# Metso Optical Consistency Transmitter

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Always ensure that the incoming voltage and frequency are correct before making any electric connections. Wrong connection may damage the equipment! The applicable safety regulations must be closely followed in all installation work. All electric connections may only be made by appropriately trained and authorized persons!

Before any welding works in the vicinity of the devices, make sure that operating voltage is not connected!

The device contains moving parts. Be careful when testing the device! Do not push your fingers between any moving parts!

Before installing any mounting parts, make sure that the process pipe is empty and depressurized!

During installation, maintenance and service operations, remember that the sample line may contain hot sample or water - be careful!
Recycling and disposal

When sorted by material, nearly all parts of the device can be recycled. A materials list is delivered with the device. Upon request, the manufacturer will provide more detailed instructions for recycling and disposal. The device may also be returned to the manufacturer for recycling and disposal against a separate fee.
1. Introduction

1.1. Metso Optical Consistency Transmitter

Metso Optical Consistency Transmitter (Metso OC) is an optical consistency transmitter that measures the reflection of light as a function of pulp consistency.

The light source is a LED which in practice does not wear in use. The logarithmic measured signal is provided with factory-calculated linearization curves for different pulp types, which greatly facilitates the setting up of the transmitter.

The response of the linearization curve can be altered with single-point or two-point calibration. Single-point calibration will be sufficient in normal conditions, while two-point calibration can be applied for pulps whose properties differ considerably from those of typical pulps.

Fig. 1. Metso OC sensor.

1.2. Acceptance inspection

After unpacking the delivery, make sure that it corresponds to the order. Also check all devices for possible transport damage.

Contents of delivery:
- Sensor probe assembly.
- Optical TCU with selected communication.
- Sensor cable.
- Process mounting set.
- Device manual and calibration quick guide.
- Possible options: Longer (10 m / 30 m) sensor cable, 10 m sensor probe assembly.

1.3. Metso OC transmitter for smartLX replacement

The Metso OCLX version replaces the smartLX transmitter. Metso OCLX can be installed in the same process coupling as smartLX. The differences between Metso OC and Metso OCLX are in the sensor probe length and the process coupling.
1.4. Conformity to CE directives and CSA approval

The entire system, consisting of a TCU with power supply, a transmitter, and the connecting cables (see chapter 4. TCU installation and cabling), has been designed to meet the CE directives and their associated standards as stated in the CE Declaration of Conformity document delivered with the device.

In order to meet the EMC directives, the following precautions must be taken:
1. All wiring must be shielded. Power supply electronics: shielded, coverage ≥ 80%. Interface cable: coverage 100% aluminum.
2. All units must be tested as a complete system to conform with the relevant CE directives and their standards.

When the units are used in other combinations, Metso cannot guarantee their CE directive conformity. In combination with customer-installed external devices, the units may conform to EMC and safety requirements when properly installed and using an adequate CE marked equipment.

NOTE: System operator is responsible for the CE directive conformity. Conformity must be checked by inspection.

• Be careful when handling the equipment around vessels containing pressurized/hot materials.
• Take necessary safety precautions when mounting the equipment by using appropriate lift gear, platforms and tools.
• TCU is powered by hazardous voltages.

The TCU box is CSA approved.

1.5. Materials

All the materials used in the exposed surfaces of the system are selected and manufactured for use in pulp and paper industry environments. The system cable is sheathed in PVC. The transmitter is made of stainless steel AISI316L.

1.6. Transmitter Central Unit (TCU)

TCU is the user interface, power supply and calculation unit of the transmitter. Operations can be performed by using the keypad and four-line display. The TCU is attached to a protective cover which protects it from falling dirt, water, pulp etc.

The TCU has the following connectors:
• Sensor cable, sensor electronics supply voltage and RS485 serial port connectors.
• 4-20 mA current output (passive) to DCS.
• Digital communication using HART communication protocol.
• RS232 connection to a PC (for maintenance purposes).
• Mains supply voltage.
• Binary inputs for recipe selection and sample status.
2. Safety recommendations

These safety recommendations are based on a risk analysis carried out in accordance with the requirements of the machinery and low voltage directives in order to comply with European standards for CE marking. Read carefully all safety recommendations and instructions before installing any parts of the delivery.

2.1. About the device

Be sure to follow precisely the instructions and recommendations when installing, connecting, or servicing the transmitter. These safety recommendations apply to a transmitter installed with an AC-powered TCU.

NOTE: Always use only parts manufactured or approved by Metso Automation. Follow valid instructions and standards during installation.

2.2. Selecting transmitter model

For a new installation select the Metso OC transmitter. Metso OCLX is used to replace smartLX. See Technical specification for more detailed information.

2.3. Installing and connecting the transmitter

NOTE: Before installing any mounting parts, make sure that the pipe is empty and depressurized!

Welding or bolting and the subsequent inspection must take place in accordance with the valid standards and regulations.

- Read the installation instructions in chapter 3 of this manual.
- Use approved lifting equipment during installation.
- Ensure that the transmitter is fastened properly.
- For transmitter dimensions and weight see Technical specifications.
- Ensure that the transmitters optical fibres are fastened properly before the calibration.

2.4. Installing the TCU

The TCU uses a hazardous voltage. Only a qualified electrician may connect the TCU. Make sure to connect the earth correctly, double-check after connecting.

NOTE: High voltage inside the TCU!
3. Transmitter installation

3.1. Basic transmitter dimensions

NOTE: Technical details are found in Technical specification.

NOTE: Always ensure, that the system can be inserted to its full depth in the selected location before you install the transmitter, TCU and necessary components.

An additional room of at least 350 mm (14") must be left behind the transmitter to enable removing the unit from the process coupling. Make sure to leave a sufficient room around the transmitter to perform this task.

Metso OC transmitter
Fig. 1 shows Metso OC transmitter dimensions.

Metso OCLX transmitter
Fig. 2 shows Metso OCLX transmitter dimensions.

Fig. 1. Metso OC transmitter dimensions.

Fig. 2. Metso OCLX transmitter dimensions.
3.2. Choosing the mounting location

Whenever possible, the transmitter should be installed in turbulent flow as this ensures a good measurement (Fig. 3). It can also be installed in a laminar flow, but in this case it is very important to make sure that the probe tip is in the optimum position with regard to the pulp flow.

Pulp consistency at the measuring point must be representative. Turbulent flow condition is preferred in order to have a representative measurement. Please notice that turbulence is influenced by consistency. Minimum flow velocity is 0.3 m/s.

Your Metso sales engineer will be pleased to assist in selecting the location that will give the best measurement result.

The best measuring results are obtained when the transmitter is installed in a pipe section immediately following a pump, as the strongest turbulence is typically found there.

Installation to a conical pipe section is not allowed. If the transmitter cannot be installed immediately after a pump, make sure the representative pulp flow is in measuring point.

The required minimum free space from the pipe surface is 500 mm to permit proper installation of the transmitter.

**NOTE:** Pay attention to the control loop lag when choosing the mounting location.

**NOTE:** If there is a globe valve between pump and transmitter that is NOT fully open all the time, align the valve axis parallel to pump axis to prevent a whirling flow.

**NOTE:** Ensure that the transmitters optical fibres are fastened properly before calibration.

![Fig. 3. Choosing the mounting location for the OC sensor.](image)
3.3. Metso OC sensor installation

Installing the sensor to the process pipe:
1. Drill a installation hole 25 - 35 mm (Fig. 4, A). The process coupling (B) diameter is 50 mm.
2. Centralize the coupling to the drilled hole and weld the process coupling to the process pipe (Fig. 5, C).

   NOTE: The inner process coupling must be installed so that the Metso OC sensor probe will be 10° against mass flow!
3. Screw down the ball valve (Fig. 5, E) to the welded process coupling with O-ring (Fig. 5, D).
4. Install and tighten locking screws (Fig. 5, F) and washers to the process coupling to prevent an unintentional opening.
5. Separate the sealing bushing (Fig. 7, J) and sealing nut (L) on the probe. Push the sealing bushing towards the probe tip until it stops at the lock ring in the sensor tip. Check that O-ring (I) is properly installed in the sealing bushing (J).
6. Install the probe (H) and tighten the sealing bushing to the ball valve. Do not tighten too much!
7. Install the locking ring (K).
   - The locking ring is meant to guide the correct opening order (it will make it impossible to open the sealing bushing first): The sealing nut must be opened before you can unscrew the sealing bushing.
   - The correct place for the locking ring is the flat tool surface of the ball valve.
8. Open the ball valve (Fig. 8, M).
9. Push the sensor probe through the ball valve (Fig. 9).
10. Screw down the sealing nut, (N) to the sealing bushing and tighten. The sealing nut mounts the sensor probe in the correct position.

   NOTE: Ensure that the transmitters optical fibres are fastened properly before calibration.

---

**Fig. 4. A. Installation hole, B. Process coupling.**

**Fig. 5. C. Welded process coupling, D. O-ring, E. Ball valve, F. Locking screws.**

**Fig. 6. G. Closing the valve.**

**Fig. 7. H. Probe, I. O-ring, J. Sealing bushing, K. Locking ring, L. Sealing nut.**

**Fig. 8. M. Opening the valve.**

**Fig. 9. N. Sealing nut (= L in Fig. 7).**
3.4. Metso OCLX sensor installation

NOTE: The installation requires a process stop!

The Metso OCLX sensor is meant to be installed to the old process coupling (Fig. 10, A2) of smartLX, which is installed to the process pipe according to the smartLX Installation Instructions. Remove from the old smartLX all the other parts but the welded process coupling.

Installing the sensor to the process:
1. Metso OCLX can be installed to the smartLX coupling with the inner process coupling (B) and nut (C).
2. Insert the inner process coupling (B) inside the smartLX’s process coupling (A2).
   NOTE: The inner process coupling must be installed so that the Metso OCLX sensor probe will be 10° against mass flow (A1)!
3. Install and tighten the nut (C).
4. Screw down the ball valve (Fig. 11, E) to the inner process coupling with an O-ring (D) and close the ball valve.
5. Install and tighten locking screws (F) to the inner process coupling to prevent an unintentional opening. The valve arrangement is now ready for the probe insertion. If needed the process can now be started.
6. Open the sealing nut in the sensor probe (Fig. 12, G) and pull the sensor as far as it goes to its back position. The tip of the sensor probe should be inside of the sealing bushing (I). Check that O-ring (H) is properly installed in the sealing bushing.
7. Install and tighten the sealing bushing to the ball valve. Do not tighten too much!
8. Install the locking ring (J).
   – The locking ring is meant to guide the correct opening order: The sealing nut must be opened before you can unscrew the sealing bushing.
   – The correct place for the locking ring is the flat tool surface of the ball valve.
9. Open the ball valve (K).
10. Push the sensor probe through the ball valve (L). Screw down the sealing nut (M) to the sealing bushing and tighten. The sealing nut mounts the sensor probe in the correct position.

NOTE: Ensure that the transmitters optical fibres are fastened properly before calibration.
4. TCU installation and cabling

4.1. TCU and protective cover
The Optical TCU (Transmitter Central Unit) is delivered attached to the protective cover. Attach the cover to the wall with three mounting screws in an easily accessible place. When selecting a place for the TCU, remember that the length of the optical cable is 5 m, as an option it can be 10 m. Fig. 1 shows the mounting dimensions of the cover.

![Fig. 1. Mounting dimensions of TCU.](image1)

4.2. Connections on transmitter
The optical unit is mounted under TCU (Fig. 2). The sensor cable between TCU and the sensor is 0.7 m. There are 10 or 30 m sensor cables available as an option.

![Fig. 2. Optical TCU unit.](image2)

![Fig. 3. Optical TCU with sensor cable option.](image3)
4.3. Electric connection of TCU

NOTE: Make sure that the power supply cables are de-energized before connecting them. Check all connections before connecting power to the cables.

1. Insert the power supply cable 90-260 VAC: Fig. 5, point A.
2. In a normal delivery the sensor cable (Fig. 5, point B) is already connected to the TCU.
3. Insert the output signal cable into the TCU connector casing through the inlet (Fig. 5, point C) and connect it to the terminal block as shown in the drawing. For voltage and resistance see Fig. 4.
   - Do not connect the protective shield of the current signal cable.
4. Insert a cable for binary inputs, see description in the chapter 4.4.

The transmitter contains a passive current supply that requires an external current source. Fig. 4 shows the load capacity of the current output as a function of supply voltage. Resistance here is the sum of load resistor, cable resistance, and power source resistance in the current loop. HART communication requires a minimum loop resistance of 250 Ohms.

NOTE: smartLX has active current loop and Metso OCLX has passive. Change must be done in the DCS side when smartLX is replaced by Metso OCLX!

![Fig. 4. Current output load capacity of the TCU.](image)

![Fig. 5. Connections of TCU. A. power, B. transmitter, C. analog signal 4-20 mA.](image)
4.4. Binary inputs

The TCU contains two galvanically isolated binary inputs, BIN 0 (connection 13) and BIN 1 (connection 14), both inputs share a common ground (connector 12). The switching device must be able to supply 12–28 VDC / 10 mA to the binary input. The connection principle of binary inputs is shown in Fig. 6.

**Operation chart**

*Table 1. BIN1 configured for recipe selection.*

<table>
<thead>
<tr>
<th>BIN0</th>
<th>BIN1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>open</td>
<td>open</td>
<td>recipe 1 selected</td>
<td></td>
</tr>
<tr>
<td>closed</td>
<td>open</td>
<td>recipe 2 selected</td>
<td></td>
</tr>
<tr>
<td>open</td>
<td>closed</td>
<td>recipe 3 selected</td>
<td></td>
</tr>
<tr>
<td>closed</td>
<td>closed</td>
<td>recipe 4 selected</td>
<td></td>
</tr>
</tbody>
</table>

*Table 2. BIN1 configured for sampler status.*

<table>
<thead>
<tr>
<th>BIN0</th>
<th>BIN1</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>open</td>
<td>open</td>
<td>recipe 1 selected</td>
<td>sampler not active</td>
</tr>
<tr>
<td>closed</td>
<td>open</td>
<td>recipe 2 selected</td>
<td>sampler not active</td>
</tr>
<tr>
<td>open</td>
<td>closed</td>
<td>recipe 1 selected</td>
<td>sampler active</td>
</tr>
<tr>
<td>closed</td>
<td>closed</td>
<td>recipe 2 selected</td>
<td>sampler active</td>
</tr>
</tbody>
</table>

Fig. 6. Connection principle of binary inputs.
5. Setting up

5.1. Important!

NOTE: Do not bend or twist the optical fiber. The smallest allowed radius is 100 mm (4”). Never pull the transmitter from the optical fiber!

The transmitter is a sensitive piece of precision equipment – handle it with care! When installing or removing the transmitter, only install it by the handle. Be careful not to damage the unit by breaking the optical fiber.

5.2. Basic configuration and calibration

1. Select the language and temperature unit (Celsius/Fahrenheit); see chapter 7 Configurations/User settings.
2. Set the device date and time; see chapter 7 Configurations/ Set clock.
3. Scale the current output; see chapter 7 Configurations/ Output signal1.
4. Calibrate the consistency; see chapter 8 Calibration.
6. Operation

6.1. General
The transmitter can be operated either by using the local user interface TCU or remotely by digital communication over the 4 – 20 mA output loop (HART communication protocol).

Total support, including sophisticated calibration methods and thorough diagnostics, is available from Metso FieldCare™. Please refer to the DTM user manual. Basic functionality is available for other field communicators or control systems capable of HART communication.

The local operation unit of the device is the Transmitter Central Unit (TCU); see Fig. 1.

6.2. TCU user interface
The display and keypad controls (see Fig. 2):
1. Number keys: enter numerical data, letters and select menu options.
2. LCD display: 20 columns, 4 rows.
3. Sample: start and stop sampling at calibration.
4. Esc: exit the edit mode without saving data; move backwards in the menu structure; toggle between result display and main menu.
5. Edit/Save: go to edit mode, save data after editing.
6. Arrows: move the cursor, move in menus.
7. Enter: move between result displays; in edit mode, jump to the next value to edit.

Display symbols:

- symbol, value is editable
- symbol, value is read only
= symbol, value is measured or a selection to enter next submenu

An example of editing instruction:
- Press "Edit/Save" to start editing, a cursor starts to blink.
- Use number keys to feed in the value.
- Press "Enter" to move to the next value.
- Press arrow keys to scroll between fixed values (Alarm curr.).
- Press "Edit/Save" to save and exit from the edit mode.
- Press "Esc" to leave the page.

Fig. 1. Transmitter Central Unit, optical TCU.

Fig. 2. Front panel.
6.3. Operation with the TCU

Fig. 3 shows a map of the TCU functions and their locations in TCU display system. The "Main result display" is the default after power-up. When you press "Enter" the extra result display will appear. Press again "Enter" to return to the main result display.

Press "Esc" in either of the result displays to access the Main menu.

Sample button: start and stop sampling at calibration operations menu (accessed from TCU main menu).

To access a menu function or submenu, press the number key indicated before the name of the function/submenu. Press "Esc" to return to the previous level.

All TCU functions can be accessed from the operations menu. You can always return to the "Main result display" by pressing "Esc" several times.

### Fig. 3. TCU menu system, main menus.
6.4. Result displays

**Main result display**

**Tag:** Transmitter’s "tag" or position code in the system. This can be changed in "Configuration" -› "User settings".

**Recipe1:** Currently selected recipe. This can be changed in "Configuration" -› "Recipe mode". Letter "R" after the number indicates that remote recipe selection is in use. In this case the active recipe is selected by two digital input signals on the TCU unit.

**Cs:** Consistency in percentage points (% Cs).

**STATUS:** Device status information (OK / alarm / error message).

```
Tag  Recipe 1
Cs (PV) = 2.51 Cs
Status = OK
```

**Extra result displays**

**Output1/2:** Analog output values (PV = Primary, SV = Secondary) in milliamps (mA).

**Elec.T:** Electronics temperature.

```
Output 1 = 12.97 mA
Elec. T = 31.08C
```
7. Configurations

7.1. To start
Select "Esc" in "Main result display" to get to "Main menu".

Then select "1=Configuration" from "Main menu".

7.2. Recipe selection
Select the active recipe to be changed here by pressing "Edit/Save".

Recipe mode
- **1 - 4**: Manual, fixed recipe selection.
- **5**: Digital input, remote control via binary inputs.
  When remote selection is activated, it overrides fixed recipe selections by the operator, and the active recipe is selected instead by the TCU’s digital inputs.
  Remotely selected recipe is indicated in the measurement display with letter "R" after the recipe number.

Current recipe = 1

7.3. Output signal1

**LRV = Lower range value**: The consistency percentage that produces the 4 mA analog output signal. Default, 0.5 % Cs.

**URV = Upper range value**: The consistency percentage that produces the 20 mA analog output signal. Default, 7.0 % Cs.

**Damping**: Damping the fluctuation of the output signal, 1 - 60 sec. Define at least the min. value required to damp harmful fluctuations.

**Alarm current**: Analog output current to indicate transmitter failure. Possible values are 3.7 mA, 22.5 mA, HOLD (analog output is frozen when alarm goes on) and NONE (no alarm signal at all). Default, 3.7 mA.

Output 1 = Cs
LVR (4mA) = 0.5
URV (20mA) = 7.0
Damping = 1 s
Alarm curr. = 3.7 mA
7.4. Output signal 2

Selected variable: Deviation or consistency. Default, "Consistency".

Other settings same as in Output signal 1.

<table>
<thead>
<tr>
<th>Output 2</th>
<th>Cs</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRV (4mA)</td>
<td>0.5</td>
</tr>
<tr>
<td>URV (20mA)</td>
<td>7.0</td>
</tr>
<tr>
<td>Damping</td>
<td>1  s</td>
</tr>
<tr>
<td>Alarm curr.</td>
<td>3.7 mA</td>
</tr>
</tbody>
</table>

7.5. User settings

**Tag:** Transmitter’s tag is a text describing the installation position of the device. Max. 8 characters, letters/numbers.

**Temp unit:** Temperature unit, degrees in Celsius = °C / Fahrenheit = °F. Default, C.

**Password:** The access to some operations is restricted by a password. This field shows if the password is in use "Y" = Yes or not "N" = No. When in use, all pages with editable values will ask for password (3121). Default, not in use.

<table>
<thead>
<tr>
<th>Tag</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp unit</td>
<td>DEG C</td>
</tr>
<tr>
<td>Password</td>
<td>N</td>
</tr>
<tr>
<td>Language</td>
<td>ENG</td>
</tr>
</tbody>
</table>

7.6. Device info

- **Sensor**
  - **Type:** Metso OC.
  - **S/N:** Serial number of transmitter electronics.
  - **SW Rev:** Software version of transmitter.

<table>
<thead>
<tr>
<th>Type</th>
<th>Metso OC</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/N</td>
<td>21050013</td>
</tr>
<tr>
<td>SW Rev</td>
<td>1.0 (2206.12)</td>
</tr>
</tbody>
</table>

- **TCU**
  - **Type:** HART/PA/FF protocol.
  - **S/N:** Serial number of TCU electronics.
  - **HW Rev:** Version number of TCU electronics.
  - **SW Rev:** Software version of TCU.

<table>
<thead>
<tr>
<th>Type</th>
<th>HART</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/N</td>
<td>0751241234</td>
</tr>
<tr>
<td>HW Rev</td>
<td>C</td>
</tr>
<tr>
<td>SW Rev</td>
<td>1.0 (2206.12)</td>
</tr>
</tbody>
</table>
7.7. Set clock

**Date and time:** Enter the date with the number keys. To start press "EDIT/SAVE". The first character in the field begins to blink. Note that the date/month order is set in "User Settings" => "Date".

Example: to enter the date 14.06.2011 (June 14, 2011) the key sequence is as follows:

1 4 ENTER 0 6 ENTER 1 1 ENTER

**Enter:** Confirm changes.

<table>
<thead>
<tr>
<th>DD.MM.YY</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.09.11</td>
<td></td>
<td>14:05:55</td>
</tr>
</tbody>
</table>

7.8. Digital inputs

**BIN0:** For recipe selection (in remote recipe selection mode).

**BIN1:** Selectable. Recipe select.
- If "BIN1" is used for recipe selection, all four recipes can be activated through input signals.
- If "BIN1" is used for sampling information, sample timing can be automated (no need to press the SAMPLE key). Only two recipes (recipe 1 and recipe 2) can be activated through input signals.

7.9. Address

HART(R) address of the device. Acceptable values are from 0 to 15. Default value is 0 (zero), i.e. normal installation with a single transmitter, analog output signal (4 - 20 mA) is active.

Values 1 - 15 define a fixed 4 mA current output and all communication with the device is performed over the digital HART protocol.

**WARNING:** Do not set values 1 - 15 if the 4 - 20 mA analog output signal is needed!

Profibus PA address, 0 - 126.

<table>
<thead>
<tr>
<th>Address:</th>
<th>0</th>
</tr>
</thead>
</table>
8. Calibration

8.1. Calibration principle

Fig. 1 shows the calibration principle. As the graph shows, the relationship between consistency and the measurement signal by the sensor is not linear and it differs for different pulp types.

The calibration curves, determined experimentally in Metso’s laboratory, represent consistency (% Cs) as a function of the measurement signal. The transmitter produces accurate consistency readings by compensating the detected signal with the information from a calibration curve.

Metso Automation recommends calibrating the device when setting it up, in order to optimize the device settings for the conditions in which it will be used. Perform calibration by taking a consistency sample and entering its laboratory value into the transmitter, as instructed further.

The transmitter should be calibrated for each pulp type used. You can save calibrations for 4 pulps in the TCU memory.

When the consistency transmitter knows the pulp recipe, it can accurately convert measured signal to % Cs.

You can save 1 - 4 recipes for different pulp types in the TCU memory. The desired calibration can be activated either directly from the transmitter or with remote selection through binary inputs or HART®. Calibrations and other operations are carried out through menus, no mechanical settings or changes are needed. Calibration data is preserved in memory even if power is switched off.

8.2. Requirements for good calibration result

IMPORTANT: To get as good calibration result and following measurement performance as possible there are some vital points that must be followed:

1. The transmitter must be installed according to supplier’s instructions.
2. Give the transmitter time to warm up to an ambient temperature.
3. The process should run as stable as possible, with a normal flow, temperature and consistency level. This gives the best conditions for an accurate calibration.
4. A sampler specifically designed for taking pulp samples must be installed close to the transmitter.
5. To eliminate human error, use a predefined standard how to take samples, how to handle the sample and how to determine the lab consistency.

Please contact your Metso representative if you need help or further advice.
8.3. Calibration methods

Consistency pulp responses of the measurement signal are following the power-law function: \( C_s = A \times x^B \). The device enables adjusting the offset value being a parameter \( C \) in a calculation formula: \( C_s = A \times x^B + C \).

IMPORTANT: Metso always recommends calibration with a pulp sample defined by a laboratory, then adjusting the offset value (\( C \)) is not required.

Single-point calibration

Select a pulp type, this defines the coefficient \( A \) for that specific. The pulp type used in the single point calibration defines the parameter's \( b \) value.

In most cases single-point calibration is sufficient for consistency control applications.

Two-point calibration

In the two-point calibration the same calculation formula than in the single point calibration is used, where the coefficients \( A \) and \( B \) are calculated according to the selected laboratory points. In this calibration 2 laboratory sample points are needed.

IMPORTANT: In two-point calibration the difference between the consistency points must be at least 25 %, calculated from the lower point. This ensures that possible errors in sampling and consistency analysis will not have a noticeable effect on the slope of the curve. The transmitter will alert the operator when an attempt is made to calibrate using points whose consistency difference is less than 25 %.

Two-point calibration is recommended in cases when accurate measurement is needed over a wide measuring range, when calibrating a pulp mix or pulp type that does not have a predefined calibration curve in the menu.

---

**Fig. 2. Single-point and two-point calibration.**
### 8.4. Creating a recipe

In the Main result display press "Esc".

<table>
<thead>
<tr>
<th>Tag</th>
<th>Recipe 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cs (PV)</td>
<td>= 2.51</td>
</tr>
<tr>
<td>Status</td>
<td>= OK</td>
</tr>
</tbody>
</table>

Select "2" (Calibration).

1 = Configuration  
2 = Calibration  
3 = Diagnostics

Select "1" (Recipe).

1=Recipe  
2=Sample history  
3=Calibrate  
4=Calib. history

Select 1 - 4 for the wanted recipe. In this example we use recipe 1.

1=Recipe1 [GW ] *  
2=Recipe2 [TMP ]  
3=Recipe3 [CTMP]  
4=Recipe4 [SW ]

Press "Edit/Save" to start editing.

**Pulp type:** Select the correct one with arrows keys. The next section shows all the possible types, select the type that is closest to your process. "Pulp type" is the only setting needed for a normal calibration.

When the settings are done press "Edit/save" to save them, press "Esc" to go to the main menu.

<table>
<thead>
<tr>
<th>Recipe</th>
<th>= 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulp Type</td>
<td>= GW</td>
</tr>
<tr>
<td>A (Gain)</td>
<td>= 2.2800</td>
</tr>
<tr>
<td>B (Exp)</td>
<td>= 1.2500</td>
</tr>
<tr>
<td>C (Offset)</td>
<td>= 0.0000</td>
</tr>
</tbody>
</table>

**Pulp type**

There are several predefined calibration curves available for the most common pulp types. These curves have been determined experimentally in Metso Automation’s laboratory. The available pulp types are:

- **GW:** Groundwood, including pressure groundwood.
- **TMP:** Thermomechanical pulp.
- **CTMP:** Chemi-thermomechanical pulp.
- **SW:** Bleached softwood chemical pulp, e.g. pine and other softwood pulps.
- **HW:** Bleached hardwood chemical pulp, e.g. birch pulp or eucalyptus, bagasse and other agro fibers.

There is one calculation mode for special purposes:

- **Other:** User can specify own values if required predefined calibration not available. Default values: A = 1.000, B = 1.000, C = 0.000.
8.5. Collecting lab samples

In the "Main result display" press "Sample".

<table>
<thead>
<tr>
<th>Tag</th>
<th>Recipe 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cs (PV)</td>
<td>2.51 Cs</td>
</tr>
<tr>
<td>Status</td>
<td>OK</td>
</tr>
</tbody>
</table>

Press again "Sample" to start storing the transmitter value. Collect the sample from the process at the same time, for a laboratory evaluation.

Press "Sample" when sample collecting is done. The display shows the "Average Cs" value and the Min. & Max. Cs values during sampling.

Ready 03.12.2011 16:24:10
Average Cs =2.51%
Min:2.45 Max:2.57

Press "Enter" to store the value in the transmitter memory or press "Esc" to discard the sample.

Average Cs=2.51%
Min:2.45 Max:2.57
Saved.

After pressing "Enter" press "Esc" to exit from sampling mode.

8.6. Entering the lab value

Press "2" (Sample history) to enter the consistency value determined at lab.

<table>
<thead>
<tr>
<th>1=Recipe</th>
<th>2=Sample history</th>
<th>3=Calibrate</th>
<th>4=Calib. history</th>
</tr>
</thead>
</table>

Select the correct recipe. The number [0] indicates how many samples have been stored in the recipe. The active recipe is indicated by an asterisk ( * ) at the end of the line.

Use arrows up/down to scroll between the sample information. If more than one sample has been stored, press "Enter" or use the left/right arrows to scroll between samples.

The display below shows sample number 1 of 4 stored samples. Press "Edit/Save" to enter the lab consistency ("Meas") value. Save the value by pressing "Edit/Save". Press "Esc" to leave "Sample history".

Rec 1 GW 1/4
15.9.2009 14:15:55
Cs =1.25 %Cs
Lab Cs =0.00 %Cs
8.7. Calibrating

Press "3" (Calibrate) in the Calibration menu.

1 = Recipe
2 = Sample history
3 = Calibrate
4 = Calib. history

• [1/2] indicates that both single-point and two-point calibrations are possible.
• [1] indicates that only a single-point calibration is possible.

Select the recipe to be calibrated.

1 = Recipe 1 [1/2]
2 = Recipe 2 [1/2]
3 = Recipe 3 [1]
4 = Recipe 4 [-]

A single-point calibration requires at least one stored transmitter value and corresponding lab value. A two-point calibration requires at least two stored transmitter values and corresponding lab values. Scroll between the samples with up/down arrows, if more than one sample is stored.

Press "Enter" when the correct sample is in the display. Now the first sample is fixed for the calibration.

Recipe 1 calibration
Select sample 1:
03.12.2011 16:24:10
Cs = 0.00 Lab = 0.00

For a two-point calibration select a second sample (use up/down arrows). To proceed with single-point calibration press "Enter".

Recipe 1 calibration
Select sample 2:
Single-point calib.
No sample 1

If the values of constants A and/or B look too low/high, or if the difference between the two samples is less than 25% of the consistency level, the display will show a message of the possible error, but you can still choose to accept the calibration. If the values are extremely low or high, the calibration parameters will not be accepted.

Press "Enter" to accept the values. The transmitter is now calibrated and operates with the new calibration settings.

8.8. Calibration history

Press "4" for the calibration history in the Calibration menu.

The following display will appear:

1 = Recipe
2 = Sample history
3 = Calibrate
4 = Calib. history

When a recipe is selected, information on the latest calibration will be shown:

Recipe 1 1/2
15.11.2011 14:15:55
A = 3.00 B = 1.35 C = 0.00
1-point calibration
9. Diagnostics

9.1. TCU diagnostics
Press "3" in "Main menu" to access the diagnostics functions.

1=Logs  
2=Diag. limits  
3=Meas values  
4=Led current  
5=Current outputs

9.2. Logs
Press "1" for the "Logs" menu.

1=Event log  
2=Config. trend  
3=Clear trend  
4=Clear sample logs  
5=Clear cabl. logs  
6=Clear event log

Event log
Event log contains the 15 most recent events. You can view events by pressing "Enter" or up/down keys.

Error log: The event index and the number of events stored in the event log.

The starting and ending times of the events are shown in the next two lines. If the event is still on or if the ending time was not detected, the ending timestamp is shown as '--.--.--:--:--'.

The message "Shutdown" in the place of the event state end time indicates that the event state was on when power was shut down. If the event state is still on when the power is switched on next time, the event is reported as a new event.

Error: A text describing the event.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.11.2011</td>
<td>01:14:47</td>
<td>37?</td>
</tr>
<tr>
<td>27.11.2011</td>
<td>01:27:55</td>
<td>xxxx</td>
</tr>
</tbody>
</table>

Config trend
The display shows the trend interval (1 min, 2 min, 5 min, 10 min, 30 min), which is used as a time stamp in the trend table and for calibration samples.

Clear trend
In this display you can clear the trend interval by pressing "Enter", “Esc” cancels the function.

Clear sample/calib logs
In these displays you can clear one sample/calibration log at a time by pressing "1" - "4" keys or clear all sample logs by pressing "0".

Clear event log
In this display you can clear the event log by pressing "Enter", "Esc" cancels the function.
9.3. Diag. limits
In this display you can set alarm limits for the self-diagnostics measurements (measurement values, compensations channel signal, electronics temperature, and LED current).

**VRfact**: Factory tuned parameter for reference channel; cannot be edited by end user.

<table>
<thead>
<tr>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meas High</td>
</tr>
<tr>
<td>Meas Low</td>
</tr>
<tr>
<td>VComp High</td>
</tr>
<tr>
<td>VComp Low</td>
</tr>
<tr>
<td>E1 Temp High</td>
</tr>
<tr>
<td>LED Error Cur</td>
</tr>
<tr>
<td>LED Warn.Cur</td>
</tr>
<tr>
<td>VRfact</td>
</tr>
</tbody>
</table>

9.4. Meas. values
This display shows the measured sample results (mV) and linearized values for the different measurement signals.

**Measured mV**: Meas, M_STD, VComp, ...measured raw values (mV).

**Lin**: Meas, M_STD, VComp, ... linearized (calculated) values.

<table>
<thead>
<tr>
<th>Measured mV: Lin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meas : 1375 1.372</td>
</tr>
<tr>
<td>M_STD : 297 0.285</td>
</tr>
<tr>
<td>VComp : 2348 2.344</td>
</tr>
</tbody>
</table>

9.5. Led
This display shows the control current to the LED.

<table>
<thead>
<tr>
<th>Currents in mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Led : 46.01</td>
</tr>
</tbody>
</table>

9.6. Current output
Press "5" in the "Diagnostics" menu for the "Current output" menu.

- **mA-looptest**
  1, 2: Select Looptest Output1/Output2.

<table>
<thead>
<tr>
<th>mA-looptest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1=Trim Output1</td>
</tr>
<tr>
<td>2=Trim Output2</td>
</tr>
</tbody>
</table>

Looptest locks the output signal to 4 mA, 20 mA, hold (present) value, or some other user-defined value. It can be used to check the cabling and current measuring circuits.

- **Output1/2**: When this display is activated, the analog output is frozen to its present value, shown here.
  - 1: Set the analog output1/2 to 4 mA.
  - 2: Set the analog output1/2 to 20 mA.
- **Up/Down**: Increase/decrease the analog output value with the Up/Down keys.

| Output1 = 3.9 mA               |
| 1 = Set to 4 mA                |
| 2 = Set to 20 mA               |
| Up/Down = modify               |
Trim mA
1, 2: Select Trim Output1/Output2.

1 = Trim Output1
2 = Trim Output2

Reset trim output
1, 2: Select Reset trim output1/output2.

1 = Reset Trim Output1
2 = Reset Trim Output2

This function requires that you connect an ammeter to the transmitter’s analog output. The transmitter will first send a 4 mA signal to the analog output. Measure the actual current value and enter it to the device by changing the "Actual" value.

- **Output1/2**: The analog output is frozen to its present value, shown here.
- **Actual**: Enter the measured value in the Edit mode.
- **Enter**: Accept the value.

Output1 set to 4 mA
Actual = 4.009 mA

ENTER = Accept

Then the transmitter sends a 20 mA signal to the analog output. Measure the actual current value and change it in the same way as for the 4 mA signal.

Output2 set to 20 mA
Actual = 20.909 mA

ENTER = Accept
9.7. Error messages / warnings

Errors can be categorized into groups:
- TCU errors,
- transmitter errors,
- measurement errors, and
- errors in communication between TCU and transmitter.

In error situations the following status messages are used:
- WARNING: No effect to output signal. Some service action is required to correct the problem.
- FAILSAFE: Serious error. Output signal set to State "fail Safe". State can be set in menu "Configuration" - "Output signal".
- INFO: Informative message. No effect on output signal.

Error messages can be viewed on the TCU, "Diagnostics/Event Log" display.

FAILSAFE messages:
- SENSOR COMMUNICATION FAIL: Serial communication Error between TCU and sensor.

TCU EEPROM ERROR: TCU EEPROM can't write or read.

LED CURRENT TOO HIGH: LED current is over the limit.
If VComp < VRfact:
- reference fiber broken.
- LED broken.
- reference detector broken.
- Sensor board broken.
If VComp > VRfact:
- Reference detector broken.
- Sensor board broken.

WARNING messages:
- ELECT OUT OF LIMITS: Electronics Temperature is over the measurement limit. -> Check maximum value (Main menu / 3=Diagnostics / 2=Diag. limits).
- SENSOR RESTART: Sensor boot-up process is active. -> Wait until restarted.
- CLOCK WARNING: TCU clock error.
  - Real time clock can't read. -> Set the clock (Main menu / 1=Configuration / 6=Set clock).
- CLOCK NOT SET: TCU clock time not checked, still in the factory time zone. -> Set the clock (Main menu / 1=Configuration / 6=Set clock).
- ANALOG OUTPUT1 SATURATED: Current output1 saturated.
- ANALOG OUTPUT1 FIXED: Fixed current value set to current output.
- ANALOG OUTPUT2 SATURATED: Current output2 saturated.
- ANALOG OUTPUT2 FIXED: Fixed current value set to current output.
- LED CURRENT WARNING: LED current is at the warning limit. -> Check the value (Main menu / 3=Diagnostics / 2=Diag. limits). Preventive maintenance recommended.
10. Service

10.1. Sensor probe replacement

Needed tools:
– 24 mm open end spanner.
– Calibration plate, K10772.

10.2. Removing sensor probe assembly

1. Open the optical unit cover, by pressing the black lever in the right side of the box (Fig. 1, A).
2. Unplug the detector and LED cable assembly from the circuit board, 3 pcs (Fig. 2, B).
3. Open the cable mounts by pressing the lever (Fig. 3, C), 3 pcs.
4. Open the compression nut of the left cable gland (Fig. 4, D). Pull the optical fiber (E) inside the optical unit until the reference fiber (F) is all the way in. The reference fiber must be straight while it is pulled in through the hole!

NOTE: No tight bends allowed!

5. Use a 24 mm spanner to remove the left cable gland from the optical unit box.
6. Thread the optical fiber out from the optical unit, all the time keeping the optical fiber straight and close against the thicker cable to protect it from bending (Fig. 4, step b).

Fig. 1. A. Black lever.

Fig. 2. B. Detector and LED cables.

Fig. 3. C. Cable mounts.

Fig. 4. D. Cable gland, E. optical fiber, F. reference fiber.
10.3. Installing sensor probe assembly

1. Thread the optical fiber inside the optical unit.
2. Pull the cable gland towards the sensor probe. The reference fiber must be straight when moved through the cable gland hole in the optical unit.
3. Set the new fiber to the same positions as previous cable was installed. If you need to change the cable mounting position, you need to break the old and install the new one to a correct position. There are spare cable mounts in the spare parts sensor assembly.
4. Install and tighten the cable gland. A spanner of 24 mm is needed.
5. Set the SMA-connectors to the cable mounts (Fig. 3, C) and close it.
6. Plug the detector and LED cable assemblies to a correct position.
7. Check and tune measurement signal. See the next section "Normalization".

10.4. Normalization

1. Take the sensor probe out of the process. See the next section "Metso OC Sensor uninstallation".
2. Set the calibration plate to the tip of the sensor probe, Fig. 5. Keep the sensor probe in upright position. Do not press the calibration plate against the probe, just hold it still.
3. Go to the diagnostics menu in Metso OC TCU by pressing "ESC" in the main display. Then select "3=Diagnostics" -> "4=Meas values".
4. "Meas Lin value" should be 0.450 V ± 5 mV.
5. If the value needs to be tuned, go to Normalization function: In TCU main display press "1213" -> "Factory testing " -› "Normalization". Follow the instructions on TCU display.
6. Open the optical unit cover by pressing the black lever in the right side of the box (Fig. 1, A).
7. Adjust voltage by trimmer TR2 (Fig. 6, F) until the target voltage is reached. During tuning the calibration plate must be against the tip of the sensor probe!
8. Press "Enter" to save the new VRfact value.
9. Lock the trimmer position with a drop of bonding varnish or corresponding (if available); not mandatory.
10.5. Metso OC sensor uninstallation

1. Unscrew the sensor probe locking nut.
2. Pull the sensor as far as it goes to its back position. The tip of the sensor probe should be inside of the sealing unit.
3. Close the ball valve.
4. Uninstall the sealing unit from the ball valve.

10.6. Quick functional check of the transmitter

1. Take the sensor probe out of the process. See section 10.4. "Metso OC sensor uninstallation".
2. Put the sensor tip to a water bucket or large water can. Use clean water! Consistency value should be 0.00 % Cs.
3. If water is not available, you can use pure air to test the zero value. Keep the area of about 30 cm from the head of the sensor tip clear from obstacles. Any kind of dust etc. will be seen in the measurement, so the air test is not so stable than testing with water.
   – Intensive or blinking light will disturb the measurement. Do not point to any lamp during the test.
4. By inserting a tuning jig to the tip of the sensor a higher measurement value can be tested. The value is depending on the selected pulp type and calibration.
   – If a tuning jig is not available other diffuse/reflecting material (white tissue paper) can be used instead.
10.7. Sensor Board replacement

Needed tools:
- Screwdriver PZ 1x75.
- Trimmer screwdriver.

Removing Sensor Board
1. Open the optical unit cover, by pressing the black lever in the right side of the box (Fig. 1, A).
2. Unplug the detector and LED cable assembly from the circuit board, 3 pcs (Fig. 2, B).
3. Unplug Sensor Cable (Fig. 7, G).
4. Unscrew cross head screws (Fig. 7, H), 4 pcs.
5. Remove Sensor board.

Installing Sensor Board
1. Install Sensor Board.
2. Screw in the cross head screws (Fig. 7, H), 4 pcs.
3. Plug in the Sensor Cable (Fig. 7, G).
4. Plug the detector and LED cable assembly to the circuit board, 3 pcs (Fig. 2, B).
5. Check and tune the measurement signal; see instructions in section "Normalization".

Fig. 7. Installing Sensor board.
## Metso Optical Consistency Transmitter - Spare parts

* Recommended spare parts with one unit installed  
** Recommended spare parts when several units are installed at the mill

<table>
<thead>
<tr>
<th><strong>Circuit board, Sensor electronics</strong></th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>K10204 Optical Platform CPU Board</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Seal Set, contains the following parts:</strong></th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-Ring, 12.3x2.4, Viton (K10122)</td>
<td>1</td>
</tr>
<tr>
<td>O-Ring, 12x4.0, Viton (K08365)</td>
<td>1</td>
</tr>
<tr>
<td>O-Ring, 21x2.0, Viton (K08363)</td>
<td>1</td>
</tr>
<tr>
<td>Locking ring, Outside (K10133)</td>
<td>1</td>
</tr>
<tr>
<td>Locking ring, Inside (K10132)</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Sensor Probe</strong></th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>K09942 Sensor Probe Assembly, OC</td>
<td>1</td>
</tr>
<tr>
<td>K10681 Sensor Probe Assembly, OCLX</td>
<td>1</td>
</tr>
<tr>
<td>K11006 10 m Sensor Probe Assembly, OC</td>
<td>1</td>
</tr>
<tr>
<td>K11011 10 m Sensor Probe Assembly, OCLX</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Sensor Cable Assemblies</strong></th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>K10662 Measurement Detector Cable Assembly</td>
<td>1</td>
</tr>
<tr>
<td>K10665 Reference Detector Cable Assembly</td>
<td>1</td>
</tr>
<tr>
<td>K10658 LED Cable Assembly</td>
<td>1</td>
</tr>
<tr>
<td>K03463 Programming Cable RS232</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Operating units</strong></th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>K10171 Metso OC Optical TCU</td>
<td>1</td>
</tr>
<tr>
<td>K10202 Operating unit, TCU (Metso OC)</td>
<td>1</td>
</tr>
<tr>
<td>QUL00284 Keyboard TCU</td>
<td>1</td>
</tr>
<tr>
<td>K10207 TCU Board (Metso OC)</td>
<td>1</td>
</tr>
<tr>
<td>K11335 Metso OC Optical TCU PA</td>
<td>1</td>
</tr>
<tr>
<td>K11340 Operating unit, TCU (Metso OC) PA</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Special Tool Kit</strong></th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>K10772 Calibration Plate</td>
<td>1</td>
</tr>
<tr>
<td>K11341 Head locking removal tool</td>
<td>1</td>
</tr>
</tbody>
</table>

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**Metso Optical Consistency Transmitter**

**Sensor part**
- Optical based transmitter for pulp consistency measurement in pulp and paper industry.
- Metso OC version for new installation.
- Metso OCLX version for replacement for smartLX sensor.

**Measurement**
- Measuring range: 0.5–7 % Cs
- Span minimum: 0.5 % Cs
- Repeatability: ± 0.01 % Cs
- Sensitivity: 0.002 % Cs
- Damping: adjustable, 1–60 sec

**Materials**
- Enclosure: Polycarbonate
- Wetted parts: AISI 316L
- O-ring material: VITON

**Process conditions**
- Temperature: 0 to +120°C (+32 to +248°F)
- Flow velocity: From 0.3 m/sec, Turbulent mass flow
- pH: 3–10
- Pressure rating: PN25/363 lbs
- Vibration: max. 2G (20 m/s²), 10–2000 Hz

**Environment**
- Ambient temperature: -20 to +60°C (-4 to +140°F)
- Temp. during storage: -50 to +80°C (-50 to +176°F)

**EMC test standards**
- Radiated interference: IEC 61000-6-2
- Interference immunity: IEC 61000-6-4

**Weight**
- Sensor + Optical TCU: 3.9 kg (8.6 lbs)
Metso Optical Consistency Transmitter

Metso OC Optical TCU

Connections
TCU to Optical Unit .......... length 0.7 m (2.3 ft)
- option ........................ length 10 m (33 ft)
- option ........................ length 30 m (100 ft)

Optical cable ............... length 5 m (16.5 ft)
- option ........................ length 10 m (33 ft)

Operating power
- TCU ......................... 90–260 VAC / 25 W

Connections to mill system
- Analog outputs .......... 2 current outputs, 4–20 mA; second output configurable
- HART® ........................ 12–35 VDC
- Binary inputs ............. 2 inputs, galvanically isolated
  12–28 VDC / 10 mA

PROFIBUS PA Slave (option)
IEC 61158-2
- Profibus power supply ... taken from the bus
- Bus voltage ............... 9–32 VDC, reverse polarity protection
- Max. basic current ....... 14.2 mA

Connections to PC (configuration & diagnostics)
- DTM ......................... HART®
- PC-connection (service) . RS-232

Environment
Ambient temperature ...... max.50°C (max.122°F)
Enclosure class .......... IP65 (NEMA 4)
Vibration
- TCU + Optical Unit ...... max. 1 G (10 m/s²), 10–2000 Hz

Weights
TCU ......................... 2 kg (4.4 lbs)
TCU + Optical Unit ....... 3 kg (6.6 lbs)

Dimensions

Options

TCU and Optical Unit separated:
- 10 m Sensor Cable (K11079)
- 30 m Sensor Cable (K11081)
- 10 m Optical Fiber

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