Point Level Transmitters

Pointek CLS200 (Standard)

Functional Safety Manual · 02/2015

Milltronics

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Pointek

Level Instruments

Functional safety for Pointek CLS200 Standard

Product Information

Pointek CLS200 Standard:

7ML5630-xxxxx-xxx0-Z C20
7ML5631-xxxxx-xxx0-Z C20
7ML5632-xxxxx-xxx0-Z C20
7ML5633-xxxxx-xxx0-Z C20
7ML5634-xxxxx-xxx0-Z C20

Ordering Number: **A5E35637149**
02/2015

Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

Danger

indicates that death or severe personal injury **will** result if proper precautions are not taken.

Warning

indicates that death or severe personal injury **may** result if proper precautions are not taken.

Caution

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

Caution

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

Notice

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

Warning

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

Trademarks

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Disclaimer of liability

While we have verified the contents of this manual for agreement with the hardware and software described, variations remain possible. Thus we cannot guarantee full agreement. The contents of this manual are regularly reviewed and corrections are included in subsequent editions. We welcome all suggestions for improvement.

Table of contents

1

1 Introduction

1.1 Safety Manual Revision History

Revision*	Document Part Number	Release Date	Revision Comments
AA	A5E35637149	02/2015	Initial Release

* See Operating Instructions for additional revision information.

1.2 General

The following table lists all available Pointek CLS200 Standard models:

Product Number
7ML5630-xxxxx-xxx0 -Z C20
7ML5631-xxxxx-xxx0 -Z C20
7ML5632-xxxxx-xxx0 -Z C20
7ML5633-xxxxx-xxx0 -Z C20
7ML5634-xxxxx-xxx0 -Z C20

The term CLS200 Standard is used in the following text for all device models.

1.3 Purpose of this document

This document contains information and safety instructions required when using the CLS200 Standard in safety-instrumented systems.

It is aimed at system planners, plant managers, service and maintenance engineers and personnel who will commission the device.

1.4 Required documentation

This document deals with the Pointek CLS200 Standard exclusively as part of a safety function. This document only applies in conjunction with the following documentation:

Name	Order No*
Pointek CLS200/CLS300 (Standard) – Operating Instructions	7ML19985JH04 (English) 7ML19985JH34 (German)

* Operating Instructions are located at the following web site:
https://www.siemens.com/level

More information

Information

The contents of these instructions shall not become part of or modify any prior or existing agreement, commitment, or legal relationship. All obligations on the part of Siemens AG are contained in the respective sales contract which also contains the complete and solely applicable warranty conditions. Any statements contained herein do not create new warranties or modify the existing warranty.

The content reflects the technical status at the time of printing. We reserve the right to make technical changes in the course of further development.

Siemens regional offices

If you need more information or have particular problems which are not covered sufficiently by the operating instructions, contact your local Siemens Regional Office. You will find the address of your local Siemens Regional Office on the Internet at https://www.siemens.com/processinstrumentation under the tab **Contacts and Partners**.

Product information on the Internet

The Operating Instructions are on the supplied CD and are also available on the Siemens Level homepage on the Internet: https://www.siemens.com/level

On the supplied CD, you will also find the product catalog sheet containing the ordering data, the Device Install software for SIMATIC PDM for subsequent installation, and the generic station description (GSD).

See also

Siemens Regional Offices
(https://www.siemens.com/processinstrumentation) under the tab **Contact**

Product information and Operating Instructions on the Internet

(https://www.siemens.com/level)

Functional Safety (SIL) Information on the internet

(https://www.siemens.com/SIL)

2

2 General safety instructions

2.1 Safety-instrumented system (SIS)

Description

A safety-instrumented system used to implement one or more safety-instrumented functions. A SIS is composed of any combination of sensor, logic solvers or control systems (PLCs), and final elements.

Control system

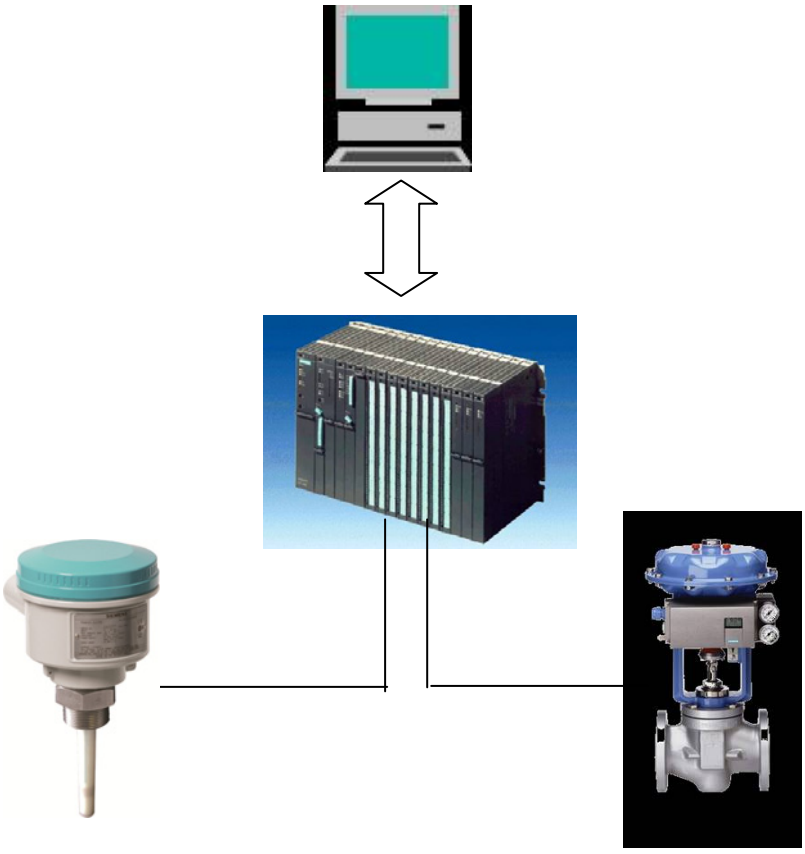


Figure 2-1: Example of a safety-instrumented system

Device operation

The CLS200 Standard is a point level measuring instrument. When the probe becomes covered in process material the output relay (K2) and the solid-state switch (K3) change state. The safety PLC monitors the state of the relay or solid-state switch to perform a specified action based on the level measurement (example: bring the valve to the defined safe position).

2.2 Safety Integrity Level (SIL)

Definition: SIL

The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL) from SIL 1 to SIL 4. Each level corresponds to the probability range for the failure in a safety function.

The higher the level of safety integrity of the safety-related system, the lower the probability that the safety-related system will fail to carry out the required safety function.

The achievable SIL is determined by the following safety characteristics:

- Average probability of dangerous failure of a safety function in case of demand (PFD_{AVG})
- Hardware fault tolerance (HFT)
- Safe failure fraction (SFF)

Description

The following table shows the dependency of the SIL on the “average probability of dangerous failure of a safety function of the entire safety-instrumented system” (PFD_{AVG}). The table deals with “Low demand mode,” i.e. the safety function is required to act a maximum of once per year on average.

Table 2-1 Safety Integrity Level

SIL	PFD_{AVG}
4	$10^{-5} \leq PFD_{AVG} < 10^{-4}$
3	$10^{-4} \leq PFD_{AVG} < 10^{-3}$
2	$10^{-3} \leq PFD_{AVG} < 10^{-2}$
1	$10^{-2} \leq PFD_{AVG} < 10^{-1}$

The “average probability of dangerous failures of the entire safety instrumented system” (PFD_{AVG}) is normally split between the three subsystems in the following figure.

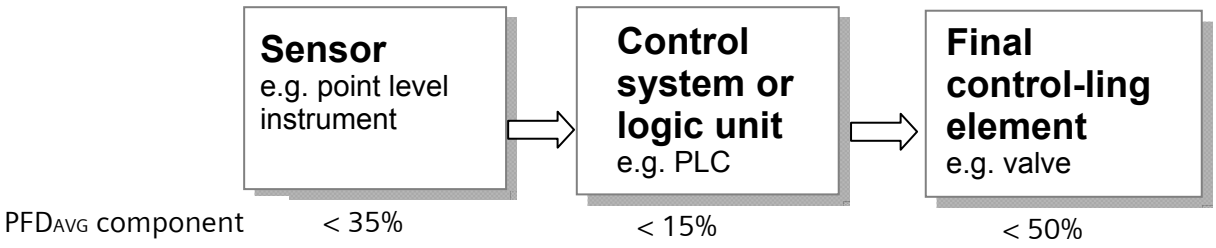


Figure 2-2 Example of PFD distribution

The following table shows the achievable Safety Integrity Level (SIL) for the entire safety-instrumented system for type A subsystems depending on the safe failure fraction (SFF) and the hardware fault tolerance (HFT). Type A subsystems include devices for which the failure modes of all constituent components are well known and the behaviour of the element under fault conditions can be completely determined (see also IEC 61508, *Section 2*).

SFF	**HFT**		
	0	**1**	**2**
< 60 %	SIL 1	SIL 2	SIL 3
60 to 90 %	SIL 2	SIL 3	SIL 4
90 to 99 %	SIL 3	SIL 4	SIL 4
> 99 %	SIL 3	SIL 4	SIL 4

3 Device-specific safety instructions

3.1 Applications

The CLS200 Standard is suitable for use in a safety instrumented function of Safety Integrity Level (SIL) 2 with a low demand mode 1oo1 architecture.

The proven in-use-assessment was carried out by RISKNOWLOGY according to IEC 61508 / IEC 61511. Product revisions will be carried out by the manufacturer in accordance with IEC 61508.

3.2 Safety function

Overfill detection is the Safety Function for the CLS200 Standard. The relay output (K2) or the solid-state switch (K3) may be used as part of a safety instrumented function (SIF), but not both.

The difference in capacitance between an uncovered probe and a covered probe (for example, between a probe in air and a probe in water) is used to detect level, and to protect the process from a level that is too high. The output (relay K2 or solid-state switch K3) de-energizes when the change in capacitance is greater than the setting at the trip point. This causes the control system to bring the process into a safe state.

The trip point is set by potentiometer P2. This determines how large the difference in capacitance needs to be before the output is switched.

When the probe is covered, indicating an overfill condition, the relay and solid-state switch are de-energized:

- Relay contact between K2 pins 1 and 2 is open (recommended)
- Relay contact between K2 pins 2 and 3 is closed
- Solid-state switch between K3 pins 1 and 2 is open

Note The normally closed relay contact between K2 pins 2 and 3 may be used, but this will mean that if power to the device is lost or an alarm condition occurs, the contact will be closed.

Warning

The settings and conditions listed in the "*Settings*" and "*Safety characteristics*" sections of this document must be met for the safety function specification to be valid.

The failure rates, SFF and PFD_{AVG} published in the SIL Declaration of Conformity are only valid for 10 years of operation.

Reference

Required documentation (Chapter 1.4)

See also

Settings (Chapter 3.4)

3.3 Application restrictions

Installation and configuration of the CLS200 Standard must be completed following the instructions detailed in the Setup Procedure in this manual (see *Chapter 3.4*). All application limitations and restrictions described in that manual must be observed. In addition:

- When the device is mounted in a vertical or diagonal position the maximum trip point level will be at the level where 100 mm of the probe is covered in material.
- When the device is mounted horizontally in the process the maximum trip point level will be when the process material is 50 mm above the top surface of the probe.

3.4 Settings

When commissioning in line with the device manual, the following device settings shall be made when the device is used as part of a SIF:

Setup Procedure

The following steps outline the setup procedure for the CLS200 Standard for overfill detection:

1. Set up the dip switches on the device to the following values:

Switch	Setting	Comment
S1	On (rocker up)	Disables delay of alarm de-activation (alarm OFF)
S2	On (rocker up)	Disables delay of alarm activation (alarm ON)
S3	On (rocker up)	Sets device to high alarm / overfill protection
S4	Off (rocker down)	Test delay settings disabled
S5	On (rocker up)	Setup mode enabled

2. Turn potentiometer P1 fully counter clockwise.
3. Bring the process material to a level that is at least 250 mm below the lowest surface of the probe.
4. If the yellow Light Emitting Diode (LED), L1, is on skip to step 6.
5. Turn potentiometer P2 counter clockwise until the yellow LED, L1, is on.

6. Slowly turn potentiometer P2 clockwise until the yellow LED, L1, just turns off.
7. Set dip switch S5 to the off position (rocker down) to enable run mode.

Safety parameters

During device operation please ensure the switch bank on the CLS200 Standard is set to the following values:

Switch	Setting	Comment
S1	On (rocker up)	Disables delay of alarm de-activation (alarm OFF)
S2	On (rocker up)	Disables delay of alarm activation (alarm ON)
S3	On (rocker up)	Sets device to high alarm / overfill protection
S4	Off (rocker down)	Test delay settings disabled
S5	Off (rocker down)	Run mode enabled

Also ensure that potentiometer P1 is turned fully counter-clockwise.

Reference

Required documentation (see *Chapter 1.4*)

Protection against configuration changes

After configuration, fix the housing cover on the CLS200 Standard so that the device is protected against unwanted and unauthorized changes/operation.

Checking the safety function after installation

After installation of the CLS200 Standard, a safety function proof test must be carried out (see *Chapter 3.6*).

3.5 Behavior in case of faults

Fault

The procedure in case of faults is described in the device Operating Instructions.

Repairs

Defective devices should be sent to the Repair Department with details of the fault and the cause. When ordering replacement devices, please specify the serial number of the original device. The serial number can be found on the nameplate.

See also

Services & Support (https://www.siemens.com/automation/services&support)

Partner (https://www.automation.siemens.com/partner)

3.6 Maintenance/Testing

Interval

We recommend that the functioning of the level transmitter be checked at regular intervals of one year.

Functional test

To ensure the proper operation of the CLS200 Standard, we recommend that the basic functions of the CLS200 Standard are tested as described below:

1. Ensure that the process material is at least 250 mm below the lowest surface of the probe. Verify that the relay output or the solid-state switch is in the energized state.
    - Note that the process material level required for the probe to indicate uncovered will vary depending on the user specific installation.
    - The probe is considered uncovered when the yellow LED, L1, is off with the settings described in this manual.
2. Bring the process material level up to cover the probe and verify that the relay output or the solid-switch is in the de-energized state.
    - When the device is mounted in a vertical or diagonal position the trip point level shall be at the level where 100mm of the probe is covered in material or lower.
    - When the device is mounted horizontally in the process the trip point level shall be when the process material is 50 mm above the top surface of the probe or lower.
    - The probe is considered covered when the yellow LED, L1, is on with the settings described in this manual.

Functional safety proof test

To reveal possible undetected faults of the safety function, the entire SIF shall be tested according to IEC 61508 or 61511.

To reveal dangerous undetected faults the CLS200 Standard relay or solid-state switch output shall be tested using the following procedure:

Step	Action
1	Bypass the safety PLC or take other appropriate action to avoid a false trip.
2	Inspect the product for signs of physical damage/defects or loose parts and replace/repair product as required.
3	Inspect the probe of the device for and verify that no build up of material has occurred. Clean the probe if necessary according to the Operating Instructions. Note that the probe will trip earlier than expected when there is material build up so this step will help reduce the likelihood of nuisance trips.
4	Perform the “Functional Test” as described in the section above.
8	Restore the loop to full operation.
9	Remove the bypass from the safety PLC or otherwise restore normal operation.

Table 3-1 Steps for Proof Test

The proof test interval (TI) is specified for the failure rate calculation of each individual SIF in a system (PFD_{AVG}). We recommend the Proof Test be performed at least once per year.

The Internet Product Page (https://www.siemens.com/pointekcls200) will be used to communicate additional Safety Information, and should be checked regularly.

3.7 Safety characteristics

The safety characteristics necessary for use of the system are listed in the SIL declaration of conformity. These values apply under the following conditions:

- The CLS200 Standard is only used for overfill protection in safety related applications.
- The CLS200 Standard is only used in safety-related systems with a low demand mode for the SIF.
- The safety-related settings (see *Settings* section) have been entered by local operation and checked before commencing safety-instrumented operation. The DIP switches must be in the safety positions described in the "Safety Parameters" section of chapter 3.4.
- The CLS200 Standard is blocked against unwanted and unauthorized changes / operation.
- The listed failure rates are valid for operating stress conditions typical of an industrial field environment similar to IEC 60654-1 class C with an average temperature over a long period of time of 40°C. For a higher average temperature of 60°C, the failure rates should be multiplied with an experience based factor of 2.5. A similar multiplier should be used if frequent temperature fluctuation must be assumed.
- All used materials are compatible with process conditions.

- Using the CLS200 Standard correctly there are no known wear out mechanisms. The minimum lifetime of the relay output is 50,000 switching cycles.
- The MTTR after a device fault is 8 hours.
- The logic solver (PLC) has to be configured to detect one of the following conditions as an overfill condition:
  - Relay contact between K2 pins 1 and 2 is open (recommended)
  - Relay contact between K2 pins 2 and 3 is closed
  - Solid-state switch between K3 pins 1 and 2 is open

- A dangerous failure of the CLS200 Standard is a failure where the safety position is not activated, (high level alarm). The output relay stays on while the sensor is covered.

See also

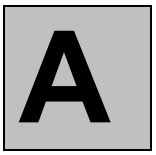
Settings (Chapter 3.4)

SIL Declaration of Conformity on the Internet Product Page (https://www.siemens.com/pointekcls200).

Go to Support > Approvals / Certificates.

https://www.siemens.com/SIL

A List of Abbreviations/Acronyms



A.1 Abbreviations

Abbrev-iation	Full term in English	Meaning
FIT	Failures in Time	Failure rates have the dimension one over time. Failure rates are specified in FIT (Failures in Time), ie. the number of failures in 10^9 component hours.
HFT	Hardware Fault Tolerance	Hardware fault tolerance: Capability of a function unit to continue executing a required function in the presence of faults or deviations.
LED	Light Emitting Diode	
MooN	"M out of N" voting	In terms of redundancy and the selection procedure used: A safety-instrumented system, or part of a system, that consists of “N” independent channels. The channels are connected to each other in such a way that “M” channels are in each case sufficient to perform the safety-instrumented function. **Example**: Pressure measurement: 1oo2 architecture. A safety instrumented system decides that a specified pressure limit has been exceeded if one out of two pressure sensors reaches this limit. In a 1oo1 architecture, there is only one pressure sensor.
MTBF	Mean Time Between Failures	Average period between two failures.
MTTR	Mean Time To Restoration	Average period between the occurrence of a fault on a device or system and the repair.
PFD	Probability of Failure on Demand	Probability of dangerous failures of a safety function on demand.
PFD_{AVG}	Average Probability of Failure on Demand	Average probability of dangerous failures of a safety function on demand.
PLC	Programmable Logic Controller	
SFF	Safe Failure Fraction	Proportion of safe failures: Proportion of failures without the potential to bring the safety instrumented system into a dangerous or not permissible functional status.
SIF	Safety Instrumented Function	A portion of a safety instrumented system consisting of a sensor, logic solver/PLC and final element used to reduce the risk of occurrence of one hazardous event.
SIL	Safety Integrity Level	The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL 1 to SIL 4). Each level corresponds to a range of probability for failure of a safety function. The higher the Safety Integrity Level of the safety-instrumented system, the lower the probability that it will not execute the required safety functions.
TI	Proof Test Interval	Interval at which the test to reveal undetected faults is performed.

Glossary

Dangerous failure

A failure with the potential to bring the safety-instrumented system into a dangerous or non-functional status.

Example:
The measurement device reports a value 10% below the actual value, preventing the safety function from acting on a value, which is too high.

Low Demand Mode

The frequency of demands for operation made on a safety related system is no greater than one per year and no greater than twice the proof-test frequency.

Safety function

Defined function of a device or system with the objective of achieving or maintaining a safe state of a system taking into account a defined dangerous occurrence.

Example:
Level/pressure/temperature measurement using 4 to 20 mA output.

Safety Integrity Level

→ SIL

Safety-instrumented system

A safety-instrumented system executes the safety functions that are required to achieve or maintain a safe status in a system. It consists of a sensor, logic solver/ control system (PLC) and final element.

Definition: Safety Instrumented Function (SIF)

A portion of a safety instrumented system consisting of a sensor, logic solver/ control system (PLC) and final element used to reduce the risk of occurrence of one hazardous event.

Example:

A safety PLC will close a valve if the measured value exceeds a specified value.

SIL

The international standard IEC 61508 defines four discrete Safety Integrity Levels (SIL) from SIL 1 to SIL 4. Each level corresponds to the probability range for the failure of a safety function. The higher the SIL of the safety-instrumented system, the higher the probability that the required safety function will work.

The achievable SIL is determined by the following safety characteristics:

- Average probability of dangerous failure of a safety function in case of demand (PFD_{AVG})
- Hardware fault tolerance (HFT)
- Safe failure fraction (SFF)

For more information

www.siemens.com/level

www.siemens.com/weighing

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