the authorisation. Password access is required – see "Password (P06)" on page 7-8.

# 7.5.26 Temperature (P44)

| Fast Keys | 1, 3, 2, 2 |
|---|---|



*(Field Communicator Screen Shown)*

The LVDT and its associated electronics have a small temperature co-efficient, and so a temperature sensor on the PCB assembly provides automatic compensation to optimize accuracy. However, the measured value can be overridden using parameter P44.

The default value is: "NaN" (Automatic)

## Field Communicator or AMS

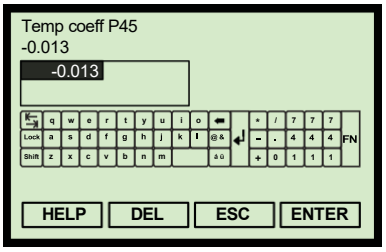
To override the measured temperature:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 3: Variables Configuration.
3. Select 3: Electronics Temperature.
4. Select 2: Temperature P44.
5. If required:
   (a) Input the new value, and then press "ENTER" to save it.
   (b) Press "SEND" to update the transmitter.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.27 Temp Coefficient (P45)

| Fast Keys | 1, 3, 2, 3 |
|---|---|



*(Field Communicator Screen Shown)*

The temperature co-efficient of the level sensor and its associated electronics is stored in P45 and provides automatic temperature compensation.

The default value is optimized, and may therefore be different for other MLT100 transmitters.

### Field Communicator or AMS

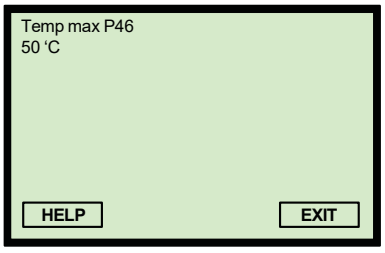
To change the temperature coefficient:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 3: Variables Configuration.
3. Select 3: Electronics Temperature.
4. Select 3: Temp coeff P45.
5. If required:
   (a) Input the new value, and then press "ENTER" to save it.
   (b) Press "SEND" to update the transmitter.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.28 Temperature Max (P46)

| Fast Keys | 1, 3, 2, 5 |
|---|---|



*(Field Communicator Screen Shown)*

The transmitter monitors the temperature of the electronics and LVDT sensor and records the maximum measured value.

### Field Communicator or AMS

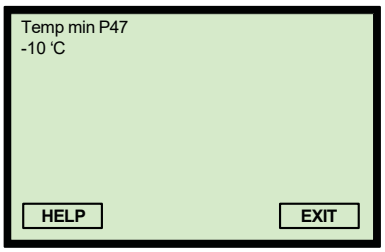
To view the highest recorded temperature:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 3: Variables Configuration.
3. Select 3: Electronics Temperature.
4. Select 5: Temp max P46.

**Note**
P46 can also be viewed with Fast Key sequence 2, 5, 6, 2.
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.29 Temperature Min (P47)

| Fast Keys | 1, 3, 2, 6 |
|---|---|



*(Field Communicator Screen Shown)*

The transmitter monitors the temperature of the electronics and LVDT sensor and records the minimum measured value.

### Field Communicator or AMS

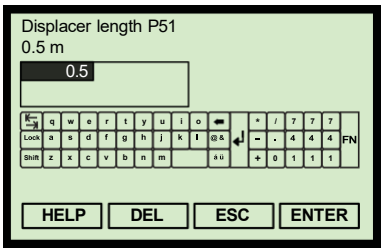
To view the lowest recorded temperature:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 3: Variables Configuration.
3. Select 2: Electronics Temperature.
4. Select 6: Temp min P47.

**Note**
P46 can also be viewed with Fast Key sequence 2, 5, 6, 3.
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.30 Displacer Length (P51)

| Fast Keys | 1, 5, 1, 1 |
|---|---|



*(Field Communicator Screen Shown)*

The transmitter is normally calibrated over the full length of the displacer. P51 is factory-set with the displacer length in metres.

### Field Communicator or AMS

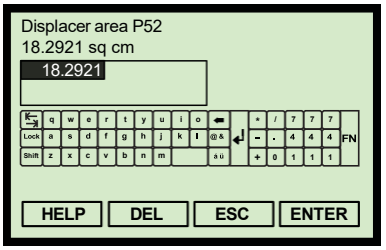
To view the displacer length:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 5: Advanced Setup.
3. Select 1: Displacer Properties.
4. Select 1: Displacer length P51.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.31 Displacer Area (P52)

| Fast Keys | 1, 5, 1, 2 |
|---|---|



*(Field Communicator Screen Shown)*

To perform its calculations, the transmitter needs to know the cross-sectional area of the displacer. P52 is factory-set with the area in square centimeters.

### Field Communicator or AMS

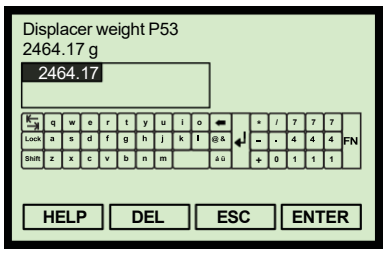
To view the cross-sectional area of the displacer:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 5: Advanced Setup.
3. Select 1: Displacer Properties.
4. Select 2: Displacer area P52.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.32 Displacer Weight (P53)

| Fast Keys | 1, 5, 1, 3 |
|---|---|



*(Field Communicator Screen Shown)*

To perform its calculations, the transmitter needs to know the weight of the suspended components including the displacer. P53 is factory-set with this total weight in grams.

### Field Communicator or AMS

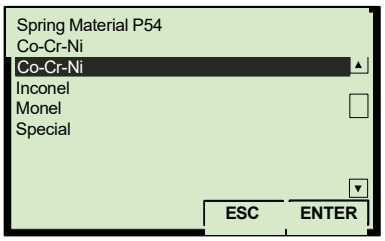
To view the weight:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 5: Advanced Setup.
3. Select 1: Displacer Properties.
4. Select 3: Displacer weight P53.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.33 Spring Material (P54)

| Fast Keys | 1, 5, 1, 4 |
|---|---|




*(Field Communicator Screen Shown)*

To perform its calculations, the transmitter needs to know the characteristics of the spring material.

P54 is factory-set and specifies the spring material from which the transmitter can calculate the relevant characteristics.

### Field Communicator or AMS

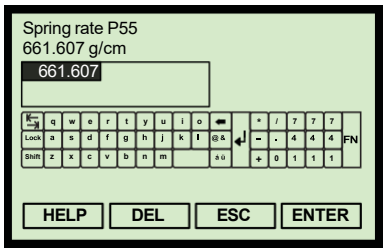
To view the spring material:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 5: Advanced Setup.
3. Select 1: Displacer Properties.
4. Select 4: Spring material P54.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.34 Spring Rate (P55)

| Fast Keys | 1, 5, 1, 5 |
|---|---|




*(Field Communicator Screen Shown)*

To perform its calculations, the transmitter needs to know the linear extension rate of the spring. P55 is factory-set with the actual spring rate in grams per centimeter.

### Field Communicator or AMS

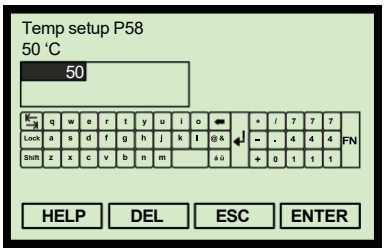
To view the spring rate:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 5: Advanced Setup.
3. Select 1: Displacer Properties.
4. Select 5: Spring rate P55.

**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.5.35 Temperature Setup (P58)

| Fast Keys | 1, 3, 2, 7 |
|---|---|



*(Field Communicator Screen Shown)*

To optimize the design of the transmitter, it is necessary to know the process temperature in which the transmitter will be operating. This is stored in P58.

### Field Communicator or AMS

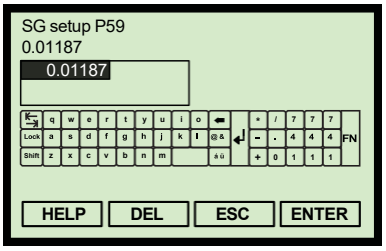
To view the pre-set process temperature:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 3: Variables Configuration.
3. Select 2: Process Properties.
4. Select 7: Temp setup P58.

**Note**
If the actual process temperature is significantly different from that advised at the time of order, enter the new value into parameter P25 (page 7-25) – *no change should be made to P58*.

## 7.5.36 SG Setup (P59)

| Fast Keys | 1, 3, 2, 8 |
|---|---|



*(Field Communicator Screen Shown)*

To optimize the MLT100 design, it is essential to know the specific gravity of the upper fluid in which the MLT100 will be operating. This is stored in P59.

### Field Communicator or AMS

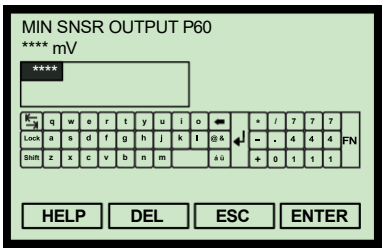
To view the factory-set upper liquid specific gravity:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 3: Variables Configuration.
3. Select 2: Process Properties.
4. Select 8: SG setup P59.

**Note**
If the actual upper liquid SG is different from that advised at the time of order, enter the new value into parameter P27 (page 7-26) – *do not change P59*.

## 7.5.37 Minimum Sensor Output (P60)

| Fast Keys | 1, 4, 3, 2 |
|---|---|



*(Field Communicator Screen Shown)*

During factory calibration, the value of the LVDT level sensor output voltage at the *zero level* is recorded and stored in P60. This is the reference value upon which the transmitter bases its calculations.

### Field Communicator or AMS

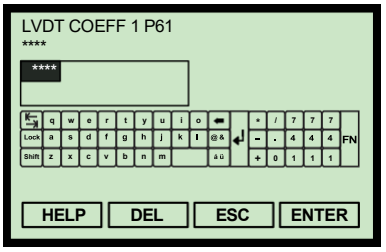
To view the factory-set minimum sensor output:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 4: Calibration Configuration.
3. Select 3: Sensor Calibration.
4. Select 2: Sensor.
5. Select P60.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.38 LDVT Coefficients 1 to 5 (P61 to P65)

| Fast Keys | 1, 4, 3, 1 |
|---|---|



*(Field Communicator Screen Shown)*

To provide a linear output over the operating range, the LVDT sensor output is linearized by a fifth order polynomial. These polynomial coefficients are stored as P61 to P65.

### Field Communicator or AMS

To view the coefficients:

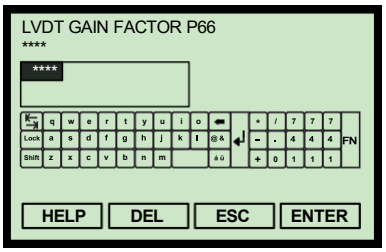
1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 4: Calibration Configuration.
3. Select 3: Sensor Calibration.
4. Select 1: LVDT
5. Select a LVDT coefficient e.g. LVDT Coeff 1 P61.
6. Repeat steps 5 for the other coefficients.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.39 LVDT Gain Factor (P66)

| Fast Keys | 1, 4, 3, 1 |
|---|---|

In order to allow interchangeability of the LVDT sensor, the output is normalized to achieve a common span. The gain factor is stored in P66.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

To view the gain factor:

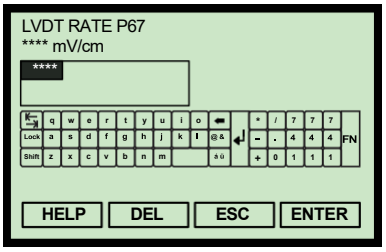
1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 4: Calibration Configuration.
3. Select 3: Sensor Calibration.
4. Select 1: LVDT
5. Select P66

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.5.40 LVDT Rate (P67)

| Fast Keys | 1, 4, 3, 1 |
|---|---|

After processing the LVDT output, the overall sensor system produces an electronic output proportional to linear movement. P67 defines the rate of change of the LVDT output (i.e. sensor sensitivity) in milli-volts per cm.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

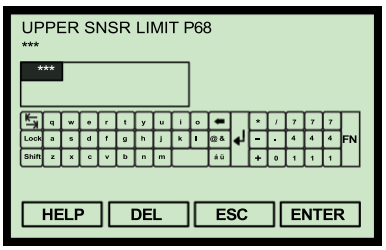
To view the calculated LVDT rate:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 4: Calibration Configuration.
3. Select 3: Sensor Calibration.
4. Select 1: LVDT
5. Select P67.

**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.5.41 Upper Sensor Limit (P68)

| Fast Keys | 1, 4, 3, 2 |
|---|---|



*(Field Communicator Screen Shown)*

The LVDT sensor is calibrated over a range where linear operation is guaranteed. In exceptional circumstances, the sensor output may extend beyond the calibrated range and, under these circumstances, the MLT100 gives a warning.

Parameter P68 stores the limit of the calibrated region at the upper end of the LVDT travel. *See also P69 (below) for the lower sensor limit*.

### Field Communicator or AMS

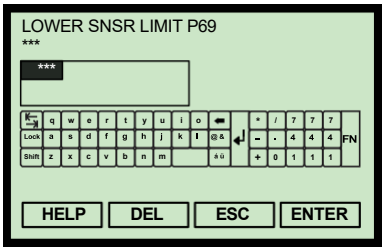
To view the factory-set sensor upper limit:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 4: Calibration Configuration.
3. Select 3: Sensor Calibration.
4. Select 2: Sensor.
5. Select P68.

**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.5.42 Lower Sensor Limit (P69)

| Fast Keys | 1, 4, 3, 2 |
|---|---|



*(Field Communicator Screen Shown)*

P69 stores the limit of the calibrated region of LVDT movement at the lower end of the LVDT travel. *See also P68 (above) for the upper sensor limit*.

### Field Communicator or AMS

To view the factory-set sensor lower limit:

1. From the *Home* screen, select 1: Configuration/Setup.
2. Select 4: Calibration Configuration.
3. Select 3: Sensor Calibration.
4. Select 2: Sensor.
5. Select P69.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

# 7.6 Monitoring and diagnostic parameters

The following "D" parameters are diagnostics read-only parameters which are either fixed in the transmitter at manufacture (D00 to D08) or produced within the transmitter as a result of measurements taken (D10 to D25).

## Field Communicator

For convenience, Field Communicator fast key sequences are labeled "Fast Keys" for each software function below the appropriate headings.

## Example Software Function

| Fast Keys | 1, 2, 3, etc. |
|---|---|

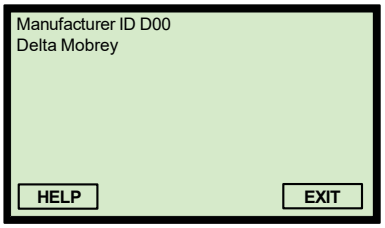
Connect the Field Communicator leads to the transmitter, and turn on the Field Communicator by pressing the ON/OFF key. The Field Communicator will search for a HART-compatible device and indicate when the connection is made. If the Field Communicator fails to connect, it indicates that no device was found. If this occurs, check the lead connections and re-try.

**Note**
A full menu map showing how to access MLT100 transmitter parameters using the Field Communicator is in Appendix D: Field Communicator Data Map.

## 7.6.1 Manufacturer ID (D00)

| Fast Keys | 3, 4, 2 |
|---|---|

For HART communications to operate correctly, the transmitter must identify its manufacturer. The manufacturer's code number automatically forms part of the communications address. The code is 59.



*(Field Communicator Screen Shown)*

## Field Communicator or AMS

To view the manufacturer name:

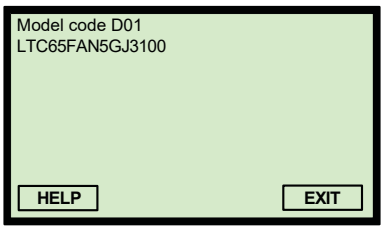
1. From the *Home* screen, select 3: Process Variables.
2. Select 4: Identification.
3. Select 2: Manufacturer ID D00.
4. When finished, press EXIT to exit to the previous menu.

**Note**
D00 can also be viewed with Fast Key sequence 1, 2, 1, 2.
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.6.2 Model Code (D01)

| Fast Keys | 3, 4, 3 |
|---|---|

D01 stores the model code e.g. LTC65FAN5GJ3100.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

To view the model code:

1. From the *Home* screen, select 3: Process Variables.
2. Select 4: Identification.
3. Select 3: Model code D01.
4. When finished, press EXIT to exit to the previous menu.

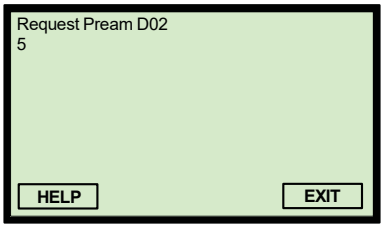
**Note**
D00 can also be viewed with Fast Key sequence 1, 2, 1, 3.
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.6.3 Request Preamble (D02)

| Fast Keys | 1, 2, 4, 2 |
|---|---|

D02 tells a HART master device how many preamble bytes it should send in its messages to the transmitter in order to guarantee reliable communications.

Sending too many bytes would simply slow down the communications update rate. In the MLT100, the value is fixed at five.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

To view the number of pre-amble bytes:

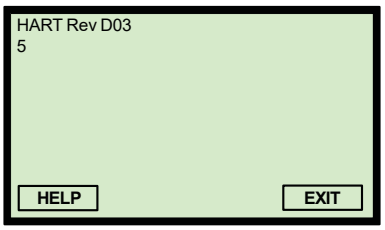
1. From the *Home* screen, select 1: Configure/Setup.
2. Select 2: Device Configuration.
3. Select 4: HART Communications.
4. Select 2: Request Pream D02.
5. When finished, press EXIT to exit to the previous menu.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.6.4 HART Command Revision (D03)

| Fast Keys | 1, 2, 2, 1 |
|---|---|

D03 identifies the *major revision* of the HART protocol with which the transmitter complies. For the MLT100, it is revision 5.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

To view the HART revision number:

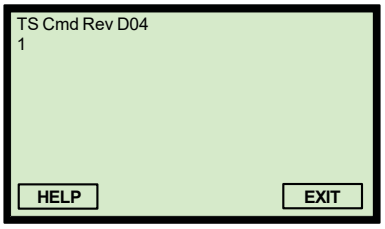
1. From the *Home* screen, select 1: Configure/Setup.
2. Select 2: Device Configuration.
3. Select 2: Device Revisions.
4. Select 1: HART Rev D03.
5. When finished, press EXIT to exit to the previous menu.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.6.5 Transmitter Specific Command Rev. (D04)

| Fast Keys | 1, 2, 2, 2 |
|---|---|

Over a lifetime of a product, extra functionality may be introduced by adding extra variables or commands. To signal this to a HART master device, D04 contains details of the Transmitter Specific Command revision.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

To view the revision number:

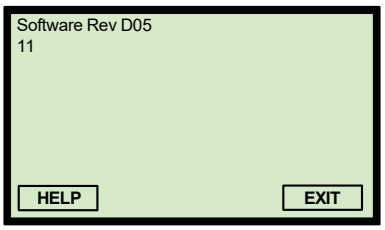
1. From the *Home* screen, select 1: Configure/Setup.
2. Select 2: Device Configuration.
3. Select 2: Device Revisions.
4. Select 2: TS Cmd Rev D04.
5. When finished, press EXIT to exit to the previous menu.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.6.6 Software Revision (D05)

| Fast Keys | 1, 2, 2, 3 |
|---|---|

Extra software functionality, which does not affect HART, may be identified to the user by D05, the Software Revision.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

To view the software revision number:

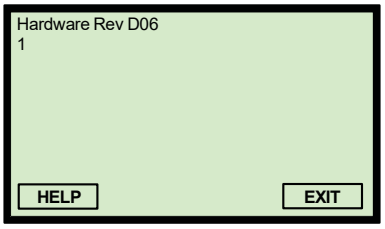
1. From the *Home* screen, select 1: Configure/Setup.
2. Select 2: Device Configuration.
3. Select 2: Device Revisions.
4. Select 3: Software Rev D05.
5. When finished, press EXIT to exit to the previous menu.

**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.6.7 Hardware Revision (D06)

| Fast Keys | 1, 2, 2, 4 |
|---|---|

The presence of any hardware changes may be identified to the user by D06, the Hardware Revision.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

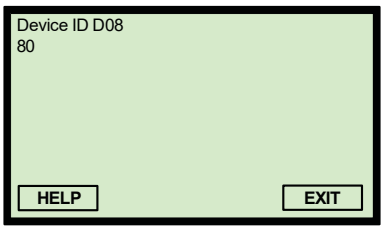
To view the hardware revision number:

1. From the *Home* screen, select 1: Configure/Setup.
2. Select 2: Device Configuration.
3. Select 2: Device Revisions.
4. Select 4: Hardware Rev D06.
5. When finished, press EXIT to exit to the previous menu.

**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.6.8 Device ID (D08)

| Fast Keys | 3, 4, 7 |
|---|---|



*(Field Communicator Screen Shown)*

The Device ID is a unique number that forms part of the transmitter's HART address, and ensures that no two HART transmitters ever have the same address.

### Field Communicator or AMS

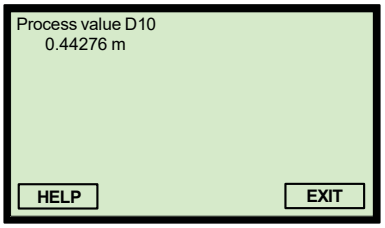
To view the factory-set device identification number:

1. From the *Home* screen, select 3: Process Variables.
2. Select 4: Identification.
3. Select 7: Device ID D08.
4. When finished, press EXIT to exit to the previous menu.

**Note**
D08 can also be viewed with Fast Key sequence 1, 2, 1, 8.
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.6.9 Process Value (D10)

| Fast Keys | 3, 1 or 2, 1, 1 |
|---|---|



*(Field Communicator Screen Shown)*

The MLT100 is fundamentally a level measuring device and, by default, the process value (PV) is the level of the lower liquid. However, the level value can be processed to provide an answer in terms of volume, mass, or flow (see Appendix E: Data Processing Flow Chart for the process).

This PV result is displayed by parameter D10
(with the displayed units as selected by parameter P12 – see page 7-15)

### Field Communicator or AMS

To view the process value (PV):

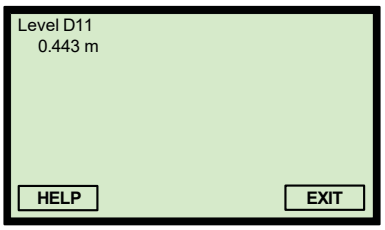
1. From the *Home* screen, select 3: Process Variables.
2. Select 1: PV (P15 = NaN) or 2: PV (P15 not = NaN).
3. Select 1: PV Measurement.
4. Select 1: Process value D10.
5. When finished, press EXIT to exit to the previous menu.

**Note**
D10 can also be viewed with Fast Key sequences 3, 3, 1, 1 and 2, 4, 1, 1.
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.6.10 Level (D11)

| Fast Keys | 3, 3, 1, 2 |
|---|---|

The length of the displacer element that is immersed in the lower liquid is displayed as D11. The process value (PV) is calculated from this basic level measurement.



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

To view this level:

1. From the *Home* screen, select 3: Process Variables.
2. Select 3: Measured Variables.
3. Select 1: Variable Measure...
4. Select 2: Level D11.
5. When finished, press EXIT to exit to the previous menu.

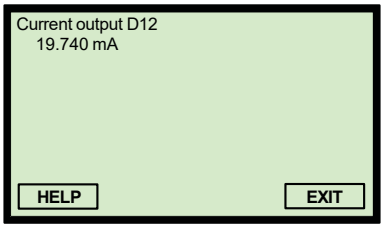
**Note**
D11 can also be viewed with Fast Key sequence 2, 4, 1, 2.

## 7.6.11 Current Output (D12)

| Fast Keys | 3, 1 or 2, 1, 2 |
|---|---|

The current output in mA is displayed by D12.

The current output is related to the process value (PV) by parameters Calibrate max P15 (page 7-19) and Calibrate min P16 (page 7-20).



*(Field Communicator Screen Shown)*

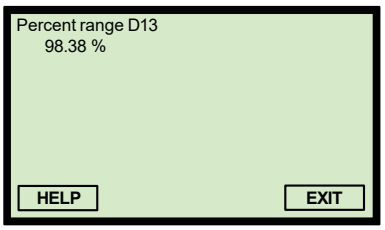
### Field Communicator or AMS

To view the current output in mA:

1. From the *Home* screen, select 3: Process Variables.
2. Select 1: PV (P15 = NaN) or 2: PV (P15 not = NaN).
3. Select 1: PV Measurement.
4. Select 2: Current output D12.
5. When finished, press EXIT to exit to the previous menu.

**Note**
D12 can also be viewed with Fast Key sequences 1, 1, 2, 4 and 2, 4, 2, 1.
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.6.12 Percent Range (D13)



*(Field Communicator Screen Shown)*

| Fast Keys | 3, 1 or 2, 1, 3 |
|---|---|

A convenient alternative way of viewing the *answer* is as a percentage. D13 displays the PV as a percentage based on the limits set on P15 and P16.

If the current output is *active*, i.e. not in multi-drop mode, D13 also represents the percentage of current output. For example, D13 is 50% if the current is 12 mA.

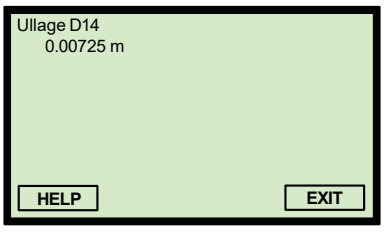
### Field Communicator or AMS

To view the live percentage of output current:

1. From the *Home* screen, select 3: Process Variables.
2. Select 1: PV (P15 = NaN) or 2: PV (P15 not = NaN).
3. Select 1: PV Measurement.
4. Select 3: Percent range D13.
5. When finished, press EXIT to exit to the previous menu.

**Note**
D13 can also be viewed with Fast Key sequences 1, 1, 2, 5 and 2, 4, 2, 2.

## 7.6.13 Ullage (D14)



*(Field Communicator Screen Shown)*

| Fast Keys | 3, 3, 1, 3 |
|---|---|

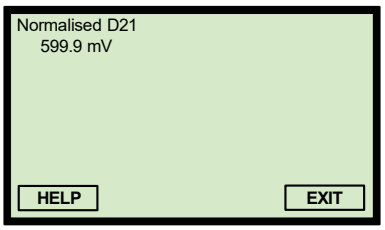
The ullage space D14 is calculated as the difference between the live process value (PV) and the maximum value defined by Calibrate max P15 (page 7-19). In other words, it is the amount in PV units required to fill the vessel so as to give 20 mA output current.

### Field Communicator or AMS

To view the live Ullage space:

1. From the *Home* screen, select 3: Process Variables.
2. Select 3: Measured Variables.
3. Select 1: Variable Measure...
4. Select 3: Ullage D14.
5. When finished, press EXIT to exit to the previous menu.

## 7.6.14 Normalized LVDT Output (D21)



*(Field Communicator Screen Shown)*

| Fast Keys | 2, 5, 1 |
|---|---|

The level sensor in the MLT100 is a Linear Variable Differential Transformer (LVDT). The LVDT output goes through several stages of processing as shown in Appendix E: Data Processing Flow Chart.

D21 is the LVDT sensor output value after temperature compensation, linearization, scaling, and smoothing are performed.

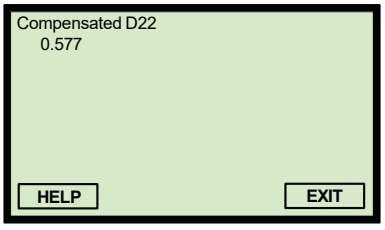
### Field Communicator or AMS

To view the normalized LDVT output:

1. From the *Home* screen, select 2: Device Diagnostics.
2. Select 5: Monitor Diagnostics.
3. Select 1: Normalised D21.
4. When finished, press EXIT to exit to the previous menu.

**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.6.15 Compensated LVDT Output (D22)



*(Field Communicator Screen Shown)*

| Fast Keys | 2, 5, 2 |
|---|---|

D22 is the LVDT sensor output value after temperature compensation.

### Field Communicator or AMS

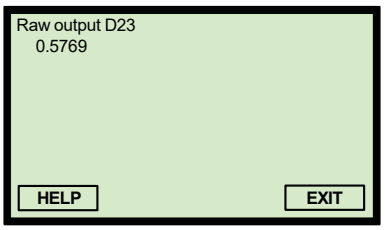
To view the compensated LDVT output:

1. From the *Home* screen, select 2: Device Diagnostics.
2. Select 5: Monitor Diagnostics.
3. Select 2: Compensated D22.
4. When finished, press EXIT to exit to the previous menu.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.6.16 Raw LVDT Output (D23)

| Fast Keys | 2, 5, 3 |
|---|---|



*(Field Communicator Screen Shown)*

D23 is the LVDT sensor output value before any processing.

### Field Communicator or AMS

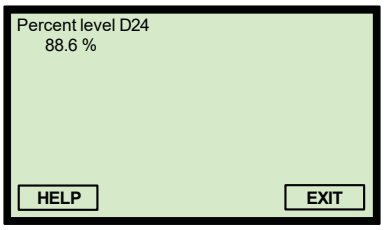
To view the raw LDVT output:

1. From the *Home* screen, select 2: Device Diagnostics.
2. Select 5: Monitor Diagnostics.
3. Select 3: Raw output D23.
4. When finished, press EXIT to exit to the previous menu.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

## 7.6.17 Percent Level (D24)

| Fast Keys | 2, 5, 4 |
|---|---|



*(Field Communicator Screen Shown)*

The MLT100 produces a value for the liquid level relative to the displacer element bottom (see D11, page 7-41). However, this may not be the range of interest and parameters P17 (page 7-45) and P18 (page 7-21) re-define where the *minimum* and *maximum* levels should be. D24 represents the position of the liquid level between these two limits.

### Field Communicator or AMS

To view the calculated percentage of level:

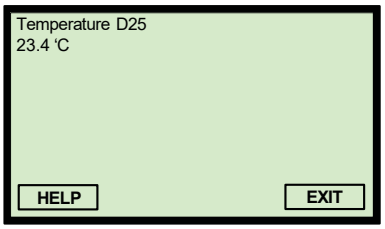
1. From the *Home* screen, select 2: Device Diagnostics.
2. Select 5: Monitor Diagnostics.
3. Select 4: Percent level D24.
4. When finished, press EXIT to exit to the previous menu.

**Note**
See Appendix D: Field Communicator Data Map for the full Field Communicator menu tree.

## 7.6.18 Temperature (D25)

| Fast Keys | 2, 5, 5 |
|---|---|

The MLT100 measures the enclosure temperature so that it may make corrections for changes in temperature if necessary. D25 displays this measured value unless it is overridden by fixing the temperature with parameter P44 (page 7-27).



*(Field Communicator Screen Shown)*

### Field Communicator or AMS

To view the temperature in the enclosure:

1. From the *Home* screen, select 2: Device Diagnostics.
2. Select 5: Monitor Diagnostics.
3. Select 5: Temperature D25.
4. When finished, press EXIT to exit to the previous menu.

**Note**
See Appendix D: Field Communicator Data Map for the Field Communicator menu tree.

# Appendix A Reference Data



## A.1 Safety messages

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol ( ⚠ ). Please refer to the following safety messages before performing an operation preceded by this symbol.

### A.1.1 Warnings

**⚠ WARNING**

**Failure to follow these installation guidelines could result in death or serious injury**

- The MLT100 is a *wired displacer level transmitter*. It must be installed, connected, commissioned, operated, and maintained by suitably qualified personnel only, observing any national and local requirements that may apply
- Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment
- Prior to energizing, always ensure that cover locking safety grub screw is tightened

**Explosions could result in death or serious injury**

- Installation of the level transmitter in a hazardous environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Please review the approvals section of this reference manual for any restrictions associated with an installation
- Before connecting a Field Communicator in an explosive atmosphere, ensure the installation is in accordance with intrinsically safe or non-incendive field wiring practices
- Verify that the operating atmosphere of the level transmitter is consistent with the appropriate hazardous locations certifications

**External surface may be hot**

- Care must be taken to avoid possible burns

Process leaks could result in death or serious injury

- Install and tighten process connectors before applying pressure
- Do not attempt to loosen or remove process connectors while the level transmitter is in service

**Electrical shock could cause death or serious injury**

- If the level transmitter is installed in a high voltage environment and a fault condition or installation error occurs, high voltage may be present on leads and terminals
- Use extreme caution when making contact with the leads and terminals
- Make sure that power to the level transmitter is off while making connections

# A.2 Ordering information

| Model | Product Description |
|---|---|
| LT | Delta Mobrey level transmitter |
| **Flange Material** | |
| C | Carbon steel |
| S | Stainless steel |
| N | No flange (1-in. NPT connection) |
| **Flange Mounting** | |
| 60 | 3-in. ASME B16.5 Class 150 Raised Face (RF) |
| 61 | 3-in. ASME B16.5 Class 300 Raised Face (RF) |
| 62 | 3-in. ASME B16.5 Class 600 Raised Face (RF) |
| 65 | 4-in. ASME B16.5 Class 150 Raised Face (RF) |
| 66 | 4-in. ASME B16.5 Class 300 Raised Face (RF) |
| 67 | 4-in. ASME B16.5 Class 600 Raised Face (RF) |
| 71 | DN80 PN16 |
| 72 | DN80 PN25 |
| 73 | DN80 PN40 |
| 76 | DN100 PN16 |
| 77 | DN100 PN25 |
| 78 | DN100 PN40 |
| 00 | No flange (1-in. NPT connection) |
| **Enclosure** | |
| ZF | IP66 Safe Area with Cast Iron, white epoxy painted |
| TF | IP66 Flameproof enclosure certified Ex d for hazardous area use, Cast Iron, white epoxy painted. |
| TR | IP66 enclosure certified Ex d for hazardous area use, Cast Iron white epoxy painted, with electronics in a remote IP66 aluminum enclosure. Note: Remote electronics must be in the non-hazardous area. |
| TG | IP66 Flameproof enclosure certified Ex d for hazardous area use, AISI 316 SS |
| **Pressure Tube Type - *Select Type A or B using*** Figure A-1 on page 4 | |
| A | Standard (up to 224 °C condensing) |
| B | High temperature (224 °C to 277 °C condensing; 320 °C non-condensing, remote electronics to 320 °C condensing) |
| **Display** | |
| D | Display |
| N | No display |

| | |
|---|---|
| **Spring** | |
| * | The code for the spring will be selected by Delta Mobrey at time of ordering or a quotation is given |
| **Displacer** | |
| * | The code for the displacer will be selected by Delta Mobrey at time of ordering or a quotation is given |

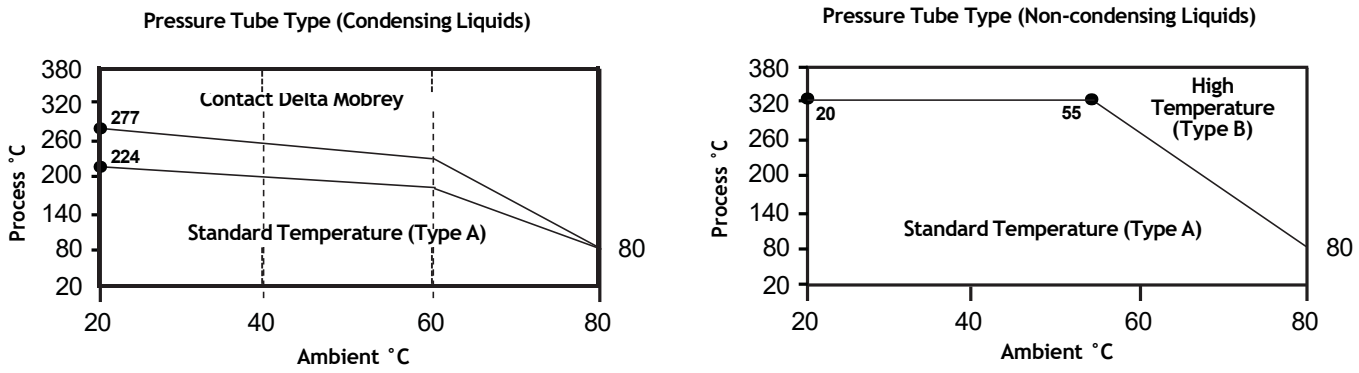
| Chamber Type and Orientation | |
|---|---|
| A | No chamber |
| B | Side/bottom, no vent |
| C | Side/bottom, 1/2-in. NPT vent |
| D | Side/bottom, 3/4-in, NPT vent |
| F | Side/bottom, 3/4-in, flanged vent |
| G | Side/side, no vent, 1/2-in. NPT drain |
| H | Side/side, no vent, 3/4-in. NPT drain |
| J | Side/side, no vent, 1-in. NPT drain |
| K | Side/side, 1/2-in. NPT drain and vent |
| L | Side/side, 3/4-in NPT drain and vent |
| M | Side/side, 1-in. NPT drain and vent |
| N | Side/side, no vent, 3/4-in. drain |
| P | Side/side, 3/4-in. NPT vent, 3/4-in. flanged drain |
| Q | Side/side, 3/4-in. flanged drain and vent |
| **Chamber Process Connections** | |
| 01 | Screwed 1-in. NPT |
| 00 | No Chamber |
| 11 | 1-in. ASME B16.5 Class 150 Raised Face (RF) flange |
| 12 | 1-in. ASME B16.5 Class 300 Raised Face (RF) flange |
| 13 | 1-in. ASME B16.5 Class 600 Raised Face (RF) flange |
| 15 | DN25 PN16 |
| 16 | DN25 PN25 |
| 17 | DN25 PN40 |
| 21 | 1 1/2-in. ASME B16.5 Class 150 Raised Face (RF) flange |
| 22 | 1 1/2-in. ASME B16.5 Class 300 Raised Face (RF) flange |
| 23 | 1 1/2-in. ASME B16.5 Class 600 Raised Face (RF) flange |
| 25 | DN40 PN16 |
| 26 | DN40 PN25 |
| 27 | DN40 PN40 |
| 31 | 2-in. ASME B16.5 Class 150 Raised Face (RF) flange |
| 32 | 2-in. ASME B16.5 Class 300 Raised Face (RF) flange |
| 33 | 2-in. ASME B16.5 Class 600 Raised Face (RF) flange |
| 35 | DN50 PN16 |
| 36 | DN50 PN25 |
| 37 | DN50 PN40 |
| Typical Model Number: LT C 61 TS A D * * B 11 | |

# A.3 Specifications

| Delta Mobrey MLT100 Transmitter Specification | |
|---|---|
| Output | 4-20 mA / HART digital |
| Range | 11.8 to 118 in. / 300 to 3000 mm (to order) |
| Maximum Operating Pressure | 2900 psi (200 bar) |
| Minimum Operating Pressure | Full vacuum |
| Specific Gravity Range | Standard: 0.5 to 1.5 |
| | Interface: 0.1 difference |
| Maximum Operating Temperature | 530 °C (277 °C) condensing, 608 °F (320 °C) non-condensing |
| | 608 °F (320 °C) condensing with remote electronics |
| Minimum Operating Temperature | -76 °F (-60 °C) |
| Ambient temperature | -40 to 176 °F / -40 to 80 °C (subject to process temperature) |
| Accuracy | < ±1% of output span |
| Repeatability | ±0.2% of output span |
| Linearity | 0.2% of output span |
| Resolution | 0.1% of output span |
| Hysteresis | 0.3% of output span |
| Power Supply | 12 to 40 Vdc loop-powered |
| Turndown | 3:1 |
| Power consumption | 21 mA / 40 V: 840 mW maximum |

## A.3.1 Pressure Tube Types A and B

**Figure A-1. Graphs for selecting a Pressure Tube Type**






HighTemperature(Type

## Materials of Construction

The transmitter head is manufactured from cast iron with a paint finish of two-pack Epoxy white paint suitable for offshore or coastal use. It is weatherproof to IP66 / IP67 ratings.

Wetted parts are made from stainless steel, including the element, trim, and pressure tube, except for the spring which is manufactured from a specialist corrosion resistant spring material, NIMONIC, chosen for it's stability and repeatability under changing process conditions.

## Optional Chamber

The material used is either as specified on the order or selected by Delta Mobrey to suit the application. Only certified materials are used, and welding is qualified to ASME IX, BS EN 287, and EN ISO 15614-1. All pressure retaining parts are hydrostatically pressure tested to a minimum of 1.5 times working pressures. NDT including radiography and dye penetrant testing is available when specified at time of ordering. Inspection by customers or their appointed agents is welcome provided that this is requested at time of ordering.

Options:

- Wetside materials in Alloy C276 (UNS N10276), Alloy 625 (UNS N06625), and others on request
- Compliance with NACE MR-01-75 for sour service duty

# A.4 Dimensions

**Figure A-2. MLT100 with optional display**

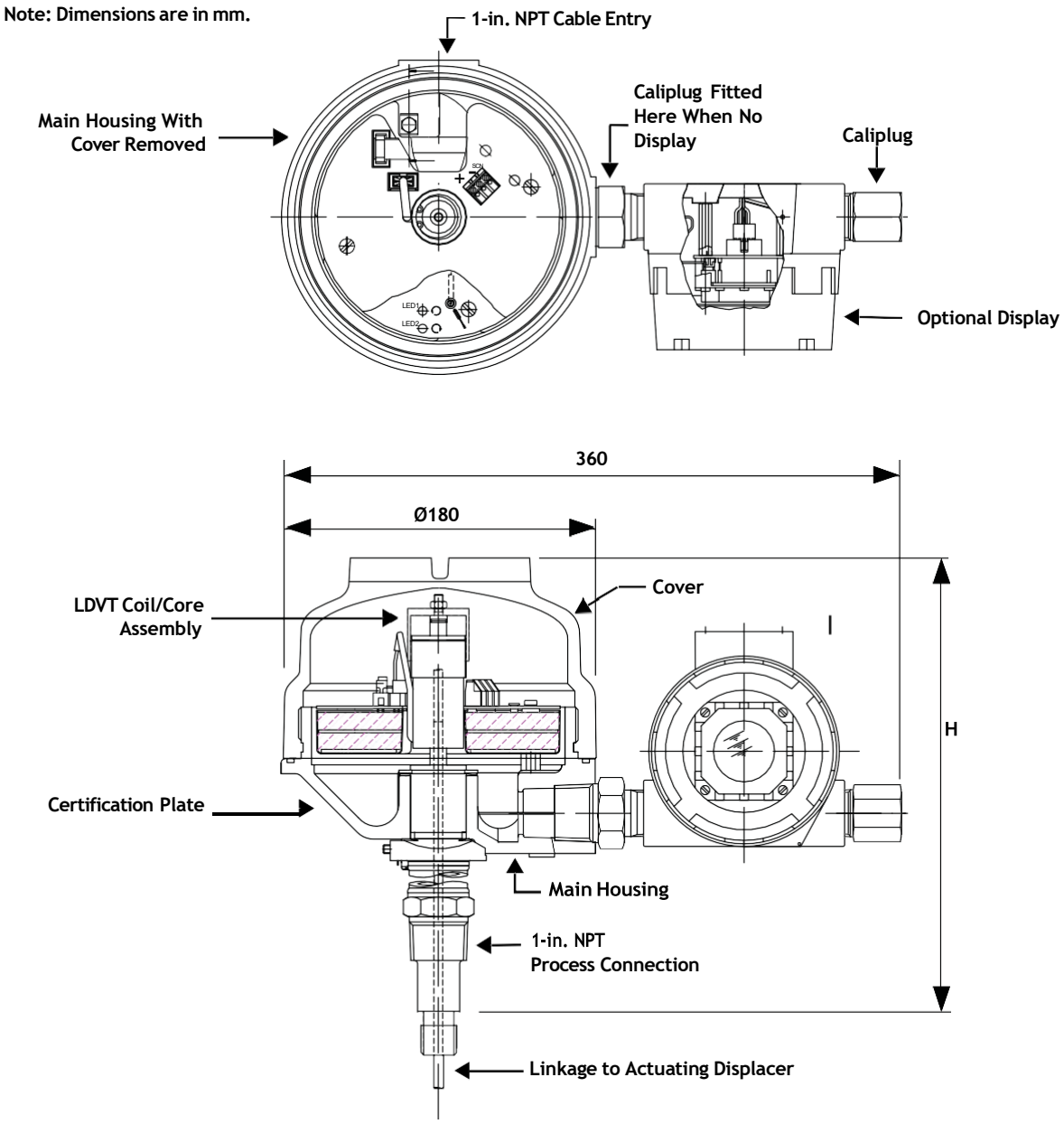



**Table A-1. Head Height Dimension H**

| Head Height | H |
|---|---|
| Pressure Tube A | 200 mm |
| Pressure Tube B | 422 mm |
| Allow an extra 90 mm for cover removal. | |

# Appendix B Bolting Torque Details (Carbon Steel Bolts Only)

## B.1 Bolting torque details (carbon steel bolts only)

Minimum torques in Nm (lbf.ft), and maximum torque = minimum + 10%

**IMPORTANT: For use with carbon steel bolts only**
If ordinary carbon steel or similar lower quality bolts are used the torques recommended are as shown below. The gasket sealing force created by the application of these torques is not sufficient to withstand full flange pressure rating. To achieve full rating, use high tensile steel bolts as below. If in doubt about your bolt/sealing application consult your engineering department or gasket manufacturer.

**Table B-1. Bolting Torques for Flanges**

| Flange | #150 | #300 |
|---|---|---|
| 3-in. | 54 (40) | 95 (70) |
| 4-in. | 54 (40) | 95 (70) |
| 6-in. | 95 (70) | |
| **Flange** | **PN16** | **PN40** |
| DN65 | 58 (43) | 58 (43) |
| DN80 | 58 (43) | 58 (43) |
| DN100 | 58 (43) | 113 (83) |
| DN125 | 58 (43) | 194 (143) |
| DN150 | 113 (83) | 194 (143) |
| **Flange** | | |
| Mobrey A | 20 (15) | |
| Mobrey B | 20 (15) | |

**Table B-2. Bolt torques for spiral wound gaskets with a compression stop: high tensile steel bolts only**

| Bolt Size (in.) | Nm | lbf.ft |
|---|---|---|
| 5/8 | 122 | 90 |
| 3/4 | 203 | 150 |
| 7/8 | 325 | 240 |
| 1 | 499 | 368 |
| 1 1/8 | 722 | 533 |
| 1 1/4 | 101 | 750 |

### Table B-3. Gaskets compression for joints without compression stops: high tensile steel bolts only

| Initial Gasket Thickness (mm) | Compressed Thickness (mm) | Compression (mm) |
|---|---|---|
| 1.6 | 1.3/1.4 | 0.2/0.3 |
| 2.5 | 1.9/2.0 | 0.5/0.6 |
| 3.2 | 2.3/2.5 | 0.7/0.9 |
| 4.4 | 3.2/3.4 | 1.0/1.2 |
| 6.4 | 4.6/5.1 | 1.3/1.8 |

# Appendix C Bench Checking – LDVT Setting 20 °C



## C.1 Using the set-up certificate to bench check

Referring to the Set-up Certificate supplied with the MLT100:

1. Read the value of the weight that must be hung on the spring to simulate a mid-point or null position of the core in the LVDT.
2. Remove the displacer element and chain (noting which chain link is used to hang the element) and hang the weight in place.
3. Hold the magnetic tip of the Delta Mobrey Magnetic Scroller (MMS) against the small target icon on the internal nameplate for about 3 seconds. If the LVDT cap is in the correct position, the two LED's adjacent to the target will flash alternately.
4. If adjustment is required, only 1 of the LEDs will flash. Slacken the locknut at the top of the LVDT cap. Note which LED is flashing and slowly turn the LVDT cap in the direction of the arrow against the flashing LED until both LEDs flash alternately.
5. The LVDT cap can now be re-secured in position. Tighten the LVDT locknut at the top of the pressure tube against the top of the LVDT casing so that the cap can no longer rotate on the LVDT.
6. To exit this mode, hold the MMS against the target for a few seconds and the LEDs will cease flashing. If left, the instrument will automatically exit this mode after a period of about 4 minutes.
7. Re-fit the Displacer element and chain assembly using the correct chain link, and ensure the locking nut on the chain adaptor is securely tightened.

## C.2 Calibration check using water at 20 °C

It is possible to check the transmitter output if the vessel or system is to be filled with water at any time.

Refer to the Set-up Certificate where you will find a graph / chart showing the mA output for a given water level at 20 °C. Simply immerse the displacer element in water to the given level and check that the output is as stated.

## C.3 The calibration certificate

If requested at the time of order, a calibration certificate will have been supplied with your MLT100.

# Appendix D Field Communicator Data Map



## D.1 Introduction

The MLT100 supports HART communications, which may be used to program or interrogate the transmitter from any point on the two-wire loop.

## D.2 MLT100 menu structure and parameter list

The performance of the MLT100 is controlled by parameters stored in its non-volatile memory. Some of these parameters are set at the factory and some are set by the customer. Further parameters are produced by the MLT100 to provide information about its performance.

The parameters used to set up the transmitter are called program or "P**" parameters. Parameters produced by the transmitter to provide information to the user are called diagnostic or "D**" parameters.

Table D-1and Table D-2 list the parameters used in the MLT100. They are accessible using a field communicator or a PC running AMS (see Figure D-1 on page 4).

**Note**
Only parameters P15, P16, and P20 may be changed using the Delta Mobrey Magnetic Scroller (MSP-MMS). Further details are provided in Section 4: Commissioning.

### Table D-1. P** Parameters

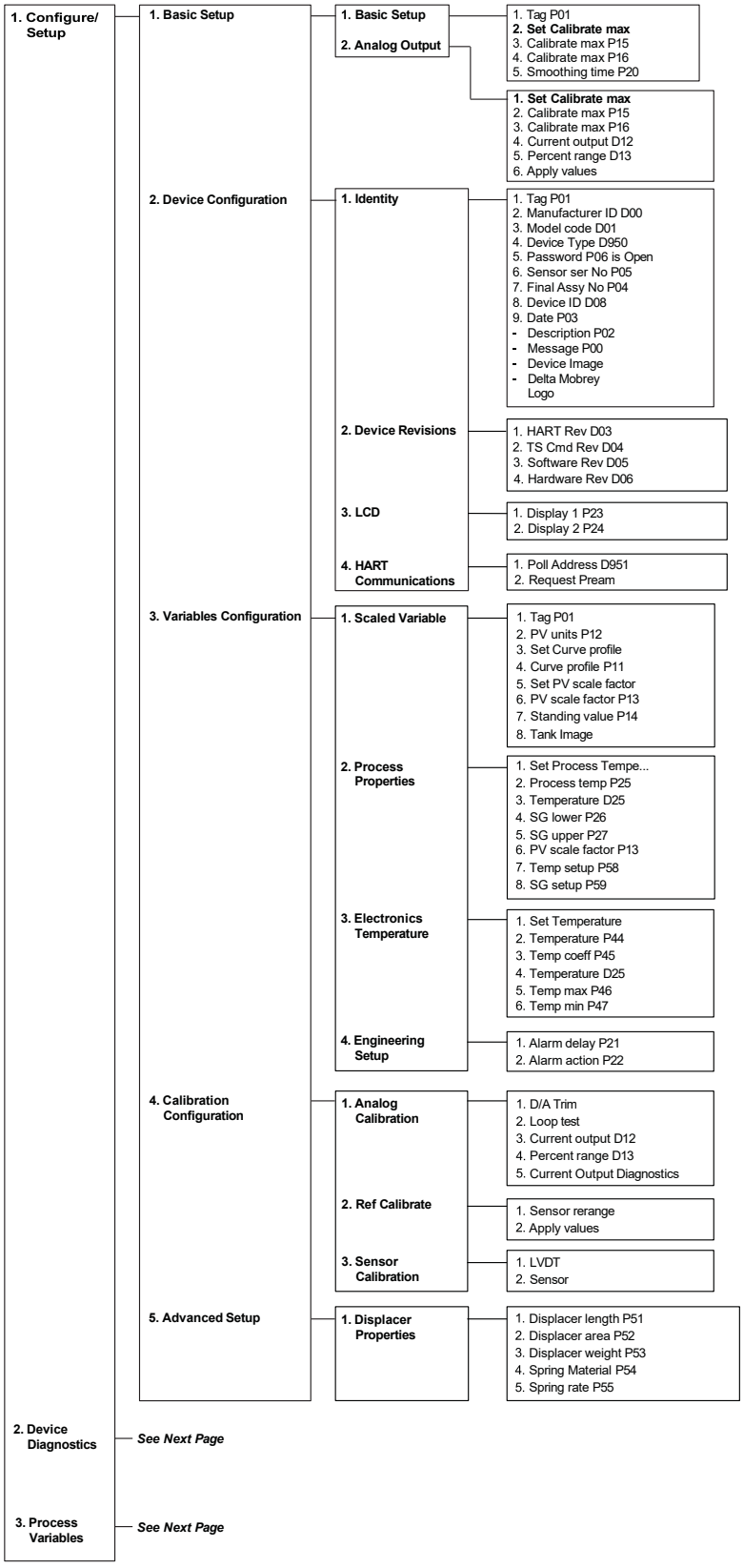
| ID | Parameter | Short Description | Reference Page |
|---|---|---|---|
| P00 | Message | General purpose 32 character message | page 5 |
| P01 | Tag | 8 character electronic 'label' for the MLT100 | page 6 |
| P02 | Description | General purpose 16 character message | page 6 |
| P03 | Date | Date when last change made to configuration | page 7 |
| P04 | Final Assy No | Overall hardware assembly number | page 7 |
| P05 | Sensor ser No | LVDT serial number | page 8 |
| P06 | Password | 3 level password system | page 8 |
| P11 | Curve profile | Curve shape selection | page 9 |
| P12 | PV units | Select display units associated with the PV | page 15 |
| P13 | PV scale factor | Maximum process value (PV) | page 16 |
| P14 | Standing value | Process value (PV) at zero level | page 17 |
| P15 | Calibration max | PV represented by 20 mA output current | page 19 |
| P16 | Calibration min | PV represented by 4 mA output current | page 20 |
| P17 | Level for max PV | Height up displacer at which PV is maximum | page 22 |
| P18 | Level for min PV | Height up displacer at which PV is minimum | page 21 |
| P20 | Smoothing time | Sets damping for the PV and current output | page 22 |
| P21 | Alarm delay | Sets delay before alarm action P22 is taken | page 23 |
| P22 | Alarm action | How the current output signals alarm condition | page 23 |
| P23 | Display 1 | Parameter to be shown on display module | page 24 |
| P24 | Display 2 | Optional second parameter to be displayed | page 24 |
| P25 | Process temp | Compensates for outside normal calibration | page 25 |
| P26 | SG lower | Specific gravity of the lower liquid in vessel | page 26 |
| P27 | SG upper | Specific gravity of the upper liquid in vessel | page 26 |
| P30 | 10% HT | %process value (PV) at 10% of liquid level | page 27 |
| P31 | 20% HT | %process value (PV) at 20% of liquid level | page 27 |
| P32 | 30% HT | %process value (PV) at 30% of liquid level | page 27 |
| P33 | 40% HT | %process value (PV) at 40% of liquid level | page 27 |
| P34 | 50% HT | %process value (PV) at 50% of liquid level | page 27 |
| P35 | 60% HT | %process value (PV) at 60% of liquid level | page 27 |
| P36 | 70% HT | %process value (PV) at 70% of liquid level | page 27 |
| P37 | 80% HT | %process value (PV) at 80% of liquid level | page 27 |
| P38 | 90% HT | %process value (PV) at 90% of liquid level | page 27 |
| P39 | 100% HT | %process value (PV) at 100% of liquid level | page 27 |
| P44 | Temperature | Overrides temperature sensor (for correction) | page 27 |
| P45 | Temp coefficient | Used for temperature correction calculation | page 28 |
| P46 | Temp max | Highest sensor temperature reading | page 28 |
| P47 | Temp min | Lowest sensor temperature reading | page 29 |
| P51 | Displacer length | Length of displacer element | page 29 |
| P52 | Displacer area | Cross-sectional area of displacer | page 30 |
| P53 | Displacer weight | Weight of suspended parts | page 30 |
| P54 | Spring material | Spring material (selectable from menu) | page 31 |
| P55 | Spring rate | Linear extension rate of spring | page 31 |
| P58 | Temp setup | Process temperature as specified on order | page 32 |
| P59 | SG setup | Specific gravity as specified on order | page 32 |
| P60 | Min snsr output | LVDT sensor output voltage at the zero level | page 33 |
| P61 | LVDT Coeff 1 | 1st order coefficient for polynomial correction | page 33 |
| P62 | LVDT Coeff 2 | 2nd order coefficient for polynomial correction | page 33 |

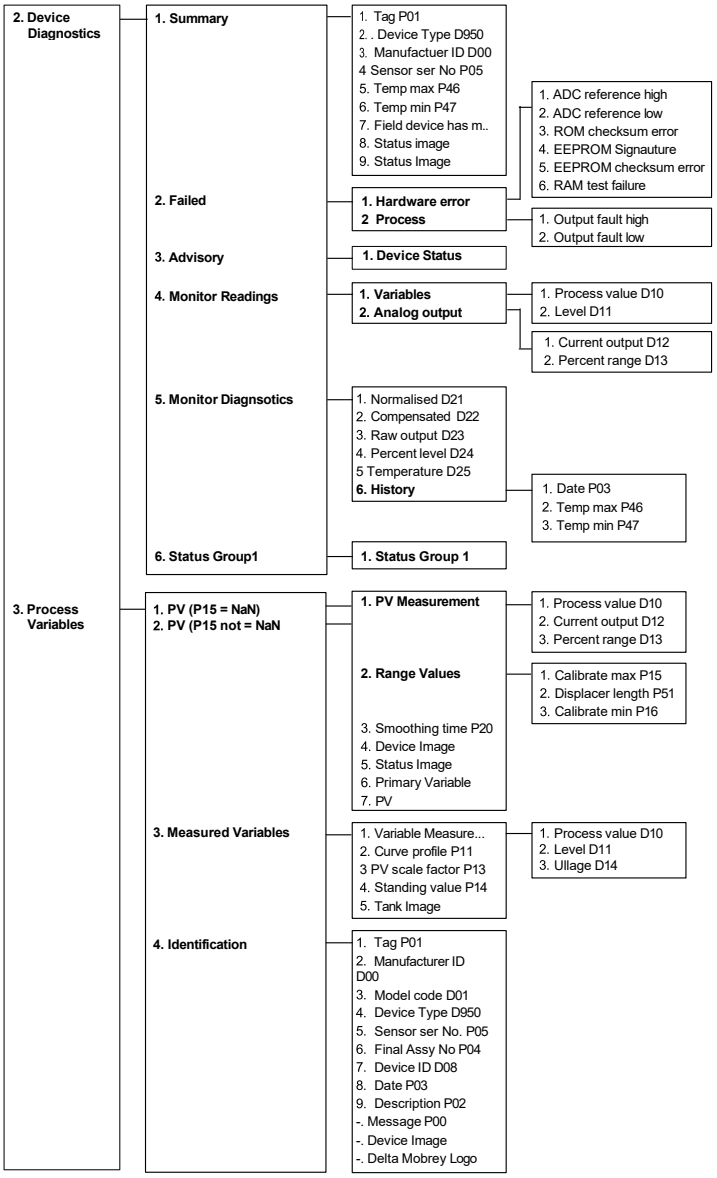
| ID | Parameter | Short Description | Reference Page |
|---|---|---|---|
| P63 | LVDT Coeff 3 | 3rd order coefficient for polynomial correction | page 33 |
| P64 | LVDT Coeff 4 | 4th order coefficient for polynomial correction | page 33 |
| P65 | LVDT Coeff 5 | 5th order coefficient for polynomial correction | page 33 |
| P66 | LVDT gain factor | Used to normalize LVDT output | page 34 |
| P67 | LVDT rate | Rate of change of LVDT output in mv per cm | page 34 |
| P68 | Upper snsr limit | Maximum usable value of sensor output D21 | page 35 |
| P69 | Lower snsr limit | Minimum usable value of sensor output D21 | page 35 |

### Table D-2. Diagnostic Parameters

| ID | Parameter | Short Description | Reference Page |
|---|---|---|---|
| D00 | Manufacturer ID | Delta Mobrey | page 36 |
| D01 | Model code | Model code e.g. LTC65FAN5GJ3100 | page 37 |
| D02 | Request preamble | No. of bytes to set up modulation | page 37 |
| D03 | HART Rev | Identifies major revision of the HART protocol | page 38 |
| D04 | TS Cmd Rev | Transmitter specific command revision | page 38 |
| D05 | Software Rev | Software functionality revision | page 39 |
| D06 | Hardware Rev | Hardware version number | page 39 |
| D10 | Process value | Output calculated from the level measurement | page 40 |
| D11 | Level | Immersed length of displacer | page 41 |
| D12 | Current output | Proportional to PV (limits set on P15 and P16) | page 41 |
| D13 | Percent range | Current output as % of full scale | page 42 |
| D14 | Ullage | Space available (re-fill quantity) | page 42 |
| D21 | Normalised | Sensor output after linearization and smoothing | page 43 |
| D22 | Compensated | Sensor output after temp compensation | page 43 |
| D23 | Raw output | Unprocessed sensor output | page 44 |
| D24 | Percent Level | % of level of interest between P17 and P18 | page 44 |
| D25 | Temperature | Sensor temperature monitored / preset by P44 | page 45 |

## Figure D-1. Field Communicator Menu Tree




2. Device Diagnostics
1. Summary
1. Tag P01
2. . Device Type D950
3. Manufactuer ID D00
4 Sensor ser No P05
5. Temp max P46
6. Temp min P47
7. Field device has m..
8. Status image
9. Status Image
2. Failed
1. Hardware error
2 Process
1. ADC reference high
2. ADC reference low
3. ROM checksum error
4. EEPROM Signauture
5. EEPROM checksum error
6. RAM test failure
1. Output fault high
2. Output fault low
3. Advisory
1. Device Status
4. Monitor Readings
1. Variables
2. Analog output
1. Process value D10
2. Level D11
1. Current output D12
2. Percent range D13
5. Monitor Diagnsotics
1. Normalised D21
2. Compensated D22
3. Raw output D23
4. Percent level D24
5 Temperature D25
6. History
1. Date P03
2. Temp max P46
3. Temp min P47
6. Status Group1
1. Status Group 1
3. Process Variables
1. PV (P15 = NaN)
2. PV (P15 not = NaN
1. PV Measurement
1. Process value D10
2. Current output D12
3. Percent range D13
2. Range Values
1. Calibrate max P15
2. Displacer length P51
3. Calibrate min P16
3. Smoothing time P20
4. Device Image
5. Status Image
6. Primary Variable
7. PV
3. Measured Variables
1. Variable Measure...
2. Curve profile P11
3 PV scale factor P13
4. Standing value P14
5. Tank Image
1. Process value D10
2. Level D11
3. Ullage D14
4. Identification
1. Tag P01
2. Manufacturer ID D00
3. Model code D01
4. Device Type D950
5. Sensor ser No. P05
6. Final Assy No P04
7. Device ID D08
8. Date P03
9. Description P02
-. Message P00
-. Device Image
-. Delta Mobrey Logo

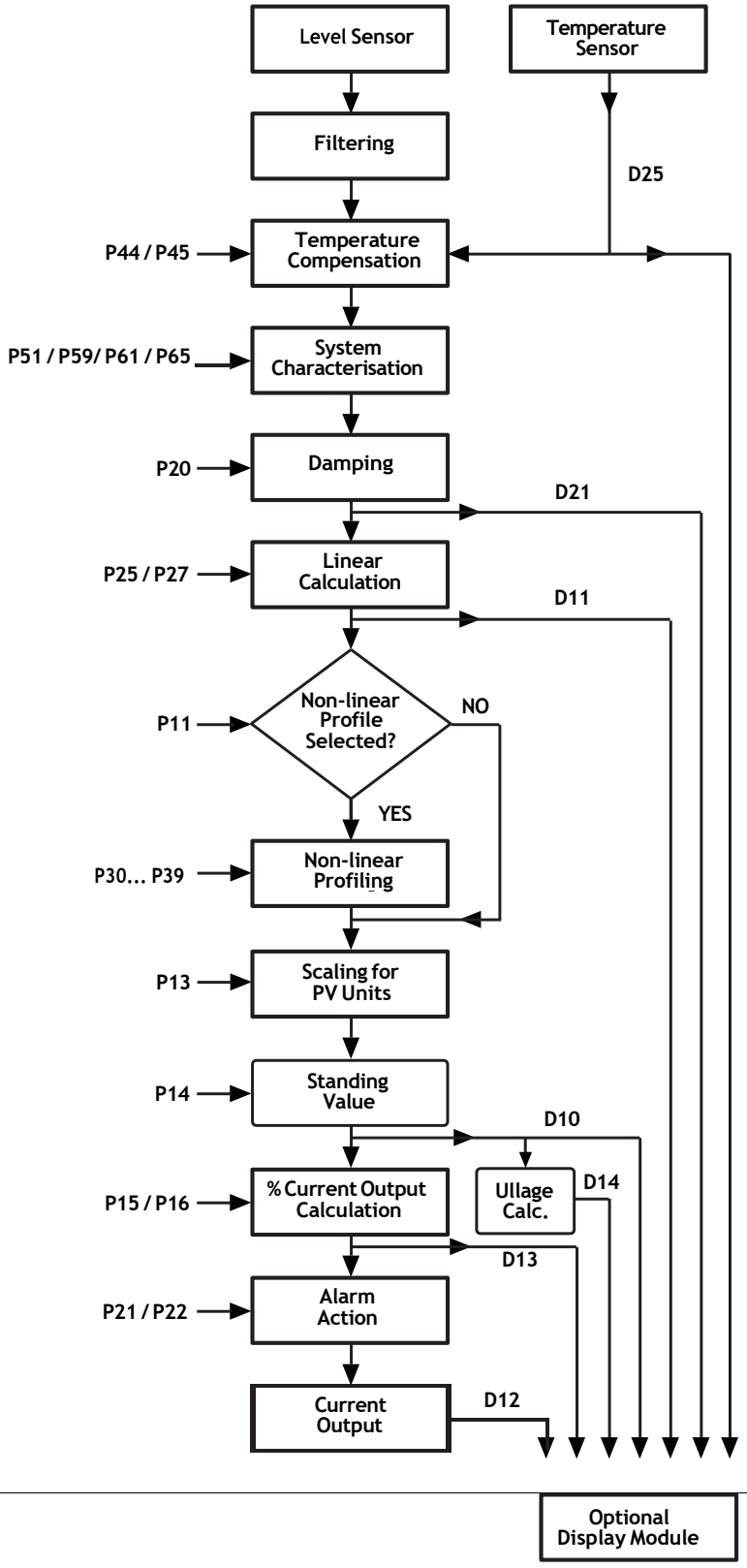
# Appendix E Data Processing Flow Chart

## E.1 Data processing flow chart

Figure E-1 below shows the data processing within the MLT100 transmitter.

The transmitter is set up by P** parameters and, as the data is processed, diagnostic information is produced which is available as D** parameters. These parameters are identified alongside the diagram.

## Figure E-1. Data processing within the MLT100 transmitter



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