FLUID COMPONENTS INTERNATIONAL LLC

Supplemental Manual

ST100 Series Safety Instrumented System (SIS) Requirements

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ST100 Series Safety Instrumented System (SIS) Requirements

Introduction

This document describes how to configure the ST100 Series for IEC 61508 compliance in a Safety Instrumented System (SIS) application. The safety-critical output of the ST100 Series is provided through the Channel #1 4-20 mA analog output.

Compliance Through FMEDA (Failure Modes, Effects And Diagnostic Analysis)

Safety Integrity Level, Hardware Fault Tolerance:

- SIL 1, HFT = 0
- SIL 2, HFT = 1
- SIL 3, HFT = 2

Subsystem Type:

- B

ST100 Safety Identification

Verify that the ST100 Series firmware is Core Board v2.92 or higher. The firmware version can be identified via the HMI (models with Display), the ST100 configuration software or by contacting FCI directly to cross reference the unit's serial number with its firmware version as shipped. The information in this document relates to all ST100 Series flow meter configurations.

Installation in SIS Applications

Installations are to be performed by qualified personnel. No special installation is required in addition to the standard installation practices outlined in the ST100 Series IO&M (Document No. 06EN003400). Environmental and operational limits are listed in the manual's Technical Specification section.

Configuring the Instrument for SIS Application

For all safety-related applications, configure the ST100 Series flow meter in a fail-safe alarm configuration as listed below.

- Verify that materials are compatible with process conditions.
- Configure the device for fault indication per NAMUR NE43 OR the logic solver is configured to interpret 4 mA as a fault condition.
  - Low Alarm current is ≤ 3.6 mA
  - High Alarm current is ≥ 21.0 mA
  - Channel #1 4-20 mA analog output is configured for Flow
- The safety accuracy of the ST100 Series mass flow output is ±2.0% of reading and ±0.5% of full scale. Base accuracy is dependent on the process gas composition, pressure and temperature. These parameters can be found in the appropriate calibration certificate. Contact FCI if you would like to obtain a copy referenced by the unit's serial number.
- Use the password protection feature of the ST100 firmware to prevent accidental or deliberate change of process parameters and configuration data during normal operation.
- HART protocol is only used for setup, calibration, and diagnostic purposes; not for safety critical operation.

Proof Test

Use the recommended proof test described below to identify Dangerous Undetected failures in the ST100 Series thermal mass flow meter. This test consists of cycling the power, setting the output to minimum and maximum values and a calibration check. It is recommended that the proof test be performed annually at a minimum.

Recommended Proof Test

1. Bypass the safety function and take appropriate action to avoid a false trip.
2. User digital communications (HART) to retrieve any diagnostics and take appropriate action.
3. Cycle the power to the transmitter. This executes initialization checks on RAM and ROM.
4. Use the ST100 Series configuration tool to perform a ROM CRC check.
5. Use digital communications (configuration tool) to retrieve any diagnostics and take appropriate action.
6. Perform a two-point calibration of the transmitter over the full working range. If this is performed with only electrical instrumentation, this proof test will not detect any failures of the sensor that were undetected by internal diagnostics.
7. Remove the bypass and otherwise restore normal operation.

Calculation of Average Probability Of Failure On Demand (PFD_{avg})

PFD_{avg} calculation can be determined by the owner/operator of a process using the failure rate data shown in Table 1 below. Contact FCI for a copy of the FMEDA report.

Product Repair

The ST100 Series is repairable by major component replacement. All product repair and part replacement is to be performed by qualified personnel only.

ST100 Series SIS Reference

The ST100 Series must be operated in accordance to the functional and performance specifications listed in the IO&M (Document No. 06EN003400) Technical Specification section.

Failure Rate Data

The FMEDA report includes failure rates and common cause Beta factor estimates (contact FCI for a copy of the report). Table 1 below summarizes the failure rate data.

Table 1 – Failure Rates According to IEC 61508-1

Device	SFF	λ_{DU}	λ_{DD}	λ_{SU}
ST100, ST100L, ST110, STP100, STP110; AC Power Supply	79.8 %	567 FIT	1927 FIT	314 FIT
ST100, ST100L, ST110, STP100, STP110; DC Power Supply	79.9 %	570 FIT	1946 FIT	317 FIT
ST102, ST112, STP102, STP112; AC Power Supply	88.9%	415 FIT	2918 FIT	404 FIT
ST102, ST112, STP102, STP112; DC Power Supply	88.9%	418 FIT	2937 FIT	407 FIT

Terminology

SFF = Safe Failure Fraction

λ_{DU}= Failure rate dangerous undetected faults

λ_{DD}= Failure rate dangerous detected faults

λ_{SU}= Failure rate safe undetected faults

FIT= Failure rate in 10^{-9}/hour

Proof Test Coverage

Based on the Proof Test procedures recommended in this document Table 2 below shows the Total Coverage of the device based on the remaining Dangerous Undetected failures not accounted for by either the Proof Test or Internal Diagnostics (Dangerous Detected).

Table 2 – Total Coverage (Proof Test DD + Internal Diagnostics DD)

Device	SFF	Proof Test Coverage	Dangerous Detected (Proof Test)	Total Coverage
ST100, ST100L, ST110, STP100, STP110; AC Power Supply	79.8%	58%	329 FIT	91.5%
ST100, ST100L, ST110, STP100, STP110; DC Power Supply	79.9%	58%	331 FIT	91.6%
ST102, ST112, STP102, STP112; AC Power Supply	88.9%	51%	212 FIT	94.6%
ST102, ST112, STP102, STP112; DC Power Supply	88.9%	51%	213 FIT	94.6%

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