Compliance report EN 50155

Qualification of Baumer Level Switch LFFS and LBFS to Railway applications according to BS EN 50155 – Shock and Vibration Standard EN 61373 (Governing Standard BS EN 50155 Railway Applications – Electronic equipment used on rolling stock) Dated 2011-11-22

Contents

1.0 Statement compliant to EN50155

We,

Baumer A/S
Jacob Knudsens Vej 14
8230 Aabyhoej
Denmark

Tel: +45 89 31 76 11

confirm that the product Level Switch LBFS xxxx x (C) and LFFS xxxx x (C) are complying with the Railway standard of EN50155. Copy of detailed test reports is available on request from Baumer A/S.
Description of the evaluation and test are attach this statement. So are the declaration of conformity for EMC according to EN50121 and accredited Vibrations test according to EN61373.

Date: 2011-11-22 Sign: 

Kurt Møller Jensen, R&D Manager

2.0 Evaluation of LFFS and LBFS according to EN50155

This document is made for proving the validation of the railway approval according to EN50155. All test mentioned in the document are available on request from Baumer A/S. Most test reports are in the document shown with two pages of the complete report.

3.0 Product under test

The evaluation is based on the Level Switches LBFS and LFFS series. For the LBFS series was test performed on versions with plastic and metal M12 electrical connection where it is critical. On LFFS was test performed on normal version and sliding connection where it is critical. Each group was tested as outlined below to demonstrate compliance to EN 50155. Both product series was successfully tested without deterioration of performance of the products as demonstrated in the test results.

4.0 Environmental service condition of operation

4.1.1 Altitude

The Level switches LFFS and LBFS are suitable for applications up to 1200m of altitude. There is no customer for requirements exceeding 1200m of altitude.

4.1.2 Ambient temperature

Baumer internal extreme temperature test ranges from - 40°C to + 85°C and are preformed on all mentioned instruments.

Extreme temperature test performed on LBFS

The LBFS are connected to a 100 Ω resistor on the output. This will ensure that the current limit circuit are activated during the test and the maximum current are known. Measuring the output is done with a 10Kohm resistor as mentioned in the datasheet.
All measurings are performed with supply voltage of 24VDC.

PNP (16556):

	22,9 0C	85 0C	-40 0C
Vout_NC	22,44 VDC	22,62 VDC	22,20 VDC
	0 VDC	0,36 VDC	0 VDC
Iout_NC	22,80 mA	19,2 mA	25,6 mA
	0 mA	0 mA	0 mA
Vout_NO	22,40 VDC	22,56 VDC	22,14 VDC
	0 VDC	0,34 VDC	0 VDC
Iout_NO	22,80 mA	19,2 mA	25,1 mA
	0 mA	0 mA	0 mA

Active high PNP (VDC -1.5V) ± 0.5V ; Rload 10 kOhm, 20 mA output current.

PNP unit are within the specification of the datasheet. The leak current when the output is off is below 100uA as described in the datasheet.

NPN (16558):

	22,9 0C	85 0C	-40 0C
Vout_NC	24,11 VDC	24,0 VDC	24,13 VDC
	1,99 VDC	1,58 VDC	2,13 VDC
Iout_NC	25,2 mA	21,1 mA	27,8 mA
	0 mA	0 mA	0 mA
Vout_NO	24,11 VDC	24,0 VDC	24,13 VDC
	1,83 VDC	1,45 VDC	2,11 VDC
Iout_NO	25,0 mA	21,0 mA	27,1 mA
	0mA	0 mA	0 mA

Active low NPN (-VDC +1.5V) ± 0.5V ; Rload 10 kOhm, 20 mA output current.

The NPN version of the LBFS is fulfilling specification within the ambient temperature area -40°C to 85°C.

Extreme temperature test performed on LFFS
The temperature test was carried out for LFFS where a function test is performed as a function of supply voltage at different temperature levels for -40°C to 85°C.

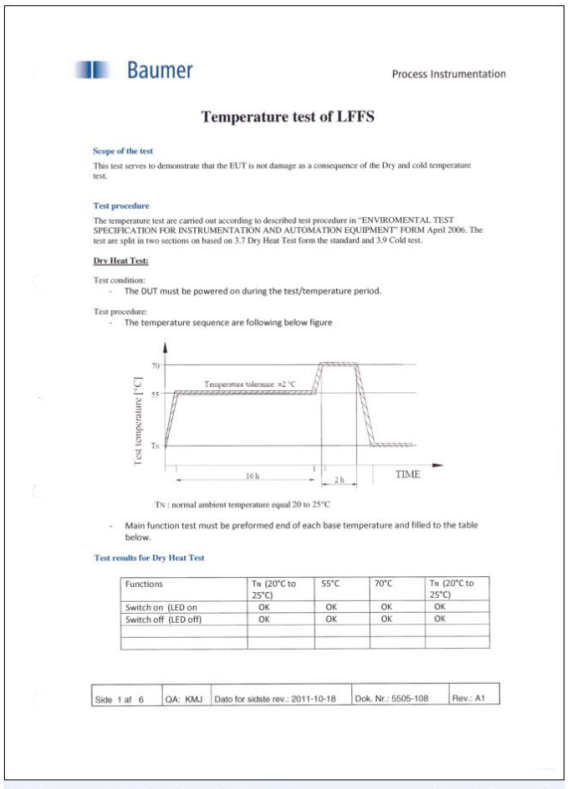
Måleresultater

V_{in} (VDC)	**-40°C (Medie: Sprit) (TRIGGER: 70%)**		
	PNP output	**NPN output**	**Digital output**
+12	trig↑ (mm): 31 trig↓ (mm): 33	trig↑ (mm): 31 trig↓ (mm): 33	trig↑ (mm): 30 trig↓ (mm): 32
+36	trig↑ (mm): 31 trig↓ (mm): 33	trig↑ (mm): 31 trig↓ (mm): 32	trig↑ (mm): 30 trig↓ (mm): 32
-12	trig↑ (mm): 31 trig↓ (mm): 33	trig↑ (mm): 31 trig↓ (mm): 33	trig↑ (mm): 31 trig↓ (mm): 32
-36	trig↑ (mm): 31 trig↓ (mm): 33	trig↑ (mm): 31 trig↓ (mm): 33	trig↑ (mm): 31 trig↓ (mm): 32
V_{in} (VDC)	**-40°C (Medie: Plexiglas klods) (TRIGGER: 82%)**		
	PNP output	**NPN output**	**Digital output**
+12	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK
+36	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK
-12	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK
-36	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK
V_{in} (VDC)	**23,6°C (Medie: Rå linolie) (TRIGGER: 82%)**		
	PNP output	**NPN output**	**Digital output**
+12	trig↑ (mm): 26 trig↓ (mm): 29	trig↑ (mm): 24 trig↓ (mm): 28	trig↑ (mm): 25 trig↓ (mm): 28
+36	trig↑ (mm): 27 trig↓ (mm): 29	trig↑ (mm): 26 trig↓ (mm): 29	trig↑ (mm): 27 trig↓ (mm): 29
-12	trig↑ (mm): 25 trig↓ (mm): 28	trig↑ (mm): 25 trig↓ (mm): 28	trig↑ (mm): 25 trig↓ (mm): 28
-36	trig↑ (mm): 27 trig↓ (mm): 29	trig↑ (mm): 26 trig↓ (mm): 29	trig↑ (mm): 27 trig↓ (mm): 29
V_{in} (VDC)	**85°C (Medie: Rå linolie) (TRIGGER: 82%)**		

	PNP output	NPN output	Digital output
+12	trig↑ (mm): 12 trig↓ (mm): 16	trig↑ (mm): 12 trig↓ (mm): 16	trig↑ (mm): 11 trig↓ (mm): 15
+36	trig↑ (mm): 14 trig↓ (mm): 17	trig↑ (mm): 13 trig↓ (mm): 16	trig↑ (mm): 13 trig↓ (mm): 17
-12	trig↑ (mm): 11 trig↓ (mm): 16	trig↑ (mm): 10 trig↓ (mm): 15	trig↑ (mm): 11 trig↓ (mm): 15
-36	trig↑ (mm): 13 trig↓ (mm): 17	trig↑ (mm): 13 trig↓ (mm): 16	trig↑ (mm): 13 trig↓ (mm): 17
V_{in} (VDC)	**85°C (Medie: Plexiglas klods) (TRIGGER 82%)**		
	PNP output	**NPN output**	**Digital output**
+12	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK
+36	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK
-12	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK
-36	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK	trig↑: OK trig↓: OK

Supplementary temperature test

Tests for LFFS and LBFS according to IEC60945 are added as supplementary test. Test reports are made in separated documents as show below.



Baumer Process Instrumentation

Temperature test of LFFS

Scope of the test

This test serves to demonstrate that the EUT is not damage as a consequence of the Dry and cold temperature test.

Test procedure

The temperature test are carried out according to described test procedure in "ENVIROMENTAL TEST SPECIFICATION FOR INSTRUMENTATION AND AUTOMATION EQUIPMENT" FORM April 2006. The test are split in two sections on based on 3.7 Dry Heat Test form the standard and 3.9 Cold test.

Dry Heat Test:

Test condition:
- The DUT must be powered on during the test/temperature period.

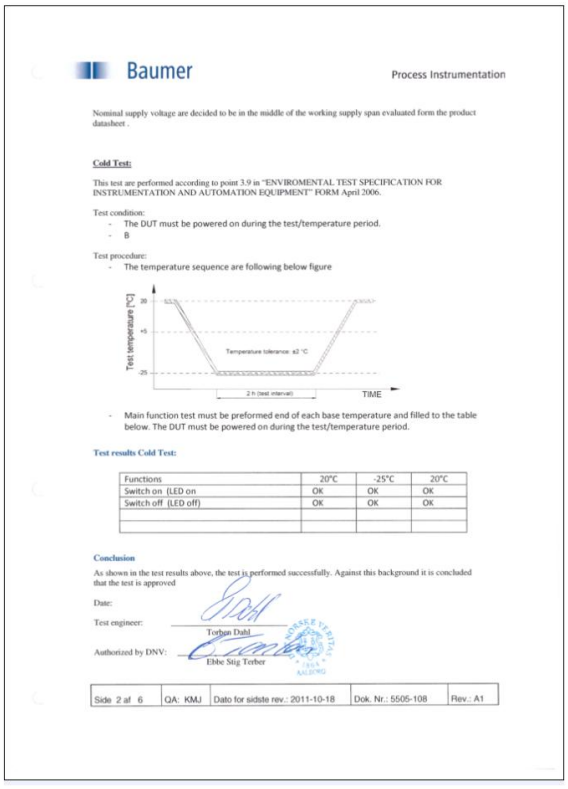
Test procedure:
- The temperature sequence are following below figure

Tn : normal ambient temperature equal 20 to 25°C

- Main function test must be preformed end of each base temperature and filled to the table below.

Test results for Dry Heat Test

Functions	Tn (20°C to 25°C)	55°C	70°C	Tn (20°C to 25°C)
Switch on (LED on	OK	OK	OK	OK
Switch off (LED off)	OK	OK	OK	OK



Baumer Process Instrumentation

Nominal supply voltage are decided to be in the middle of the working supply span evaluated form the product datasheet .

Cold Test:

This test are performed according to point 3.9 in "ENVIROMENTAL TEST SPECIFICATION FOR INSTRUMENTATION AND AUTOMATION EQUIPMENT" FORM April 2006.

Test condition:
- The DUT must be powered on during the test/temperature period.
- B

Test procedure:
- The temperature sequence are following below figure

- Main function test must be preformed end of each base temperature and filled to the table below. The DUT must be powered on during the test/temperature period.

Test results Cold Test:

Functions	20°C	-25°C	20°C
Switch on (LED on	OK	OK	OK
Switch off (LED off)	OK	OK	OK

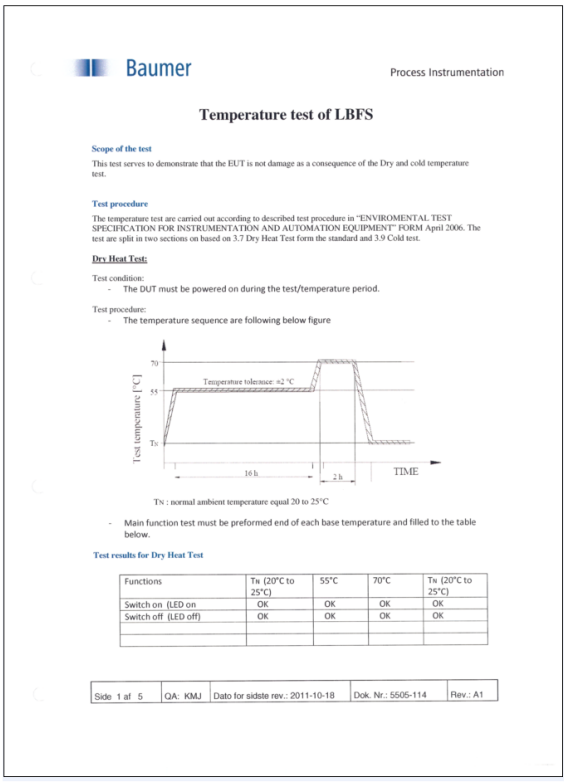
Conclusion

As shown in the test results above, the test is performed successfully. Against this background it is concluded that the test is approved

Date:

Test engineer: Torbjørn Dahl

Authorized by DNV: Ebbe Stig Torber



Baumer Process Instrumentation

Temperature test of LBFS

Scope of the test

This test serves to demonstrate that the EUT is not damage as a consequence of the Dry and cold temperature test.

Test procedure

The temperature test are carried out according to described test procedure in "ENVIROMENTAL TEST SPECIFICATION FOR INSTRUMENTATION AND AUTOMATION EQUIPMENT" FORM April 2006. The test are split in two sections on based on 3.7 Dry Heat Test form the standard and 3.9 Cold test.

Dry Heat Test:

Test condition:
- The DUT must be powered on during the test/temperature period.

Test procedure:
- The temperature sequence are following below figure

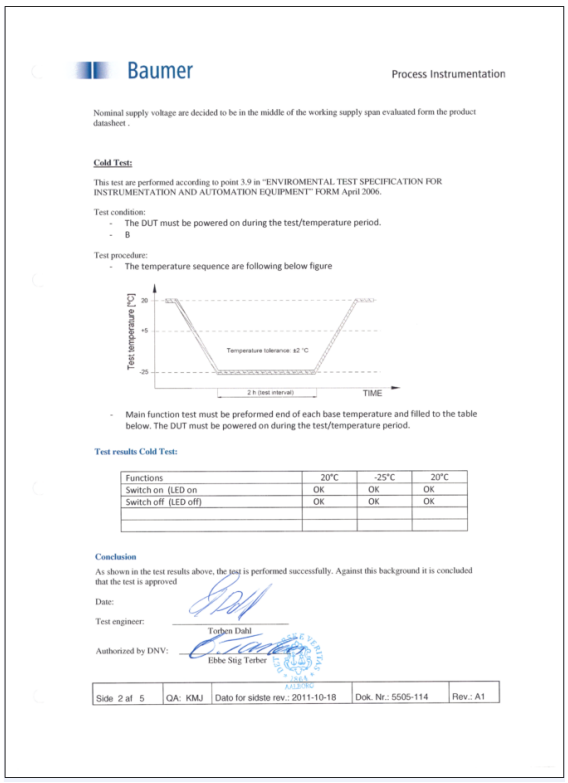
Tn : normal ambient temperature equal 20 to 25°C

- Main function test must be preformed end of each base temperature and filled to the table below.

Test results for Dry Heat Test

Functions	Tn (20°C to 25°C)	55°C	70°C	Tn (20°C to 25°C)
Switch on (LED on	OK	OK	OK	OK
Switch off (LED off)	OK	OK	OK	OK

Side 1 af 5	QA: KMJ	Dato for sidste rev.: 2011-10-18	Dok. Nr.: 5505-114	Rev.: A1



Baumer Process Instrumentation

Nominal supply voltage are decided to be in the middle of the working supply span evaluated form the product datasheet .

Cold Test:

This test are performed according to point 3.9 in "ENVIROMENTAL TEST SPECIFICATION FOR INSTRUMENTATION AND AUTOMATION EQUIPMENT" FORM April 2006.

Test condition:
- The DUT must be powered on during the test/temperature period.
- B

Test procedure:
- The temperature sequence are following below figure

- Main function test must be preformed end of each base temperature and filled to the table below. The DUT must be powered on during the test/temperature period.

Test results Cold Test:

Functions	20°C	-25°C	20°C
Switch on (LED on	OK	OK	OK
Switch off (LED off)	OK	OK	OK

Conclusion

As shown in the test results above, the test is performed successfully. Against this background it is concluded that the test is approved

Date:

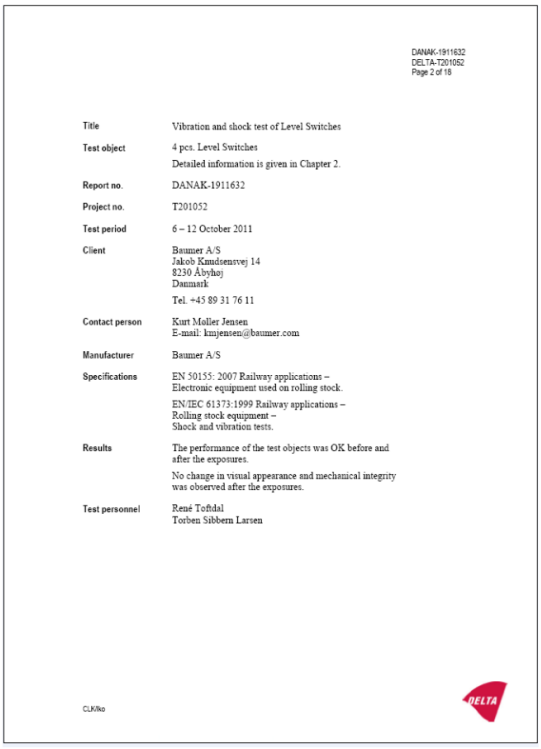
Test engineer: Torben Dahl

Authorized by DNV: Ebbe Stig Terber

Side 2 af 5	QA: KMJ	Dato for sidste rev.: 2011-10-18	Dok. Nr.: 5505-114	Rev.: A1

4.1.3 Shock and vibration

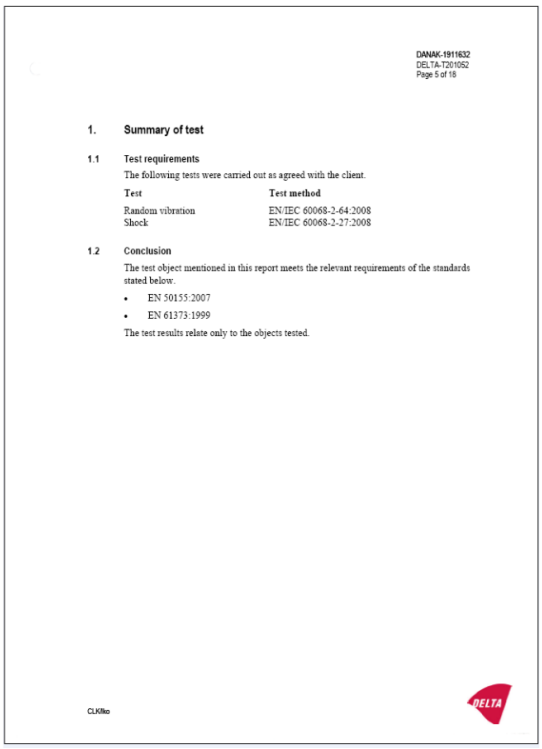
Tests of LFFS and LBFS according Requirements from IEC publication 600068-2-6 and EN 61373 were verified. Test reports are made in separated documents two pages are shown below.
Total Accredited report for fulfilling vibration and shock requirements fromEN50155 and EN61373 can be seen in appendix B.



DANAK-1911632
DELTA-T201052
Page 2 of 18

Title	Vibration and shock test of Level Switches
Test object	4 pcs. Level Switches Detailed information is given in Chapter 2.
Report no.	DANAK-1911632
Project no.	T201052
Test period	6 – 12 October 2011
Client	Baumer A/S Jakob Knudsensvej 14 8230 Åbyhøj Danmark Tel. +45 89 31 76 11
Contact person	Kurt Møller Jensen E-mail: kmjensen@baumer.com
Manufacturer	Baumer A/S
Specifications	EN 50155: 2007 Railway applications – Electronic equipment used on rolling stock. EN/IEC 61373:1999 Railway applications – Rolling stock equipment – Shock and vibration tests.
Results	The performance of the test objects was OK before and after the exposures. No change in visual appearance and mechanical integrity was observed after the exposures.
Test personnel	René Toftdal Torben Sibbern Larsen

CLK/ko



DANAK-1911632
DELTA-T201052
Page 5 of 18

1. Summary of test

1.1 Test requirements

The following tests were carried out as agreed with the client.

Test	Test method
Random vibration	EN/IEC 60068-2-64:2008
Shock	EN/IEC 60068-2-27:2008

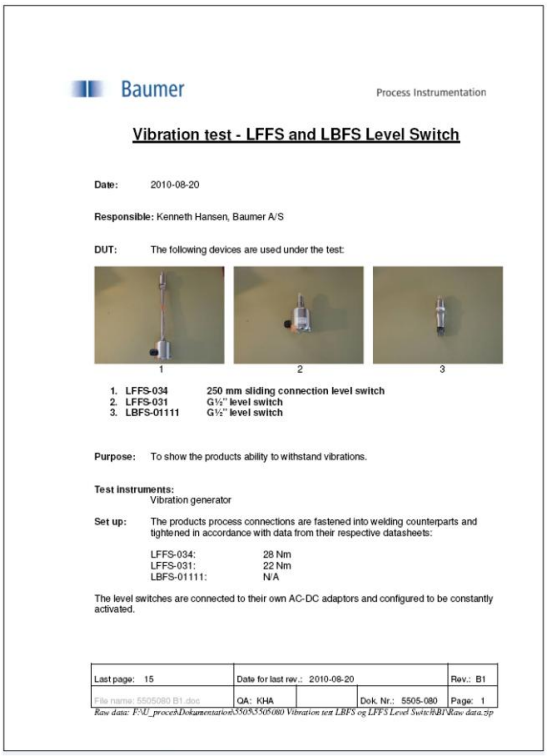
1.2 Conclusion

The test object mentioned in this report meets the relevant requirements of the standards stated below.

- EN 50155:2007
- EN 61373:1999

The test results relate only to the objects tested.

CLK/ko



Baumer Process Instrumentation

Vibration test - LFFS and LBFS Level Switch

Date: 2010-08-20

Responsible: Kenneth Hansen, Baumer A/S

DUT: The following devices are used under the test:

1 2 3

1. **LFFS-034** **250 mm sliding connection level switch**
2. **LFFS-031** **G½" level switch**
3. **LBFS-01111** **G½" level switch**

Purpose: To show the products ability to withstand vibrations.

Test instruments:
Vibration generator

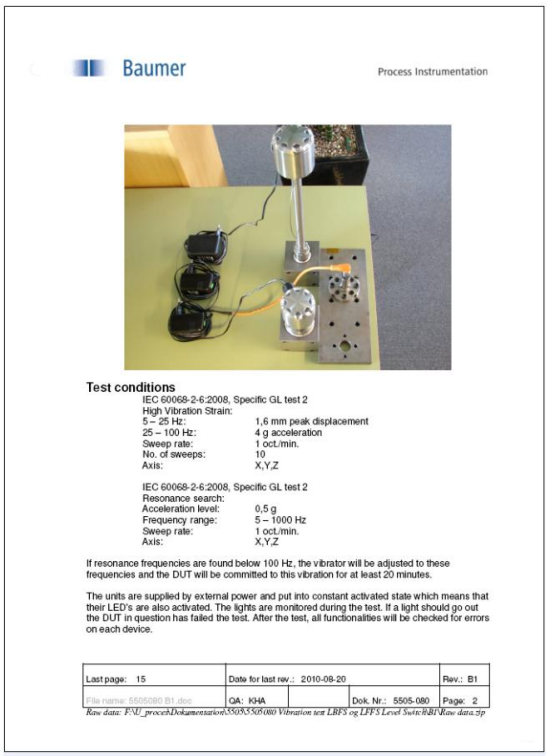
Set up: The products process connections are fastened into welding counterparts and tightened in accordance with data from their respective datasheets:

LFFS-034:	28 Nm
LFFS-031:	22 Nm
LBFS-01111:	N/A

The level switches are connected to their own AC-DC adaptors and configured to be constantly activated.

Last page: 15	Date for last rev.: 2010-08-20		Rev.: B1
File name: 5505080 B1.doc	QA: KHA	Dok. Nr.: 5505-080	Page: 1

Raw data: F:\U_proces\Dokumentation\5505\5505080 Vibration test LBFS og LFFS Level Switch\B1\Raw data.zip



Baumer Process Instrumentation

Test conditions

IEC 60068-2-6:2008, Specific GL test 2
High Vibration Strain:

5 – 25 Hz:	1,6 mm peak displacement
25 – 100 Hz:	4 g acceleration
Sweep rate:	1 oct./min.
No. of sweeps:	10
Axis:	X,Y,Z

IEC 60068-2-6:2008, Specific GL test 2
Resonance search:

Acceleration level:	0,5 g
Frequency range:	5 – 1000 Hz
Sweep rate:	1 oct./min.
Axis:	X,Y,Z

If resonance frequencies are found below 100 Hz, the vibrator will be adjusted to these frequencies and the DUT will be committed to this vibration for at least 20 minutes.

The units are supplied by external power and put into constant activated state which means that their LED's are also activated. The lights are monitored during the test. If a light should go out the DUT in question has failed the test. After the test, all functionalities will be checked for errors on each device.

Last page: 15	Date for last rev.: 2010-08-20		Rev.: B1
File name: 5505080 B1.doc	QA: KHA	Dok. Nr.: 5505-080	Page: 2

Raw data: F:\U_proces\Dokumentation\5505\5505080 Vibration test LBFS og LFFS Level Switch\B1\Raw data.zip

Both tests fulfill the specification from the standard and are therefore approved.

4.1.4 Relative humidity

Requirements according to IEC 60068-2-30 were verified.

Concerning LFFS:

Baumer Process Instrumentation

Humidity test for LFFS

Scope of the test

This test serves to demonstrate that the EUT is not damage and no permanent or temporary malfunction occurs during a high humidity.

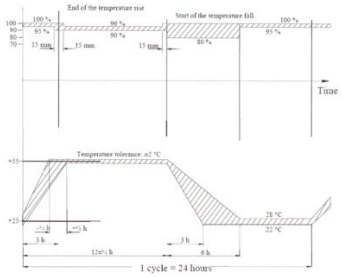
Test procedure

The temperature test are carried out according to described test procedure in "ENVIROMENTAL TEST SPECIFICATION FOR INSTRUMENTATION AND AUTOMATION EQUIPMENT" FORM April 2006. The test performed in according to 3.8.1 Damp Heat Test from the standard. Furthermore are the test carried out with respect to cyclic condensation which are mandatory for class B.

Damp Heat Test:

Test condition:
- The DUT must be powered on during the test period.

Test procedure:
- Let the instrument stabilize in temperature at 25°C without power.
- Below shown test cycle must be run through 2 times. During first test cycle the unit must be switched off. The DUT must be switched on in second run. The temperature and humidity must follow the sequence shown in below figure.



Side 1 af 2	QA: KMJ	Dato for sidste rev.: 2011-10-18	Dok. Nr.: 5505-105	Rev.: A1

Baumer Process Instrumentation

- In second cycle must the power be switch on. Afterward same procedure at carried out again. Let the instrument stabilize in temperature at 25°C without power.
- Performance test must be carried out during the test cycle, results should be filled in below table

Test results for Dry Heat Test

Functions	High temperature (55°C) /humidity (96%)	Low temperature (25°C) /humidity (95%)	Comments
Detect of media (LED on)	OK	OK	
Detect of media (LED off)	OK	OK	

Nominal supply voltage are decided to be in the middle of the working supply span evaluated form the product datasheet .

Conclusion

As shown in the test results above, the test is performed successfully. Against this background it is concluded that the test is approved

Date:

Test engineer: Torbjørn Dahl

Authorized by DNV: Ebbe Stig Terber

Side 2 af 2	QA: KMJ	Dato for sidste rev.: 2011-10-18	Dok. Nr.: 5505-105	Rev.: A1

Concerning LBFS :

Baumer Process Instrumentation

Humidity test for LFBS

Scope of the test

This test serves to demonstrate that the EUT is not damage and no permanent or temporary malfunction occurs during a high humidity.

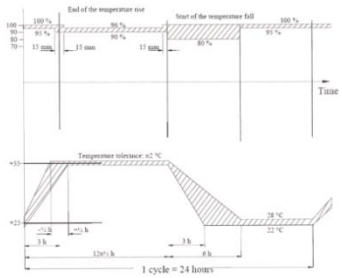
Test procedure

The temperature test are carried out according to described test procedure in "ENVIROMENTAL TEST SPECIFICATION FOR INSTRUMENTATION AND AUTOMATION EQUIPMENT" FORM April 2006. The test performed in according to 3.8.1 Damp Heat Test from the standard. Furthermore are the test carried out with respect to cyclic condensation which are mandatory for class B.

Damp Heat Test:

Test condition:
- The DUT must be powered on during the test period.

Test procedure:
- Let the instrument stabilize in temperature at 25°C without power.
- Below shown test cycle must be run through 2 times. During first test cycle the unit must be switched off. The DUT must be switched on in second run. The temperature and humidity must follow the sequence shown in below figure.



Side 1 af 2	QA: KMJ	Dato for sidste rev.: 2011-10-21	Dok. Nr.: 5505-111	Rev.: A1

Baumer Process Instrumentation

- In second cycle must the power be switch on. Afterward same procedure at carried out again. Let the instrument stabilize in temperature at 25°C without power.
- Performance test must be carried out during the test cycle, results should be filled in below table

Test results for Dry Heat Test

Functions	High temperature (55°C) /humidity (96%)	Low temperature (25°C) /humidity (95%)	Comments
Detect of media (LED on)	OK	OK	
Detect of media (LED off)	OK	OK	

Nominal supply voltage are decided to be in the middle of the working supply span evaluated form the product datasheet .

Conclusion

As shown in the test results above, the test is performed successfully. Against this background it is concluded that the test is approved

Date: 2011-10-21

Test engineer: Torbjørn Dahl

Authorized by DNV: Ebbe Stig Terber

Side 2 af 2	QA: KMJ	Dato for sidste rev.: 2011-10-21	Dok. Nr.: 5505-111	Rev.: A1

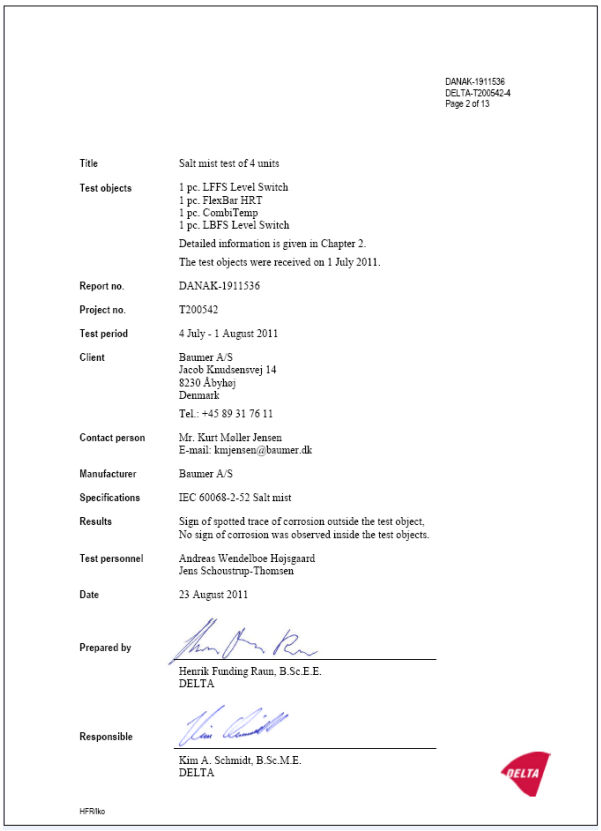
4.2 Special service conditions

The products can be adjusted according to the customer needs within the limit of the product configuration possibilities. This can be done with the Flexprogram software and the configuration unit Flexprogrammer9701. Software og konfiguration enhed er ikke en del af LFFS og LBFS men tjener som service udstyr.

4.2.1 Atmospheric pollutants

Requirements according IEC 60068-2-30 Damp heat cyclic test were verified and accredited by Det Norske Veritas (DNV). See point 4.1.4

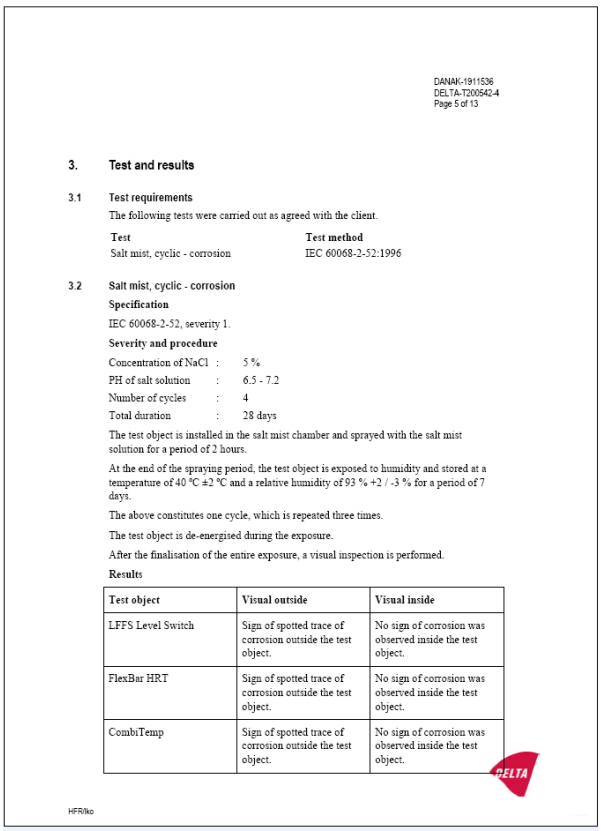
Requirements according IEC 60068-2-52 Salt mist test were verified and accredited by Delta A/S



DANAK-1911536
DELTA-T200542-4
Page 2 of 13

Title	Salt mist test of 4 units
Test objects	1 pc. LFFS Level Switch 1 pc. FlexBar HRT 1 pc. CombiTemp 1 pc. LBFS Level Switch Detailed information is given in Chapter 2. The test objects were received on 1 July 2011.
Report no.	DANAK-1911536
Project no.	T200542
Test period	4 July - 1 August 2011
Client	Baumer A/S Jacob Knudsensvej 14 8230 Åbyhøj Denmark Tel.: +45 89 31 76 11
Contact person	Mr. Kurt Møller Jensen E-mail: kmjensen@baumer.dk
Manufacturer	Baumer A/S
Specifications	IEC 60068-2-52 Salt mist
Results	Sign of spotted trace of corrosion outside the test object, No sign of corrosion was observed inside the test objects.
Test personnel	Andreas Wendelboe Højsgaard Jens Schoustrup-Thomsen
Date	23 August 2011
Prepared by	Henrik Funding Raun, B.Sc.E.E. DELTA
Responsible	Kim A. Schmidt, B.Sc.M.E. DELTA

HFR/ko



DANAK-1911536
DELTA-T200542-4
Page 5 of 13

3. Test and results

3.1 Test requirements

The following tests were carried out as agreed with the client.

Test	Test method
Salt mist, cyclic - corrosion	IEC 60068-2-52:1996

3.2 Salt mist, cyclic - corrosion

Specification

IEC 60068-2-52, severity 1.

Severity and procedure

Concentration of NaCl : 5 %
PH of salt solution : 6.5 - 7.2
Number of cycles : 4
Total duration : 28 days

The test object is installed in the salt mist chamber and sprayed with the salt mist solution for a period of 2 hours.

At the end of the spraying period, the test object is exposed to humidity and stored at a temperature of 40 °C ±2 °C and a relative humidity of 93 % +2 / -3 % for a period of 7 days.

The above constitutes one cycle, which is repeated three times.

The test object is de-energised during the exposure.

After the finalisation of the entire exposure, a visual inspection is performed.

Results

Test object	Visual outside	Visual inside
LFFS Level Switch	Sign of spotted trace of corrosion outside the test object.	No sign of corrosion was observed inside the test object.
FlexBar HRT	Sign of spotted trace of corrosion outside the test object.	No sign of corrosion was observed inside the test object.
CombiTemp	Sign of spotted trace of corrosion outside the test object.	No sign of corrosion was observed inside the test object.

HFR/ko

5.0 Electric service conditions

5.1 Power supply

5.1.1 Supply from accumulator

The specification of the power supple voltage for LFFS is 12,5Vdc to 36Vdc. Most of the tests are carried out at 24VDC.

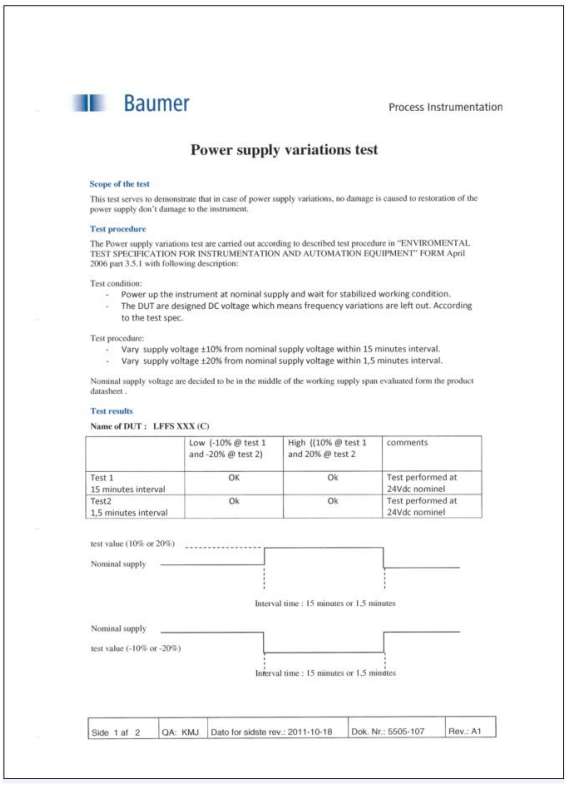
5.1.1.1 Variation of voltage supply

The power supply range for LFFS is specified between 12,5VDC to 36VDC while LBFS is specified to a power supply range from 12VDC and 30VDC.

For both products is the voltage supply range limited for the ATEX version.

Requirements according Det Norske Veritas (DNV). were verified in below test reports.

LFFS:



Baumer Process Instrumentation

Power supply variations test

Scope of the test

This test serves to demonstrate that in case of power supply variations, no damage is caused to restoration of the power supply don't damage to the instrument.

Test procedure

The Power supply variations test are carried out according to described test procedure in "ENVIROMENTAL TEST SPECIFICATION FOR INSTRUMENTATION AND AUTOMATION EQUIPMENT" FORM April 2006 part 3.5.1 with following description:

Test condition:
- Power up the instrument at nominal supply and wait for stabilized working condition.
- The DUT are designed DC voltage which means frequency variations are left out. According to the test spec.

Test procedure:
- Vary supply voltage ±10% from nominal supply voltage within 15 minutes interval.
- Vary supply voltage ±20% from nominal supply voltage within 1,5 minutes interval.

Nominal supply voltage are decided to be in the middle of the working supply span evaluated form the product datasheet .

Test results

Name of DUT : LFFS XXX (C)

	Low (-10% @ test 1 and -20% @ test 2)	High ((10% @ test 1 and 20% @ test 2	comments
Test 1 15 minutes interval	OK	Ok	Test performed at 24Vdc nominel
Test2 1,5 minutes interval	Ok	Ok	Test performed at 24Vdc nominel

Side 1 af 2	QA: KMJ	Dato for sidste rev.: 2011-10-18	Dok. Nr.: 5505-107	Rev.: A1

Baumer Process Instrumentation

Conclusion

As shown in the test results above, the test is performed successfully. Against this background it is concluded that the test is approved

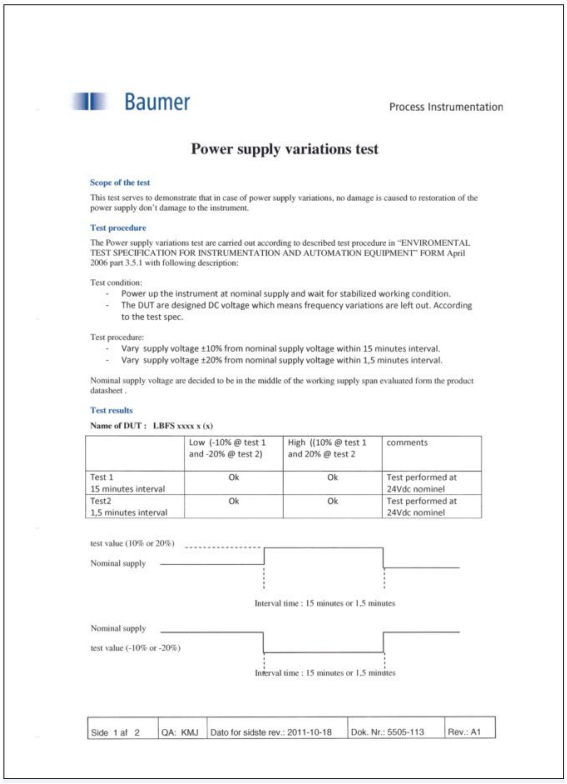
Date: 2011-10-18

Test engineer: Torben Dahl

Authorized by DNV: Ebbe Stig Terber

Side 2 af 2	QA: KMJ	Dato for sidste rev.: 2011-10-18	Dok. Nr.: 5505-107	Rev.: A1

LBFS:



Baumer Process Instrumentation

Power supply variations test

Scope of the test

This test serves to demonstrate that in case of power supply variations, no damage is caused to restoration of the power supply don't damage to the instrument.

Test procedure

The Power supply variations test are carried out according to described test procedure in "ENVIROMENTAL TEST SPECIFICATION FOR INSTRUMENTATION AND AUTOMATION EQUIPMENT" FORM April 2006 part 3.5.1 with following description:

Test condition:
- Power up the instrument at nominal supply and wait for stabilized working condition.
- The DUT are designed DC voltage which means frequency variations are left out. According to the test spec.

Test procedure:
- Vary supply voltage ±10% from nominal supply voltage within 15 minutes interval.
- Vary supply voltage ±20% from nominal supply voltage within 1,5 minutes interval.

Nominal supply voltage are decided to be in the middle of the working supply span evaluated form the product datasheet .

Test results

Name of DUT : LBFS xxxx x (x)

	Low (-10% @ test 1 and -20% @ test 2)	High ((10% @ test 1 and 20% @ test 2	comments
Test 1 15 minutes interval	Ok	Ok	Test performed at 24Vdc nominel
Test2 1,5 minutes interval	Ok	Ok	Test performed at 24Vdc nominel

Side 1 af 2	QA: KMJ	Dato for sidste rev.: 2011-10-18	Dok. Nr.: 5505-113	Rev.: A1

Baumer Process Instrumentation

Conclusion

As shown in the test results above, the test is performed successfully. Against this background it is concluded that the test is approved

Date: 2011-10-18

Test engineer: Torben Dahl

Authorized by DNV: Ebbe Stig Terber

Side 2 af 2	QA: KMJ	Dato for sidste rev.: 2011-10-18	Dok. Nr.: 5505-113	Rev.: A1

5.1.1.2 Interruption of voltage supplies

LFFS comply to Class S1, means no interruption of the supply voltage available according to EN50155. This is only true in worst case

LFFS:

#	Beskrivelse	Test	Status
8. Power Supply interruption	Test according to IEC 770 At supply interruption must the product shown correct condition immediately after the interruption. In case of restart of the product must the unstable condition be equal to the starting up time.	Output : short cut (Absolute worst case is with a short cut of the output)	2 ms: OK 4 ms: Restarts only during measuring. >4 ms: restarts

LBFS:

#	Beskrivelse	Test	Status
8. Power Supply interruption	Test according to IEC 770 At supply interruption must the product shown correct condition immediately after the interruption. In case of restart of the product must the unstable condition be equal to the starting up time.	Output : short cut	2 ms: OK 4 ms: Restarts only during measuring. >4 ms: restarts

5.1.1.3 Variation of voltage supplies

The requirement of this point concerns power supply units and therefore not applicable for the LFFS and LBFS series.

5.1.1.4 D.C. ripple factor

The requirement of this point concerns power supply units and therefore not applicable for the LFFS and LBFS series.

5.1.2 Supply by a static converter or a rotating set

See test performed in 5.1.1.1.

5.1.3 Supply change over

The LBFFS and LBFS comply to class C1, which means a power supply reduction to 0.6xUn during 100ms. A class C2 of power supply changeover would generate a power restart of device T400 series. But no failure can be generated in that case.

5.1.4 Supply with overhead line or third rail

The requirement of this point is not applicable for the LFFS and LBFS series.

5.1.5 Supply rated surges
This requirement is part of voltage supply variation, see point 5.1.1.1
Requirements according to IEC EN 61000-4-2 DNV: 60068-2-30 was verified.

5.2 Supply overvoltage
This requirement is part of voltage supply variation, see point 5.1.1.1

5.3 Installation
The installation requirements are defined in manual for LFFS or LBFS.
For detailed description see operating manual for each product.

5.4 Surges and electrostatic discharge according to EN 50155 / EN50121
Requirements according EN50121 was verified. For test result see report in appendix A

5.5 Electromagnetic compatibility according to EN 50155 / EN50121
Requirements according EN50121 was verified. For test result see report in appendix A

6 Reliability, maintainability and expected useful life

6.1 Equipment reliability

6.1.1 Predicted reliability

MTTF calculations for LFFS and LBFS are carried out as show below:

Typ designation:	**LFFS Level Switch**
Operating temperature [°C] 40	
Operating voltage range [VDC] 12,5 - 36	
Calculation base:	EN ISO 13849-1:2007
Calculation method	Part Count
MTTF(d)-Components (Worst Case)	Factor 10
50% hazardous failures	Factor 0.5
Environment temperature [°C] 40	
Operating conditions	Nominal load
MTTF-base values (remaining parts)	MIL-HDBK 217F, Notice 2 / RDF 2000
Environmental conditions	Ground fixed, 40°C (Industry standard)
Conditions	constant failure rate

Total	Worst case
Mean time to dangerous failure MTTF(d) [year]	>100
Mean time to dangerous failure MTTF(d) [hours, h]	876'000
Probability of a dangerous failure per hours [1/h]	< 1.14E-06

Remarks:
- The values of applicable EN-ISO calculation method refers to worst case conditions, which are improved by factor 2 compared to calculation according to MIL-HDBK-217.
- Typical values by considering of effective applications can be improved up to factor 5.

- The resulting MTTF(d) values judges not the safety of the product. It is a calculation or estimation of the random failures, which causing based on random hardware failures as a result of limited reliability of components.

Typ designation:	**LBFS Level Switch**
Operating temperature [°C] 40	
Operating voltage range [VDC] 12 - 30	
Calculation base:	EN ISO 13849-1:2007
Calculation method	Part Count
MTTF(d)-Components (Worst Case)	Factor 10
50% hazardous failures	Factor 0.5
Environment temperature [°C] 40	
Operating conditions	Nominal load
MTTF-base values (remaining parts)	MIL-HDBK 217F, Notice 2 / RDF 2000
Environmental conditions	Ground fixed, 40°C (Industry standard)
Conditions	constant failure rate

Total	Worst case
Mean time to dangerous failure MTTF(d) [year]	>90
Mean time to dangerous failure MTTF(d) [hours, h]	788'400
Probability of a dangerous failure per hours [1/h]	< 1.27E-06

Remarks:
- The values of applicable EN-ISO calculation method refers to worst case conditions, which are improved by factor 2 compared to calculation according to MIL-HDBK-217.
- Typical values by considering of effective applications can be improved up to factor 5.
- The resulting MTTF(d) values judges not the safety of the product. It is a calculation or estimation of the random failures, which causing based on random hardware failures as a result of limited reliability of components.

6.1.2 Proof reliability

MTBF calculations for LFFS and LBFS are carried out as show below:

LFFS:
The foundation of the used MTBF calculation method is “The Field Data Measurement”
The interpretation of registered failure has been evaluated with respect to the nature of the malfunction which was discovered in the data gathering period. Some of the distinctively failures was, measurings gives rise to a wrong output, wrong start up or an incorrect function during configuration. Inappropriate handling which could cause fault has not been taken into consideration.

Conditions for the calculation:
It is assumed that the Level Switch LFFS works continually to perform level detection in the data gathering period, the ambient temperature is 25°C.
In the MTBF calculation is a year corresponding to 8.760 hours in one year. The data gathering period during this calculation has been 39 weeks.
Furthermore, following considerations have been taken in to account, 85% of sold transmitters are actually installed and fully operation. 90% of failed products in the test period are returned for the factory for repair, the rest have not been return or are still waiting for being returned.

Annual Failure Rate [%]	0,975
MTBF [years]	102
MTBF [Hour]	897.652

LBFS:
The foundation of the used MTBF calculation method is "The Field Data Measurement"
The interpretation of registered failure has been evaluated with respect to the nature of the malfunction which was discovered in the data gathering period. Some of the distinctively failures was, measurings gives rise to a wrong output, wrong start up or an incorrect function during configuration. Inappropriate handling which could cause fault has not been taken into consideration.

Conditions for the calculation:
It is assumed that the Level Switch LBFS works continually to perform level detection in the data gathering period, the ambient temperature is 25°C.
In the MTBF calculation is a year corresponding to 8.760 hours in one year. The data gathering period during this calculation has been 46 weeks.
Furthermore, following considerations have been taken in to account, 80% of sold transmitters are actually installed and fully operation. 90% of failed products in the test period are returned for the factory for repair, the rest have not been return or are still waiting for being returned.

Annual Failure Rate [%]	0,3595
MTBF [years]	278
MTBF [Hour]	2.436.823

6.2 Useful life
Baumer A/S confirms that 20 years as useful life duration. This expectation is made on background of calculation made in 6.1.1.

6.3 Maintainability
The Level Switch LFFS and LBFS have no maintenance requirements as long as they are not exposed to medias that PEEK and the used stainless steel cannot resist.

6.4 Maintenance levels

6.4.1 On-vehicle diagnosis and repair
For some versions of the Level Switch LFFS and LBFS there a blue indication light for showing if it is trigged. Both product can be tested and configured with the Flexprogram and Flexprogrammer9701,. For details see operation manual.

6.4.2 Off-vehicle diagnosis and repair
Both LFFS and LBFS can be tested and configured with the Flexprogram and Flexprogrammer9701. On extra power are necessary. For details see operation manual.

6.5 Built-in diagnostic
There is no build-in option for diagnostic on the fly. When the product is power off the functionality can be tested with the Flexprogram and Flexprogrammer9701. For details see operation manual.

6.6 Automatic test equipment
Both products can be tested and configured with the Flexprogram and Flexprogrammer9701. For details see operation manual.

6.7 Alternative methods for fault diagnosis
Both products can be tested and configured by the Flexprogram and Flexprogrammer9701. For details see operation manual.

6.8 Purpose built test equipment special tools

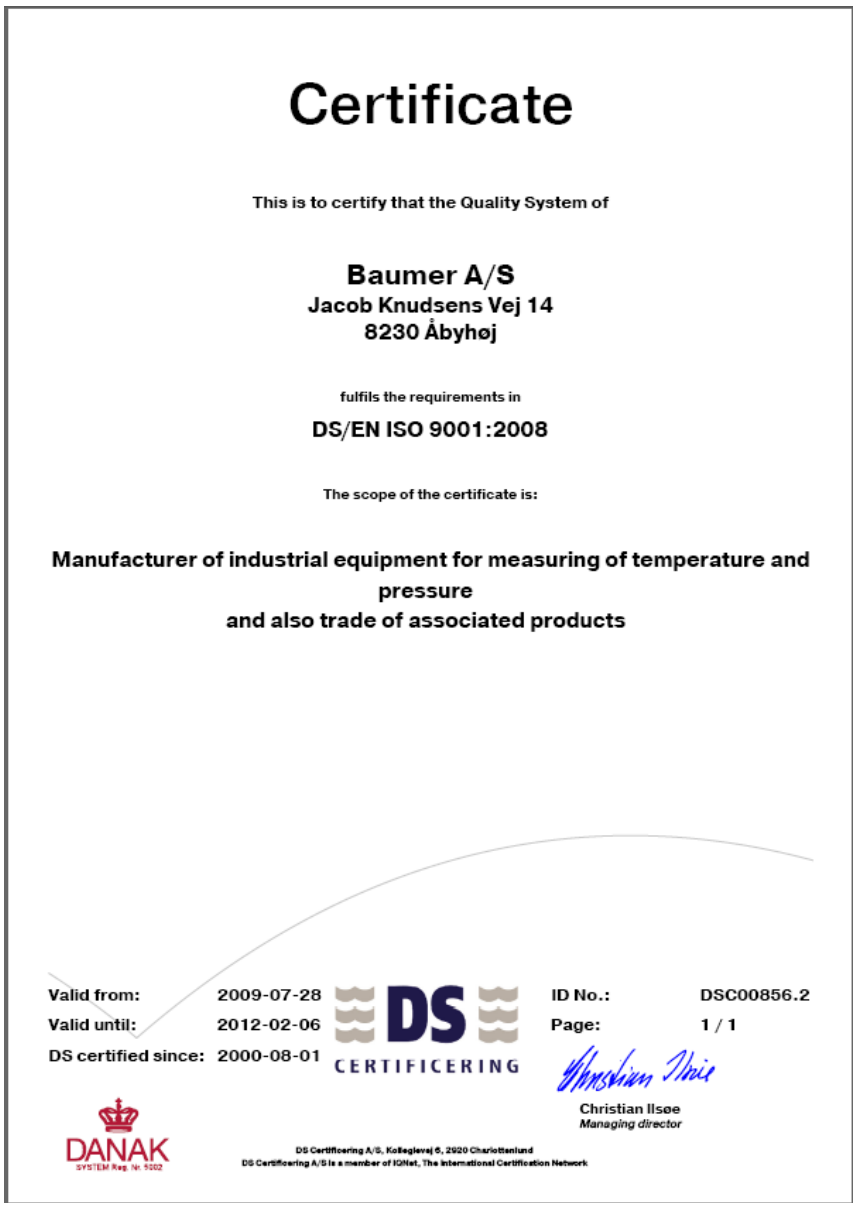
The Flexprogram and Flexprogrammer9701 can be ordered at Baumer. The software can be downloaded free from www.Baumer.com.

7.0 Design

7.1 General

7.1.1 Quality management

Certificate DS/EN ISO 9001:2008:



Certificate

This is to certify that the Quality System of

Baumer A/S
Jacob Knudsens Vej 14
8230 Åbyhøj

fulfils the requirements in

DS/EN ISO 9001:2008

The scope of the certificate is:

Manufacturer of industrial equipment for measuring of temperature and pressure
and also trade of associated products

Valid from: 2009-07-28
Valid until: 2012-02-06
DS certified since: 2000-08-01

DS CERTIFICERING

ID No.: DSC00856.2
Page: 1 / 1

Christian Ilsøe
Managing director

DANAK
SYSTEM Reg. nr. 1002

DS Certificering A/S, Kollegievej 6, 2920 Charlottenlund
DS Certificering A/S is a member of IQNet, The International Certification Network

7.1.2 Life Cycle

The product life cycle are described in the quality system which covers the process from design to scrap.

7.2 Detailed practices – Hardware

7.2.1 Interface

All circuits are tested to meet requirements from actual norms regarding EMC immunity and emission. All tests are documented as shown in appendix A. There are not galvanic isolation build in the electrical construction. However there is not contact between the media and the electrical parts.

The principals used for level measurement do not involve moving part for measured the level of the media. This ensures mechanical stability.

The allowed power supply voltage is below 60VDC/AC which means the European guideline 73/23/EWG is not applicable for those instruments.

7.2.2 Fault protection

The LFFS and LBFS are protected against permanent reverse polarity of the power lines in the voltage domain defined by the supply voltage range.
A change or restoring can be done by the configuration unit Flexprogrammer9701. Teach-in can also be performed without configuration unit, see the manual.

7.2.3 Referring power supplies

Not applicable, this is a requirement for power supplies.

7.2.4 Interchangeability

Not applicable, these requirement concern modular systems which contain single replaceable elements.

7.2.5 Reduction of power supply voltage

The LFFS and LBFS will not be damage by reducing power supply voltage. If power supply voltage drops below specified supply voltage will cause a reset of the microcontroller. The microcontroller wil A rise again in the power supply will reset and started again if supply raises again.

7.2.6 Polarity reversal

LFFS and LBFS are protected against permanent reversed polarity.

7.2.7 Inrush currents

No inrush current occurs with LFFS and LBFS.

7.2.8 Spare capacity

Adaption of user demands can be implemented on request. Product Firmware can be change on user location.

7.3 Detailed practices – Software

7.3.1 General

The design phase is part of the company quality system according to ISO9001, which ensures a model where each phase in the product development procedure from specification to integration is described. This procedure covers hardware as well as software development and ensures a uniform development procedure where each step is documented.

The two instruments LFFS and LBFS are both able to be firmware updated in case on maintenance. This also ensures the possibility for adaption of user demands if needed on site. The firmware update can be carried out by the customer them self with the Flexprogrammer9701. Newest firmware will always be available for downloaded on Baumer WEB.

7.3.2 Software design measures

7.3.2.1 Modular approach
The firmware is made in a modular way to ensure that the complexity doesn't prevent systematic testing and maintenance.

7.3.2.2 Translator proven in use
For the product isn't a translator applicable.

For the configurations tools, Flexprogram, can be applied in several languages. For translations to the customers language a translator can be applied.

7.3.2.3 Recording
All documentation from product design phase is made to meet demands of the quality system.
It is not applicable with a translator for LFFS and LFFS

7.3.2.4 Structured methodology
Checklists are worked out according to the procedure 5509-353 of Baumer A/S ISO9001 quality system.

7.3.2.5 Design and coding methods
Design of the code is done according to best practice and to ensure a test can be performed.

7.3.2.6 Structured programming and analysis
See point 7.3.2.5.

7.3.2.7 Programming language
High level language as C is used where it is possible. This ensures fast and sure maintenance.

7.3.2.8 Proven techniques
Proven techniques which has been used for software development and process are
- Function block diagrams
- sequence diagrams
- data flow diagrams
- decision tables
- process simulation

7.4 Equipment features

7.4.1 Memory checking
All memory are located onboard the microcontroller which helps to ensure full functionality.

7.4.2 Self test
There are not implemented self test routines to the products. However test can be performed by using the diagnostic routine from the Flexprogam.

7.4.3 Watchdog
Watchdog is build-in the product. Additional will code processing outside defined code area initiate a reset of the product. This is only applicable for Firmware version 11.

7.3.4 Error indication
Error indication is implemented by indicating an error by blinking with the LEDs.

7.4.5 Recovery
Recovery is ensured as described in point 7.4.3 Watchdog.

8.0 Components

8.1 Procurement

All component used in the product are specified with details as supplier and product code number.

8.2 Application

The product will fulfill requirement as long as the products are used for dedicated applications as level measurement and if all data have been taken into consideration.

9. Construction

8.1 Mechanical construction

The principal used in LFFS and LBFS ensure that no mechanical stress occurs as a consequence of no moving parts. However, attention should be given to the specification of the PEEK tip and stainless steel in connection with the media and environment where the product should work.

10. Safty

11. Documentation

These requirements are covered by the Baumer Quality Management System according to EN ISO 9001.

12. Testing

State of validation of Baumer Level Switch LFFS and LBFS series referring to the test list according to EN 50155:

Ref.	Test	type	Comment
1	Visual inspection	Applied	Applied during daily work
2	Performance test	Applied	Test procedure is performed on each product during production
3	Cooling test	Applied	IEC 60068-2-1, approved by DNV
4	Dry Heat test	Applied	IEC 60068-2-2 approved by DNV
5	Damp heat test, cycle	Applied	IEC 60068-2-3 approved by DNV
6	Supply overvoltage	Applied	Performed according to specifications of DNV, Approved by DNV
7	Surges, electrostatic discharge and transient burst susceptibility	Applied	According to EN50121, EN 61326 Test is performed on Delta A/S test site
8	Radio interference test	Applied	According to DNV test spec. (156MHz to 165Mhz)
9	Insulation test	Applied	Performed according to specifications of DNV, Approved by DNV
10	Salt mist test	Applied	IEC 60068-2-52, accredit by Delta A/S
11	Vibration, shock and bump test	Applied	IEC 60068-2-6, GL test2 EN61373/EN50155, accredit by Delta A/S
12	Water tightness test	Applied	IP67 accredit test performed by Delta A/S
13	Equipment stress test		
14	Low temperature storage test	Applied	-50°C, tested locally at Baumer

Appendix A

EMC test for LFFS and LBFS

First version: A1, 2009-06-11

EMC specification of product LFFS Level Switch

1. Introduction

2. The product

3. Relevant standards

4. Test plan

5. Definition of error criterions

1. Introduction

1.1 Aim:

To set up minimum requirements to meet the protection requirements in the EMC directive 2004/108/EC

2. The product

2.1 The product:

Level switch with a NPN, PNP or digital output.

2.2 Type:

Product type no. LFFS Level Switch

2.3 Environmental use:

Industry.

2.4 Description of the product:

Construction:
The product contains a circuit board, built into a round plastic cabinet mounted in a ø55 metal housing. The module contains analogue circuits and a low power CPU circuits.

The module has the following ports:
- Voltage supply input, 12-36 VDC and Flex programming (two terminals).
- Output (NPN, PNP or Digital out)

Adjustments:
The product has been adjusted from factory.

Accuracy:
Must be able to detect media with a DK value as low as 1,5.

3. Relevant standards

3.1 Emission: EN 61326

The following tests are estimated to be relevant:
- CISPR 16 and 16-1: Emission.

3.2 Immunity: EN 61326

The following tests are estimated to be relevant:
- EN 61000-4-2: ESD discharge 4/4 kV. Criterion B.
- EN 61000-4-3: HF field, 80 - 1000 MHz, 80% AM (10 V/m) and 1,4 - 2GHz, 80% AM, (3 V/m). Criterion A.
- EN 61000-4-4: Burst transients 1 kV CM. Criterion B.
- EN 61000-4-5: Surge transients 0,5 kV line to ground. Criterion B.
- EN 61000-4-6: Conducted HF, 0.15 - 80 MHz, 80% AM, 3 VRMS. Criterion A.

(+), (-) and the output port are defined as: “I/O signal/control connected directly to mains supply”. This definition is used because a power supply unit might be connected to these ports. The teach in port is defined as an “I/O signal/control” port because it is not meant for power supply connection. Teach-In is initiated by shorting the port to the (-) terminal.

4. Test plan

4.1 The unit is programmed for PNP output to begin with. The unit output is changed to NPN and Digital out when needed.

5. Error criterions

5.1 Criterion A:

The product is unaffected during the test, within the specified levels.

5.2 Criterion B:

The output of the product varies beyond the specified range during test, but returns to normal operation after disturbance is removed. No reset or crash is allowed.

5.3 Criterion C:

Not relevant.

DECLARATION OF CONFORMITY

We,

Baumer A/S
Jacob Knudsens Vej 14
8230 Aabyhoj
Denmark

Tel: +45 89 31 76 11

declare under our sole responsibility that the product

Product Name: **LFFS Level Switch**

Product Description: **Level switch with LED indication and PNP, NPN and Digital output adjustments possible**

Product Type: **Level Switch**

to which this declaration relates is in conformity with
the following European Directives:

2004/108/EC

And related European Standards.

EN 61 326 Issue 1. 2006-11-03

Date 17-08-2010 Sign Kurt M Jensen

Kurt Moeller Jensen
Development Manager

First version: A1, 2010-04-21

EMC specification of product LBFS Level Switch

1. Introduction

2. The product

3. Relevant standards

4. Test plan

5. Definition of error criterions

1. Introduction

1.1 Aim:

To set up minimum requirements to meet the protection requirements in the EMC directive 2004/108/EC, as well as other directives that are determined to be relevant:
EN50121-3-2:2007
DNV 2.4:2006

2. The product

2.1 The product:

A NPN or PNP level switch with normally open and normally closed outputs

2.2 Type:

Product type no. LBFS Level Switch

2.3 Environmental use:

Industry.

2.4 Description of the product:

Construction:
The product contains a circuit board mounted in a “cylindrical” metal housing. The product is electrically connected by either a M12 or a standard four wire cable. The module contains analogue circuits and a low power CPU circuits.

The module has the following ports:
- Voltage supply input, 12-30 VDC and Flex programming (two terminals).
- Two outputs: NO and NC. The LBFS will be produced with either PNP or NPN output configuration.

Adjustments:
The product has been adjusted from factory.

Accuracy:
Must be able to detect media with a DK value as low as 1,5.

3. Relevant standards

3.1 Emission: EN 55011

The following tests are estimated to be relevant:

EN55011:2007:	Conducted and radiated emission.
DNV 2,4:2006:	Special requirement: 156 – 165 MHz Emergency frequency band

3.2 Immunity: EN 61326

The following tests are estimated to be relevant:

- EN 61000-4-2:	ESD discharge 8/8 kV. Criterion B.
- EN 61000-4-3:	HF field, 80 - 1000 MHz, 80% AM (20 V/m) and 1 – 2,5GHz, 80% AM, (10 V/m). Criterion A.
- EN 61000-4-4:	Burst transients 2 kV CM. Criterion B.
- EN 61000-4-5:	Surge transients 1 kV line to line, 2 kV line to ground. Criterion B.
- EN 61000-4-6:	Conducted HF, 0.15 - 80 MHz, 80% AM, 10 VRMS. Criterion A.

(+), (-) and the output ports are defined as: “I/O signal/control connected directly to mains supply”. This definition is used because a power supply unit might be connected to these ports.

3.3 DNV classification

This product is classified for use on open deck (Class B) as defined in the DNV 2.4:2006 directive Table 2-1.

4. Test plan

4.1 A NPN and a PNP unit, mounted in a G½" stainless steel housing, will be tested. The units will be electrical connected via a M12 cable

5. Error criterions

5.1 Criterion A:

The product is unaffected during the test, within the specified levels.

5.2 Criterion B:

The output of the product varies beyond the specified range during test, but returns to normal operation after disturbance is removed. No reset or crash is allowed.

5.3 Criterion C:

Not relevant.

DECLARATION OF CONFORMITY

We,

Baumer A/S
Jacob Knudsens Vej 14
8230 Aabyhoj
Denmark

Tel: +45 89 31 76 11

declare under our sole responsibility that the product

Product Name: **LBFS Level Switch**
Product Description: **Level switch, PNP or NPN outputs, with LED indication.**
Product Type: **Level Switch**

to which this declaration relates is in conformity with
the following European Directives:

2004/108/EC

And related European Standards:

EN 61 326 Issue 1. 2006-11-03

We also declare conformity with the following specific Directives:

DNV 2.4: 2006	**The Norwegian Veritas:** **STANDARD FOR CERTIFICATION No. 2.4** **ENVIRONMENTAL TEST SPECIFICA-** **TION FOR INSTRUMENTATION AND** **AUTOMATION EQUIPMENT**
EN50121: 2006	**Railway applications – Electromagnetic compatibility – Part 3-2:** **Rolling stock apparatus**

Date: 7/11 - 2011 Sign: Kurt M Jensen

R&D Manager
Kurt Møller Jensen

Appendix B

Vibrations test EN50155 / EN61373

We help ideas meet the real world

DELTA Test Report

TEST Reg. no. 19

Vibration and shock test of Level Switches

Performed for Baumer A/S

DANAK-1911632
Project no.: T201052
Page 1 of 18
including 4 annexes

24 October 2011

DELTA
Venlighedsvej 4
2970 Hørsholm
Denmark

Tel. (+45) 72 19 40 00
Fax (+45) 72 19 40 01
www.delta.dk

Title	Vibration and shock test of Level Switches
Test object	4 pcs. Level Switches Detailed information is given in Chapter 2.
Report no.	DANAK-1911632
Project no.	T201052
Test period	6 – 12 October 2011
Client	Baumer A/S Jakob Knudsensvej 14 8230 Åbyhøj Danmark Tel. +45 89 31 76 11
Contact person	Kurt Møller Jensen E-mail: kmjensen@baumer.com
Manufacturer	Baumer A/S
Specifications	EN 50155: 2007 Railway applications – Electronic equipment used on rolling stock. EN/IEC 61373:1999 Railway applications – Rolling stock equipment – Shock and vibration tests.
Results	The performance of the test objects was OK before and after the exposures. No change in visual appearance and mechanical integrity was observed after the exposures.
Test personnel	René Toftdal Torben Sibbern Larsen

Date 24 October 2011

Project manager

Claus Kirk, B.Sc. ME, M.Sc. AVD
Specialist, Centre of Test Excellence
DELTA

Responsible

Andreas Wendelboe Højsgaard
Specialist, Centre of Test Excellence
DELTA

Table of contents

1. Summary of test

1.1 Test requirements

The following tests were carried out as agreed with the client.

Test	Test method
Random vibration	EN/IEC 60068-2-64:2008
Shock	EN/IEC 60068-2-27:2008

1.2 Conclusion

The test object mentioned in this report meets the relevant requirements of the standards stated below.

- EN 50155:2007
- EN 61373:1999

The test results relate only to the objects tested.

2. Test objects

2.1 Test objects

EUT #1	Level Switch LFFS 011	S/N: 24641
EUT #2	Level Switch LFFS 014	S/N: 25610
EUT #3	Level Switch LBFS 0112 1	S/N: 24682
EUT #4	Level Switch LBFS 0312 1	S/N: 25615

EUT #3 was fitted with a plastic connector receptacle and EUT #4 was fitted with a steel receptacle.

2.2 Auxiliary equipment

Power supplies delivered by the client were used for functional tests.

3. General test conditions

3.1 Test setup

Photos describing the test setup are enclosed in Annex 2.

3.2 Test sequence

The tests were performed in the following order:

Exposure	EUT #1 and #2	EUT #3 and #4
Shock	Y	X
Random vibration	Y	X
Random vibration	X	Z
Shock	X	Z
Random vibration	Z	Y
Shock	Z	Y

3.3 Criteria for compliance

Performance criterion A: Performance according to EN/IEC 61373 section 6.3.3 remains within the defined limits.

Performance criterion B: Function according to EN/IEC 61373 6.3.2 remains within the defined limits.

Performance criterion C: The visual appearance and mechanical integrity has not changed.

3.4 Functional test

A functional test was performed before, during and after each test.

The test consisted of manually triggering the level switches and observing a blue LED indicating that the switch had been triggered and that the EUT was working.

On EUT #3 with the steel receptacle observing the LED was not possible. Instead a change in voltage between the output pins was measured using a voltmeter.

4. Test and results

4.1 Vibration – Endurance random

Specifications

EN 50155:2007

EN/IEC 61373:1999

Test method

IEC 60068-2-64: 2008, Test Fh: Vibration, broadband random and guidance.

Severity and procedure

Frequency range:	5 – 150 Hz
Acceleration spectral:	5 – 20 Hz: 0.019 g^2/Hz
Density: 20 – 150 Hz:	-6 dB/octave
Total RMS level:	0.79 g
Duration:	300 minutes per axis
Number of axes:	3 mutually perpendicular

A functional test was performed before and after the exposure in each axis at a vibration level of -18 dB (0.1 grms).

The test object is de-energised during the exposure to the endurance vibration levels.

A performance test is performed before and after the exposure.

A visual inspection is performed after the exposure.

Results

The function of the test objects was OK during the functional tests performed at 0.1grms in each axis.

The performance of the test objects was OK before and after the exposure to 0.79 grms in each axis.

No change in visual appearance and mechanical integrity was observed after the exposures.

Exposure curves and definition of axes are enclosed in Annex 3.

4.2 Shock

Specifications

EN 50155:2007

EN/IEC 61373:1999

Test method

EN/IEC 60068-2-27: 2008, Test Ea and guidance: Shock.

Severity and procedure

Shock pulse:	Half sine, 5 g, 30 ms
Number of directions:	Each direction of 3 mutually perpendicular axes
Number of shocks:	3 per direction (18 in total)

The test object is de-energised during the exposure. A functional test is performed after each axis.

Results:

The performance of the test objects was OK before and after the exposure to 5 g, 30 ms in each axis.

No change in visual appearance and mechanical integrity was observed after the exposures.

Exposure curves are enclosed in Annex 4.

Annex 1

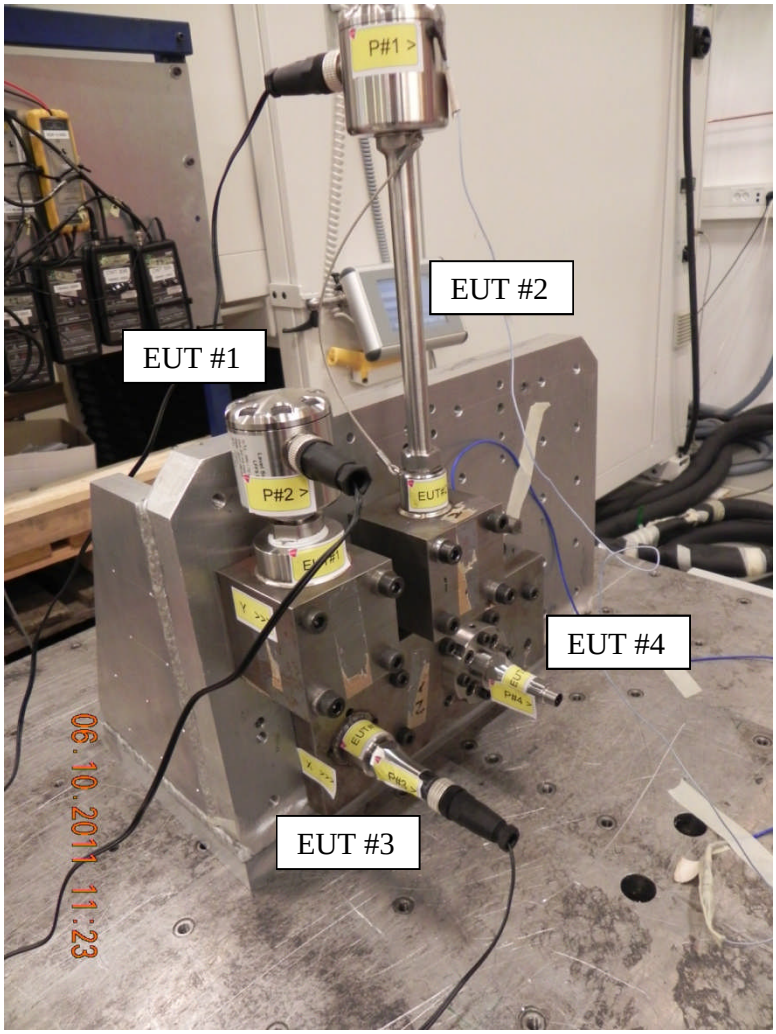
List of instruments

List of instruments

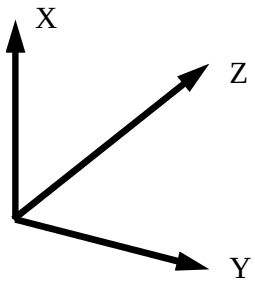
V01020	Shaker	LDS	V850-440 LPT 750 Combo
V01027	Shaker control system	LDS Dactron	Laser USB LAS 200
V01024	Accelerometer	Kistler	8702B500M1
V01041	Accelerometer	Kistler	8778A500

Annex 2

Photos of test setup



Axis definition for EUT #1 and #2.



Axis definition for EUT #3 and #4.

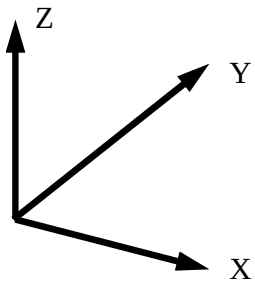


Photo 1. Axis definition, Y-axis for EUT 1 & 2 and X-axis for EUT 3 & 4.

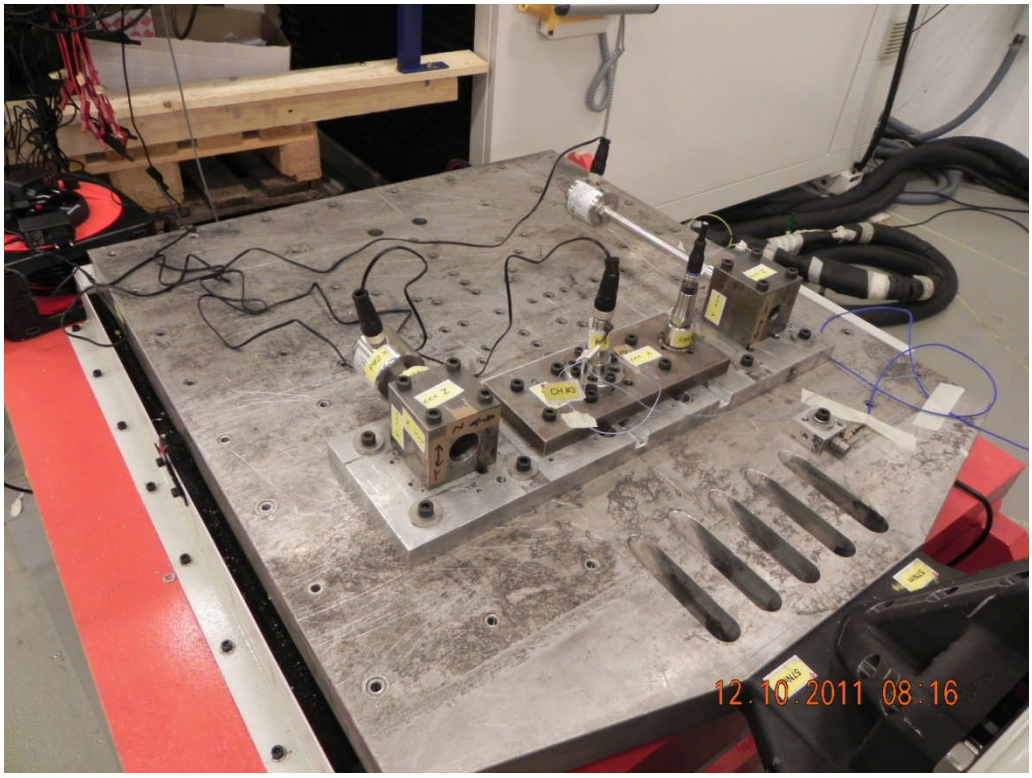


Photo 2. X-axis for EUT 1 & 2, Z-axis for EUT 3 & 4.

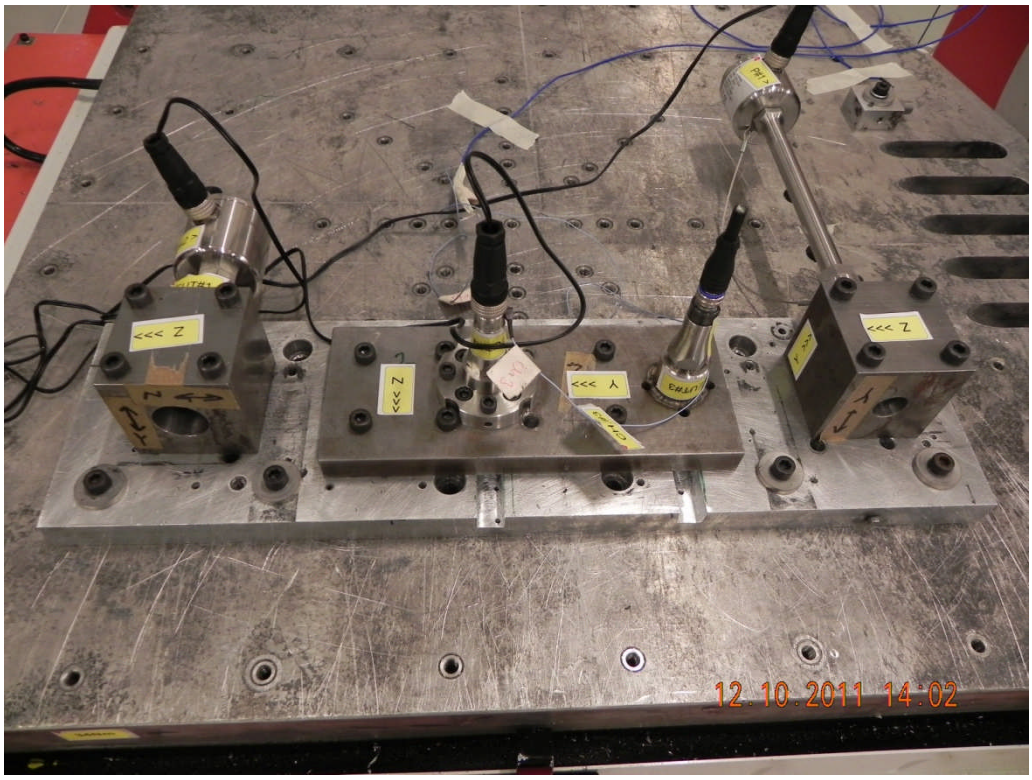
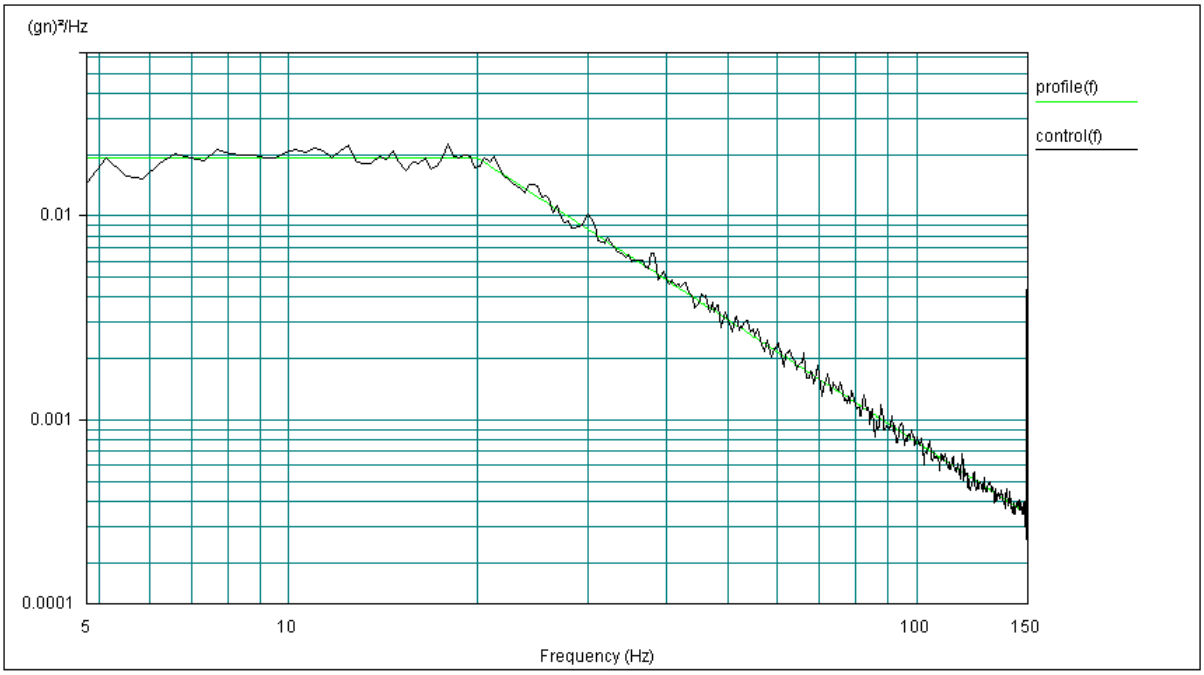


Photo 3. Z-axis for EUT 1 & 2, Y-axis for EUT 3 & 4.

Annex 3

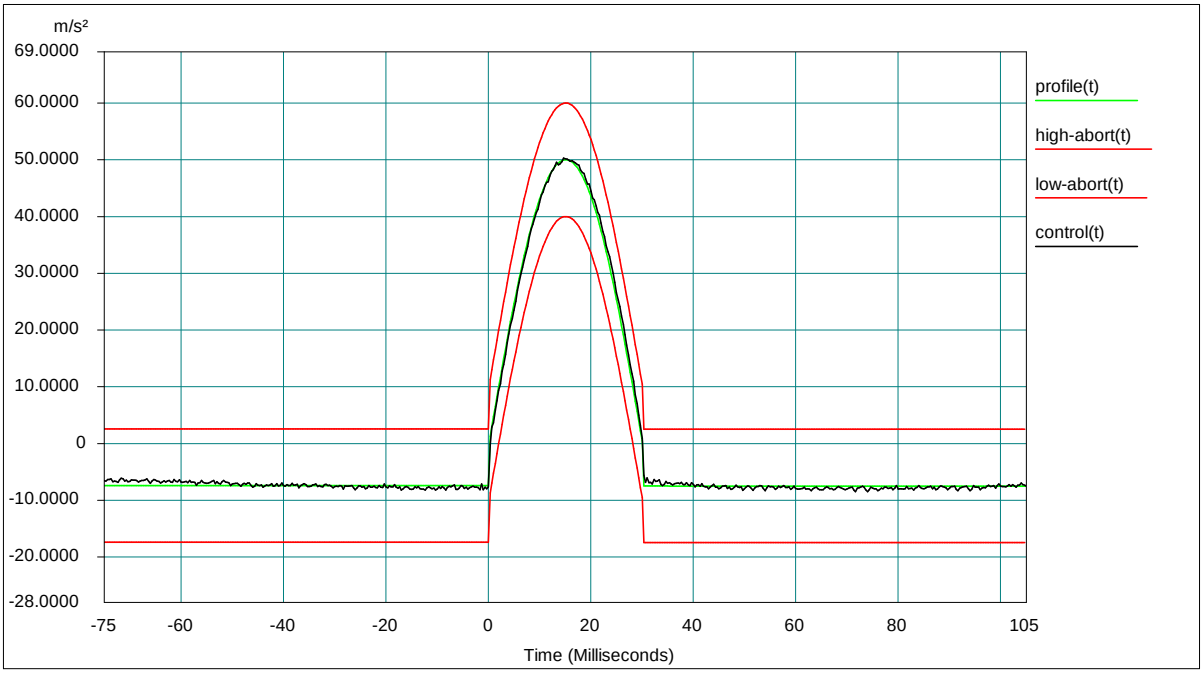
Measurement curves - Vibration

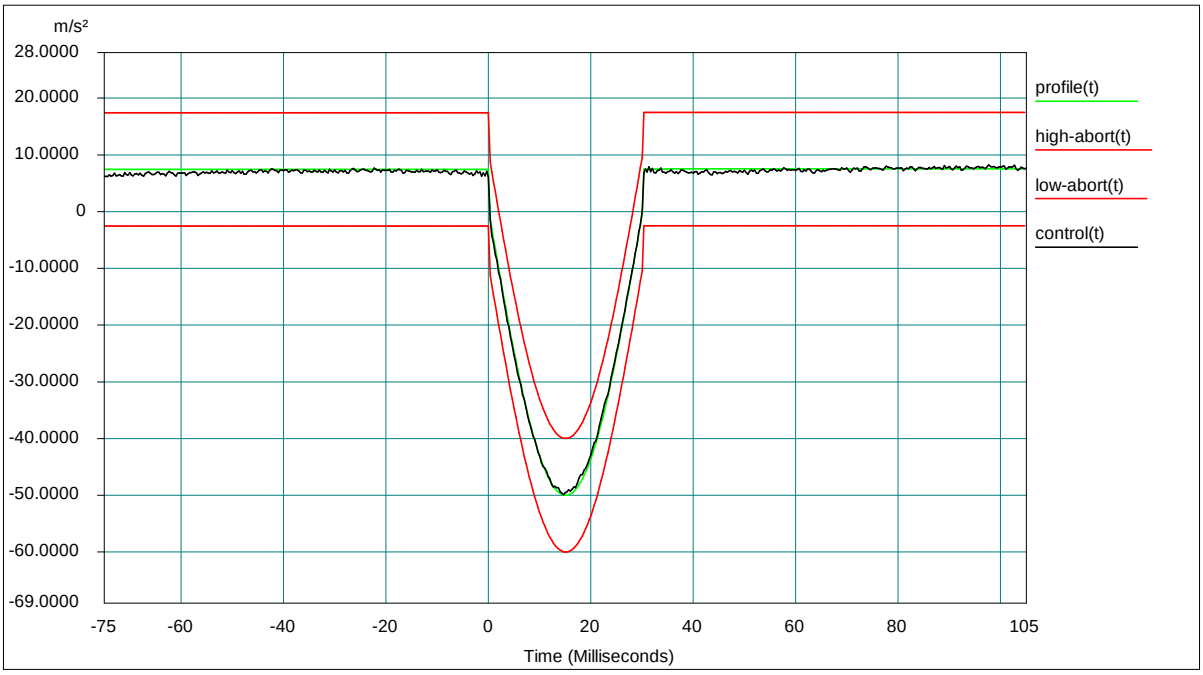


Graph 1. EUT #1 and #2 EUT #3 and #4	 Y-axis X-axis

Graphs in the 3 other axis are similar.

Annex 4
Measurement curves – Shock





Graph 2 and3.

EUT #1 and #2 Y-axis

EUT #3 and #4 X-axis

Graphs in the 3 other axis are similar.