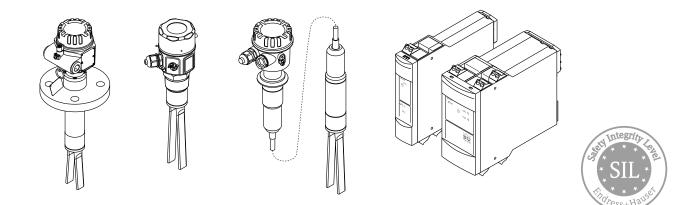
# Special Documentation Soliphant M with electronic insert FEM57 + Nivotester FTL325P

Functional Safety Manual



Point level measuring system



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# Declaration of conformity

SIL\_00072\_01.15 Endress+Hauser People for Process Automation SIL-Declaration of Conformity Functional Safety according to IEC 61508 Supplement 1 / NE130 Form B.1 and IGR 49-02-15 Datasheet 1 Endress+Hauser GmbH+Co. KG, Hauptstraße 1, 79689 Maulburg being the manufacturer, declares that the product stated below Soliphant M with electronic insert FEM57 (+ Nivotester FTL325P) (Serial number XXXXXXXXXXX) is suitable for the use in safety-instrumented systems according to IEC61508, if the safety instructions and following parameters are observed. This declaration of conformity is only valid for the customer listed in the cover letter of the responsible Endress+Hauser sales center and for the listed products in delivery status. Maulburg, 4-November-2015 Endress+Hauser GmbH+Co. KG i. V. Q. Fm . i. V. 0 Dr. Dietmar Frühauf Dr. Arno Götz Dept. Manager Product Safety Dept. Manager Level Switches Research & Development **Research & Development** 1/2

Type of evalutation (theck only one box)         and change request acc. to IEC 61508-2, 3 Evaluation of HW/SW field data to verify, prior use" acc. to IEC 61511           Image: IEC 61511         Evaluation of HW/SW field data to verify, prior use" acc. to IEC 61511           Image: IEC 61511         Image: IEC 61511           Image: Ima	Soliphant M with electronic insert FEM57 (+ Nivotester FTL325P)           For details see Functional Safety Manual SD00207F           Safety-related output signal           Relay           Four details see Functional Safety Manual SD00207F           Safety related output signal           Process variable/function           Level switch for solids           Safety function(s)         Overfill protection or operating maximum           Device type acc. to EE (61508-2         Typ A           Operating mode         Imp A           Valid Hardware-Version         FEM57 as of 01.00, FTL325P without SW           Safety manual         SD00207F           Valid Software-Version         FEM57 as of 01.00, I, FTL325P without SW           Safety manual         SD00207F           Complete HW/SW evaluation parallel to development incl.           FMEDA and change request acc. to EE (61508-2, 3           Check only one box)         Evaluation of HW/SW field data to verify prior use* acc. to EE (61508-2, 3           Evaluation through - report no.         TUV Rheinland, Report No 960F/SP 1148.00/15           Test documents         Development documents         Test reports           Systematic safety integrity         Single channel use (HFT = 0)         Sill 2 capable         Sill 3 capabl           Hardware safety integrity         Sill 4	Device designation and permissible types Safety-related output signal Fault current Process variable/function Safety function(s) Device type acc. to IEC 61508-2 Operating mode Valid Hardware-Version Valid Software-Version Safety manual Type of evalutation (check only <u>one</u> box) Evaluation through – report no. Test documents SIL - Integrity Systematic safety integrity Hardware safety integrity FMEDA <sup>*3</sup>	For details Relay - Level switc Overfill pr Typ A FEM57 as FEM57 as SD00207F	see Functional Safety h for solids stection or operating m mand Mode of 01.01, FTL325P as of 01.00.01, FTL325P Complete HW/SW e FMEDA and change Evaluation of "Prove and change request Evaluation of HW/S IEC 61511 Evaluation by FMED land, Report No 968/F	Manual SD00207F  naximum  Typ B  High Demand or C of 02.00  without SW  evaluation parallel to deve request acc. to IEC 61508 en-in-use" performance fe acc. to IEC 61508-2, 3 W field data to verify "pri Aacc. to IEC61508-2 for SP 1148.00/15	Continuous Mode elopment incl. 8-2, 3 or HW/SW incl. FMEE or use" acc. to	
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Device type acc. to IEC 61508-2       □ Typ A       □ Typ A         Operating mode       ○ Low Demand Mode       □ High Demand or Continuous Mode         Valid Andware-Version       FEMS7 as of 01.01, FTL325P as of 02.00       V         Valid Software-Version       FEMS7 as of 01.00.01, FTL325P without SW       Safety manual         Safety manual       SD00207F       □       Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3         Type of evalutation (check only one box)       □       Evaluation of "Proven-in-use" performance for HW/SW incl. FMEDA acc. to IEC 61508-2, 3         □       Evaluation of HW/SW field data to verify _prior use" acc. to IEC 61508-2, 3       □         □       Evaluation of "Proven-in-use" performance for HW/SW incl. FMEDA acc. to IEC 61508-2, 1         □       Evaluation of "Proven-in-use" performance for HW/SW incl. FMEDA acc. to IEC 61508-2, 1         □       Evaluation of HW/SW field data to verify _prior use" acc. to IEC 61508-2, 1         □       Evaluation by FMEDA acc. to IEC 61508-2, 1         State start safety integrify       Development documents       Test reports       Data sheets         SIL - Integrify       Single channel use (HFT = 0)       Sill 2 capable       Sill 3 capabl         Hardware safety integrify       Single channel use (HFT = 1)       Sill 2 capable       Sill 3 capabl	Device type acc. to IEC 61508-2       □ Typ A       ⊠ Typ B         Operating mode       ⊠ Low Demand Mode       □ High Demand or Continuous Mode         Valid Hardware-Version       FEM57 as of 01.01, FTL325P as of 02.00         Valid Software-Version       FEM57 as of 01.01, FTL325P without SW         Safety manual       SD00207F         Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3         □       EValuation of "Proven-in-use" performance for HW/SW incl. FMEE and change request acc. to IEC 61508-2, 3         □       EValuation of HW/SW field data to verify "prior use" acc. to IEC 61511         □       EValuation of HW/SW field data to verify "prior use" acc. to IEC 61511         □       EValuation by FMEDA acc. to IEC 61508-2 for devices w/o software Evaluation through – report no.         TUV Rheinland, Report No 960/FSP 1148.00/15         Test documents       Development documents         SIL - Integrity         Systematic safety integrity       Single channel use (HFT = 0)         Multi channel use (HFT ≥1)       ⊠ SIL 2 capable         SIL 2 capable       SIL 3 capable         FPE.grag1 = 1 year       2,83 × 10 <sup>-4</sup> Aca <sup>-13</sup> 65 FIT         Aca <sup>-13</sup> 65 FIT         Aca <sup>-13</sup> 65 FIT         Aca <sup>-13</sup> 63	Device type acc. to IEC 61508-2 Operating mode Valid Hardware-Version Safety manual Type of evalutation (check only <u>one</u> box) Evaluation through – report no. Test documents SIL – Integrity Systematic safety integrity Hardware safety integrity FMEDA <sup>*3</sup>	Typ A     Typ A     Survey Constraints     Typ A     Survey Constraints     Survey Constraints     Typ A     Typ A     Typ A     Typ A     Developme	mand Mode of 01.01, FTL325P as of 01.00.01, FTL325P Complete HW/SW e FMEDA and change Evaluation of "Provu and change request Evaluation of HW/S IEC 61511 Evaluation by FMED land, Report No 968/F	☑ Typ B         ☐ High Demand or C         of 02.00         without SW         evaluation parallel to devere request acc. to IEC 61500         endition the set of the s	elopment incl. 8-2, 3 or HW/SW incl. FMED or use" acc. to	
Valid Hardware-Version       FEM57 as of 01.01, FTL325P as of 02.00         Valid Software-Version       FEM57 as of 01.00.01, FTL325P without SW         Safety manual       SD00207F         Type of evaluation (check only one box)       Complete HW/SW evaluation parallel to development ind. FWEDA and change request acc. to IEC 61508-2, 3         Evaluation of Proven-inuse* performance for HW/SW ind. FMEDA and change request acc. to IEC 61508-2, 3         Evaluation of Proven-inuse* performance for HW/SW ind. FMEDA and change request acc. to IEC 61508-2, 3         Evaluation through - report no.       TÜV Rheinland, Report No 968/FSP 1148.00/15         Test documents       Development documents       Test reports         Systematic safety integrity       Single channel use (HFT = 0)       Sill 2 capable       Sill 3 capabl         Hardware safety integrity       Single channel use (HFT ≥ 1)       Sill 2 capable       Sill 3 capabl         FPDwyTa = 1 year       2,83 x 10 <sup>4</sup> Acc <sup>10</sup> Acc <sup>10</sup> Acc <sup>10</sup> MAX       PPTevyTa       Asil 2 F F 1         Acc <sup>10</sup> MAX       PPTevyTa       Asil 2 Capable       Sill 3 capabl         FMEDA *3       Stept function       MAX       PPTevyTa       Asil 2 Capable       Sill 3 Capabl         FMEDA *3       Step function       MAX       PPTevyTa       Asil 3 F FIT       Acc <sup></sup>	Valid Hardware-Version       FEM57 as of 01.01, FTL325P as of 02.00         Valid Software-Version       FEM57 as of 01.00.01, FTL325P without SW         Safety manual       SD00207F         Type of evaluation (check only one box)       Complete HW/SW evaluation parallel to development incl. FWEDA and change request acc. to IEC 61508-2, 3         Image: Complete HW/SW evaluation of "Proven-in-use" performance for HW/SW incl. FMED and change request acc. to IEC 61508-2, 3         Image: Complete HW/SW evaluation of HW/SW incled data to verify, prior use" acc. to IEC 61511         Image: Complete HW/SW field data to verify, prior use" acc. to IEC 61508-2, 3         Evaluation through - report no.       TÜV Rheinland, Report No 968/FSP 1148.00/15         Test documents       Development documents       Test reports         SIL - Integrity       Single channel use (HFT = 0)       SIL 2 capable       SIL 3 capabl         Hardware safety integrity       Single channel use (HFT ≥ 1)       SIL 2 capable       SIL 3 capabl         FPDeyTi = 1 year       2,83 x 10 <sup>4</sup> Qui'ii       Qui'iii Acc Acc Acc Acc Acc Acc Acc Acc Acc	Valid Hardware-Version Valid Software-Version Safety manual Type of evalutation (check only <u>one</u> box) Evaluation through – report no. Test documents <b>SIL – Integrity</b> Systematic safety integrity Hardware safety integrity <b>FMEDA *3</b>	FEM57 as FEM57 as SD00207F C C C TÜV Rhein Developme	of 01.01, FTL325P as of 01.00.01, FTL325P FMEDA and change Evaluation of "Prove and change request Evaluation of HW/S IEC 61511 Evaluation by FMED land, Report No 968/F	of 02.00 without SW evaluation parallel to deve request acc. to IEC 61500 en-in-use" performance for cacc. to IEC 61508-2, 3 W field data to verify "pri A acc. to IEC 61508-2 for SP 1148.00/15	elopment incl. 8-2, 3 or HW/SW incl. FMED or use" acc. to	
Valid Software-Version       FEM57 as of 01.00.01, FTL325P without SW         Safety manual       SD00207F         Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3         Check only one box)       Evaluation of Proven-in-use" performance for HW/SW field data to verify prior use" acc. to IEC 61511         Image: Substance of the state of the st	Valid Software-Version       FEM57 as of 01.00.01, FTL325P without SW         Safety manual       SD00207F         Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3         Check only one box)       Evaluation of Proven-in-use" performance for HW/SW field data to verify ,prior use" acc. to IEC 61511         Evaluation through - report no.       TÜV Rheinland, Report No 968/FSP 1148.00/15         Test documents       Development documents         Sligle channel use (HFT = 0)       SIL 2 capable         Single channel use (HFT = 0)       SIL 2 capable         State steps integrity       Single channel use (HFT = 0)         Multi channel use (HFT = 0)       SIL 2 capable         Single channel use (HFT = 0)       SIL 2 capable         Single channel use (HFT = 0)       SIL 2 capable         Single channel use (HFT = 0)       SIL 2 capable         Single channel use (HFT = 0)       SIL 2 capable         Single channel use (HFT = 1)       SIL 2 capable         Single channel use (HFT = 0)       SIL 2 capable         Single channel use (HFT = 1)       SIL 2 capable         Single channel use (HFT = 1)       SIL 2 capable         Single channel use (HFT = 1)       SIL 2 capable         Single channel use (HFT = 1)       SIL 2 capable         Single channel	Valid Software-Version Safety manual Type of evalutation (check only <u>one</u> box) Evaluation through – report no. Test documents SIL – Integrity Systematic safety integrity Hardware safety integrity FMEDA *3	FEM57 as SD00207F	of 01.00.01, FTL32SP Complete HW/SW e FMEDA and change Evaluation of "Prove and change request Evaluation of HW/S IEC 61511 Evaluation by FMEC land, Report No 968/F	without SW evaluation parallel to dever request acc. to IEC 61501 en-in-use" performance for acc. to IEC 61508-2, 3 W field data to verify "pri DA acc. to IEC 61508-2 for SP 1148.00/15	8-2, 3 or HW/SW incl. FMED or use" acc. to	
Safety manual       SD00207F         Type of evalutation (check only one box)       Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3         □       Evaluation of "Proven-in-use" performance for HW/SW incl. FMED 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 IEC 61508-2, 3         □       Evaluation of W/SW field data to verify, prior use" acc. to IEC 61511         □       Evaluation by FMEDA acc. to IEC 61508-2 for devices w/o software IEC 61511         Evaluation through - report no.       TÜV Rheinland, Report No 968/FSP 1148.00/15         Test documents       Development documents       Test reports       Data sheets         SlL - Integrity       Single channel use (HFT = 0)       Sill 2 capable       Sill 3 capabl         Hardware safety integrity       Single channel use (HFT = 0)       Sill 2 capable       Sill 3 capabl         FMEDA "3       Single channel use (HFT = 1)       Sill 2 capable       Sill 3 capabl         FY F-Safe Fillume Fraction       Adx       Sill 3 capabl         FY F-Safe Fillure Fraction       G5 Fill       Sill 3 capabl         Autar <sup>10</sup> 65 Sill       Sill 3 capabl       Sill 3 capabl         FY F-Safe Fillure Fraction       G4 Sill 7 F	Safety manual       SD00207F         Type of evalutation (check only one box)       Complete HW/SW evaluation parallel to development incl. FMEDA and change request act. to IEC 61508-2, 3         □       Evaluation of "Proven-in-use" performance for HW/SW lind. FMED and change request act. to IEC 61508-2, 3         □       Evaluation of W/SW field data to verify, prior use" acc. to IEC 61511         □       Evaluation of PMEDA acc. to IEC61508-2, 3         □       Evaluation of MW/SW field data to verify, prior use" acc. to IEC 61511         □       Evaluation of PMEDA acc. to IEC61508-2 for devices w/o software IEC 61511         Evaluation through - report no.       TÜV Rheinland, Report No 968/FSP 1148.00/15         Test documents       Development documents       Test reports       Data sheets         SIL - Integrity       Single channel use (HFT = 0)       SIL 2 capable       SIL 3 capabl         Hardware safety integrity       Single channel use (HFT = 0)       SIL 2 capable       SIL 3 capabl         FMEDA "3       Soft function       MAX         PED <sub>eva</sub> T <sub>1</sub> = 1 year       2,83 x 10*       Single channel use (HFT ≥ 1)       Single Chancel use (HFT ≥ 1)         Aug <sup>11</sup> Gos <sup>11</sup> Gos 5 FIT       Solution 10       Single Chancel use (HFT ≥ 1)       Single Chancel use	Safety manual Type of evalutation (check only <u>one</u> box) Evaluation through – report no. Test documents SIL – Integrity Systematic safety integrity Hardware safety integrity FMEDA *3	SD00207F	Complete HW/SW e FMEDA and change Evaluation of "Prove and change request Evaluation of HW/S IEC 61511 Evaluation by FMEE land, Report No 968/F	evaluation parallel to deve request acc. to IEC 61500 en-in-use" performance for acc. to IEC 61508-2, 3 W field data to verify "pri DA acc. to IEC61508-2 for 5P 1148.00/15	8-2, 3 or HW/SW incl. FMED or use" acc. to	
Type of evalutation (check only one box)       Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3         □       Evaluation of "Proven-in-use" performance for HW/SW incl. FMED and change request acc. to IEC 61508-2, 3         □       Evaluation of W/SW field data to verify prior use" acc. to IEC 61511         □       Evaluation by FMEDA acc. to IEC 61508-2, 3         Evaluation through - report no.       TÜV Rheinland, Report No 968/FSP 1148.00/15         Test documents       Development documents       Test reports         SIL - Integrity       Single channel use (HFT = 0)       Sill 2 capable       Sill 3 capabl         Hardware safety integrity       Single channel use (HFT ≥1)       Sill 2 capable       Sill 3 capabl         Multi channel use (HFT ≥1)       Sill 2 capable       Sill 3 capabl         Safety function       MAX         PFD <sub>eng1</sub> = 1 year       2,83 x 10 <sup>4</sup> Aou <sup>11</sup> 65 FIT         Aou <sup>11</sup> 617 FIT         Aou <sup>11</sup> 617 FIT         Au <sup>11</sup> 817 FIT         Au <sup>11</sup> 617 FIT	Type of evalutation (check only one box)       Complete HW/SW evaluation parallel to development incl. FMEDA and change request acc. to IEC 61508-2, 3         □       Evaluation of "Proven-in-use" performance for HW/SW incl. FMEE and change request acc. to IEC 61508-2, 3         □       Evaluation of Proven-in-use" performance for HW/SW incl. FMEE and change request acc. to IEC 61508-2, 3         □       Evaluation of PM/SW field data to verify prior use" acc. to IEC 61511         □       Evaluation by FMEDA acc. to IEC 61508-2, 3         Evaluation through - report no.       TÜV Rheinland, Report No 968/FSP 1148.00/15         Test documents       Development documents       Test reports         State and the state of the s	Type of evalutation (check only <u>one</u> box) Evaluation through – report no. Test documents SIL – Integrity Systematic safety integrity Hardware safety integrity FMEDA <sup>*3</sup>	Image: Second	Complete HW/SW e FMEDA and change Evaluation of "Prove and change request Evaluation of HW/S IEC 61511 Evaluation by FMED and, Report No 968/F	request acc. to IEC 61508 en-in-use" performance for acc. to IEC 61508-2, 3 W field data to verify "pri DA acc. to IEC61508-2 for SP 1148.00/15	8-2, 3 or HW/SW incl. FMED or use" acc. to	
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(check only one box)         □         Evaluation of HW/SW field data to verify ,prior use" acc. to IEC 61511           □         Evaluation by FMEDA acc. to IEC 61508-2 for devices w/o software           Evaluation through - report no.         TÜV Rheinland, Report No 968/FSP 1148.00/15           Test documents         Development documents         Test reports           SIL - Integrity         Image: Software         Image: Software           Systematic safety integrity         Image: Software         Image: Software           Hardware safety integrity         Single channel use (HFT = 0)         Image: Software           Software         Single channel use (HFT = 0)         Image: Software         Image: Software           FMEDA         Single channel use (HFT = 0)         Image: Software         Image: Software         Image: Software           Software         Single channel use (HFT = 0)         Image: Software         Image: Software         Image: Software           Software         Single channel use (HFT ≥ 1)         Image: Software         Image: Software         Image: Software           Software         Single channel use (HFT ≥ 1)         Image: Software         Image: Software         Image: Software           Software         Single channel use (HFT ≥ 1)         Image: Software         Image: Software         Sint 2 capable         Sint 2 capable </td <td>(check only one box)       □       Evaluation of HW/SW field data to verify "prior use" acc. to IEC 61511         □       Evaluation by FMEDA acc. to IEC 61508-2 for Jevices w/o software         Evaluation through - report no.       TÜV Rheinland, Report No 968/FSP 1148.00/15         Test documents       Development documents       Test reports         SIL - Integrity       Image: Software Software Software       Data sheets         Systematic safety integrity       Image: Software So</td> <td>(check only <u>one</u> box) Evaluation through - report no. Test documents SIL - Integrity Systematic safety integrity Hardware safety integrity FMEDA *3</td> <td>TÜV Rhein Developme</td> <td>Evaluation of HW/S IEC 61511 Evaluation by FMED land, Report No 968/F</td> <td>W field data to verify "pri DA acc. to IEC61508-2 for SP 1148.00/15</td> <td></td>	(check only one box)       □       Evaluation of HW/SW field data to verify "prior use" acc. to IEC 61511         □       Evaluation by FMEDA acc. to IEC 61508-2 for Jevices w/o software         Evaluation through - report no.       TÜV Rheinland, Report No 968/FSP 1148.00/15         Test documents       Development documents       Test reports         SIL - Integrity       Image: Software Software Software       Data sheets         Systematic safety integrity       Image: Software So	(check only <u>one</u> box) Evaluation through - report no. Test documents SIL - Integrity Systematic safety integrity Hardware safety integrity FMEDA *3	TÜV Rhein Developme	Evaluation of HW/S IEC 61511 Evaluation by FMED land, Report No 968/F	W field data to verify "pri DA acc. to IEC61508-2 for SP 1148.00/15		
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Evaluation through - report no.       TÜV Rheinland, Report No 968/FSP 1148.00/15         Test documents       Development documents       Test reports       Data sheets         SIL - Integrity       Sill 2 capable       SIL 3 capable       SIL 3 capable         Hardware safety integrity       Single channel use (HFT = 0)       SIL 2 capable       SIL 3 capable         Hardware safety integrity       Multi channel use (HFT = 1)       SIL 2 capable       SIL 3 capable         Safety function       MAX       SIL 2 capable       SIL 3 capable         PrDews Ta = 1 year       2,83 x 10^4       And 3 x 10^4         Aqu <sup>-11</sup> 40 FIT       And 9 FIT         Aqu <sup>-13</sup> 817 FIT       Stresset         Stresset       Single channel use (HFT = 0)       Single channel use         PrDews Ta = 1 year       2,83 x 10^4       Stresset         Aqu <sup>-13</sup> 65 FIT       And 9 FIT         Aqu <sup>-13</sup> 63 97 % Test       Stresset         PTC T <sup>21</sup> 63 97 % Test       Stresset         Anata <sup>13</sup> 1079 FIT       Stresset         Diagnostic test interval       <60 s	Evaluation through - report no.       TÜV Rheinland, Report No 968/FSP 1148.00/15         Test documents       Development documents       Test reports       Data sheets         SIL - Integrity       Sill 2 capable       III.3 capable       III.3 capable         Hardware safety integrity       Single channel use (HFT = 0)       Sill 2 capable       III.3 capable         Hardware safety integrity       Multi channel use (HFT = 1)       Sill 2 capable       Sill 3 capable         FMEDA *3       Safety function       MAX       Sill 2 capable       Sill 3 capable         Safety function       MAX       PPDergT = 1 year       2,83 × 10 <sup>-4</sup> Aqui'a       Ado FIT         Aqui'a)       65 FIT       40 FIT       Aqui'a)       Ado FIT       Aqui'a)       Sill 2 capable       Sill 2 capable       Sill 2 capable       Sill 2 capable       Sill 3 capable         Systematic safety function       MAX       PPTC *2)       65 FIT       Aqui'a)       Ado FIT       Ado FIT       Ado FIT	Test documents SIL - Integrity Systematic safety integrity Hardware safety integrity FMEDA *3	TÜV Rhein Developme	l land, Report No 968/F	SP 1148.00/15	devices w/o softwar	
Test documents       Development documents       Test reports       Data sheets         SIL - Integrity       Sill 2 capable       Sill 3 capabl         Systematic safety integrity       Single channel use (HFT = 0)       Sill 2 capable       Sill 3 capabl         Hardware safety integrity       Multi channel use (HFT = 0)       Sill 2 capable       Sill 3 capabl         FMEDA *3       Safety function       MAX       Sill 2 capable       Sill 3 capabl         Safety function       MAX       PPDevgT1 = 1 year       2,83 × 10.4       Acuto $\lambda_{00}^{-11}$ 65 FIT       Acuto       Acuto       Acuto $\lambda_{00}^{-11}$ 65 FIT       Acuto       Acut	Test documents       Development documents       Test reports       Data sheets         SIL - Integrity       Sill - Capable       SIL - Capable<	Test documents SIL - Integrity Systematic safety integrity Hardware safety integrity FMEDA *3	Developme		1		
SIL - Integrity       Sill 2 capable       SIL 3 capable         Systematic safety integrity       Single channel use (HFT = 0)       SIL 2 capable       SIL 3 capable         Hardware safety integrity       Multi channel use (HFT = 0)       SIL 2 capable       SIL 3 capable         FMEDA *3       Safety function       MAX       PFDerg1 = 1 year       2,83 x 10*4 $Aou^{-11}$ G5 FIT       Aou^{-11}       Aou^{-11} $Aou^{-11}$ 40 FIT       Aou^{-11}       Aou^{-11} $Aou^{-11}$ A0 FIT       Aou^{-11}       Aou^{-11}       Aou^{-11} $Aou^{-11}$ A0 FIT       Aou^{-11}	SIL - Integrity       Sill 2 capable       SIL 3 capable         Systematic safety integrity       Single channel use (HFT = 0)       Sill 2 capable       Sill 3 capable         Hardware safety integrity       Multi channel use (HFT = 0)       Sill 2 capable       Sill 3 capable         FMEDA *3       Multi channel use (HFT = 1)       Sill 2 capable       Sill 3 capable         Safety function       MAX       PFDeg1 = 1 year       2,83 x 10* $Aou^{-11}$ Capable       Sill 2 capable       Sill 3 capable $Aou^{-11}$ MAX       PFDeg1 = 1 year       2,83 x 10* $Aou^{-11}$ 65 FIT       Aou <sup>-11</sup> Aou <sup>-11</sup> $Aou^{-11}$ 40 FIT       Aou <sup>-11</sup> Aou <sup>-11</sup> $Aou^{-11}$ 157 FIT       SFF - Safe Failure Fraction       94 %         PTC *2 <sup>1</sup> 63 97 % *4       Aou <sup>+11</sup> Aou <sup>+11</sup> 1079 FIT       Diagnostic test interval $\leq 60$ 5         Fault reaction time $\leq 3$ s       Comments         This information is based on the variant II in the Safety Manual.         'Depending on methode of proof test.         Declaration         Our internal company quality management system ensures information on safety-related systematic faults whi	SIL - Integrity Systematic safety integrity Hardware safety integrity FMEDA <sup>*3</sup>		ent documents	Test reports	Data shaata	
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Safety function       MAX         PFD <sub>erg</sub> T <sub>1</sub> = 1 year       2,83 × 10 <sup>-4</sup> $\lambda_{00}^{-11}$ 65 FIT $\lambda_{00}^{-11}$ 65 FIT $\lambda_{00}^{-11}$ 60 FIT $\lambda_{00}^{-11}$ 60 FIT $\lambda_{00}^{-11}$ 61 FIT $\lambda_{00}^{-11}$ 817 FIT $\lambda_{00}^{-11}$ 157 FIT         SFF - Safe Failure Fraction       94 %         PTC <sup>-70</sup> 63 97 % <sup>-6</sup> $\lambda_{0041}^{-11}$ 1079 FIT         Diagnostic test interval       ≤ 60 s         Fault reaction time       ≤ 3 s         Comments <sup>-1</sup> This information is based on the variant II in the Safety Manual. <sup>+</sup> Depending on methode of proof test. <b>Declaration</b> $\square$ Our internal company quality management system ensures information on safety-related systematic faults which become evident in the future         '1) FIT = Failure In Time, Number of fallures per 10 <sup>9</sup> h	Safety function       MAX         PFD <sub>erg</sub> T <sub>1</sub> = 1 year       2,83 × 10 <sup>-4</sup> $\lambda_{00}^{-11}$ 65 FIT $\lambda_{00}^{-11}$ 65 FIT $\lambda_{00}^{-11}$ 40 FIT $\lambda_{00}^{-11}$ 817 FIT $\lambda_{00}^{-11}$ 157 FIT         SFF - Safe Failure Fraction       94 %         PTC <sup>-70</sup> 63 97 % <sup>-6</sup> $\lambda_{0041}^{-11}$ 1079 FIT         Diagnostic test interval       ≤ 60 s         Fault reaction time       ≤ 3 s         Comments <sup>1</sup> This information is based on the variant II in the Safety Manual. <sup>1</sup> Diagnostic test interval         S         Comments <sup>1</sup> This information is based on the variant II in the Safety Manual. <sup>1</sup> Diagnostic test interval         S         Comments <sup>1</sup> This information is based on the variant II in the Safety Manual. <sup>1</sup> Diagnostic test interval         Our internal company quality management system ensures information on safety-related systematic faults which become evident in the future <sup>1</sup> Thi Information company quality management system ensures information on safety-related		Multi chan			SIL 3 capable	
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Auge <sup>11</sup> 157 FIT         SFF - Safe Failure Fraction       94 %         PTC <sup>72</sup> 63 97 % <sup>14</sup> Jugan <sup>513</sup> 1079 FIT         Diagnostic test Interval       ≤ 60 s         Fault reaction time       ≤ 3 s         Comments       3 s <sup>1</sup> This information is based on the variant II in the Safety Manual.       *Depending on methode of proof test.         Declaration	Age <sup>11</sup> 157 FIT         SFF - Safe Failure Fraction       94 %         PTC <sup>721</sup> 63 97 % <sup>14</sup> Jogan <sup>313</sup> 1079 FIT         Diagnostic test Interval       ≤ 60 s         Fault reaction time       ≤ 3 s         Comments       3 s <sup>1</sup> This information is based on the variant II in the Safety Manual.       *Depending on methode of proof test.         Declaration	Noo					
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Our internal company quality management system ensures information on safety-related systematic faults which become evident in the future	Our internal company quality management system ensures information on safety-related systematic faults which become evident in the future						
evident in the future     evident in the future     FIT = Failure In Time, Number of failures per 10 <sup>9</sup> h	evident in the future     evident in the future     FIT = Failure In Time, Number of failures per 10 <sup>9</sup> h						
1) FIT = Failure In Time, Number of failures per 10 <sup>9</sup> h	1) FIT = Failure In Time, Number of failures per 10 <sup>9</sup> h 2) PTC = Proof Test Coverage (Diagnostic coverage for proof test)		ment system ensur	es information on safe	ety-related systematic fau	ilts which become	
2) PTC = Proof Test Coverage (Diagnostic coverage for proof test)		1) FIT = Failure In Time, Number of failure	es per 10 <sup>9</sup> h	of test)	-+		

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The components can be operated as different versions: ■ Version II (→ 🗎 6)
One Soliphant with a 1-channel Nivotester; for the activation of an actuator or a safety-related PLC via switching contacts, for instance
• Version III ( $\rightarrow \square 7$ )
One Soliphant with a 3-channel Nivotester; switching contacts are switched in series ■ Version IV (→ 🗎 8)
Two Soliphant devices with a 3-channel Nivotester; the switching contacts are switched in series ■ Version V (→   □ 10)
Three Soliphant devices with a 3-channel Nivotester; evaluation is performed in a safety-related PLC, for example
• Version VI ( $\rightarrow \square$ 12) Three Soliphant devices with a 3-channel Nivotester; only channel 1 has a SIL-specific monitoring function. Channels 2 and 3 are used for level control of the same level (e.g. $\Delta$ s). This level control may not then be considered as a safety measure as part of functional safety according to EN 61508.
<ul> <li>NOTICE</li> <li>Measuring another, independent level (e.g. in a second tank)</li> <li>The remaining channels may not be used for other levels.</li> </ul>
Please note the following for the tables below:
<ul> <li>A common cause factor β = 10 % has been assumed in the calculations indicated below.</li> <li>For multi-channel systems, the PFD<sub>avg</sub> values already contain common cause failures for the specific wiring scheme.</li> </ul>
<ul> <li>The PFD<sub>avg</sub> values only apply to the particular wiring scheme for which the values have been calculated. They are not a suitable basis for making calculations for other wiring schemes. The use of NC contacts instead of NO contacts, in particular, is not permitted for operation according to SIL specifications.</li> <li>The wiring scheme indicates the number of devices and the circuitry of the level relay</li> </ul>
<ul> <li>If there are several devices in a wiring scheme, all the devices have the same settings shown.</li> <li>The tables show safety-related values and wiring options for the measuring system.</li> <li>FIT = Failure in Time, 1 FIT = 10<sup>-9</sup> l/h.</li> </ul>

Specific functional safety parameters:

Characteristics as per IEC 61508	Value
Safety function	MAX
Example	<b>\$</b> 200
Wiring scheme	A Other safety equipment e.g. actuator/safety-related PLC
SIL	2
HFT	0
Device type	В
Mode of operation	Low demand mode
SFF	94 %
MTTR	8 h
$\lambda_{sd}^{1}$	157 FIT
$\lambda_{su}$	817 FIT
$\lambda_{dd}$	40 FIT
λ <sub>du</sub>	65 FIT
$PFD_{avg}$ for $T_1 = 1$ year	2.83 x 10 <sup>-4</sup>
MTBF	106 years
Diagnostic test interval <sup>2)</sup>	≤60 s
Fault reaction time <sup>3)</sup>	≤3 s
System reaction time <sup>4)</sup>	Switching delay + :0.5 s (free > covered); 1 s (covered > free) Switching delay + :5 s (free > covered and covered > free)
PTC test sequence A <sup>5)</sup>	97 %
PTC test sequence B <sup>6)</sup>	63 %

1) This value takes into account failure types relevant to the function of the electronic components according to Siemens SN29500.

2) During this time, all diagnostic functions are executed at least once.

3) Time between error detection and error response.

4) Step response time as per DIN EN 61298-2.

5) Proof test coverage when the level is approached, or when the sensor is removed and the tines are immersed in a medium of similar density and granulation.

6) Proof test coverage when simulation is performed on the Nivotester by activating the test button.

Version II: Soliphant M/S; 1-channel Nivotester FTL325P

Characteristics as per IEC 61508	Value
Safety function	MAX
Example	
Wiring scheme	A Other safety equipment e.g. actuator/safety-related PLC B Possibility 1 C Possibility 2; 1002 assessment
SIL	2
HFT	0
Device type	В
Mode of operation	Low demand mode
SFF	97 %
MTTR	8 h
$\lambda_{sd}$ <sup>1)</sup>	168 FIT
λ <sub>su</sub>	1020 FIT
$\lambda_{dd}$	39 FIT
λ <sub>du</sub>	34 FIT
$PFD_{avg}$ for $T_1 = 1$ year	1.49 x 10 <sup>-4</sup>
MTBF	91 years
Diagnostic test interval <sup>2)</sup>	≤60 s
Fault reaction time <sup>3)</sup>	≤3 s
System reaction time <sup>4)</sup>	Switching delay $\vdash$ :0.5 s (free > covered); 1 s (covered > free) Switching delay $\vdash$ :5 s (free > covered and covered > free)
PTC test sequence A <sup>5)</sup>	98 %
PTC test sequence B <sup>6)</sup>	75 %

Version III: Soliphant M/S; 3-channel Nivotester FTL325P, CH2 and CH3 in series

1) This value takes into account failure types relevant to the function of the electronic components according to Siemens SN29500.

- 2) 3) During this time, all diagnostic functions are executed at least once.
- Time between error detection and error response.
- 4) Step response time as per DIN EN 61298-2.
- 5) Proof test coverage when the level is approached, or when the sensor is removed and the tines are immersed in a medium of similar density and granulation.
- 6) Proof test coverage when simulation is performed on the Nivotester by activating the test button.

Characteristics as per IEC 61508	Value
Safety function	MAX
Example	
Wiring scheme	B       CH1        CH1        A         CH2        A       CH2        A         CH3        CH3        CH3        CH3          A Other safety equipment e.g. actuator/safety-related PLC       B Possibility 1       CPossibility 2; 1003 assessment
SIL	2
HFT	1
Device type	В
Mode of operation	Low demand mode
SFF	99 %
MTTR	8 h
$\lambda_{sd}^{1)}$	402 FIT
λ <sub>su</sub>	1637 FIT
$\lambda_{dd}$	2 FIT
λ <sub>du</sub>	12 FIT
$PFD_{avg}$ for $T_1 = 1$ year	5.11 x 10 <sup>-5</sup>
MTBF	56 years
Diagnostic test interval <sup>2)</sup>	≤60 s
Fault reaction time <sup>3)</sup>	≤3 s
System reaction time <sup>4)</sup>	Switching delay $\vdash$ :0.5 s (free > covered); 1 s (covered > free) Switching delay $\vdash$ :5 s (free > covered and covered > free)
PTC test sequence A <sup>5)</sup>	97 %
PTC test sequence B $^{\rm 6)}$	63 %

Version IV: 2 Soliphant M/S; 3-channel Nivotester FTL325P

1) This value takes into account failure types relevant to the function of the electronic components according to Siemens SN29500.

- During this time, all diagnostic functions are executed at least once. Time between error detection and error response. 2)
- 3)

4) Step response time as per DIN EN 61298-2.

- 5) Proof test coverage when the level is approached, or when the sensor is removed and the tines are immersed in a medium of similar density and granulation.
- 6) Proof test coverage when simulation is performed on the Nivotester by activating the test button.



The failure rates are based on an analysis in accordance with DIN EN 61508-6: 2011-02, Table D.4, "Using the  $\beta$ -factor to calculate the probability of failure in an E/E/PE safety-related system due to common cause failures". The calculation gives a  $\beta$ -factor of 10 %. This factor is based on the failure rates indicated above. If additional measures are implemented during installation to prevent common cause errors as defined in Table D.1, the  $\beta$ -factor can possibly be reduced to 5 %. Possible measures are:

- Sensors installed in a physically separate location
- Cable routed separately between Soliphant and Nivotester
- Separate protection from environmental influences: impact, sunshine, EMC protection and/or overvoltage
- Use of different sensor materials, and combination of high-temperature and normal version

Characteristics as per IEC 61508	Value
Safety function	MAX
Example	
Wiring scheme	A Other safety equipment e.g. actuator/safety-related PLC; 2003 assessment
SIL	2
HFT	1
Device type	В
Mode of operation	Low demand mode
SFF	99 %
MTTR	8 h
$\lambda_{sd}^{1}$	598 FIT
λ <sub>su</sub>	1984 FIT
$\lambda_{dd}$	3 FIT
λ <sub>du</sub>	14 FIT
$PFD_{avg}$ for $T_1 = 1$ year	5.96 x 10 <sup>-5</sup>
MTBF	44 years
Diagnostic test interval <sup>2)</sup>	≤60 s
Fault reaction time <sup>3)</sup>	≤3 s
System reaction time <sup>4)</sup>	Switching delay $\vdash$ :0.5 s (free > covered); 1 s (covered > free) Switching delay $\vdash$ :5 s (free > covered and covered > free)
PTC test sequence A <sup>5)</sup>	97 %
PTC test sequence B <sup>6)</sup>	63 %

Version V: 3 Soliphant M/S; 3-channel Nivotester FTL325P

1) This value takes into account failure types relevant to the function of the electronic components according to Siemens SN29500.

2) During this time, all diagnostic functions are executed at least once.

3) Time between error detection and error response.

4) Step response time as per DIN EN 61298-2.

5) Proof test coverage when the level is approached, or when the sensor is removed and the tines are immersed in a medium of similar density and granulation.

6) Proof test coverage when simulation is performed on the Nivotester by activating the test button.

The failure rates are based on an analysis in accordance with DIN EN 61508-6: 2011-02, Table D.4, "Using the  $\beta$ -factor to calculate the probability of failure in an E/E/PE safety-related system due to common cause failures". The calculation gives a  $\beta$ -factor of 10 %. This factor is based on the failure rates indicated above. If additional measures are implemented during installation to prevent common cause errors as defined in Table D.1, the  $\beta$ -factor can possibly be reduced to 5 %. Possible measures are:

- Sensors installed in a physically separate location
- Cable routed separately between Soliphant and Nivotester
- Separate protection from environmental influences: impact, sunshine, EMC protection and/or overvoltage
- Use of different sensor materials, and combination of high-temperature and normal version

	Characteristics as per IEC 61508	Value
	Safety function	MAX
	Example	
	Wiring scheme	A Other safety equipment e.g. actuator/safety-related PLC
		$\Delta s$ level control (not SIL)
	SIL	2
	HFT	0
	Device type	B
	Mode of operation	Low demand mode
	SFF	94%
	$\frac{\text{MTTR}}{\lambda_{sd}^{-1)}}$	8 h
		157 FIT 817 FIT
	$\lambda_{su}$	40 FIT
	λ <sub>dd</sub>	65 FIT
	$\lambda_{du}$	2.83 x 10 <sup>-4</sup>
	$PFD_{avg} \text{ for } T_1 = 1 \text{ year}$ $MTBF$	106 years
	Diagnostic test interval <sup>2)</sup>	≤60 s
	Fault reaction time <sup>3)</sup>	≤3 s
	System reaction time <sup>4)</sup>	Switching delay $\vdash$ :0.5 s (free > covered); 1 s (covered > free) Switching delay $\vdash$ :5 s (free > covered and covered > free)
	PTC test sequence A <sup>5)</sup>	97 %
	PTC test sequence B <sup>6)</sup>	63 %
	<ul> <li>to Siemens SN29500.</li> <li>During this time, all diag</li> <li>Time between error dete</li> <li>Step response time as pe</li> <li>Proof test coverage when immersed in a medium of</li> </ul>	ount failure types relevant to the function of the electronic components accordir mostic functions are executed at least once. ection and error response. er DIN EN 61298-2. In the level is approached, or when the sensor is removed and the tines are of similar density and granulation. In simulation is performed on the Nivotester by activating the test button.
etime of electrical nts	The established failure rate IEC 61508-2:2010 section	s of electrical components apply within the useful lifetime as per 7.4.9.5 note 3.
		8-2:2011 section 7.4.9.5 national footnote N3, appropriate measures and operator can extend the useful lifetime.

Version VI: Soliphant M/S; 3-channel Nivotester FTL325P (CH1 for SIL; CH2+CH3 e.g. for level control  $\Delta$ S)

# Certificate

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Certificate				
e alcis				
Nr./No.: 968/FSP	1148.00/15			
Prüfgegenstand	Füllstandswächter	Zertifikats-	Endress + Hauser GmbH +	
Product tested	Level monitor	inhaber Certificate holder	Co. KG Hauptstraße 1 79689 Maulburg	
		noider	Germany	
Typbezeichnung Type designation	Liquiphant M/S with FEL56/58/5 Soliphant M with FEM57 + Nivo Possible device combinations so	tester FTL 325 P		
Prüfgrundlagen Codes and standards	IEC 61508 Parts 1-7:2010			
Bestimmungsgemäße Verwendung Intended application	Die Geräte erfüllen die Anforder Sicherheitsintegrität SIL 2 nach IEC 61508) und können in Anwe nach IEC 61508 für die Sicherh	IEC 61508 und syste endungen bis SIL 2 (H eitsfunktionen MIN oc	matische Eignung SIL 3 nach IFT=0) bzw. SIL 3 (HFT=1)	
	Füllstandsüberwachung eingese The devices comply with the rec safety integrity SIL 2 acc. to IEC	uirements of the relevant		
	61508) and can be used in appl acc. to IEC 61508 for the safety	ications up to SIL 2 (H	HFT=0) resp. SIL 3 (HFT=1)	
Besondere Bedingungen Specific requirements	Die Hinweise in der zugehöriger sind zu beachten. The instructions of the associate			hany
Gültig bis / Valid until 2020-10	considered.			bin / Gem
-	ates liegt eine Prüfung zugrunde, de	ren Ergebnisse im Be	richt Nr. 968/ESP 1148.00/15	. 51105 H
vom 05.10.2015 dokumentiert s Dieses Zertifikat ist nur gültig fü jeglicher Änderung der Prüfgru	sind. Ir Erzeugnisse, die mit dem Prüfgeg ndlagen für den angegebenen Verw	enstand übereinstimm endungszweck.	en. Es wird ungültig bei	Service GmbH, Am Graven Stein, 51105 Köh / Germany
Report No. 968/FSP 1148.00/1 This certificate is valid only for	products which are identical with the	product tested. It bed		se GmbH, An
the codes and standards formin	ng the basis of testing for the intende			
	Bereich Automat	ion	CIAL	nd Indus
	Funktionale Siche Am Grauen Stein, 51	105 Köln	Diel les Steehen Häh	TÜV Rheinland Industrie
Köln, 2015-10-05	Cortification Dedute - FO	FIDDUCIS	DiplIng. Stephan Häb	Ę
Köln, 2015-10-05	Certification Body for FS			
Köln, 2015-10-05 www.fs-products.com		^	<b>TÜV</b> Rheinland®	

# **Document information**

**Document function** 

The document is part of the Operating Instructions and serves as a reference for application-specific parameters and notes.

Symbols used

# Safety symbols

Symbol	Meaning
<b>A</b> DANGER	<b>DANGER!</b> This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.
<b>WARNING</b>	<b>WARNING!</b> This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.
	<b>CAUTION!</b> This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.
NOTICE	<b>NOTE!</b> This symbol contains information on procedures and other facts which do not result in personal injury.

# Symbols for certain types of information

Symbol	Meaning
A0011193	Tip Indicates additional information.
A0011194	<b>Reference to documentation</b> Refers to the corresponding device documentation.
A0011195	Reference to page Refers to the corresponding page number.
A0011196	<b>Reference to graphic</b> Refers to the corresponding graphic number and page number.
1. , 2. , 3	Series of steps

# Symbols in graphics

Symbol	Meaning
1, 2, 3,	Item numbers
1. , 2. , 3	Series of steps
A, B, C,	Views

# Supplementary device documentation

### Soliphant M FTM51, FTM51, FTM52

Documentation	Comment			
Technical Information: TI00392F/00	The documentation is available on the internet: $\rightarrow$ www.de.endress.com			
Operating Instructions: • KA00229F/00 (FTM50, FTM51) • KA00230F/00 (FTM52)	<ul> <li>The document is provided with the device.</li> <li>The documentation is available on the internet:         → www.de.endress.com     </li> </ul>			
Safety instructions depending on the selected option "Approval".	Additional safety instructions (XA, ZE) are supplied with certified device version. Please refer to the nameplate for the relevant safety instructions.			

#### Nivotester FTL325P

Documentation	Comment
Technical Information: TI00350F/00	The documentation is available on the internet: $\rightarrow$ www.de.endress.com
Operating Instructions: • KA00167F/00 (1-channel) • KA00168F/00 (3-channel)	<ul> <li>The document is provided with the device.</li> <li>The documentation is available on the internet:         <ul> <li>→ www.de.endress.com</li> </ul> </li> </ul>
Safety instructions depending on the selected option "Approval".	Additional safety instructions (XA, ZE) are supplied with certified device version. Please refer to the nameplate for the relevant safety instructions.

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This supplementary Safety Manual applies in addition to the Operating Instructions, Technical Information and Safety Instructions. The supplementary device documentation must be observed during installation, commissioning and operation. The requirements specific for the protection function are described in this Safety Manual.

# Permitted devices types

The details pertaining to functional safety in this manual relate to the device versions listed below and are valid as of the specified firmware and hardware versions. Unless otherwise specified, all the following versions can also be used for protective systems. A modification process according to IEC 61508 is applied for device changes.

Ordering feature	Designation	Option
010	Approval	All
020	Process connection	All
030	Material; surface refinement	All
040	Fork; bulk density	All
050	Electronics; output	7 FEM57; 2-wire PFM
060	Type of probe	All
070	Housing	All
080	Cable entry	All
090	Additional options 1	<ul><li> R Glass cover, SIL Declaration of Conformity</li><li> S SIL Declaration of Conformity</li></ul>
100	Additional options 2	All
995	Marking	All

• Valid firmware version: 01.01.00 and higher

Valid hardware version: 01.00 and higher

Valid device versions for safety-related use: Nivotester FTL325P

Ordering feature	Designation	Option
010	Approval	<ul> <li>G ATEX II 3(1)G Ex nC/A [ia] IIC T4, SIL, IECEx Zone 2</li> <li>H ATEX II (1)GD [EEx ia] IIC, WHG, SIL, IECEx [Ex ia] IIC</li> <li>N NEPSI [Ex ia] IIC, SIL</li> <li>P FM IS CI. I, II, III Div. 1 Gr. A-G, SIL</li> <li>T CSA IS CI. I, II, III Div. 1 Gr. A-G, SIL</li> <li>W TIIS Ex ia IIC, SIL, labeling in Japan</li> <li>2 INMETRO [Ex ia Ga] IIC, SIL</li> </ul>
020	Housing	<ul> <li>1 Rail mounting, 22.5 mm, 1-channel</li> <li>3 Rail mounting, 45mm, 3-channel</li> </ul>
030	Power supply	All
040	Switch output	<ul> <li>1 1x SPDT level + 1x SPST alarm</li> <li>3 3x SPDT level + 1x SPST alarm</li> </ul>
995	Marking	All

Valid hardware version: 02.00 and higher

SIL label on the nameplate

SIL certified devices are marked with the following symbol on the nameplate: 📾

# Safety function

Definition of the safety	The measuring system's safety functions are:				
function	Maximum point level monitoring (overfill protection)				
	For information on the choice of operating mode, $\rightarrow \equiv 19$ .				
Restrictions for use in safety- related applications	<ul> <li>The measuring system must be used correctly for the specific application, taken into account the medium properties and ambient conditions. Carefully follow instructions pertaining to critical process situations and installation conditions from the Operating Instructions. The application-specific limits must be observed.</li> <li>The specifications from the Operating Instructions must not be exceeded, →  <sup>(1)</sup> <sup>(2)</sup> <sup>(2)</sup> <sup>(2)</sup> <sup>(2)</sup> <sup>(3)</sup> <sup>(4)</sup> <sup>(4</sup></li></ul>				
	Density of the medium				
	<ul> <li>Operation is only permitted with bulk solids:</li> <li>Depending on the configured density setting and the fork length, the density of the bulk material must be as follows: <ul> <li>Over 50 g/l with standard fork and with switch position "high bulk density" •.</li> <li>Over 10 g/l with standard fork and with switch position "low bulk density" •.</li> <li>Over 200 g/l with short fork and with switch position "high bulk density" •.</li> <li>Over 50 g/l with short fork and with switch position "low bulk density" •.</li> </ul> </li> </ul>				
	<ul> <li>There is no maximum density for the bulk solids. Recommendation: for heavy bulk solids, select the "high bulk density" setting to reduce the risk of false alarms.</li> <li>For more information on the levels of diagnostic coverage, refer to IEC 61508-2:2010 Appendix A.2, Comment 2 and Table A.1.</li> </ul>				
	Gas phase				
	There must be a gas phase or a vacuum above the bulk solids. The detection of boundary layers, e.g. to liquids, is not permitted!				
	Wall distance				
	Recommendation: select the clearance to the wall such that bulk solids cannot get jammed between the vessel wall and the fork. This prevents the system from not quitting the demand mode.				

# Corrosion

The device may only be used in media to which the wetted parts used are resistant. Corrosion can have the effect that the demand mode of the safety function is not detected and the device will not switch as intended.

Corrosion is detected with low diagnostic coverage in the event of a low bulk density and with diagnostics switched ON.

If coated sensors are used, measures must be taken to ensure there is no damage during installation and operation.

### Abrasion

The device may not be used or cleaned in abrasive media. Material removal can have the effect that the demand mode is not detected.



Abrasion is detected with low diagnostic coverage in the event of a low bulk density and with diagnostics switched ON.

### External vibration

In systems exposed to strong external vibrations, e.g. in the 50 to 600 Hz range (acceleration spectral density >1  $(m/s^2)^2/Hz$ ) or ultrasound with cavitation, the safety function must be verified by simulating a demand mode prior to operation. Accidental switchings may sporadically occur if a strong frequency from an external source is superimposed on the frequency of the tuning fork.

### **EMC** compatibility

The device is certified in accordance with IEC 61326-3-2 and is therefore suitable for safety-related, industrial applications in a specified electromagnetic environment. If the specified electromagnetic ambient conditions are exceeded, the switch status might not be reliably detected. An unshielded cable up to 1000 m (3281 ft) long can be used between the devices in these environmental conditions. Electromagnetic interference immunity can be further improved by using shielded cables.

### Mounting the Soliphant M FTM51 with a sliding sleeve

Particular care is required when mounting the device with a pipe extension in conjunction with a sliding sleeve. The operator must implement appropriate measures is to ensure that the switch point is not tampered with or that any tampering is reliably detected.

Device behavior during	Behavior of d	evice during p	ower-up					
operation	The behavior of the device during power-up is described in the relevant Operating Instructions ( $\rightarrow \ igodot 14$ ).							
	Device behavi	Device behavior in safety function demand mode						
		The safety-related output signal consists of one switching contact per channel: Channel 1: terminal 4 and 5						
	For the 3-char Channel 2: t Channel 3: t	erminal 22 an	d 23					
	The swite							
	The switching contacts are de-energized in the following situations: In demand mode If a fault is detected If the supply voltage fails							
	Behavior of device in event of alarms and warnings							
	The behavior of Instructions (-		alarms or warning	s occur is described in the relevant Operating				
Device configuration for	The device cor	The device configuration may not be changed if SIL operation is in progress.						
safety-related applications		Recommendation: perform a proof test after configuring to ensure that the safety function is working correctly.						
	Configuring the Soliphant							
	D Switch to switch the self-test on and off							
	Switch representatio n	Function	Switch position	Start behavior				
	D⊿tâŸ	OFF	Тор	~ 1 s 0 Hz				
		ON	Bottom	<ul> <li>~ 3 s 0 Hz</li> <li>~ 4 s 150 Hz (covered = demand mode)</li> <li>~ 3 s 50 Hz (free = potentially dangerous)</li> </ul>				

# Use in safety instrumented systems

# **WARNING**

A0025600

# The safety function is disabled during the self-test!

A potentially dangerous output signal is output temporarily.

• Measures must be taken to guarantee the safety function during this period.

### ⊿t Switch for switching delay

Switch representatio n	Function	Switch position	Switching delay
D⊿t a v		Тор	0.5 s (free > covered); 1 s (covered > free)
A0025586		Bottom	5 s (free > covered and covered > free)

Switch representatio n	Function	Switch position	Standard fork density	Short fork density
	•	Тор	Over 50 g/l	Over 200 g/l
A0025583	•	Bottom	Over 10 g/l	Over 50 g/l

The switch position depends on the individual medium ( $\rightarrow \square 17$ ).  $\mathbf{f}$ 

 $\ensuremath{\mathbb{W}}$  Switch for diagnosis for abrasion

H

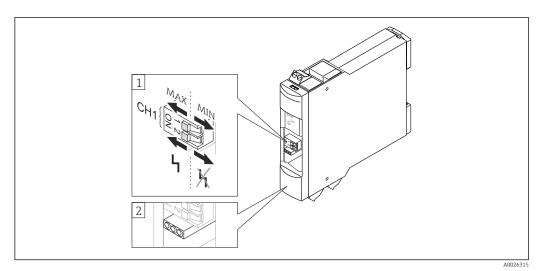
Switch representatio n	Function	Switch position	High bulk density •	Low bulk density •
D⊿tễ 好	OFF	Тор	Off	Off
OFF ⊢ • OFF • ON • ON • OFF • ON • ON • OFF	ON	Bottom	Off (only indicated by LED on electronic insert)	On (relay de-energizes in the event of an error)

The function depends on the selected density setting (→ 
☐ 17).
The switch position is not relevant for SIL since the diagnostics function does not have the high level of diagnostics coverage which is required for SIL 2 (→ 
☐ 17).

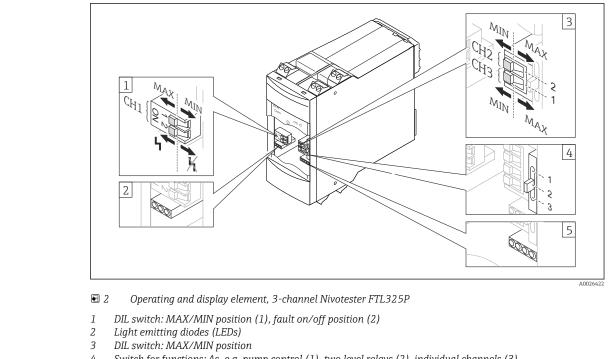
# Nivotester configuration

		Switch				
		Channel 1	Fault message	Channel 2 <sup>1)</sup>	Channel 3 <sup>1)</sup>	MODE 1)
Mode of operation	Version	1	2	2	1	
MAX	II	MAX	With	Not applicable		
	III		None	MAX	MAX	2
	IV		With			2
	V					3
	VI					1

1) Only for 3-channel Nivotester FTL325P



- 1 Operating and display element, 1-channel Nivotester FTL325P
- 1 DIL switch: MAX/MIN position (1), fault on/off position (2)
- 2 Light emitting diodes (LEDs)



- Switch for functions:  $\Delta s$ , e.g. pump control (1), two level relays (2), individual channels (3) 4
- 5 Light emitting diodes (LEDs)

Check the operativeness and safety of safety functions at appropriate intervals! The operator must determine the time intervals.

The values and figures in the "Additional safety-related characteristic values" section can be used to this end,  $\rightarrow \square$  5. The check must be carried out in such a way that it is proven that the protective system functions perfectly in interaction with all components.

Proof-testing can be performed as follows:

- Test sequence A:
- Approach the bulk solid or remove and immerse in a medium of similar density and granulation. • Test sequence B:
- Activate simulation by pressing the test button on the Nivotester

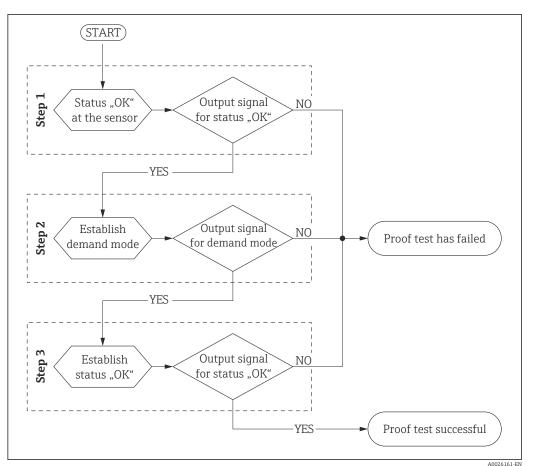
# NOTICE

### Ensuring correct device sealing!

You must also check and ensure that all cover seals and cable entries are sealing correctly.

**Proof-testing** 

### Procedure of the proof-test



A demand mode or a fault takes absolute precedence over the proof test and in the measuring system safety path. For this reason, the demand mode must first be ended or the fault rectified before the proof test can commence. It is advisable to also check that the alarm relay (terminal 15 and 16) has not de-energized (no fault is present) at the start of the proof test (step 1).

The proof test can and may only be performed if the device state is GOOD.

The status of the individual output signal is indicated by a measuring device or a downstream component of the safety path (e.g. safety-related PLC, actuator). For more information,  $\rightarrow \cong 29$ .



It is advisable to document the steps of the proof test ( $\rightarrow \square$  30).

	Mode of operation
	MAX
Approach the level	Test sequence A ( $\rightarrow \square 24$ )
Remove and immerse in a medium of similar density and viscosity	
Activate simulation by pressing the test button on the Nivotester	Test sequence B ( $\Rightarrow \square 26$ )

### Test sequence A

- Approach the level or
- Remove and immerse in a medium of similar density and granulation.

Step 1

- 2. Lower the level or remove the tuning fork of the sensor that has been removed out of the medium until the tuning fork is completely free.
  - If it is not possible to do this with the original medium, a medium of a similar density and granulation must be used.
- 3. Check the status of the safety contacts.

	Version						
Terminal	II III IV VI						
4+5	Closed	Not applicable	Closed	Closed	Closed		
22+23	Not applicable	Closed	Closed	Closed	Not applicable		
26+27	Not applicable	Closed	Closed	Closed	Not applicable		

If one or more safety contacts are open, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

# Step 2

- 2. Raise the level or immerse the tuning fork of the sensor that has been removed into the medium until the tuning fork is fully covered.
- 3. In the event of a switching delay  $\vdash$  once the fork is covered (plus a response time of approx. 1 s) check the status of the safety contacts ( $\rightarrow \cong 19$ ).
- 4. In the event of a switching delay → once the fork is covered (plus a response time of approx. 5 s) check the status of the safety contacts (→ 🗎 19).

	Version						
Terminal	II III IV VI						
4+5	Open	Not applicable	Open	Open	Open		
22+23	Not applicable	Open	Open	Open	Not applicable		
26+27	Not applicable	Open	Open	Open	Not applicable		

If one or more safety contacts are closed, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

#### Step 3

2. Re-install the sensor that was removed.

- 3. Restore the GOOD state by fully exposing the tuning fork.
- 4. Once the fork is exposed, in the event of a switching delay → (plus a response time of approx. 1 s) or in the event of a switching delay → (plus a response time of approx. 5 s), check the status of the safety contacts.
- 5. Once the voltage is restored when the self-test is OFF (plus a response time of approx. 3 s) or once the voltage is restored when the self-test is ON (plus a response time of approx. 10 s), check the status of the safety contacts.

	Version						
Terminal	II III IV V VI						
4+5	Closed	Not applicable	Closed	Closed	Closed		
22+23	Not applicable	Closed	Closed	Closed	Not applicable		
26+27	Not applicable	Closed	Closed	Closed	Not applicable		

If one or more safety contacts are open, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

### Test sequence B

Activate simulation by pressing the test button on the Nivotester.

Step 1

• Check the status of the safety contacts.

	Version						
Terminal	II III IV VI						
4+5	Closed	Not applicable	Closed	Closed	Closed		
22+23	Not applicable	Closed	Closed	Closed	Not applicable		
26+27	Not applicable	Closed	Closed	Closed	Not applicable		



If one or more safety contacts are open, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

### Step 2

2. Press and hold the test button on the Nivotester.

3. Check the status of the safety contacts.

	Version						
Terminal	II III IV VI						
4+5	Open	Not applicable	Open	Open	Open		
22+23	Not applicable	Open	Open	Open	Not applicable		
26+27	Not applicable	Open	Open	Open	Not applicable		

If one or more safety contacts are closed, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

#### Step 3

- 2. Release the test button on the Nivotester.
- 3. The safety contacts switch once the voltage is restored when the self-test is OFF (plus a response time of approx. 3 s) or once the voltage is restored when the self-test is ON (plus a response time of approx. 10 s).

	Version						
Terminal	II III IV VI						
4+5	Closed	Not applicable	Closed	Closed	Closed		
22+23	Not applicable	Closed	Closed	Closed	Not applicable		
26+27	Not applicable	Closed	Closed	Closed	Not applicable		

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If one or more safety contacts are open, a fault has occurred in the safety path. The proof test has not been passed and must be aborted.

Life cycle

Life cycle						
Requirements for personnel	<ul> <li>The personnel for installation, commissioning, diagnostics, repair and maintenance must meet the following requirements:</li> <li>Trained, qualified specialists must have a relevant qualification for this specific function and task</li> <li>Are authorized by the plant owner/operator</li> <li>Are familiar with federal/national regulations</li> <li>Before beginning work, the specialist staff must have read and understood the instructions in the manuals and supplementary documentation as well as in the certificates (depending on the</li> </ul>					
	application)	id comply with basic conditions	in the certificates (depending on the			
	<ul> <li>The operating personnel must meet the following requirements:</li> <li>Are instructed and authorized according to the requirements of the task by the facility's owner-operator</li> <li>Follow the instructions in this manual</li> </ul>					
Installation	The installation of the device is described in the relevant Operating Instructions $\Rightarrow \square 14$ .					
	As the application conditions affect the reliability of the measurement, please parameters in the Technical information and Operating Instructions ( $\Rightarrow \boxminus 14$ ).					
Operation	Mandatory settings and information for the safety function ( $\rightarrow \square$ 19).					
Maintenance	Maintenance information, $\rightarrow \cong 22$ .					
	Alternative monito proof-testing and m	ring measures must be taken to en naintenance work on the device.	nsure process safety during configuration,			
Repair	Repair means a one-to-one replacement of components. Repairs on the devices must always be carried out by Endress+Hauser. Safety functions cannot be guaranteed if repairs are carried out by anybody else.					
	Exceptions:					
	Qualified personnel may replace the following components on the condition that original spare parts are used and the relevant Installation Instructions are observed:					
	Component	Installation Instructions	Checking the device after repair			
	Electronic insert	EA01050F	Proof testing, see the "Proof-testing" section			
	Housing cover T13	<ul> <li>EA01049F/00 (electronics)</li> <li>EA01049F/00 (inspection glass)</li> </ul>	- (→ 🖹 22) <sup>1)</sup>			

# 1) Additional country-specific regulations and tests must be observed.

In the event of failure of a SIL-labeled Endress+Hauser device, which has been operated in a protection function, the "Declaration of Contamination and Cleaning" with the corresponding note "Used as SIL device in protective system" must be enclosed when the defective device is returned. Please refer to the "Return" section of the relevant Operating Instructions  $\rightarrow \bigoplus 14$ .

Modification



Housing cover F13

Housing cover F15

Housing cover F16

Housing cover F17

Housing cover F27

Cover seal F15

Sensor

Modifications are changes to SIL capable devices already delivered or installed.

EA01050F/00 (connection)

EA01046F/00

EA01034F/00

EA01035F/00

EA01036F/00

EA01047F/00

KA00620F/00

KA00628F/00

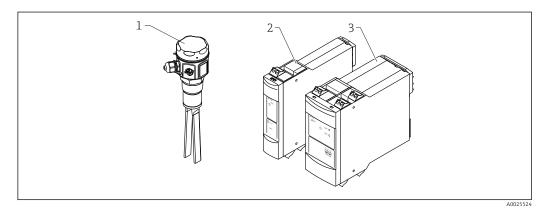
	Modifications to SIL capable devices are usually performed in the Endress+Hauser manufacturing center.
	Modifications to SIL capable devices onsite at the user's plant are possible following approval by the Endress+Hauser manufacturing center. In this case, the modifications must be performed and documented by an Endress+Hauser service technician.
	Modifications to SIL capable devices by the user are not permitted.
Decommissioning	For detailed information on decommissioning, see the relevant Operating Instructions $\rightarrow$ 🗎 14

# Appendix

Structure of the measuring system

#### System components

The measuring system's devices are displayed in the following diagram (example):



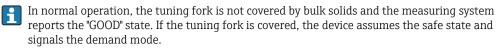
- 1 Soliphant M/S
- 2 1-channel Nivotester FTL325P
- 3 3-channel Nivotester FTL325P

#### Description of use as a protective system

The sensor's tuning fork vibrates at its intrinsic frequency. When the fork is covered by a bulk solid, the amplitude decreases. This loss of energy causes the current signal to change. The Maximum Detection operating mode can be selected.

### MAX detection

The measuring system is used to protect against a level that is too high (e.g. overfill prevention).



The switch point depends on the installation. It is in the area of the tuning fork.



Correct installation is a prerequisite for safe operation of the device.

Commissioning or proof test report	F	Report					
System-specific data							
Company							
Measuring point/TAG no.							
Facility							
Device type/Order code							
Serial no. of Soliphant(s)				·			
Serial no. of Nivotester							
Name							
Date							
Signature							
Operating mode, density ra	ange and v	version (please tio	ck appropriate b	ox)			
Bulk density	High bulk	density 🔵 over 5	0 g/l for standard	d fork, over 20	00 g/l for short fork	τ	
	Low bulk	density • over 10	) g/l for standard	fork, over 50	g/l for short fork		
Version	П	One Soliphant at	one channel (1c	01)			
	Ш	II One Soliphant (1001), output relay CH2 and CH3 switched in series (1002)					
	IV	Two Soliphants (					
	v	Three Soliphants					
	VI	Three Soliphants	s, 1 x SIL, 2 x leve	l control (∆s)			
Commissioning or proof te	st report						
Test sequence	A	Approach the lev	<i>r</i> el				
		Remove and imn					
	В	Simulation on Ni	votester by press	ing the test b	utton		
		Version					
Test step	Termin al	П	ш	IV	V	VI	Actual value
Step 1	4+5	_Ł	1)	Ł	L	Ł	
(GOOD state)	22+23	1)	Ł	Ł		2)	
Switch is closed	26+27	1)	L	Ł		2)	
Step 2	4+5	~-	1)	~-	~~	~-	
(demand mode)	22+23	1)	~-	~-	~-	2)	
Switch is open	26+27	1)		~-	~~	2)	
Step 3	4+5	Ł	1)	Ł		Ł	
(GOOD state)	22+23	1)	L	Ł	Ł	2)	
Switch is closed	26+27	1)	Ł	Ł	Ł	2)	
Conclusion		Passed 🗆			Failed 🗆		

1) Not applicable as channel is not used.

2) Not relevant for SIL, is used for level control ( $\Delta$ s).

Further information

General information on functional safety (SIL) is available at:

www.de.endress.com/SIL (Germany) or www.endress.com/SIL (English) and in the Competence Brochure CP01008Z/11 "Functional Safety in the Process Industry- Risk Reduction with Safety Instrumented Systems".

Version history	Version	Changes	Valid for hardware version
	SD00207F/00/EN/01.06	First version	01.00
	SD00207F/00/EN/13.15	Nivotester updated to IEC 61508-2011	02.00



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