

Test Report

No.: U60108b

Designation of equipment under test: Pluggable Terminal Blocks

Test Laboratory

for

**"Safety of Electrical Equipment and
Industrial Low-Voltage Devices
as well as Environmental Tests"**

accredited by

DATech e.V.

in compliance with DIN EN ISO/IEC 17025

under

Reg. No. DAT-P-105/00-11

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Testing body: PHOENIX TESTLAB GmbH
Königswinkel 10

D-32825 Blomberg

Applicant: Phoenix Contact GmbH & Co. KG
Flachsmarktstraße 8-28

D-32825 Blomberg

Order number: 60108

Type of test: Environmental Test
- Vibration, random
- Shock

Method of measurement to: EN 50155

reference to:

- EN 60068-2-64
- EN 60068-2-27
- EN 61373

Manufacturer: Phoenix Contact GmbH & Co. KG

Place of test: PHOENIX TESTLAB GmbH, Blomberg

Equipment under
test (EUT): Pluggable Terminal Blocks

Type identification:

Type	Bridge / Plug Type	Article- No.	Cross section	Test Specification	Date of test / Original Test-Report No.
SC 4	-----	3042489	4 mm ² (flexible)	EN 50155 : 2001 / EN 61373 : 1999 according to EN 60068-2-64 : 1994 and EN 60068-2-27 : 1993	26 August 2004 to 09 September 2004 S40850
	SP 4/5	3042939			
	SSL 2,5	3043815			
ST 2,5/1P		3040012	2,5 mm ² (flexible)	EN 50155 : 2001 / EN 61373 : 1999 according to EN 60068-2-64 : 1994 and EN 60068-2-27 : 1993	11 July 2003 to 17 July 2003 S30593b_eng
	SPDB 2,5/5	3040449			
ST 2,5/2P		3042133	2,5 mm ² (flexible)		
	SPB 2,5/5	3040143			
	SPDB 2,5/5	3040449			
ST 2,5-TWIN/1P		3042117	2,5 mm ² (flexible)		
	SPDB 2,5/5	3040449			
ST 2,5-QUATTRO /2P		3040038	2,5 mm ² (flexible)		
	SPB 2,5/5	3040143			
ST 2,5-QUATTRO /4P		3042159	2,5 mm ² (flexible)		
	SP 2,5/5	3040290			
STTB 2,5/2P		3040054	2,5 mm ² (flexible)		
	SPB 2,5/5	3040143			
ST 2,5/1P-PE		3040025	2,5 mm ² (flexible)		
	SPDB 2,5/5	3040449			
ST 2,5/2P-PE		3042146	2,5 mm ² (flexible)		
	SPB 2,5/5	3040143			
	SPDB 2,5/5	3040449			
ST 2,5-TWIN/1P-PE		3042120	2,5 mm ² (flexible)		
	SPDB 2,5/5	3040449			
ST 2,5-QUATTRO/2P-PE		3040041	2,5 mm ² (flexible)		
	SPB 2,5/5	3040143			
ST 2,5-QUATTRO/4P-PE		3042162	2,5 mm ² (flexible)		
	SPB 2,5/5	3040143			
STTB 2,5/2P-PE		3040067	2,5 mm ² (flexible)		
	SPB 2,5/5	3040143			

Type	Bridge / Plug Type	Article- No.	Cross section	Test Specification	Date of test / Original Test-Report No.		
ST 4/1P	-----	3042719	4 mm ² (rigid)	EN 50155 : 2001 / EN 61373 : 1999 according to EN 60068-2-64 : 1994 and EN 60068-2-27 : 1993	21 July 2003 to 23 July 2003 S30593d_eng		
	SP 4/5	3042939					
ST 4/1P-PE	-----	3042722	4 mm ² (rigid)				
	SP 4/5	3042939					
ST 4-QUATTRO/ 2P	-----	3042845	4 mm ² (rigid)				
	SP 4/5	3042939					
ST 4-QUATTRO/ 2P-PE	-----	3042858	4 mm ² (rigid)				
	SP 4/5	3042939					
ST 4 / 2P	-----	3042735	4 mm ² (flexible)			EN 50155 : 2001 / EN 61373 : 1999 according to EN 60068-2-64 : 1994 and EN 60068-2-27 : 1993	25 January 2005 to 04 February 2005 U50157
	SP 4/5	3042939					
ST 4 / 2P-PE	-----	3042748	4 mm ² (flexible)				
	SP 4/5	3042939					
QTC 1,5/1P	-----	3050073	1,5 mm ² (flexible)	EN 50155 : 2001 / EN 61373 : 1999 according to EN 60068-2-64 : 1994 and EN 60068-2-27 : 1993	19 April 2004 to 17 May 2004 S40411a		
	SP 2,5/5	3040290	2,5 mm ² (flexible)				
QTTCB 1,5/2P	-----	3050196	1,5 mm ² (flexible)				
	SP 2,5/5	3040290	2,5 mm ² (flexible)				
QTTCB1,5/2P- PV	-----	3206377	1,5 mm ² (flexible)				
	SP 2,5/5	3040290	2,5 mm ² (flexible)				
QTC 1,5/1P-PE	-----	3050099	1,5 mm ² (flexible)				
	SP 2,5/5	3040290	2,5 mm ² (flexible)				
QTTCB 1,5/2P-PE	-----	3050219	1,5 mm ² (flexible)				
	SP 2,5/5	3040290	2,5 mm ² (flexible)				
UT 2,5/1P	-----	3045017	2,5 mm ² (flexible)	EN 50155 : 2001 / EN 61373 : 1999 according to EN 60068-2-64 : 1994 and EN 60068-2-27 : 1993	04 June 2004 to 09 June 2004 S40512b		
	SP 2,5/5	3040290					
UT 2,5/1P-PE	-----	3045033	2,5 mm ² (flexible)				
	SP 2,5/5	3040290					
UT 4 / 1P		3045583	4 mm ² (flexible)			EN 50155 : 2001 / EN 61373 : 1999 according to EN 60068-2-64 : 1994 and EN 60068-2-27 : 1993	12 April 2006 to 27 April 2006 U60673
	UPBV 4/5	3045842					
UT 4 / 1P-PE		3045606	4 mm ² (flexible)				
	UPBV 4/5	3045842					
UT 4-TWIN / 1P		3060267	4 mm ² (flexible)				
	UP 4/5	3060157					
UT 4-TWIN / 1P-PE		3060283	4 mm ² (flexible)				
	UP 4/5	3060157					
UT 4-QUATTRO / 2P		3060296	4 mm ² (flexible)				
	UP 4/5	3060157					
UT 4-QUATTRO / 2P-PE		3060319	4 mm ² (flexible)				
	UP 4/5	3060157					

Note: All tests were carried out with snap-lock fittings PR/2 (Article-No. 3040630).

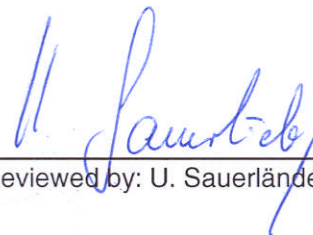
Test result: The complete test results are present in the following.
The requirements made in the test documents were **fulfilled**
by the equipment under test.

Note: This test report contains the results of seven single vibration tests.
The measured values were taken from the test reports S30593b_eng,
S30593d_eng, S40411a, S40512b, S40850, U50157 and U60673.

Blomberg, 09 August 2006



Examiner: D. Töberich



Reviewed by: U. Sauerländer

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1 Test specifications and test conditions

1.1 Vibration, broad-band random

Test Fh: Vibration, broad-band random / EN 60068-2-64

This standard is applicable to specimens which may be subjected to vibration of a stochastic nature resulting from transport or operational environments, for example in aircraft, space vehicles and land vehicles.

Severity, Category 1B:

Test specification:	EN 50155 : 2001 / EN 61373 : 1999
Frequency range:	5 Hz to 150 Hz
ASD-Level: - 5 Hz – 20 Hz - 20 Hz – 150 Hz	1,857 (m/s ²) ² /Hz -6 dB/Oct
rms value 5 Hz – 150 Hz	7,9 m/s ²
Axis:	X, Y, Z
Test duration:	5 h in each axis

Severity, Category 2:

Test specification:	EN 50155 : 2001 / EN 61373 : 1999
Frequency range:	5 Hz to 250 Hz
ASD-Level: - 10 Hz – 100 Hz - 5 Hz – 10 Hz - 100 Hz – 250 Hz	11,83 (m/s ²) ² /Hz -9 dB/Oct -6 dB/Oct
rms value 5 Hz – 250 Hz	42,5 m/s ²
Axis:	X, Y, Z
Test duration:	5 h in each axis

1.2 Shock

Test Ea: Shock / EN 60068-2-27

This test is applicable to components, equipment and other electrotechnical products which, during transportation or in use, may be subjected to conditions involving relatively infrequent non-repetitive shocks.

Severity, Category 1B

Test specification:	EN 50155 : 2001 / EN 61373 : 1999
Pulse shape:	Half-sine
Peak acceleration:	50 m/s ²
Corresponding duration of the nominal pulse:	30 ms
Number of shocks in each of six directions:	3
Axis:	X, Y, Z (pos. and neg.)

Severity, Category 2

Test specification:	EN 50155 : 2001 / EN 61373 : 1999
Pulse shape:	Half-sine
Peak acceleration:	300 m/s ²
Corresponding duration of the nominal pulse:	18 ms
Number of shocks in each of six directions:	3
Axis:	X, Y, Z (pos. and neg.)

1.3 Operating states and test setup

Definition of the functions of the monitoring and their tolerances:

- Optical test for mechanical stability
- Monitoring for contact breaks
- Measuring of contact resistance

The terminals and a 80 Ohm resistor became connected in series and were supplied with a 10 V_{DC} power supply.

During the test the terminals were monitored over the 80 Ohm resistor with an oscilloscope for contact breaks $t > 1 \mu\text{s}$.

The value of the current was 125 mA.

Note: The contact resistance is measured by the applicant!

2 Test performance and test results

2.1 Test performance

The test samples are mounted on a mounting rail NS 35/7,5.

The tests are performed in three mutually perpendicular axes (X ,Y ,Z).

Sequence of tests:

EN 50155 : 2001 / EN 61373 : 1999

1. Vibration, random
2. Shock

Before and after each test the contact resistance is measured.

Note: The contact resistance is measured by the applicant!

2.2 Test results

2.2.1 Vibration, random (EN 50155 : 2001 / EN 61373 : 1999)

Requirements fulfilled:

Severity	Type	Pass
Category 1B 5 Hz to 150 Hz rms value 7,9 m/s ²	SC 4	yes
	ST 2,5/1P	yes
	ST 2,5/2P	yes
	ST 2,5-TWIN/1P	yes
	ST 2,5-QUATTRO/2P	yes
	ST 2,5-QUATTRO/4P	yes
	STTB 2,5/2P	yes
	ST 2,5/1P-PE	yes
	ST 2,5/2P-PE	yes
	ST 2,5- TWIN/1P-PE	yes
	ST 2,5- QUATTRO/2P-PE	yes
	ST 2,5-QUATTRO/4P-PE	yes
	STTB 2,5/2P-PE	yes
	ST 4/2P	yes
	ST 4/2P-PE	yes
	QTC 1,5/1P	yes
	QTTCB 1,5/2P	yes
	QTTCB1,5/2P- PV	yes
	QTC 1,5/1P-PE	yes
	QTTCB 1,5/2P-PE	yes
	UT 2,5/1P	yes
	UT 2,5/1P-PE	yes
	UT 4 / 1P	yes
UT 4-TWIN / 1P	yes	
UT 4-QUATTRO/2P	yes	
UT 4 / 1P-PE	yes	
UT 4-TWIN/1P-PE	yes	
UT 4-QUATTRO/2P-PE	yes	
Category 2 5 Hz to 250 Hz rms value 42,5 m/s ²	ST 4/1P	yes
	ST 4-QUATTRO/2P	yes
	ST 4/1P-PE	yes
	ST 4-QUATTRO/2P-PE	yes

2.2.2 Shock (EN 50155 : 2001 / EN 61373 : 1999)

Requirements fulfilled:

Severity	Type	Pass
Category 1B 50 m/s ² 30 ms	SC 4	yes
	ST 2,5/1P	yes
	ST 2,5/2P	yes
	ST 2,5-TWIN/1P	yes
	ST 2,5-QUATTRO/2P	yes
	ST 2,5-QUATTRO/4P	yes
	STTB 2,5/2P	yes
	ST 2,5/1P-PE	yes
	ST 2,5/2P-PE	yes
	ST 2,5- TWIN/1P-PE	yes
	ST 2,5- QUATTRO/2P-PE	yes
	ST 2,5-QUATTRO/4P-PE	yes
	STTB 2,5/2P-PE	yes
	ST 4/2P	yes
	ST 4/2P-PE	yes
	QTC 1,5/1P	yes
	QTTCB 1,5/2P	yes
	QTTCB1,5/2P- PV	yes
	QTC 1,5/1P-PE	yes
	QTTCB 1,5/2P-PE	yes
	UT 2,5/1P	yes
	UT 2,5/1P-PE	yes
	UT 4 / 1P	yes
UT 4-TWIN / 1P	yes	
UT 4-QUATTRO/2P	yes	
UT 4 / 1P-PE	yes	
UT 4-TWIN/1P-PE	yes	
UT 4-QUATTRO/2P-PE	yes	
Category 2 300 m/s ² 18 ms	ST 4/1P	yes
	ST 4-QUATTRO/2P	yes
	ST 4/1P-PE	yes
	ST 4-QUATTRO/2P-PE	yes

2.2.3 Contact resistance

Legend: **P** ⇒ Pass
 F ⇒ Fail

Requirement:

Contact resistance --- $R_2 \leq 1,5 \times R_1$

R_1 – Contact resistance before test

R_2 – Contact resistance after test

Contact breaks --- no $> 1 \mu\text{s}$
 (Only Feed-Through Terminal Blocks)

2.2.3.1 Terminal blocks SC 4...

SC 4 with SP 4/5 and SSL 2,5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,26	1,45	1,66
2	1,37	1,69	1,84
3	1,38	1,71	1,86
4	1,36	1,64	1,81
5	1,38	1,68	1,85
average	1,350	1,634	1,804
maximum	1,38	1,71	1,86
result	P	P	P

2.2.3.2 Terminal blocks ST 2,5...

ST 2,5/1P with SPDB 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	2,08	2,57	2,41
2	2,10	2,45	2,47
3	2,04	2,29	2,09
4	2,17	2,32	2,18
5	2,04	2,46	2,25
average	2,086	2,418	2,280
maximum	2,17	2,57	2,47
result	P	P	P

ST 2,5/2P with SPB 2,5/5 and SPDB 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	2,63	3,07	3,06
2	2,48	2,58	2,71
3	2,61	2,86	2,85
4	2,42	3,23	3,38
5	2,51	3,11	3,26
average	2,530	2,970	3,052
maximum	2,63	3,23	3,38
result	P	P	P

ST 2,5-TWIN/1P with SPDB 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	2,17	2,11	2,09
2	2,17	2,38	2,34
3	2,24	2,44	2,66
4	2,26	2,79	3,00
5	2,08	2,68	2,69
average	2,184	2,480	2,556
maximum	2,26	2,79	3,00
result	P	P	P

ST 2,5-QUATTRO/2P with SPB 2,5/5

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	2,29	2,72	2,72
2	2,29	2,61	2,65
3	2,33	3,11	3,24
4	2,17	2,40	2,48
5	2,35	2,26	2,46
average	2,286	2,620	2,710
maximum	2,35	3,11	3,24
result	P	P	P

ST 2,5-QUATTRO/4P with SP 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	2,81	2,68	2,79
2	2,71	2,93	3,13
3	2,85	2,68	2,81
4	2,70	2,46	2,53
5	2,78	2,57	2,70
average	2,770	2,664	2,792
maximum	2,85	2,93	3,13
result	P	P	P

STTB 2,5/2P with SPB 2,5/5

1 st level	contact resistance [mΩ]		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	2,23	2,32	2,23
2	2,09	2,37	2,29
3	2,26	2,66	2,56
4	2,24	3,02	2,86
5	2,16	2,78	2,66
average	2,196	2,630	2,520
maximum	2,26	3,02	2,86
result	P	P	P

2 nd level	contact resistance [mΩ]		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,94	2,51	2,46
2	1,98	2,22	2,17
3	1,95	2,22	2,09
4	1,88	2,36	2,19
5	1,98	2,47	2,26
average	1,946	2,356	2,234
maximum	1,98	2,51	2,46
result	P	P	P

ST 2,5/1P-PE with SPDB 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,99	2,96	2,87
2	2,02	2,82	2,77
3	1,95	2,81	2,55
4	1,83	2,59	2,31
5	2,00	2,51	2,37
average	1,958	2,738	2,574
maximum	2,02	2,96	2,87
result	P	P	P

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,11	1,63	1,31
2	1,08	1,36	1,15
3	1,02	1,41	1,17
4	1,00	1,24	0,96
5	1,03	1,28	1,02
average	1,048	1,384	1,122
maximum	1,11	1,63	1,31
result	P	P	P

ST 2,5/2P-PE with SPB 2,5/5 and SPDB 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	2,38	2,73	2,76
2	2,30	2,48	2,48
3	2,11	2,48	2,41
4	2,30	2,71	2,59
5	2,26	2,74	2,62
average	2,270	2,628	2,572
maximum	2,38	2,74	2,76
result	P	P	P

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,45	1,68	1,34
2	1,43	1,58	1,25
3	1,37	1,58	1,24
4	1,40	1,78	1,43
5	1,41	1,79	1,48
average	1,412	1,682	1,348
maximum	1,45	1,79	1,48
result	P	P	P

ST 2,5-TWIN/1P-PE with SPDB 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,84	2,69	2,63
2	2,18	2,58	2,43
3	2,16	2,78	3,02
4	2,11	2,22	2,13
5	2,15	2,31	2,74
average	2,088	2,516	2,590
maximum	2,18	2,78	3,02
result	P	P	P

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,31	1,73	1,42
2	1,34	1,61	1,33
3	1,35	1,98	1,58
4	1,38	1,15	1,66
5	1,29	1,52	1,25
average	1,334	1,598	1,448
maximum	1,38	1,98	1,66
result	P	P	P

ST 2,5-QUATTRO/2P-PE with SPB 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,91	1,91	1,91
2	2,17	2,17	2,17
3	2,31	2,31	2,31
4	2,29	2,29	2,29
5	2,17	2,17	2,17
average	2,170	2,170	2,170
maximum	2,31	2,31	2,31
result	P	P	P

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,14	1,25	1,08
2	1,17	1,54	1,69
3	1,25	1,92	1,62
4	1,23	1,80	1,60
5	1,15	1,46	1,31
average	1,188	1,594	1,460
maximum	1,25	1,92	1,69
result	P	P	P

ST 2,5-QUATTRO/4P-PE with SPB 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	2,45	3,24	3,14
2	2,35	3,04	2,99
3	2,53	3,49	3,29
4	2,44	3,08	2,74
5	2,39	3,24	3,48
average	2,432	3,218	3,128
maximum	2,53	3,49	3,48
result	P	P	P

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,51	2,15	1,67
2	1,46	1,79	1,57
3	1,50	1,91	1,49
4	1,50	1,97	1,49
5	1,55	2,20	2,30
average	1,504	2,004	1,704
maximum	1,55	2,20	2,30
result	P	P	P

STTB 2,5/2P-PE with SPB 2,5/5

1 st level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	2,09	2,09	2,12
2	2,04	2,43	2,36
3	2,20	2,67	2,09
4	2,12	2,68	2,59
5	2,15	2,73	2,05
average	2,120	2,520	2,242
maximum	2,20	2,73	2,59
result	P	P	P

1 st level	contact resistance [mΩ] (terminal to mounting rail)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,14	1,18	1,18
2	1,14	1,47	1,20
3	1,22	1,66	1,19
4	1,24	1,77	1,38
5	1,18	1,66	1,25
average	1,184	1,548	1,240
maximum	1,24	1,77	1,38
result	P	P	P

2 nd level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,92	2,37	2,49
2	1,88	2,40	2,55
3	1,92	2,09	2,49
4	1,93	2,87	2,11
5	1,91	2,11	2,23
average	1,912	2,368	2,374
maximum	1,93	2,87	2,55
result	P	P	P

2 nd level	contact resistance [mΩ] (terminal to mounting rail)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,36	1,62	1,41
2	1,30	1,71	1,48
3	1,28	1,62	1,56
4	1,40	1,99	1,43
5	1,31	1,64	1,51
average	1,330	1,716	1,478
maximum	1,40	1,99	1,56
result	P	P	P

2.2.3.3 Terminal blocks ST 4...

ST 4/1P with SP 4/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	0,92	0,75	0,77
2	1,06	0,82	0,81
3	1,22	0,84	0,84
4	1,06	0,93	0,91
5	1,04	0,90	0,89
average	1,060	0,848	0,844
maximum	1,22	0,93	0,91
result	P	P	P

ST 4/2P with SP 4/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,51	1,61	1,89
2	1,67	1,90	2,20
3	1,57	1,71	1,80
4	1,64	1,84	1,95
5	1,58	2,12	2,03
average	1,594	1,836	1,974
maximum	1,67	2,12	2,20
result	P	P	P

ST 4-QUATTRO/2P with SP 4/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	0,92	0,75	0,77
2	1,06	0,82	0,81
3	1,22	0,84	0,84
4	1,06	0,93	0,91
5	1,04	0,90	0,89
average	1,060	0,848	0,844
maximum	1,22	0,93	0,91
result	P	P	P

ST 4/1P-PE with SP 4/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,10	0,90	0,88
2	1,03	0,86	0,86
3	0,97	0,90	0,91
4	1,13	0,87	0,85
5	1,03	0,85	0,85
average	1,052	0,876	0,870
maximum	1,13	0,90	0,91
result	P	P	P

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 30 g/18 ms
1	0,91	1,13	1,11
2	0,93	0,96	0,97
3	0,96	0,99	1,02
4	0,95	1,00	1,05
5	0,94	0,97	0,99
average	0,938	1,010	1,028
maximum	0,96	1,13	1,11
result	P	P	P

ST 4/2P-PE with SP 4/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,48	1,68	1,96
2	1,59	1,64	1,88
3	1,64	1,68	1,97
4	1,74	1,73	2,10
5	1,52	1,86	2,03
average	1,594	1,718	1,988
maximum	1,74	1,86	2,10
result	P	P	P

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,01	1,10	1,22
2	1,04	1,12	1,19
3	1,05	1,10	1,15
4	1,18	1,10	1,39
5	1,02	1,07	1,11
average	1,060	1,098	1,212
maximum	1,18	1,12	1,39
result	P	P	P

ST 4-QUATTRO/2P-PE with SP 4/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,11	1,11	1,14
2	1,16	1,14	1,15
3	1,08	1,09	1,08
4	1,12	1,09	1,09
5	1,07	1,06	1,05
average	1,108	1,098	1,102
maximum	1,16	1,14	1,15
result	P	P	P

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 30 g/18 ms
1	0,98	1,11	1,03
2	0,96	1,14	0,98
3	0,99	1,09	0,95
4	1,05	1,09	1,10
5	1,00	1,06	1,13
average	0,996	1,098	1,038
maximum	1,05	1,14	1,13
result	P	P	P

2.2.3.4 Terminal blocks QTC 1,5...

QTC 1,5/2P with SP 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,83	1,95	1,92
2	1,77	1,82	1,89
3	1,75	1,73	1,93
4	1,78	1,84	1,93
5	1,87	2,02	2,27
average	1,800	1,872	1,988
maximum	1,87	2,02	2,27
result	P	P	P

QTTCB 1,5-PV/2P with SP 2,5/5

1 st / 2 nd level test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	2,05	2,07	1,77
2	2,02	1,97	1,76
3	1,85	1,84	1,64
4	1,95	2,03	1,75
5	2,14	2,29	1,72
average	2,002	2,040	1,728
maximum	2,14	2,29	1,77
result	P	P	P

QTTCB 1,5/2P with SP 2,5/5

1st level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,97	2,00	2,09
2	1,96	2,05	2,18
3	1,93	2,20	2,20
4	1,99	2,16	2,29
5	1,86	1,93	2,13
average	1,942	2,068	2,178
maximum	1,99	2,20	2,29
result	P	P	P

2nd level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,98	2,12	2,29
2	1,61	1,66	1,84
3	1,66	1,90	2,03
4	1,70	1,74	1,85
5	1,66	1,80	1,98
average	1,722	1,844	1,998
maximum	1,98	2,12	2,29
result	P	P	P

QTC 1,5/1P-PE with SP 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,83	1,95	1,92
2	1,77	1,82	1,89
3	1,75	1,73	1,93
4	1,78	1,84	1,93
5	1,87	2,02	2,27
average	1,800	1,872	1,988
maximum	1,87	2,02	2,27
result	P	P	P

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,01	1,12	0,98
2	0,99	1,09	0,99
3	0,95	1,05	0,96
4	0,96	1,05	0,96
5	0,93	1,01	0,99
average	0,968	1,064	0,976
maximum	1,01	1,12	0,99
result	P	P	P

test sample	contact resistance [mΩ] (plug to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,38	1,65	1,43
2	1,35	1,48	1,38
3	1,29	1,37	1,41
4	1,30	1,50	1,49
5	1,41	1,61	1,34
average	1,346	1,522	1,410
maximum	1,41	1,65	1,49
result	P	P	P

QTTCB 1,5/2P-PE with SP 2,5/5

1 st level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,86	1,92	2,16
2	1,94	2,04	2,22
3	1,83	1,91	2,10
4	1,91	1,95	2,15
5	1,93	2,05	2,55
average	1,894	1,974	2,236
maximum	1,94	2,05	2,55
result	P	P	P

1 st level	contact resistance [mΩ] (terminal to mounting rail)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	0,98	1,36	1,01
2	0,96	1,32	1,03
3	0,98	1,32	1,00
4	0,95	1,28	0,98
5	1,08	1,37	1,21
average	0,990	1,330	1,046
maximum	1,08	1,37	1,21
result	P	P	P

1 st level	contact resistance [mΩ] (plug to mounting rail)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,33	1,78	1,65
2	1,40	1,90	1,74
3	1,31	1,78	1,63
4	1,37	1,75	1,65
5	1,48	1,95	1,98
average	1,378	1,832	1,730
maximum	1,48	1,95	1,98
result	P	P	P

QTTCB 1,5/2P-PE with SP 2,5/5

2nd level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,45	1,79	1,98
2	1,70	1,77	1,94
3	1,59	1,67	1,99
4	1,76	1,88	1,98
5	1,62	1,68	1,75
average	1,624	1,758	1,928
maximum	1,76	1,88	1,99
result	P	P	P

2nd level	contact resistance [mΩ] (terminal to mounting rail)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,16	1,40	1,21
2	1,11	1,48	1,19
3	1,13	1,48	1,17
4	1,09	1,42	1,13
5	1,17	1,55	1,39
average	1,132	1,466	1,218
maximum	1,17	1,55	1,39
result	P	P	P

2nd level	contact resistance [mΩ] (plug to mounting rail)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,49	1,97	1,77
2	1,48	1,95	1,79
3	1,41	1,79	1,76
4	1,51	2,00	1,72
5	1,51	1,89	1,84
average	1,480	1,920	1,776
maximum	1,51	2,00	1,84
result	P	P	P

2.2.3.5 Terminal blocks UT 2,5...

UT 2,5/1P with SP 2,5/5

test sample	contact resistance [$m\Omega$] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,70	1,63	1,72
2	1,69	1,65	1,80
3	1,69	1,64	1,64
4	1,63	1,67	1,69
5	1,75	1,82	1,74
average	1,692	1,682	1,718
maximum	1,75	1,82	1,80
result	P	P	P

UT 2,5/1P-PE with SP 2,5/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,65	1,71	1,73
2	1,66	1,68	1,70
3	1,66	1,68	1,77
4	1,71	1,74	1,81
5	1,67	1,69	1,74
average	1,670	1,700	1,750
maximum	1,71	1,74	1,81
result	P	P	P

test sample	contact resistance [mΩ] (terminal to mounting rail) terminal connection / plug connection		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,99 / 1,63	1,05 / 1,68	1,01 / 1,71
2	0,97 / 1,47	0,98 / 1,50	0,98 / 1,57
3	0,95 / 1,52	0,97 / 1,53	0,96 / 1,56
4	0,93 / 1,55	0,94 / 1,55	0,95 / 1,67
5	0,93 / 1,55	0,95 / 1,50	0,96 / 1,56
average	0,954 / 1,544	0,978 / 1,552	0,972 / 1,614
maximum	0,99 / 1,63	1,05 / 1,68	1,01 / 1,71
result	P	P	P

2.2.3.6 Terminal blocks UT 4...

UT 4 / 1P with UPBV 4/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1.06	1.08	1.08
2	1.06	1.04	1.18
3	1.02	1.02	1.02
4	1.01	1.03	1.01
5	1.05	1.06	1.06
average	1.04	1.05	1.07
maximum	1.06	1.08	1.18
result	P	P	P

UT 4-TWIN / 1P with UP 4/5

test sample	contact resistance [mΩ] (terminal to terminal)					
	before test		after vibration, random		after shock 5 g/30 ms	
	1 st level	2 nd level	1 st level	2 nd level	1 st level	2 nd level
1	0.95	1.04	0.96	1.04	0.96	1.04
2	0.95	1.06	0.99	1.08	0.99	1.00
3	0.97	1.06	0.97	1.06	0.97	1.05
4	0.98	1.06	0.99	1.06	0.99	1.06
5	1.00	1.10	1.02	1.12	1.02	1.11
average	0.97	1.06	0.99	1.07	0.99	1.05
maximum	1.00	1.10	1.02	1.12	1.02	1.11
result	P		P		P	

UT 4-QUATTRO/2P with UP 4/5

test sample	contact resistance [mΩ] (terminal to terminal)					
	before test		after vibration, random		after shock 5 g/30 ms	
	1 st level	2 nd level	1 st level	2 nd level	1 st level	2 nd level
1	0.92	1.10	0.92	1.10	0.92	1.10
2	0.91	1.10	0.91	1.10	0.91	1.10
3	0.91	1.09	0.92	1.10	0.92	1.10
4	0.94	1.08	0.96	1.09	0.96	1.09
5	0.90	1.09	0.91	1.10	0.91	1.10
average	0.92	1.09	0.92	1.10	0.92	1.10
maximum	0.94	1.10	0.96	1.10	0.96	1.10
result	P		P		P	

UT 4/1P-PE with UPBV 4/5

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1.02	1.02	1.02
2	1.01	1.02	1.01
3	1.01	1.00	1.00
4	1.00	0.99	0.99
5	1.00	1.02	1.02
average	1.01	1.01	1.01
maximum	1.02	1.02	1.02
result	P	P	P

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0.75	0.76	0.78
2	0.82	0.84	0.74
3	0.81	0.82	0.71
4	0.81	0.79	0.85
5	0.77	0.77	0.77
average	0.79	0.80	0.77
maximum	0.82	0.84	0.85
result	P	P	P

test sample	contact resistance [mΩ] (plug to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1.04	1.05	1.06
2	1.10	1.13	1.02
3	1.08	1.13	1.04
4	1.08	1.06	1.13
5	1.05	1.06	1.05
average	1.07	1.09	1.06
maximum	1.10	1.13	1.13
result	P	P	P

UT 4-TWIN/1P-PE with UP 4/5

test sample	contact resistance [mΩ] (terminal to terminal)					
	before test		after vibration, random		after shock 5 g/30 ms	
	1 st level	2 nd level	1 st level	2 nd level	1 st level	2 nd level
1	1.10	1.00	1.03	1.09	1.04	1.10
2	1.06	0.98	0.97	1.06	0.97	1.06
3	1.06	0.97	0.97	1.05	0.97	1.05
4	1.06	0.97	0.97	1.07	0.97	1.06
5	1.07	0.97	0.98	1.06	0.98	1.06
average	1.07	0.98	0.98	1.07	0.99	1.07
maximum	1.10	1.00	1.03	1.09	1.04	1.10
result	P		P		P	

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
	1	0.85	0.86
2	0.95	0.98	0.97
3	0.90	0.89	0.89
4	0.92	0.94	0.94
5	0.89	0.86	0.86
average	0.90	0.91	0.90
maximum	0.95	0.98	0.97
result	P	P	P

test sample	contact resistance [mΩ] (plug to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
	1	1.02	1.02
2	1.05	1.08	1.07
3	1.01	0.99	0.98
4	1.02	1.04	1.05
5	0.98	0.96	0.96
average	1.02	1.02	1.02
maximum	1.05	1.08	1.07
result	P	P	P

UT 4-QUATTRO/2P-PE with UP 4/5

test sample	contact resistance [mΩ] (terminal to terminal)					
	before test		after vibration, random		after shock 5 g/30 ms	
	1 st level	2 nd level	1 st level	2 nd level	1 st level	2 nd level
1	0.90	1.09	0.91	1.10	0.91	1.10
2	0.90	1.08	0.91	1.10	0.91	1.10
3	0.90	1.11	0.90	1.12	0.90	1.12
4	0.90	1.09	0.89	1.10	0.90	1.10
5	0.91	1.09	0.91	1.11	0.91	1.11
average	0.90	1.09	0.90	1.11	0.91	1.11
maximum	0.91	1.11	0.91	1.12	0.91	1.12
result	P		P		P	

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
	1	0.86	0.85
2	0.84	0.84	0.85
3	0.87	0.88	0.90
4	0.89	0.90	0.91
5	0.89	0.88	0.90
average	0.87	0.87	0.88
maximum	0.89	0.90	0.91
result	P	P	P

test sample	contact resistance [mΩ] (plug to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
	1	1.06	1.07
2	1.06	1.06	1.07
3	1.11	1.11	1.14
4	1.11	1.10	1.12
5	1.08	1.10	1.12
average	1.08	1.09	1.10
maximum	1.11	1.11	1.14
result	P	P	P

3 List of measuring instruments

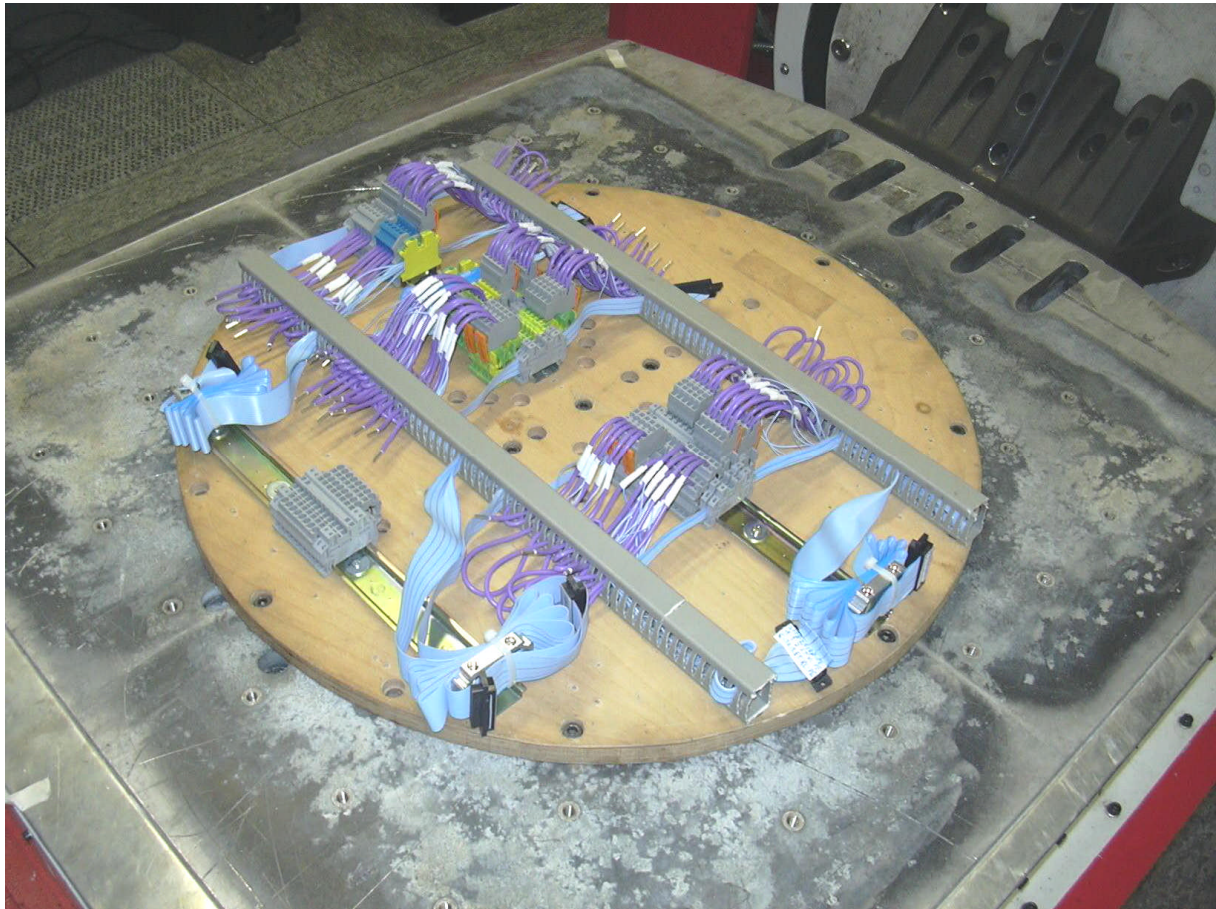
Measuring instrument	Type	PM-No.
Vibration test system	LDS V 850-440 LPT 600	490082
Vibration test system	LDS V 875-640 LPT 900	490022
Vibration test system	LDS V 895-440 HBT 600	490074
Vibration test system	LDS V 895-640 LPT 900	490101
Oscilloscope	HP 54645A	490028
DC-supply	TOE 8852 / 51706	490001
Contact break measurement	LDS Relaccs	490113
Milliohmmeter	MR 1012P	Phoenix Contact
Measuring point switch	HP 34970A	Phoenix Contact

4 Photos

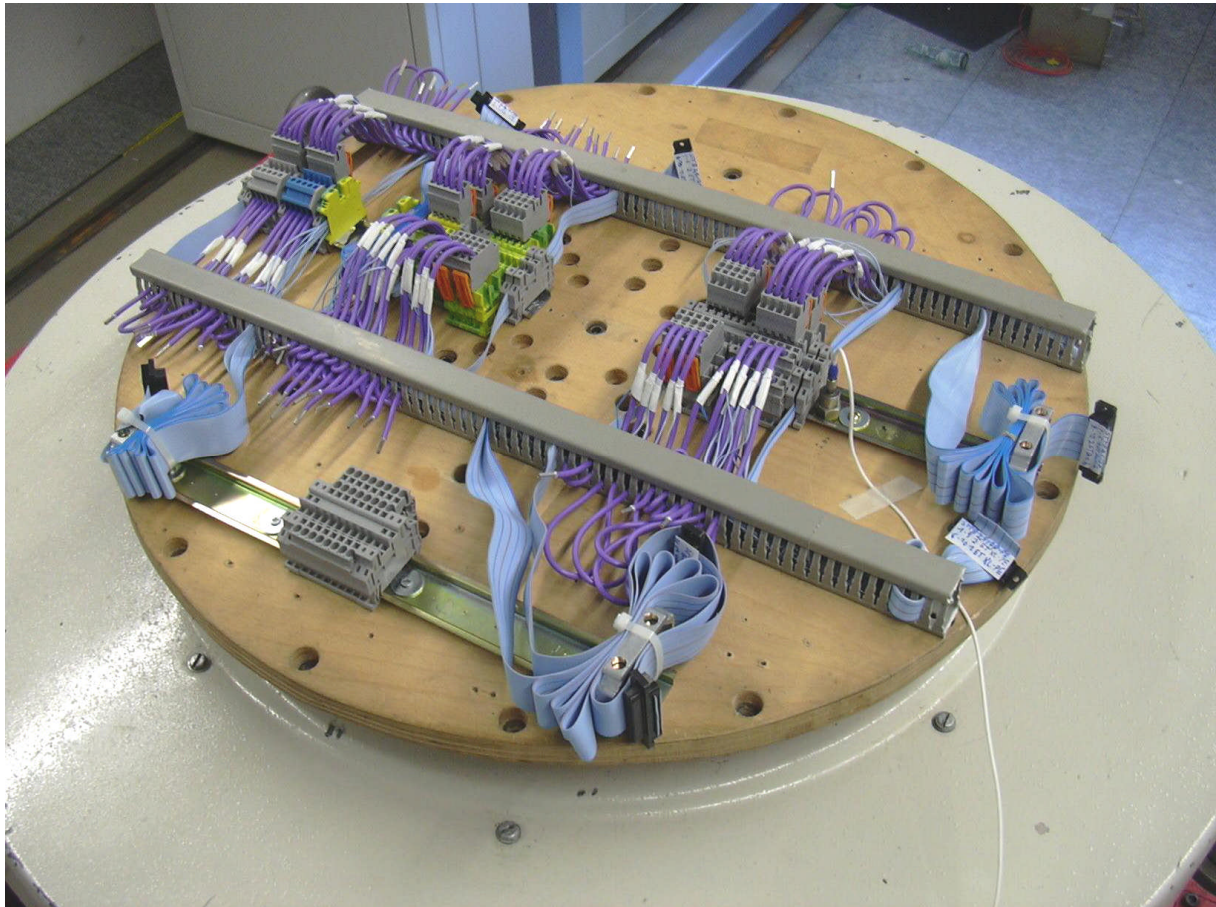
4.1 Test set-up, x-axis (exemplary)



4.2 Test set-up, y-axis (exemplary)



4.3 Test set-up, z-axis (exemplary)



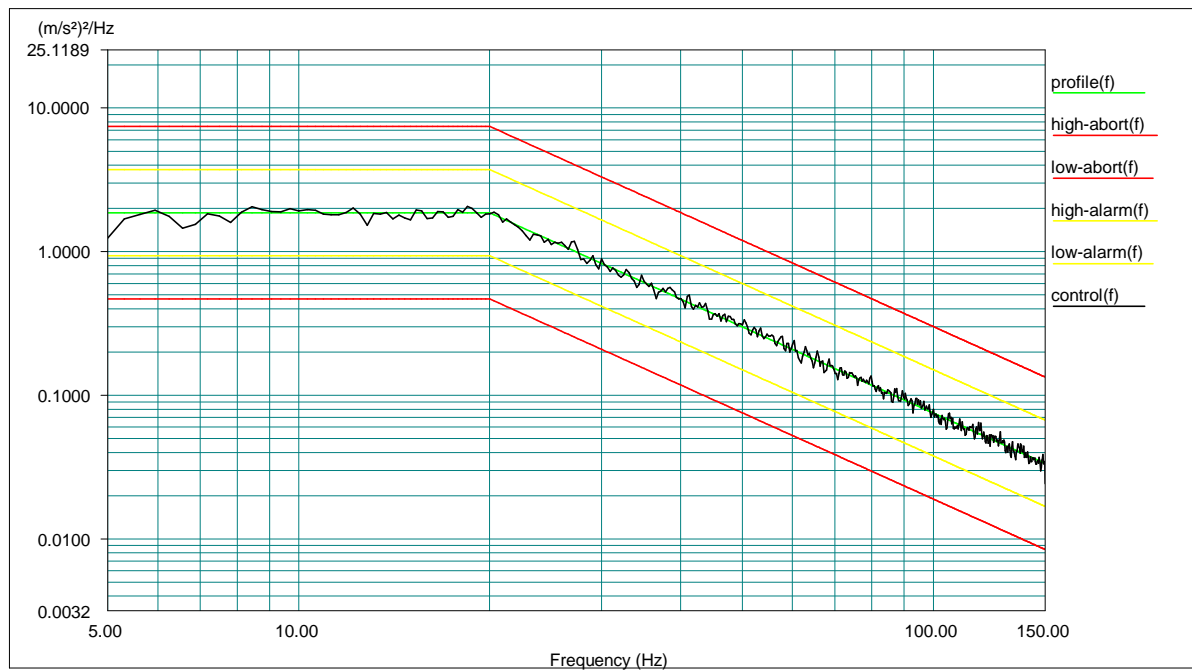
5 Oscillation profiles

5.1 Vibration, random (EN 50155 : 2001 / Category 1B), exemplary

Project File Name: Random Cat. 1B.prj
Profile Name: 5-150Hz

Test Type: Random

Run Folder: .\RunDefault April 19,2004 09-07-14



Level: 100 %

Control RMS: 7.730914 m/s^2
Demand RMS: 7.762140 m/s^2

Full Level Elapsed Time: 05:00:00
Remaining Time: 00:00:00

Lines: 800
DOF: 154

Frame Time: 3.200000 Seconds
dF: 0.312500 Hz

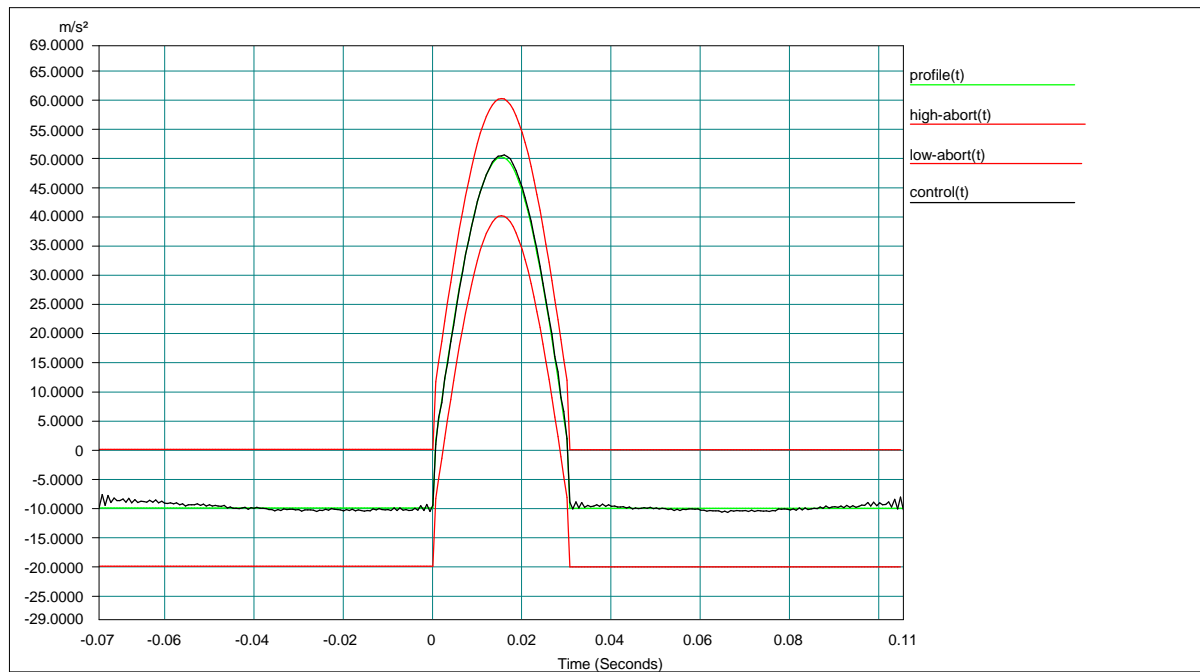
Data saved at 02:09:53 PM, Monday, April 19, 2004

5.2 Positive shock (EN 50155 : 2001 / Category 1B), exemplary

Project File Name: Shock Cat. 1B.prj
Profile Name: 50m/s² 30ms

Test Type: Classical Shock

Run Folder: .\RunDefault April 22,2004 13-19-51



Level: 100 %	Block Size: 1024	Elapsed Pulses: 15
Frame Time: 0.682667 Seconds	Control Peak: 50.359528 m/s ²	Control RMS: 9.296963 m/s ²
dT: 0.000667 Seconds	Demand Peak: 50.000000 m/s ²	Demand RMS: 9.224827 m/s ²
Pulse Type: Half Sine	Amplitude: 50.000000 m/s ²	Full Level Elapsed Pulses: 3
		Remaining Pulses: 9

Data saved at 01:20:20 PM, Thursday, April 22, 2004

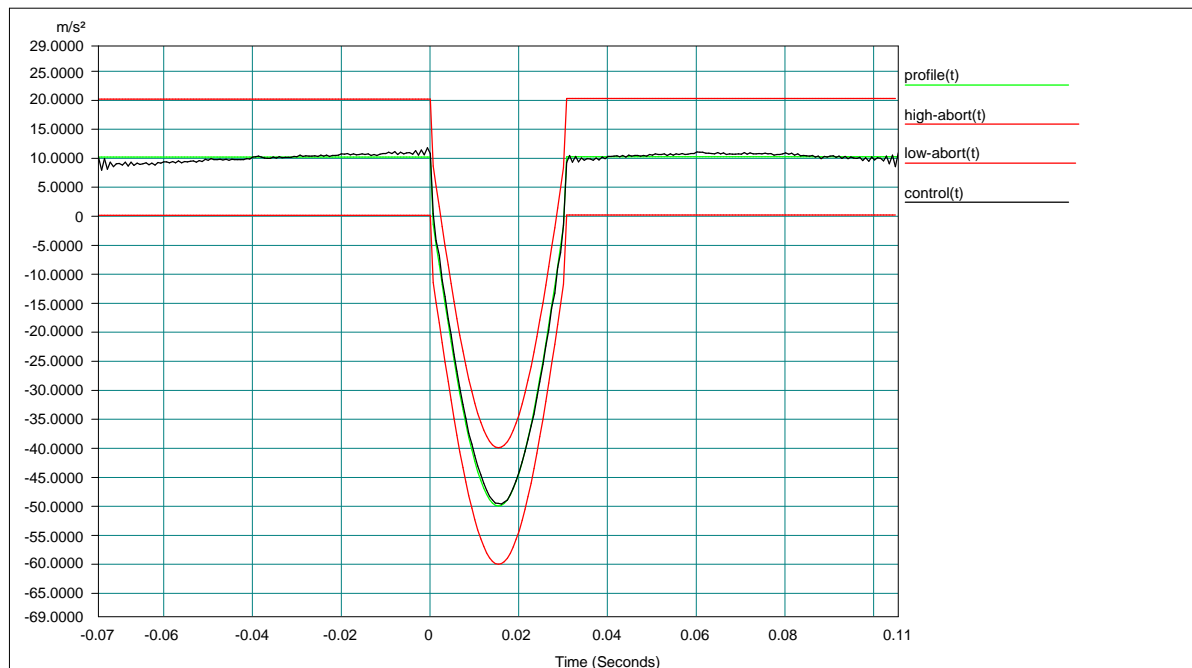
5.3 Negative shock (EN 50155 : 2001 / Category 1B), exemplary

Project File Name: Shock Cat. 1B.prj

Profile Name: 50m/s² 30ms

Test Type: Classical Shock

Run Folder: .\RunDefault April 22,2004 13-19-51



Level: 100 %	Block Size: 1024	Elapsed Pulses: 24
Frame Time: 0.682667 Seconds	Control Peak: 49.639999 m/s ²	Control RMS: 9.200580 m/s ²
dT: 0.000667 Seconds	Demand Peak: 50.000000 m/s ²	Demand RMS: 9.224827 m/s ²
Pulse Type: Half Sine	Amplitude: 50.000000 m/s ²	Full Level Elapsed Pulses: 6
		Remaining Pulses: 0

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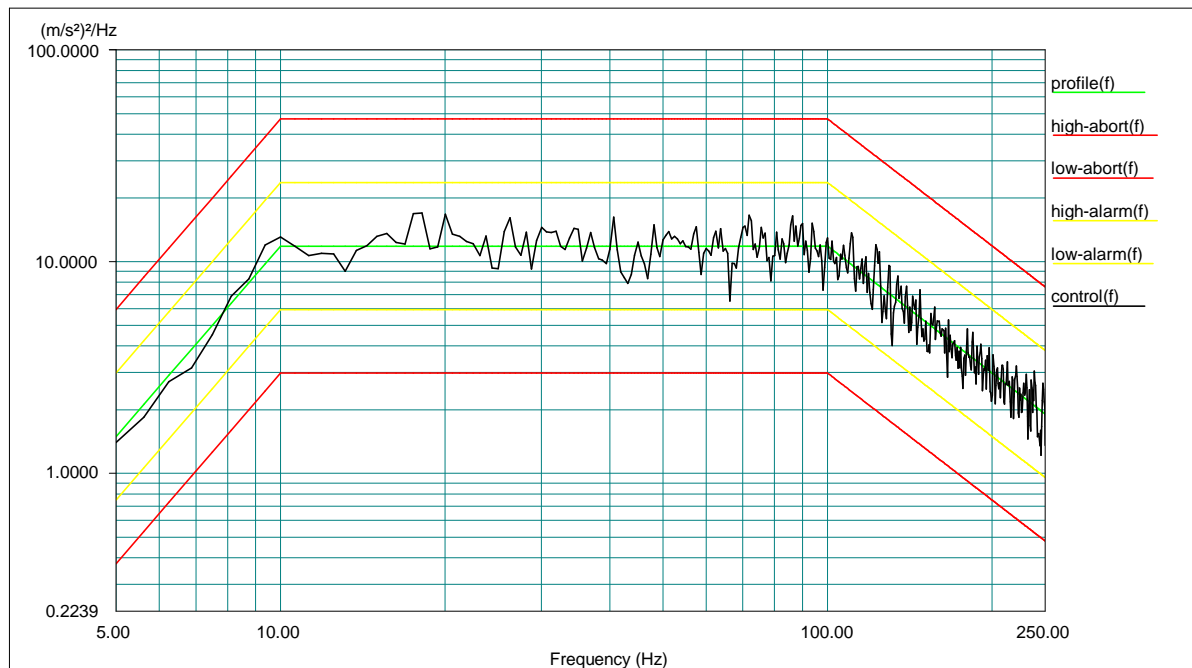
5.4 Vibration, random (EN 50155 : 2001 / Category 2), exemplary

Project File Name: Random 5-250 Hz.prj

Profile Name: Random 5-250 Hz

Test Type: Random

Run Folder: .\RunDefault Jul 22,2003 13-08-49



Level: 100 %

Control RMS: 42.628349 m/s^2

Demand RMS: 42.474407 m/s^2

Full Level Elapsed Time: 05:00:00

Remaining Time: 00:00:00

Lines: 400

DOF: 154

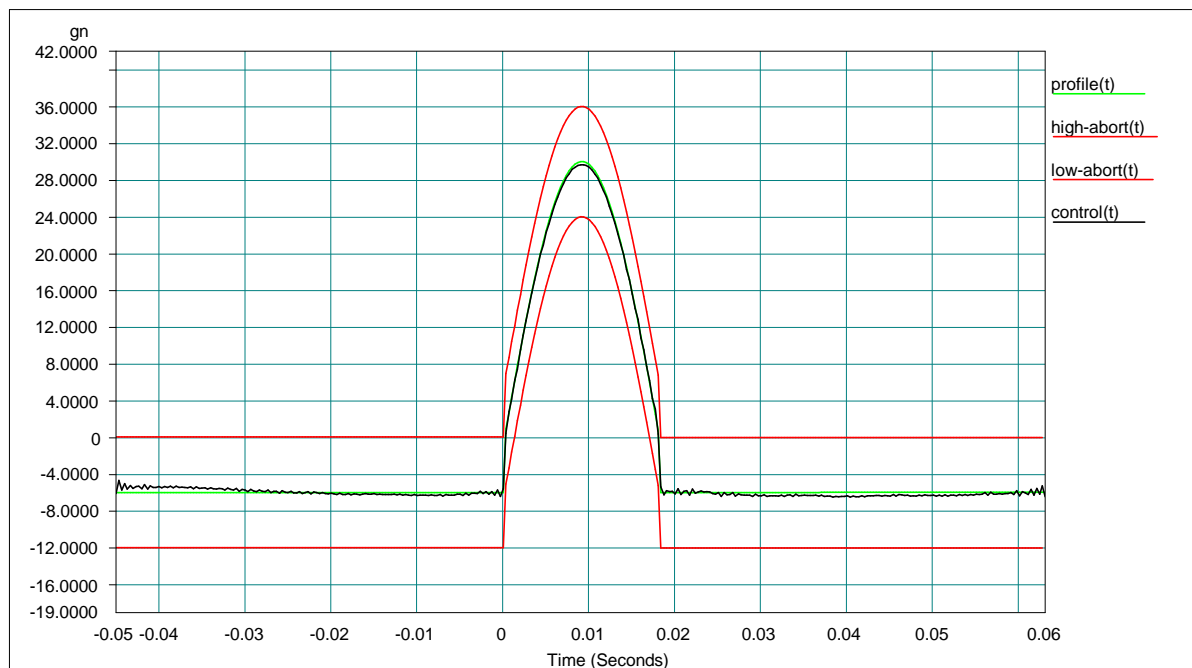
Frame Time: 1.600000 Seconds

dF: 0.625000 Hz

Data saved at 06:12:47 PM, Tuesday, July 22, 2003

5.5 Positive shock (EN 50155 : 2001 / Category 2), exemplary

Project File Name: 30g_18ms.prj Test Type: Classical Shock Run Folder: .\RunDefault Jul 24,2003 07-48-37
 Profile Name: 300m/s² 18mSec

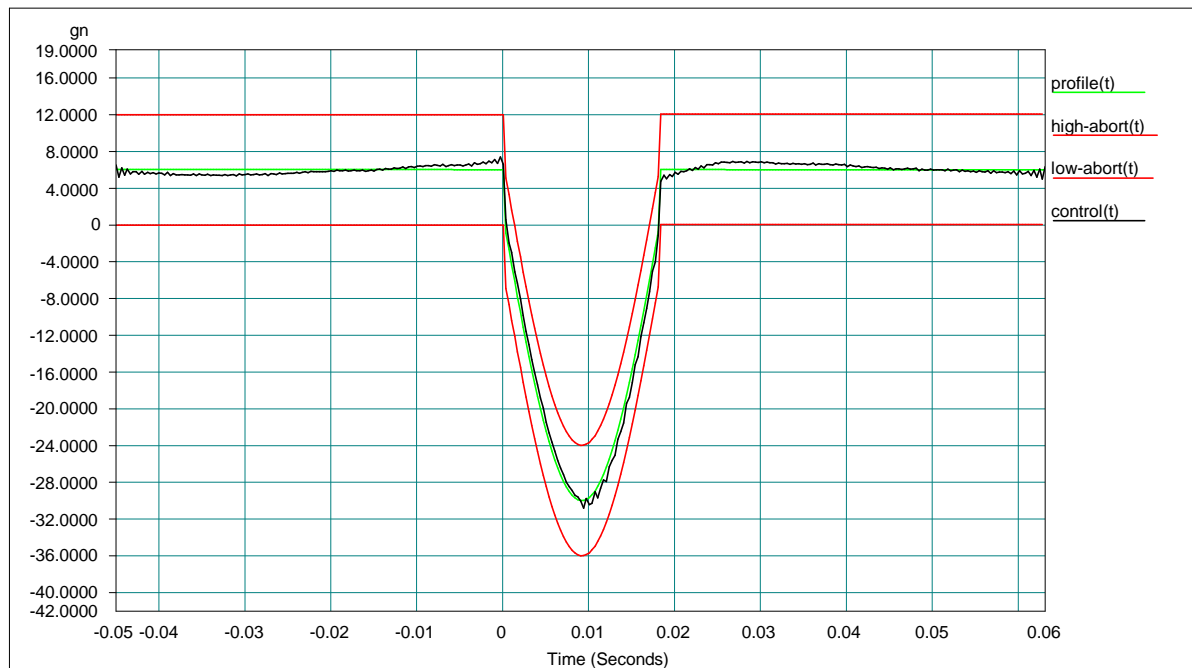


Level: 100 %	Block Size: 1024	Elapsed Pulses: 17	
Frame Time: 0.341333 Seconds	Control Peak: 291.945129 m/s ²	Control RMS: 60.110031 m/s ²	Full Level Elapsed Pulses: 3
dT: 0.000333 Seconds	Demand Peak: 300.000000 m/s ²	Demand RMS: 60.667191 m/s ²	Remaining Pulses: 9
Pulse Type: Half Sine	Amplitude: 300.000000 m/s ²		

Data saved at 07:49:10 AM, Thursday, July 24, 2003

5.6 Negative shock (EN 50155 : 2001 / Category 2), exemplary

Project File Name: 30g_18ms.prj
 Profile Name: 300m/s² 18mSec Test Type: Classical Shock Run Folder: .\RunDefault Jul 24,2003 07-48-37



Level: 100 %	Block Size: 1024	Elapsed Pulses: 26	
Frame Time: 0.341333 Seconds	Control Peak: 301.260162 m/s ²	Control RMS: 60.997120 m/s ²	Full Level Elapsed Pulses: 6
dT: 0.000333 Seconds	Demand Peak: 300.000000 m/s ²	Demand RMS: 60.667191 m/s ²	Remaining Pulses: 0
Pulse Type: Half Sine	Amplitude: 300.000000 m/s ²		

Data saved at 07:49:37 AM, Thursday, July 24, 2003