RC SYSTEMS
“The Art of Gas Detection”

Suitable for Safety Applications
SIL
IEC 61508 / IEC 61511

Declaration of Conformity

Functional Safety acc. to IEC 61508 / IEC 61511

Product: ST-48 Sensor Transmitter

Brand Name of RC Systems products using ST-48: SenSmart 2000 and SenSmart 3000

Data source: Exida Report No.: IS 10/10-010 R001

The ST-48 is a single or dual channel fixed-point monitor designed to provide continuous monitoring of hazardous gases in the workplace. Input types include Electrochemical toxic/Oxygen sensors, catalytic bead combustible sensors as well as 4~20mA input. The ST-48 provides a standard 4~20mA output signal for connection to control systems or other alarm instrumentation. Available options include an Alarm Relay/RS-485 Modbus board.

R.C.Systems, Inc. as the manufacturer declares that the transmitter **ST-48** (used for **SenSmart 2000 and 3000)** is suitable to be used in safety related applications up to SIL 2 according to IEC 61508 / 61511, providing that the below safety instructions are followed.

The assessment of safety relevant and dangerous failures resulted in the following characteristic parameters:

		CB 4~20mA 4-Wire	CB Relay	EC 4~20mA 2 Wire	EC 4~20mA 4 wire	EC Relay
Safety Integrity Level	SIL	2	2	2	2	2
Hardware Fault Tolerance	HFT	0	0	0	0	0
Safe Failure Fraction	SFF	82.70%	83.50%	85.80%	85.90%	86.20%
Test Proof Interval	Tp	2160 h	2160 h	2160 h	2160 h	2160 h
Failure rate of an undetectable dangerous failure	λdu	6.34×10^{-7}	6.44×10^{-7}	4.97×10^{-7}	5.04×10^{-7}	5.12×10^{-7}
Average probability of a dangerous failure	PFDavg	1.17E-03	1.19E-03	9.41E-04	9.55E-04	9.49E-04

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Product Manager

Safety Instructions

Field of application:

Detection of combustible gases, toxic gases and vapors and oxygen, depending on the sensor being used. The transmitter produces a 4-20-mA-signal which is proportional to the gas concentration and, in combination with a suitable controller system, can be used to activate safety relevant functions in compliance with the requirements of the IEC 61508 / IEC 61511-1.

Assumptions:

The following assumptions have been made during the Failure Modes, Effects, and Diagnostic Analysis of the ST-48.
Only a single component failure will fail the entireST-48
Failure rates are constant, wear-out mechanisms are not included
Propagation of failures is not relevant
All components that are not part of the safety function and cannot influence the safety function (feedback immune) are excluded
The stress levels are average for an industrial environment and can be compared to the exida Profile 3 with temperature limits within the manufacturer’s rating. Other environmental characteristics are assumed to be within manufacturer’s rating
Practical fault insertion test can demonstrate the correctness of the failure effects assumed during the FMEDA and the diagnostic coverage provided by the online diagnostics
The HART protocol is only used for setup, calibration, and diagnostic purpose, not for safety critical operation
The application program in the logic solver is constructed in such a way that Fail High and Fail Low failures are detected regardless of the effect, safe or dangerous, on the safety function
For configuration with relay outputs, the logic solver is configured to detect the outputs of both the fault and alarm relays and will send the SIF to the fail-safe state if either or both relay(s) de-energize
Material are compatible with process conditions
The device is installed per manufacturer’s instruction
External power supply failure rates are not included
Recommended calibration intervals and replacement schedules of the catalytic bead or electrochemical cartridge are observed and used to implement frequent proof testing of the device
Worst-case internal fault detection time is 1 hour.

Proof Test:

Refer to Exida Report No: IS 10/10-010 R001 Appendix B (attached)

Appendix B Proof tests to reveal dangerous undetected faults

According to section 7.4.5.2 f) of IEC 61508-2 proof tests shall be undertaken to reveal dangerous faults which are undetected by diagnostic tests. This means that it is necessary to specify how dangerous undetected faults which have been noted during the Failure Modes, Effects, and Diagnostic Analysis can be detected during proof testing.

B.1 Suggested Proof Test

The suggested proof tests described in **Error! Reference source not found.** and Table 19 will detect 99% of possible DU failures in the ST-48. The suggested proof test in combination with automatic diagnostics will detect xx% of possible DU failures in the ST-48.

Table 18 Suggested Proof Test – 4-20mA Output

Step	Action
1.	Bypass the safety function and take appropriate action to avoid a false trip
2.	Interrupt power to the transmitter long enough to cause a reset[10]. While the transmitter is powered down, confirm that the output current goes to zero. Restore power.
3.	Force an alarm condition and confirm that the output current goes to the fail-safe value[11].
4.	Perform a two-point calibration[12] of the transmitter over the full working range[13].
5.	Remove the bypass and otherwise restore normal operation

[10] This clears out possible accumulated memory errors.

[11] This tests for possible quiescent current related failures.

[12] If the two-point calibration is performed with electrical instrumentation, this proof test will not detect any failures of the sensor

[13] This tests for compliance voltage problems such as a low loop power supply voltage or increased wiring resistance. This also tests for other possible failures.

Table 19 Suggested Proof Test – Relay Output

Step	Action
1.	Bypass the safety function and take appropriate action to avoid a false trip
2.	Interrupt power to the transmitter long enough to cause a reset[14]. While the transmitter is powered down, confirm that the output relays are de-energized. Restore power.
3.	Force an alarm condition and confirm that the fault relay (K3) is de-energized.
4.	Perform a two-point calibration[15] of the transmitter over the full working range. Ensure that the alarm relay (K1 or K2) de-energizes at the appropriate concentration.
5.	Remove the bypass and otherwise restore normal operation

[14] This clears out possible accumulated memory errors.

[15] If the two-point calibration is performed with electrical instrumentation, this proof test will <u>not</u> detect any failures of the sensor