



# Safety and Reliability Assessment Specification

## ds821 Standard and ds822 ATEX

### ECDS series ds821 Standard and series ds822 ATEX

*The safety and reliability related values of a dangerous failure PFH and MTTF for the above product have been evaluated according to DIN EN ISO 13849-1 and are listed in this document.*

#### System Function

An eddy current displacement sensor (ECDS) system typically consists of two or three components: a sensor probe with integrated cable e.g. ds82x.ds1003, possibly an extension cable e.g. ds82x.ec102 and a driver unit e.g. ds82x.od110.

An alternating electrical signal is generated by the driver unit (oscillator / demodulator) and applied to the coil located inside the probe tip. As a result, it builds up an alternating magnetic field in the vicinity of the probe tip. This alternating magnetic field induces eddy currents into the measurement surface without getting in contact with it. The eddy currents effectuate an attenuation of the undamped oscillating electrical signal. The attenuated alternating electrical signal is processed inside the driver unit to an appropriate analogue voltage output signal.

The driver unit (oscillator/demodulator) contributes substantially to the safety and reliability related values as it contains the main part of the measurement systems electronics.

All drivers of our ECDS family ds820 automatically detect the connected nominal system length and adapt to this configuration. For each measuring range and each series ds821 or series ds822 there is one specific driver unit. In contrast to the upper temperature limit of a driver unit the sensor and the connection cable of the system is applicable at temperatures up to +180 °C.

#### Assumptions:

- The safety analysis was performed according to standards Telcordia Issue 3 (2011)
- Only random failures, no systematic failures are taken into account
- Duty Cycle: 100 %
- Where applicable, stress ratio of 50 % was assumed
- Failure rate of mechanical components is negligible
- The monitoring system the sensor is connected to, performs an OK-Monitoring. The OK-Limits of this system must be in the range of -2 ... -18 V
- Operating environment: Ground Fixed, Uncontrolled environment

The ECDS system series ds822 ATEX is designed and approved to be used in hazardous areas (ATEX).

#### Scope and Means of Assessment

The analysed product contains active and passive electronic components. Some are mounted on a printed circuit board. The series ds821 Standard and ds822 ATEX are designed in the measuring ranges 2 mm, 4 mm and 8 mm. The individual components are directly assigned to a measuring range, which is reflected in its product designation.

Components covered by this assessment:

- For 2 mm measuring range:  
Sensor probes ds82x.1001, ds82x.1002, ds82x.1003, and ds82x.1004  
Connection cables ds82x.ec100, ds82x.ec102 and ds82x.ec103;  
Drivers ds82x.110
- For 4 mm measuring range:  
Sensor probes ds82x.3001, ds82x.3002 and ds82x.3003  
Connection cables ds82x.ec300, ds82x.ec302 and ds82x.ec303;  
Drivers: ds82x.od130
- For 8 mm measuring range:  
Sensor probes ds82x.5001, ds82x.5004  
Connection cables ds82x.ec500, ds82x.ec502 and ds82x.ec503;  
Drivers: ds82x.od150



## Results of Assessment series ds82x

MTTF		Operating temperature of driver	Operating Temperature of sensor and cable	[ hours ]	[ years ]
Environment	Ground, Fixed, Uncontrolled	+30 °C	+30 °C	1,51E+07	1722
			+120 °C	8,46E+06	966
			+150 °C	5,32E+06	608
			+180 °C	3,14E+06	358
		+65 °C	+65 °C	5,01E+06	571
			+120 °C	4,08E+06	465
			+150 °C	3,18E+06	362
			+180 °C	2,24E+06	256

MTTF <sub>d</sub>		Operating temperature of driver	Operating Temperature of sensor and cable	[ hours ]	[ years ]
Environment	Ground, Fixed, Uncontrolled	+30 °C	+30 °C	1,02E+08	11592
			+120 °C	1,43E+07	1634
			+150 °C	1,30E+07	1485
			+180 °C	1,11E+07	1268
		+65 °C	+65 °C	3,67E+07	4191
			+120 °C	3,14E+07	3584
			+150 °C	2,57E+07	2938
			+180 °C	1,92E+07	2196

PFH		Operating temperature of driver	Operating Temperature of sensor and cable	[ 1 / hours ]	[ FIT ]
Environment	Ground, Fixed, Uncontrolled	+30 °C	+30 °C	9,85E-09	9,8
			+120 °C	6,99E-08	69,9
			+150 °C	7,69E-08	76,9
			+180 °C	9,00E-08	90,0
		+65 °C	+65 °C	2,72E-08	27,2
			+120 °C	3,19E-08	31,9
			+150 °C	3,89E-08	38,9
			+180 °C	5,20E-08	52,0

Performance Level (PL)	Category
<b>c</b>	for safety related systems of the categories B and 1
<b>d</b>	for safety related systems of categories 2 and 3, with average diagnostic coverage = "low"

SIL rating according to IEC 61508	Conditions
<b>SIL 1</b>	always valid without any preconditions
<b>SIL 2</b>	If the safety related system fulfils ISO 13849 PL d requirements

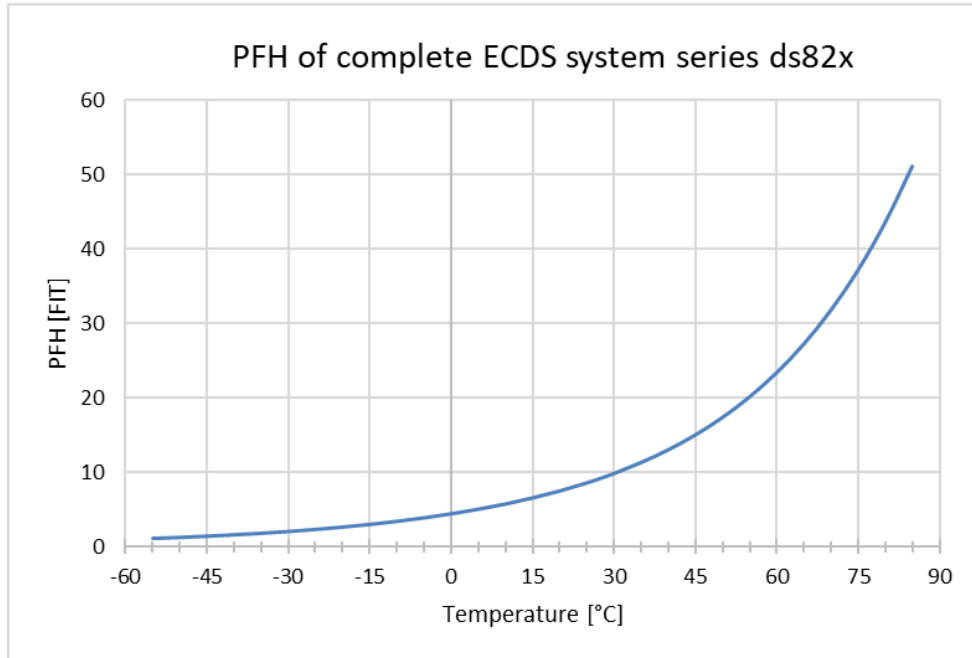


Figure 1

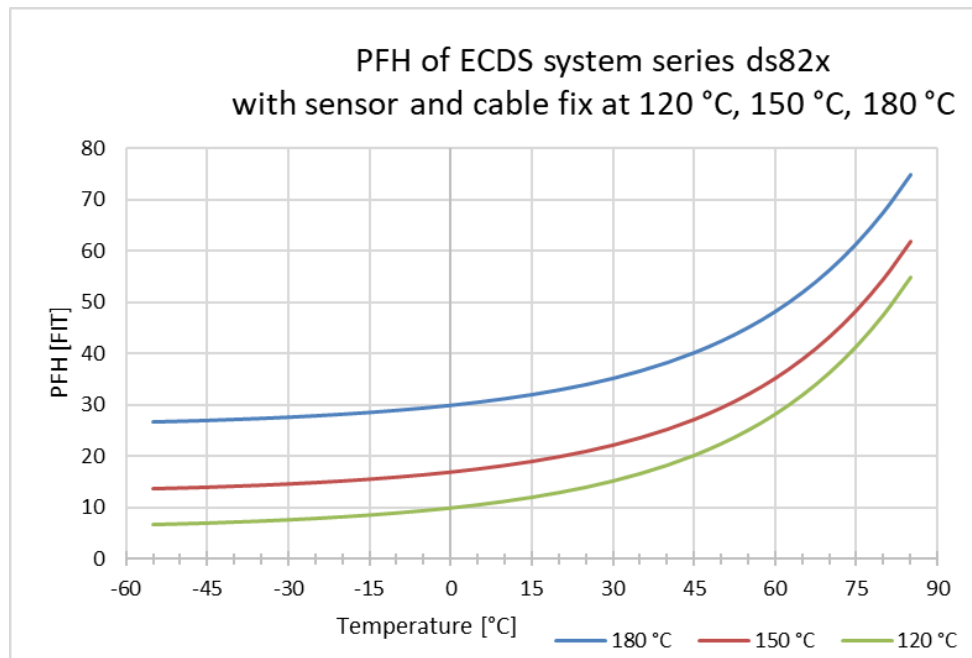


Figure 2:

Figure 1 shows the PFH of a complete eddy current displacement sensor system series ds82x versus its operating temperature. For real applications the operating temperature of the driver on the one hand and the sensor and its connection cable on the other hand will be different. On account of that Figure 2 shows the PFH of the system depending on the operating temperature of the driver unit. Sensor and connection cable are assumed to be installed at a fixed operating temperature of 120 °C, 150 °C or 180 °C.

## Abbreviations:

<b>MTTF</b>	Mean Time To Failure
<b>MTTF<sub>d</sub></b>	Mean Time To Failure, dangerous
<b>PFH</b>	Probability of dangerous failure per hour
<b>PL</b>	Performance Level From PL "a" (highest failure probability) to PL "e" (lowest failure probability)
<b>FIT</b>	Failure in time (1 FIT = 1 E-9 h <sup>-1</sup> )
<b>Category</b>	Category (CAT) Classification of the safety related parts of a control system in respect of their resistance to faults and their subsequent behaviour in the fault condition, and which is achieved by the structural arrangement of the parts, fault detection and/or by their reliability
<b>Ground, Fixed, Uncontrolled</b>	Some environmental stress with limited maintenance. Typical applications are manholes, poles, remote terminals, customer premise areas subject to shock, vibration, temperature, or atmospheric variations.
<b>SIL</b>	Safety Integrity Level

## Note:

Stated characteristics refer to a complete measurement chain consisting out of a valid combination of following system components: a sensor probe, a connection cable (if required) and a driver.

## Contact

**Brüel und Kjaer Vibro GmbH**  
Leydheckerstrasse 10  
64293 Darmstadt  
Germany

Phone: +49 6151 428 0  
Fax: +49 6151 428 1000

Corporate E-Mail: [info@bkvibro.com](mailto:info@bkvibro.com)

**Brüel & Kjaer Vibro A/S**  
Skodsborgvej 307 B  
2850 Nærum  
Denmark

Phone: +45 77 41 25 00  
Fax: +45 45 80 29 37

Homepage: [www.bkvibro.com](http://www.bkvibro.com)

**BK Vibro America Inc**  
1100 Mark Circle  
Gardnerville NV 89410  
USA

Phone: +1 (775) 552 3110