Safety Manual

PROTRAC series 30

Four-wire 4 … 20 mA/HART

With SIL qualification

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Contents

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1 Document language

DE	Das vorliegende *Safety Manual* für Funktionale Sicherheit ist verfügbar in den Sprachen Deutsch, Englisch, Französisch und Russisch.
EN	The current *Safety Manual* for Functional Safety is available in German, English, French and Russian language.
FR	Le présent *Safety Manual* de sécurité fonctionnelle est disponible dans les langues suivantes: allemand, anglais, français et russe.
RU	Данное руководство по функциональной безопасности *Safety Manual* имеется на немецком, английском, французском и русском языках.

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2 Scope

2.1 Instrument version

This safety manual applies to the following radiometric transmitter:

- **POINTRAC 31** Four-wire 8/16 mA/HART
- **MINITRAC 31, 32** Four-wire 4 … 20 mA/HART
- **SOLITRAC 31** Four-wire 4 … 20 mA/HART
- **FIBERTRAC 31, 32** Four-wire 4 … 20 mA/HART

Valid versions:

- from hardware version 1.0.6
- from software version 1.8.0 to 2.1.0

SIL FIBERTRAC 31 and 32 must only be used with a detector length of max. 1.524 m!

The SOLITRAC 31 is only available in the version " *short*" stated in the certification and hence suitable with all detector lengths for safety-related applications.

SIL The source holder was not part of the instrument certification!

2.2 Application area

The transmitters can be used for point level detection or level measurement of liquids and bulk solids in a safety-instrumented system according to IEC 61508 in the modes *low demand mode* and *high demand mode*.

Due to the systematic capability SC2 this is possible up to:

- SIL2 in a single-channel architecture
- SIL3 in a multiple-channel architecture with diversitary redundancy

The following interfaces can be used:

Point level detection

- Relay output: NO contact [1)]
- Current output: 8/16 mA
- Current output 4 … 20 mA, if the limit value is stipulated in a connected processing system

Level measurement

- Current output: 4 … 20 mA

SIL The following interfaces are only permitted for parameter adjustment and for informative use:

- HART
- Display and adjustment module PLICSCOM (also via Bluetooth)
- VEGACONNECT

[1)] NO = Normal Open

2.3 SIL conformity

The SIL conformity was independently judged and certified by *exida* Certification LLC according to IEC 61508. [2)]

[2)] Verification documents see "appendix"

3 Planning

3.1 Safety function

Safety function point level detection

The transmitter detects a stipulated limit level and signals the detected condition to its relay output with contact open/closed or to its current output with 8 mA/16 mA.

Safety function level measurement

The transmitter generates on its current output a signal between 3.8 mA and 20.5 mA corresponding to the level. This analogue signal is fed to a connected processing system to monitor the following conditions:

- Exceeding a preset level
- Falling below a preset level
- Monitoring a level range (limitations, see chapter " *Characteristics for level measurement applications*")

Safety tolerance

For the design of the safety function, the following aspects must be taken into account with regard to the tolerances:

- Due to undetected failures in the range between 3.8 mA and 20.5 mA, an incorrect output signal can be generated which deviates from the real measured value by up to 2 %
- Due to the special application conditions, increased measurement deviations can be caused (see Technical data in the operating instructions)

3.2 Safe state

Safe state, point level detection

Safe state relay output
The safe condition of the output is independent of the mode, by definition the currentless state of the relay (quiescent current principle).

Therefore only the NO contact may be used for safety-relevant applications.

Safe state, current output
The safe state of the current output depends on the mode and the characteristics set in the sensor.

	Overfill protection	**Dry run protection**
Level	uncovered (high count rate)	covered (low count rate)
Relay output	NO contact open (currentless)	NO contact open (currentless)
Current output: 8/16 mA	8 mA ±2 %	16 mA ±2 %
Current output: 16/8 mA	16 mA ±2 %	8 mA ±2 %

Safe state, level measurement

Safe state, current output
The safe state of the current output depends on the mode and the characteristics set in the sensor.

Characteristics	Monitoring upper limit value	Monitoring lower limit value
4 … 20 mA	Output current > Switching point	Output current < Switching point
20 … 4 mA	Output current < Switching point	Output current > Switching point

Fault signals in case of malfunction

Relay output
- NO contact open

Current output
- ≤ 3.6 mA ("fail low")
- > 21 mA ("fail high")

3.3 Prerequisites for operation

Instructions and restrictions

- The measuring system should suit the application. The application-specific limits must be maintained
- The specifications according to the operating instructions manual, particularly the current load on the output circuits, must be kept within the specified limits
- To avoid a fusing of the relay contacts, these must be protected by an external fuse that triggers at 60 % of the max. contact current load.
- Existing communication interfaces (e. g. HART, USB) are not used for transmission of the safety-relevant measured value
- The instructions in chapter " *Safety-related characteristics*", paragraph " *Supplementary information*" must be noted
- All parts of the measuring chain must correspond to the planned " *Safety Integrity Level (SIL)*"

SIL In mode "Dry run protection" the switching position ON must be fixed on the source holder!

3.4 System limitations

SIL There are several factors relating to the measuring principle that influence the measurement result. These factors must be taken into account in order to meet the requirements on the instrument with respect to stability and nonrepeatability. Further information on this can be found in the operating instructions manual in chapter " *Product description*".

3.5 Water/air cooling

SIL If a water/air cooling is necessary to keep the specified operating temperature, then the cooling facility is part of the safety function and must be monitored accordingly, for example by a SIL qualified temperature sensor.

The instructions in the operating instructions manual referring to mounting and flow characteristics values must be observed.

4 Safety-related characteristics

4.1 Key figures according to IEC 61508 for all applications

Parameter according to IEC 61508	Value
Safety Integrity Level	SIL2 in single-channel architecture SIL3 in multiple channel architecture [3]
Hardware fault tolerance	HFT = 0
Instrument type	Type B
Mode	Low demand mode, High demand mode
SFF	> 90 %
MTTR	8 h
MTBF [4]	0.39 x 10^6 h (45 years)
Diagnostic test interval [5]	< 10 min
Fault reaction time [6]	10 s

4.2 Key figures according to IEC 61508 for the applications for point level detection

Relay output

Relay for control of an actuator for monitoring a limit value (e.g. overfill or dry run protection)

Possible instrument versions:

- POINTRAC 31
- MINITRAC 31, 32
- SOLITRAC 31
- FIBERTRAC 31, 32

λ_S	λ_{DD}	λ_{DU}	λ_H	λ_L	λ_{AD}	λ_{AU}
458 FIT	1097 FIT	123 FIT	0 FIT	0 FIT	24 FIT	30 FIT

PFD_{AVG}	0.102 x 10^{-2}	(T1 = 1 year)
PFD_{AVG}	0.150 x 10^{-2}	(T1 = 2 years)
PFD_{AVG}	0.295 x 10^{-2}	(T1 = 5 years)
PFH	0.123 x 10^{-6} 1/h	

Proof Test Coverag (PTC)

Test type (see section "Proof test")	Remaining dangerous undetected failures	PTC
Test 1	12 FIT	90 %

[3] Only diversitary redundancy possible, because instrument software SIL2.
[4] Refers only to failures concerning the safety function.
[5] Time during which all internal diagnoses are carried out at least once.
[6] Time between failure detection and output of the failure signal.

Current output

Current output 8/16 mA or 4 … 20 mA for control of a connected processing system (e.g. SSPS) for monitoring a limit value (e.g. overfill or dry run protection).

Possible instrument versions:

- POINTRAC 31
- MINITRAC 31, 32
- SOLITRAC 31
- FIBERTRAC 31, 32

Single or Master device

λ_S	λ_{DD}	λ_{DU}	λ_H	λ_L	λ_{AD}	λ_{AU}
123 FIT	1413 FIT	125 FIT	12 FIT	71 FIT	86 FIT	11 FIT

PFD_{AVG}	0.105×10^{-2}	(T1 = 1 year)
PFD_{AVG}	0.154×10^{-2}	(T1 = 2 years)
PFD_{AVG}	0.302×10^{-2}	(T1 = 5 years)
PFH	0.125×10^{-6} 1/h	

Proof Test Coverag (PTC)

Test type (see section "Proof test")	Remaining dangerous undetected failures	PTC
Test 1	13 FIT	90 %

Current output in summation mode

Current output 4 … 20 mA for control of a connected processing system (e.g. SSPS) for monitoring a limit value (e.g. overfill or dry run protection).

Possible instrument versions with N slaves: [7)]

- SOLITRAC 31 Master + Slave(s)
- FIBERTRAC 31, 32 Master + Slave(s)

Slave

λ_S	λ_{DD}	λ_{DU}	λ_H	λ_L	λ_{AD}	λ_{AU}
123 FIT	1372 FIT	120 FIT	0 FIT	0 FIT	19 FIT	2 FIT

Master + 1 Slave

λ_S	λ_{DD}	λ_{DU}	λ_H	λ_L	λ_{AD}	λ_{AU}
246 FIT	2785 FIT	245 FIT	12 FIT	71 FIT	105 FIT	13 FIT

PFD_{AVG}	0.206×10^{-2}	(T1 = 1 year)
PFD_{AVG}	0.303×10^{-2}	(T1 = 2 years)
PFH	0.245×10^{-6} 1/h	

[7)] For N Slaves: $\lambda_X = \lambda_{X\ Master} + N * \lambda_{X\ Slave}$.

Proof Test Coverag (PTC)

Test type (see section "Proof test")	Remaining dangerous undetected failures	PTC
Test 1	25 FIT	90 %

Master + 2 Slaves

λ_S	λ_{DD}	λ_{DU}	λ_H	λ_L	λ_{AD}	λ_{AU}
368 FIT	4157 FIT	365 FIT	12 FIT	71 FIT	125 FIT	16 FIT

PFD_{AVG}	0.307×10^{-2}	(T1 = 1 year)
PFH	0.365×10^{-6} 1/h	

Proof Test Coverag (PTC)

Test type (see section "Proof test")	Remaining dangerous undetected failures	PTC
Test 1	37 FIT	90 %

4.3 Key figures according to IEC 61508 for the applications for level measurement

Current output

Current output 4 … 20 mA for control of a connected processing system (e.g. SSPS) for monitoring a level range.

Possible instrument versions:

- MINITRAC 31, 32
- SOLITRAC 31
- FIBERTRAC 31, 32

Single or Master device

λ_S	λ_{DD}	λ_{DU}	λ_H	λ_L	λ_{AD}	λ_{AU}
0 FIT	1507 FIT	154 FIT	12 FIT	71 FIT	86 FIT	11 FIT

PFD_{AVG}	0.129×10^{-2}	(T1 = 1 year)
PFD_{AVG}	0.190×10^{-2}	(T1 = 2 years)
PFD_{AVG}	0.371×10^{-2}	(T1 = 5 years)
PFH	0.154×10^{-6} 1/h	

Proof Test Coverag (PTC)

Test type [8)]	Remaining dangerous undetected failures	PTC
Test 2	15 FIT	90 %

Current output in summation mode

Current output 4 … 20 mA for control of a connected processing system (e.g. SSPS) for monitoring a level range.

[8)] See section "Proof test".

Possible instrument versions with N slaves: [9]

- SOLITRAC 31 Master + Slave(s)
- FIBERTRAC 31, 32 Master + Slave(s)

Slave

λ_S	λ_{DD}	λ_{DU}	λ_H	λ_L	λ_{AD}	λ_{AU}
0 FIT	1466 FIT	149 FIT	0 FIT	0 FIT	19 FIT	2 FIT

Master + 1 Slave

λ_S	λ_{DD}	λ_{DU}	λ_H	λ_L	λ_{AD}	λ_{AU}
0 FIT	2973 FIT	302 FIT	12 FIT	71 FIT	105 FIT	13 FIT

PFD_{AVG}	0.254×10^{-2}	(T1 = 1 year)
PFD_{AVG}	0.373×10^{-2}	(T1 = 2 years)
PFH	0.302×10^{-6} 1/h	

Proof Test Coverag (PTC)

Test type [10]	Remaining dangerous undetected failures	PTC
Test 2	30 FIT	90 %

Master + 2 Slaves

λ_S	λ_{DD}	λ_{DU}	λ_H	λ_L	λ_{AD}	λ_{AU}
0 FIT	4439 FIT	451 FIT	12 FIT	71 FIT	125 FIT	16 FIT

PFD_{AVG}	0.379×10^{-2}	(T1 = 1 year)
PFH	0.451×10^{-6} 1/h	

Proof Test Coverag (PTC)

Test type [11]	Remaining dangerous undetected failures	PTC
Test 2	45 FIT	90 %

4.4 Characteristics acc. to ISO 13849-1

Derived from the safety-related characteristics, the following figures result according to ISO 13849-1 machine safety): [12]

Point level detection

Application	MTTFd	DC	Performance Level
Relay output	91 years	90 %	1.23×10^{-7} 1/h
Current output	66 years	93 %	1.25×10^{-7} 1/h

[9] For N Slaves: $\lambda_X = \lambda_{X\ Master} + N * \lambda_{X\ Slave}$.
[10] See section "Proof test".
[11] See section "Proof test".
[12] ISO 13849-1 was not part of the certification of the instrument.

Application	MTTFd	DC	Performance Level
Summation operation with 1 slave	35 years	92 %	2.45 x 10^{-7} 1/h
Summation operation with 2 slaves	24 years	92 %	3.65 x 10^{-7} 1/h

Level measurement

Application	MTTFd	DC	Performance Level
Current output	62 years	92 %	1.54 x 10^{-7} 1/h
Summation operation with 1 slave	33 years	91 %	3.02 x 10^{-7} 1/h
Summation operation with 2 slaves	22 years	91 %	4.51 x 10^{-7} 1/h

4.5 Supplementary information

Determination of the failure rates

The failure rates of the instruments were determined by an FMEDA according to IEC 61508. The calculations are based on failure rates of the components according to **SN 29500**:

All figures refer to an average ambient temperature of 40 °C (104 °F) during the operating time. For higher temperatures, the values should be corrected:

- Continuous application temperature > 50 °C (122 °F) by factor 1.3
- Continuous application temperature > 60 °C (140 °F) by factor 2.5

Similar factors apply if frequent temperature fluctations are expected.

Assumptions of the FMEDA

- The failure rates are constant. Take note of the useful service life of the components according to IEC 61508-2.
- Multiple failures are not taken into account
- Wear on mechanical parts is not taken into account
- Failure rates of external power supplies are not taken into account
- The environmental conditions correspond to an average industrial environment
- To avoid a fusing of the relay contacts, these must be protected by an external fuse

Calculation of PFD_{AVG}

The values for PFD_{AVG} specified above were calculated as follows for a 1oo1 architecture:

$$PFD_{AVG} = \frac{PTC \times \lambda_{DU} \times T1}{2} + \lambda_{DD} \times MTTR + \frac{(1 - PTC) \times \lambda_{DU} \times LT}{2}$$

Parameters used:

- T1 = Proof Test Interval
- PTC = 90 %
- LT = 10 years
- MTTR = 8 h

Boundary conditions relating to the configuration of the processing unit

A connected control and processing unit must have the following properties:

- The failure signals of the measuring system are judged according to the idle current principle
- " *fail low*" and " *fail high*" signals are interpreted as a failure, whereupon the safe state must be taken on

If this is not the case, the respective percentages of the failure rates must be assigned to the dangerous failures and the values stated in chapter *Safety-related characteristics*“ redetermined!

Multiple channel architecture

In multiple channel systems for SIL3 applications, this measuring system must only be used with diversitary redundancy.

The safety-related characteristics must be calculated especially for the selected structure of the measuring chain using the stated failure rates. In doing this, a suitable Common Cause Factor (CCF) must be considered (see IEC 61508-6, appendix D).

5 Setup

5.1 General information

Mounting and installation

Take note of the mounting and installation instructions in the operating instructions manual.

Setup must be carried out under process conditions.

5.2 Instrument parameter adjustment

Tools

The following adjustment units are permitted for parameterization of the safety function:

- Display and adjustment module
- The DTM suitable for PROTRAC in conjunction with an adjustment software according to the FDT/DTM standard, e. g. PACTware

The parameter adjustment is described in the operating instructions manual.

SIL The documentation of the device settings is only possible with the full version of the DTM Collection.

Safety-relevant parameters

For protection against unwanted or unauthorzed adjustment, the set parameters must be protected against unauthorized access. For this reason, the instrument is shipped in locked condition. The PIN in delivery status is "0000".

The default values of the parameters are listed in the operating instructions. When shipped with customer-specific parameter settings, the instrument is accompanied by a list of the values differing from the default values.

By means of the serial number this list can also be downloaded at " www.vega.com", " *Instrument search (serial number)*".

Safe parameterization

To avoid or detect possible errors during parameter adjustment for unsafe operating environments, a verification procedure is used that allows the safety-relevant parameters to be checked.

Parameter adjustment proceeds according to the following steps:

- Unlock adjustment
- Change parameters
- Lock adjustment and verify modified parameters

The exact process is described in the operating instructions.

SIL Wireless connection is also possible with existing Bluetooth function.

SIL The instrument is shipped in locked condition!

SIL For verification, all modified, safety-relevant and non safety-relevant parameters are shown.

The verification texts are displayed either in German or, when any other menu language is used, in English.

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Unsafe device status

Warning:
When the adjustment is released, the safety function must be considered as unsafe. This applies until the parameters are verified and the adjustment is locked again.

If necessary, you must take other measures to maintain the safety function.

Incomplete process of the parameter adjustment

Warning:
If the described process was not carried out completely or correctly (e.g. interruption or voltage loss), the instrument remains in "unlocked" status.

Instrument reset

Warning:
In case a reset to " *Basic adjustment*" or " *Default setting*" is carried out, all safety-relevant parameters must be checked or set anew.

6 Diagnostics and servicing

6.1 Behaviour in case of failures

Internal diagnosis

The instrument is permanently monitored by an internal diagnostic system. If a malfunction is detected, this will be signalled by respective failure signals (see section " *Safe status*").

The diagnosis interval is specified in chapter " *Safety-related characteristics*".

SIL

If faults are detected, the entire measuring system must be shut down and the process held in a safe state by other measures.

The manufacturer must be informed of the occurrence of a dangerous undetected failure (incl. fault description).

6.2 Messages in case of malfunction

Messages in case of malfunction

A fault message coded according to the type of fault is output. The fault messages are listed in the operating instructions.

Rectifying the malfunction

Malfunctions occur for different reasons and have to be rectified accordingly:

- Malfunctions due to an operating error (for example communication problems, incorrect adjustment, etc.) are gone immediately after rectification.
- Malfunctions due to a hardware failure can usually be rectified by a manual restart. If the reason for the failure is no longer present, the safety function will be executed correctly.
- In case of hardware failures "F041 Photomultiplier error“ and "F045 Error on the current output", the malfunction is gone immediately after rectification of the error.
- When a failure that automatically triggers a restart occurs, the instrument remains in the "malfunction" status for at least 5 seconds after the restart. If the failure is no longer detected, the safety function is executed again correctly.

6.3 Repair

Electronics exchange

An exchange of the electronics may only be carried out by VEGA service technicians or other qualified personnel that have received training from VEGA (e.g. VEGA sales partners).

The procedure is described in the operating instructions manual. Note the instructions for parameter adjustment and setup.

Software update

A software update may be carried out by the user. The procedure is described in the operating instructions manual. The instructions for parameter adjustment and setup must be taken into account.

7 Proof test

7.1 General information

Objective

To identify possible dangerous, undetected failures, the safety function must be checked by a proof test at adequate intervals. It is the user's responsibility to choose the type of testing. The time intervals are determined by the selected PFD_{AVG} (see chapter " *Safety-related characteristics*").

For documentation of these tests, the test protocol in the appendix can be used.

If one of the tests proves negative, the entire measuring system must be switched out of service and the process held in a safe state by means of other measures.

In a multiple channel architecture this applies separately to each channel.

Preparation

- Determine safety function (mode, switching points)
- If necessary, remove the instruments from the safety chain and maintain the safety function by other means

Unsafe device status

Warning:
During the function test, the safety function must be treated as unreliable. Take into account that the function test influences downstream connected devices.

If necessary, you must take other measures to maintain the safety function.

After the function test, the status specified for the safety function must be restored.

7.2 Test 1: For mode "Point level detection"

Conditions

- Instrument in installed condition
- Output signal corresponds to the process pressure or the level
- Device status in the menu Diagnosis: " *OK*"

Procedure

1. Change the process conditions in such a way that the radiation on the sensor is as high as possible
2. Check if the measured value is correct
3. Close radiation source(s)
4. Check if the measured value is correct
5. Open radiation source(s)
6. Check if the measured value is correct
7. Continue normal operation

Expected result

- On 1: Level below the sensor
- On 2: Switching status signals "uncovered"
- On 4: Switching status signals "covered"
- On 6: like point 2

Proof Test Coverage

See *Safety-related characteristics*

7.3 Test 2: For mode "Level measurement"

Conditions

- Instrument in installed condition
- Output signal corresponds to the process pressure or the level
- Device status in the menu Diagnosis: " *OK*"

Procedure

1. Change the process conditions in such a way that the radiation on the sensor is as high as possible
2. Check if the measured value is correct
3. Close radiation source(s)
4. Check if the measured value is correct
5. Open radiation source(s)
6. Check if the measured value is correct
7. Continue normal operation

Expected result

- On 1: Level below 50 %
- On 2: Measured value corresponds to the level
- On 4: Instrument displays "Full"
- On 6: like point 2

Proof Test Coverage

See *Safety-related characteristics*

8 Appendix A: Test report

Identification	
Company/Tester	
Plant/Instrument TAG	
Meas. loop TAG	
Instrument type/Order code	
Instrument serial number	
Date, setup	
Date, last function test	

Test reason		**Test scope**	
(…)	Setup	(…)	Test 1
(…)	Proof test	(…)	Test 2

Adjusted device parameters of the safety function		
Isotope	(…) Cs-137 (…) Co-60	
Used safety-relevant outputs	(…) relay output (…) current output	
Set mode	(…) level detection, overfill protection (…) level detection, dry run protection (…) level measurement	
Detector length	mm	
Point level detection: setting "uncovered"	ct/s	
Point level detection: setting "covered"	ct/s	
Level measurement: max. process value		
Level measurement: min. process value		

Test result			
Test step	**Status relay**	**Output current**	**Test result**
		mA	
		mA	
		mA	
		mA	
		mA	
		mA	
		mA	

Confirmation

Date: Signature:

9 Appendix B: Term definitions

Abbreviations

SIL	Safety Integrity Level (SIL1, SIL2, SIL3, SIL4)
SC	Systematic Capability (SC1, SC2, SC3, SC4)
HFT	Hardware Fault Tolerance
SFF	Safe Failure Fraction
PFD_{AVG}	Average Probability of dangerous Failure on Demand
PFH	Average frequency of a dangerous failure per hour (Ed.2)
FMEDA	Failure Mode, Effects and Diagnostics Analysis
FIT	Failure In Time (1 FIT = 1 failure/10^9 h)
λ_{SD}	Rate for safe detected failure
λ_{SU}	Rate for safe undetected failure
λ_S	$\lambda_S = \lambda_{SD} + \lambda_{SU}$
λ_{DD}	Rate for dangerous detected failure
λ_{DU}	Rate for dangerous undetected failure
λ_H	Rate for failure, who causes a high output current (> 21 mA)
λ_L	Rate for failure, who causes a low output current (≤ 3.6 mA)
λ_{AD}	Rate for diagnostic failure (detected)
λ_{AU}	Rate for diagnostic failure (undetected)
DC	Diagnostic Coverage
PTC	Proof Test Coverage (Diagnostic coverage for manual proof tests)
T1	Proof Test Interval
LT	Useful Life Time
MTBF	Mean Time Between Failure = MTTF + MTTR
MTTF	Mean Time To Failure
MTTR	IEC 61508, Ed1: Mean Time To Repair IEC 61508, Ed2: Mean Time To Restoration
$MTTF_d$	Mean Time To dangerous Failure (ISO 13849-1)
PL	Performance Level (ISO 13849-1)

10 Supplement C: SIL conformity

SIL Manufacturer declaration, NE130: Form B.1

Manufacturer	
VEGA Grieshaber KG Am Hohenstein 113, D-77761 Schiltach, Germany	VEGA Americas, Inc. 4241 Allendorf Drive, Cincinnati, Ohio 45209, USA

General			
Device designation and permissible types	**PROTRAC Series 30**		
	POINTRAC 31 8/16 mA/HART - Four-wire with SIL qualification PT31.***I/L/S******* MINITRAC 31, 32 4 … 20 mA/HART - Four-wire with SIL qualification MT31/32.***I/L/S**** SOLITRAC 31 4 … 20 mA/HART - Four-wire with SIL qualification ST31.***I/L/S******* FIBERTRAC 31, 32 4 … 20 mA/HART - Four-wire with SIL qualification FT31/32.***I/L/S*******		
Safety-related output signal	4…20 mA or 8/16 mA and/or Relay		
Fault current	Current output: ≥ 21 mA; ≤ 3,6 mA; Relay output: NO contact open		
Process variable / function	Point level detection or level measurement In addition with slave sensor in summation mode		
Safety function(s)	- MIN/MAX limit detection - Range measurement		
Device type acc. to IEC 61508-2	☐ Type A	☒ Type B	
Operating mode	☒ Low Demand Mode	☒ High Demand or Continuous Mode	
Valid Hardware-Version	≥ 1.0.6		
Valid Software-Version	≥ 1.8.0		
Safety manual	Document ID: 49354		
Type of evaluation (check only one box)	☒ Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3		
	☐ Evaluation of "Prior use" performance for HW/SW incl. FMEDA and change request acc. to IEC 61508-2, 3		
	☐ Evaluation of HW/SW field data to verify „prior use" acc. to IEC 61511		
	☐ Evaluation by FMEDA acc. to IEC61508-2 for devices without software		
Evaluation through (incl. certificate no.)	exida.com -Excellence in Dependable Automation GmbH, VEGA 1202050C P0011 C004		
Test documents	Development documents	Test reports	Data sheets

Safety Integrity			
Systematic Capability (SC)		☒ SC2 for SIL2	☐ SC3 for SIL3
Hardware Safety Integrity	Single-channel use (HFT=0)	☒ SIL2 capable	☐ SIL3 capable
	Multi-channel use (HFT≥1)	☐ SIL2 capable	☒ SIL3 capable

FMEDA	Version: POINTRAC 31; MINITRAC 31, 32; SOLITRAC 31; FIBERTRAC 31, 32	
	Relay	**Current output**
Safety function(s)	MIN / MAX	MIN / MAX
λ_{DU} (FIT = Failure In Time / 10^9 h)	123 FIT	125 FIT
λ_{DD}	1097 FIT	1413 FIT
λ_{SU}	364 FIT	29 FIT

SIL Manufacturer declaration, NE130: Form B.1

λ_{SD}	94 FIT	94 FIT
SFF (Safe Failure Fraction)	> 90 %	> 90 %
PTC (Proof Test Coverage)	Test 1: 90%, with checking the process value	Test 1: 90%, with checking the process value
FMEDA data source	SN 29500	

FMEDA	**Version with slave sensor consisting of a combination of SOLITRAC 31 Master + Slave; FIBERTRAC 31, 32 Master + Slave**		
	Slave	**Master + 1 Slave**	**Master + 2 Slaves**
Safety function(s)	MIN / MAX	MIN / MAX	MIN / MAX
λ_{DU} (FIT = Failure In Time / 10^9 h)	120 FIT	245 FIT	365 FIT
λ_{DD}	1372 FIT	2785 FIT	4157 FIT
λ_{SU}	62 FIT	90 FIT	152 FIT
λ_{SD}	61 FIT	155 FIT	216 FIT
SFF (Safe Failure Fraction)		> 90 %	> 90 %
PTC (Proof Test Coverage)		Test 1: 90%*)	Test 1: 90%*)
	*) Test 1 with checking the process value		
FMEDA data source	SN 29500		

FMEDA	**Version: MINITRAC 31, 32; SOLITRAC 31; FIBERTRAC 31, 32 Current output**
Safety function(s)	Range
λ_{DU} (FIT = Failure In Time / 10^9 h)	154 FIT
λ_{DD}	1507 FIT
λ_{SU}	0 FIT
λ_{SD}	0 FIT
SFF (Safe Failure Fraction)	> 90 %
PTC (Proof Test Coverage)	Test 1: 90%, with checking the process value
FMEDA data source	SN 29500

FMEDA	**Version with slave sensor consisting of a combination of SOLITRAC 31 Master + Slave; FIBERTRAC 31, 32 Master + Slave**		
	Slave	**Master + 1 Slave**	**Master + 2 Slaves**
Safety function(s)	Range	Range	Range
λ_{DU} (FIT = Failure In Time / 10^9 h)	149 FIT	302 FIT	451 FIT
λ_{DD}	1466 FIT	2973 FIT	4439 FIT
λ_{SU}	0 FIT	0 FIT	0 FIT
λ_{SD}	0 FIT	0 FIT	0 FIT
SFF (Safe Failure Fraction)		> 90 %	> 90 %
PTC (Proof Test Coverage)		Test 1: 90%*)	Test 1: 90%*)
	*) Test 1 with checking the process value		
FMEDA data source	SN 29500		

Declaration	
☒	Our internal company quality management system ensures information on safety-related systematic faults which become evident in the future.

Konformitätserklärung
Declaration of conformity
Déclaration de conformité

Funktionale Sicherheit nach IEC 61508
Functional safety according to IEC 61508
Sécurité fonctionnelle selon IEC 61508

PROTRAC Serie 30
PROTRAC series 30
PROTRAC série 30

Vierleiter 4 … 20 mA/HART, mit SIL-Qualification
Four-wire 4 … 20 mA/HART, with SIL qualification
4 fils 4 … 20 mA/HART, avec qualification SIL

Document ID: 66386

49354-EN-211124

Konformitätserklärung

Declaration of conformity
Déclaration de conformité

Radiometrische Messumformer
Radiometric transmitter
Radiomètriques suivants

POINTRAC 31
MINITRAC 31, 32
SOLITRAC 31
FIBERTRAC 31, 32

VEGA Grieshaber KG erklärt hiermit in alleiniger Verantwortung, dass die Geräteserie PROTRAC 30, in der Ausführung 4 … 20 mA/HART, mit SIL-Qualifikation, in unveränderter Form, in der zertifizierten Hardwareversion 1.0.6 und Softwareversion 2.1.0 gefertigt wird.

Das Zertifikat VEGA 1202050C P0011 C004, Rev. 2.3 kann weiterhin zum Sicherheitsnachweis verwendet werden.

VEGA Grieshaber KG hereby declares in sole responsibility that the instrument series PROTRAC 30 in the version four-wire 4 … 20 mA/HART, with SIL qualification, is manufactured in unchanged form with the certified hardware version 1.0.6 and software version 2.1.0.

The certificate VEGA 1202050C P0011 C004, Rev. 2.3 can still be used for safety verification.

VEGA Grieshaber KG déclare par la présente, sous sa seule responsabilité, que la série d'appareils PROTRAC 30 en version quatre fils 4 … 20 mA/HART, avec qualification SIL, sont fabriqués sous forme inchangée, selon la version matérielle certifiée 1.0.6 et la version logicielle 2.1.0.
Le certificat VEGA 1202050C P0011 C004, Rev. 2.3 peut toujours être utilisé pour la vérification de la sécurité.

VEGA Grieshaber KG
Am Hohenstein 113
77761 Schiltach

01.09.2021

Holger Sack
Head of Product Compliance & QM

66386-04-210901

SIL_PROTRAC Serie 30

The manufacturer may use the mark:

Revision 2.3 August 19, 2019
Surveillance Audit Due
September 1, 2021

ANSI Accredited Program
PRODUCT CERTIFICATION
#1004

Certificate / Certificat
Zertifikat / 合格証

VEGA 1202050C P0011 C004

exida hereby confirms that the:

Radiation-based Transmitters PROTRAC 30 Series

VEGA Grieshaber KG Schiltach - Germany

Have been assessed per the relevant requirements of:

IEC 61508 : 2010 Parts 1-7

and meets requirements providing a level of integrity to:

Systematic Capability: SC 2 (SIL 2 Capable)

Random Capability: Type B Element

SIL 2 @ HFT = 0; Route 1_H

PFD_{AVG} and Architecture Constraints must be verified for each application

Safety Function:
The PROTRAC 30 Series Transmitter will measure the level of the process material within the stated safety accuracy.

Application Restrictions:
The unit must be properly designed into a Safety Instrumented Function per the Safety Manual requirements.

Evaluating Assessor

Certifying Assessor

Page 1 of 2

49354-EN-211124

Certificate / Certificat / Zertifikat / 合格証

VEGA 1202050C P0011 C004

Systematic Capability: SC 2 (SIL 2 Capable)

Random Capability: Type B Element

SIL 2 @ HFT = 0; Route 1_H

PFD_{AVG} and Architecture Constraints must be verified for each application

PROTRAC 30 Series Transmitter

Systematic Capability:

These Products have met manufacturer design process requirements of Safety Integrity Level (SIL) 2. These are intended to achieve sufficient integrity against systematic errors of design by the manufacturer.
A Safety Instrumented Function (SIF) designed with these products must not be used at a SIL level higher than stated.

Random Capability:

The SIL limit imposed by the Architectural Constraints must be met for each element.

Versions:
Applications with continuous level measurement and level limit detection of liquids and bulk solids.
Hardware version 1.0.6 and Software version 2.1.0

Single or Master devices:
C1 – Point Level PT31, MT31, MT32 using relay output (MIN/MAX)
C2 – Point Level PT31, MT31, MT32 using 8/16mA current output (MIN/MAX)
C3 – Level MT31, MT32, FT31/32, ST31 (short) using 4..20mA current output (MIN/MAX/RANGE)
C4 – Level FT31/32, ST31 (long) using 4..20mA current output (MIN/MAX)

Slave devices:
C5 – Level FT31/32, ST31 (short scintillator) (MIN/MAX/RANGE)
C6 – Level FT31/32, ST31 (long scintillator) (MIN/MAX)

Configuration	λ_S	λ_{DD}	λ_{DU}	λ_H	λ_L	λ_{AD}	λ_{AU}
C1: MIN/MAX limit detection	458	1097	123	0	0	24	30
C2, C3, C4: MIN/MAX limit detection	123	1413	125	12	71	86	11
C3: Range measurement	0	1507	154	12	71	86	11
C5: Range measurement	0	1466	149	0	0	19	2
C5, C6: MIN/MAX limit detection	123	1372	120	0	0	19	2
C3 with 2 slaves, C5: RANGE measurement	0	4439	451	12	71	125	16
C4 with 2 slaves C6: MIN/MAX limit detection	368	4157	365	12	71	125	16

All failure rates are given in FIT (failures / 10^9 hours)

SIL Verification:

The Safety Integrity Level (SIL) of an entire Safety Instrumented Function (SIF) must be verified via a calculation of PFD_{AVG} considering redundant architectures, proof test interval, proof test effectiveness, any automatic diagnostics, average repair time and the specific failure rates of all products included in the SIF. Each element must be checked to assure compliance with minimum hardware fault tolerance (HFT) requirements.

The following documents are a mandatory part of certification:

Assessment Report: VEGA 1202-050-C R008 V1R4

Safety Manual: PROTRAC 30 Series 49354

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T-013, V3R7

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