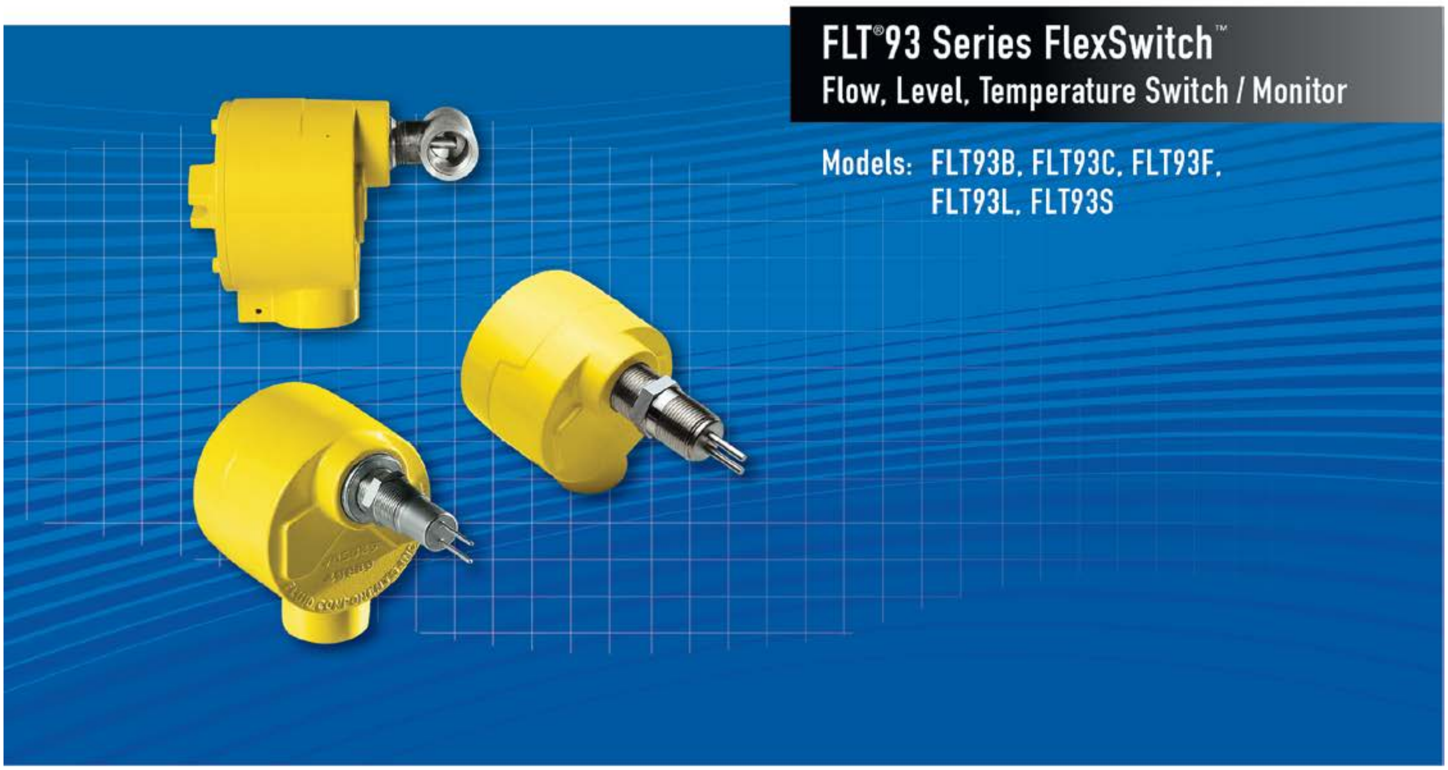
FLUID COMPONENTS INTERNATIONAL LLC

# Supplemental Manual

## FLT93 Safety Instrumented System (SIS) Requirements



# Table of Contents



# List of Figures



# List of Tables

This Page Intentionally Left Blank

# FLT93 Safety Instrumented System (SIS) Requirements

## Introduction

This document describes how to configure the FLT93 (with 5208 control module) for SIL 2 compliance in a Safety Instrumented System (SIS) application. The safety-critical output of the FLT93 is provided through the SPDT relays.

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

| | |
|---|---|
| SIL (Safety Integrity Level): | 2 |
| HFT (Hardware Fault Tolerance): | 0 |
| Subsystem Type: | A |

## FLT93 Safety Identification

The FLT93 does not contain any firmware that requires verification. The information contained in this document relates to the circuit design utilizing surface mount components. The electronics shall be contained within manufacturer's standard enclosures.

## 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 FLT93 IO&M (Document No. 06EN003401). 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 FLT93 in a fail-safe alarm configuration as listed below. In each of the listed applications, Alarm No. 1 is assigned to the process variable being measured and Alarm No. 2 is the fail-safe circuit. Refer to Figure 1 and Figure 2 below for module jumper locations and component locations, respectively.

1. Low Flow Alarm Applications:

- Jumpers J20 and J18 – Set Alarm No 1 and Alarm No. 2 both to **Flow/Level** configuration
- Jumper J23 – Set Relay to **Dual SPDT (One Relay per Alarm**) configuration
- Jumper J27 – Set Alarm No. 1 to **Relay De-Energized with Low Flow** configuration
- Jumper J24 – Set Alarm No. 2. To **Relay De-Energized with High Flow** configuration
- Alarm No. 1 setpoint is adjusted for desired low flow alarm condition.
- Alarm No. 2 setpoint is adjusted below minimum signal output (0.5 volts)

2. High Flow Alarm Applications:

- Jumpers J20 and J18 – Set Alarm No 1 and Alarm No. 2 both to **Flow/Level** configuration
- Jumper J23 – Set Relay to **Dual SPDT (One Relay per Alarm**) configuration
- Jumper J26 – Set Alarm No. 1 to **Relay De-Energized with High Flow** configuration
- Jumper J25 – Set Alarm No. 2. To **Relay De-Energized with Low Flow** configuration
- Alarm No. 1 setpoint is adjusted for desired high flow alarm condition.
- Alarm No. 2 setpoint is adjusted above maximum signal output (7.0 volts)

3. Low Level Alarm Applications:

- Jumpers J20 and J18 – Set Alarm No 1 and Alarm No. 2 both to **Flow/Level** configuration
- Jumper J23 – Set Relay to **Dual SPDT (One Relay per Alarm**) configuration
- Jumper J27 – Set Alarm No. 1 to **Relay De-Energized with Low Level** configuration
- Jumper J24 – Set Alarm No. 2. To **Relay De-Energized with High Level** configuration
- Alarm No. 1 setpoint is adjusted for the average value between the air/gas and liquid signals.
- Alarm No. 2 setpoint is adjusted below minimum signal output (0.5 volts).

4. High Level Alarm Applications:

- Jumpers J20 and J18 – Set Alarm No 1 and Alarm No. 2 both to Flow/Level configuration
- Jumper J23 – Set Relay to Dual SPDT (One Relay per Alarm) configuration
- Jumper J26 – Set Alarm No. 1 to Relay De-Energized with High Level configuration
- Jumper J25 – Set Alarm No. 2. To Relay De-Energized with Low Level configuration
- Alarm No. 1 setpoint is adjusted for the average value between the air/gas and liquid signals.
- Alarm No. 2 setpoint is adjusted above the maximum signal output (7.0 volts).

Through the monitoring of both the Alarm No. 1 and Alarm No. 2 relays, the FLT93 is considered to be "intrinsically reliable" because in addition to monitoring the process condition it also monitors itself and alarms the operator in either case.

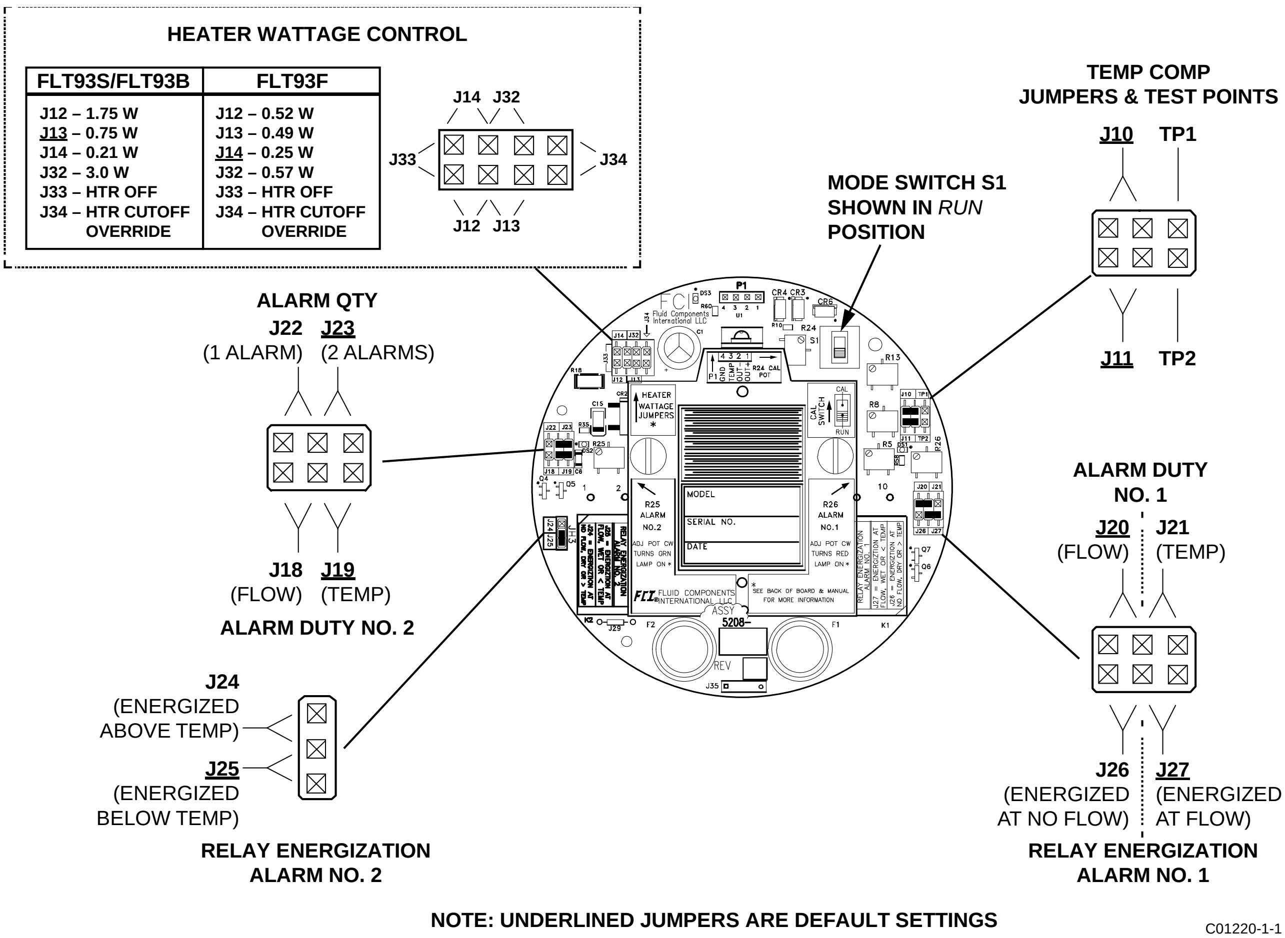



Figure 1 – 5208 Control Module Jumper Locations

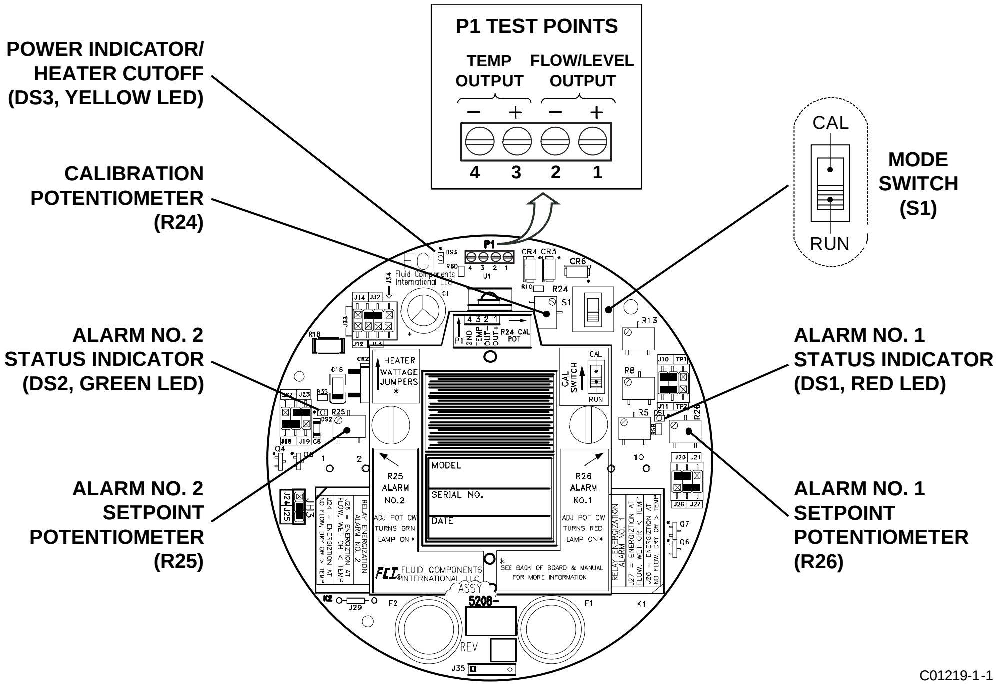



Figure 2 – 5208 Control Module Component Locations

Reference the FLT93 IO&M (Document No. 06EN003401) for proper configuration and verification of the FLT93 relay outputs. Bypass the output of the SPDT relays during testing to avoid a false trip. After use of the calibration potentiometer for adjusting Alarm No. 1 and Alarm No. 2, turn the calibration potentiometer (R24) to the appropriate minimum or maximum value (0.5 or 7.0 volts) to ensure random switching of the Mode switch leads to a fail-safe state. Ensure the Mode switch (S1) is set to “RUN” when placing the instrument in service.

## Configuring Alarm Levels

Ensure that the relay configuration for Alarm No. 1 is set for energized contacts during normal flow or level conditions. Thus, a detection of adverse flow or level condition, loss of power to the FLT93 or sensor failure will cause the relay to de-energize to a fail-safe alarm state. Ensure that the relay configuration for Alarm No. 2 is set for energized contacts during normal operation and that the alarm setpoint is outside of normal operating conditions to assure against false trips. With Alarm No. 2 set up in this manner, a loss of power to the FLT93 or a sensor failure will cause the Alarm No. 2 relay to de-energize to a fail-safe alarm state.

Common practice is to connect the Alarm No. 1 and Alarm No. 2 relays to independent inputs at the PLC/DCS. An alternative method that allows for the use of a single input at the PLC/DCS is to connect the Alarm No. 1 and Alarm No. 2 relays in series as shown in Figure 3 below.

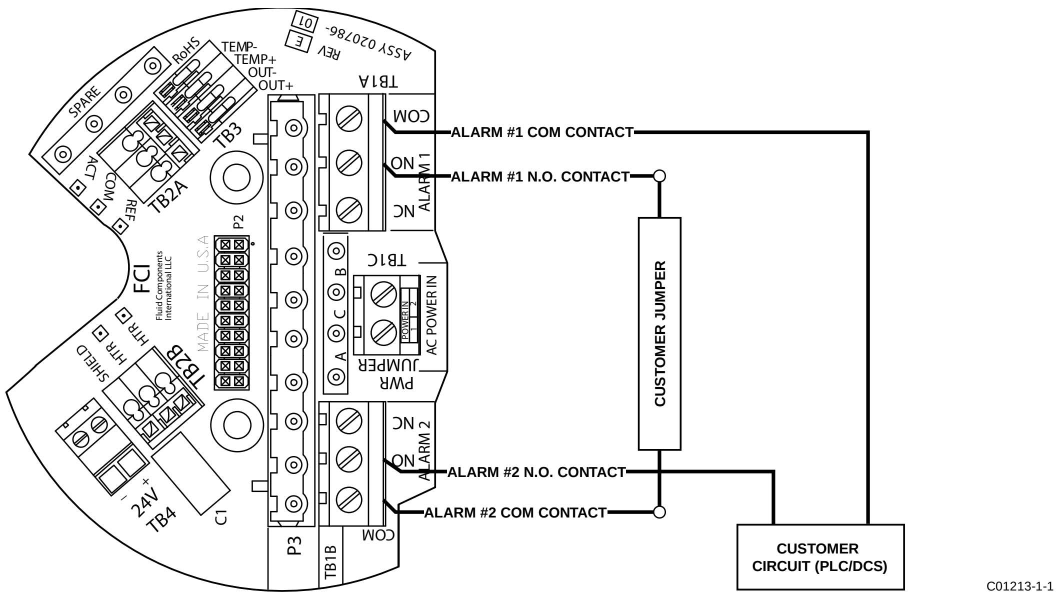



Figure 3 – Wiring Alarm Outputs in Series for Use with 1 PLC/DCS Input

## Proof Test

Use the recommended proof test or alternate proof test described below to identify dangerous, undetected failures in the FLT93 switch. It is recommended that the proof test be performed yearly at minimum.

### Recommended Proof Test (Verifies Sensor and Electronics)

1. Bypass the safety function and take appropriate action to avoid a false trip.
2. Confirm that both Alarm No. 1 and Alarm No. 2 relays are energized.
3. Increase or decrease the process variable (flow or level) to the desired trip point. Observe that the Alarm No. 1 relay changes state (de-energized) and that Alarm No. 2 relay remains energized.
4. Return the process variable to normal operating conditions. Observe that both Alarm No. 1 and Alarm No. 2 relays are energized again.
5. Remove the bypass and otherwise restore normal operation.

### Alternate Proof Test (Verifies Electronics, Isolates Sensor)

1. Bypass the safety function and take appropriate action to avoid a false trip.
2. Confirm that both Alarm No. 1 and Alarm No. 2 relays are energized.
3. Place Mode switch S1 to CAL. This isolates the sensor input and simulates a voltage input to the relay control circuits.
4. Adjust the calibration potentiometer (R24) until Alarm No. 1 changes state.
5. Readjust the calibration potentiometer to the maximum value to ensure fail-safe operation.
6. Place Mode switch S1 to RUN.
7. Confirm that both Alarm No. 1 and Alarm No. 2 relays are energized.
8. Remove the bypass and otherwise restore normal operation.

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

$PFD_{avg}$ calculation is found in the FMEDA report (contact FCI for a copy of the report).

## Product Repair

The FLT93 is repairable by major component replacement. All product repair and part replacement is to be performed by qualified personnel only.

## FLT93 SIS Reference

The FLT93 must be operated in accordance to the functional and performance specifications listed in the IO&M (Document No. 06EN003401) 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). The following is a summary of the failure rate data. The data shown reflects the relay outputs being used in conjunction with high-impedance PLC-inputs.

Table 1 – Failure Rates According to IEC 61508-1

| Function | SFF | PFD | $\lambda_{DU}$ | $\lambda_{DD}$ | $\lambda_{SU}$ | $\lambda_{SD}$ |
|---|---|---|---|---|---|---|
| Low Level/Flow | 84% | $1.43 \times 10^{-3}$ | 326 FIT | 178 FIT | 1170 FIT | 354 FIT |
| High Level/Flow | 82% | $1.63 \times 10^{-3}$ | 371 FIT | 116 FIT | 1120 FIT | 417 FIT |

## Terminology

SFF = Safe Failure Fraction

PFD = Probability of failure on demand

$\lambda_{DU}$= Failure rate dangerous undetected faults

$\lambda_{DD}$= Failure rate dangerous detected faults

$\lambda_{SU}$= Failure rate safe undetected faults

$\lambda_{SD}$= Failure rate safe detected faults

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


**FCI's Complete Customer Commitment. Worldwide**
**ISO 9001 and AS9100 Certified**

Visit FCI on the Worldwide Web: www.fluidcomponents.com

FCI World Headquarters

1755 La Costa Meadows Drive | San Marcos, California 92078 USA | Phone: 760-744-6950 Toll Free (US): 800-854-1993 Fax: 760-736-6250

FCI Europe

Persephonestraat 3-01 | 5047 TT Tilburg, The Netherlands | Phone: 31-13-5159989 Fax: 31-13-5799036

FCI Measurement and Control Technology (Beijing) Co., LTD | www.fluidcomponents.cn

Room 107, Xianfeng Building II, No.7 Kaituo Road, Shangdi IT Industry Base, Haidian District | Beijing 100085, P. R. China

Phone: 86-10-82782381 Fax: 86-10-58851152