

# Test Report

No.: U60108c

Designation of equipment under test: Fast Connection 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):                      Fast Connection Terminal Blocks

Type identification:

Type	Bridge / Plug Type	Article- No.	Cross section	Test Specification	Date of test / Original Test-Report No.
QTC 1,5	---	3205019	0,25 mm <sup>2</sup> flexible	EN 50155 : 2001 / EN 61373 : 1999 according to EN 60068-2-64 : 1994 and EN 60068-2-27 : 1993	04 July 2003 to 11 July 2003  S30593a_eng
	FBS 2,5	3030161	1,5 mm <sup>2</sup> flexible		
QTC 1,5-TWIN	---	3205048	0,25 mm <sup>2</sup> flexible		
	FBS 2,5	3030161	1,5 mm <sup>2</sup> flexible		
QTC 1,5- QUATTRO	---	3205077	0,25 mm <sup>2</sup> flexible		
	FBS 2,5	3030161	1,5 mm <sup>2</sup> flexible		
QTTCB 1,5	---	3205116	0,25 mm <sup>2</sup> flexible		
	FBS 2,5	3030161	1,5 mm <sup>2</sup> flexible		
QTC 1,5-MT	---	3205103	1,5 mm <sup>2</sup> flexible		
QTC 1,5-TG	---	3205145	1,5 mm <sup>2</sup> flexible		
QTTCB 1,5-PV	---	3205153	1,5 mm <sup>2</sup> flexible		
QTC 1,5-PE	---	3205035	1,5 mm <sup>2</sup> flexible		
QTC 1,5- TWIN-PE	---	3205064	1,5 mm <sup>2</sup> flexible		
QTC 1,5- QUATTRO-PE	---	3205093	1,5 mm <sup>2</sup> flexible		
QTTCB 1,5-PE	---	3205132	1,5 mm <sup>2</sup> flexible		
QTC 2,5	---	3206416	0,5 mm <sup>2</sup> flexible 1,5 mm <sup>2</sup> flexible	EN 50155 : 2001 / EN 61373 : 1999 according to EN 60068-2-64 : 1994 and EN 60068-2-27 : 1993	05 August 2004 to 10 August 2004  S40746
	FBS 2-6	3030336			
	FBS 5-6	3030349			
QTC 2,5-PE	---	3206432	0,5 mm <sup>2</sup> flexible 1,5 mm <sup>2</sup> 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
QTC 2,5-MT	---	3206487	2,5 mm <sup>2</sup> rigid	EN 50155 : 2001 / EN 61373 : 1999 according to EN 60068-2-64 : 1994 and EN 60068-2-27 : 1993	05 January 2005 to 04 February 2005
	P-DI	3036783			
QTC 2,5-TG	---	3206490	2,5 mm <sup>2</sup> rigid	EN 50155 : 2001 / EN 61373 : 1999 according to EN 60068-2-64 : 1994 and EN 60068-2-27 : 1993	U41253
	P-DI	3036783			

Type	Bridge / Plug Type	Article- No.	Cross section	Test Specification	Date of test / Original Test-Report No.
QTC 2,5-TWIN	---	3206445	2,5 mm <sup>2</sup> rigid	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
QTC 2,5-TWIN-PE	---	3206474	2,5 mm <sup>2</sup> rigid		
QTC 2,5-HESI (5x20)	---	3050293	2,5 mm <sup>2</sup> rigid		
QTCS 2,5	---	3206500	2,5 mm <sup>2</sup> rigid		
QTCS 2,5-TWIN	---	3050332	2,5 mm <sup>2</sup> rigid		
QTCS 2,5-PE	---	3206526	2,5 mm <sup>2</sup> rigid		
QTCS 2,5- TWIN-PE	---	3050358	2,5 mm <sup>2</sup> rigid		
QTCU 2,5	---	3206539	2,5 mm <sup>2</sup> rigid		
QTCU 2,5-TWIN	---	3050303	2,5 mm <sup>2</sup> rigid		
QTCU 2,5-PE	---	3206555	2,5 mm <sup>2</sup> rigid		
QTCU 2,5- TWIN-PE	---	3050329	2,5 mm <sup>2</sup> rigid		
QTTCBU 1,5	---	3050264	2,5 mm <sup>2</sup> rigid		
QTTCBU 1,5-PE	---	3050277	2,5 mm <sup>2</sup> rigid		

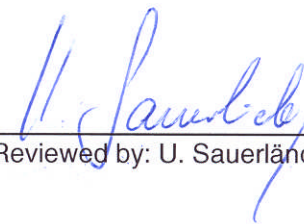
Test result: The complete test results are present in the following.  
The requirements made in the test documents were **fulfilled**  
by the equipment under test.

Note: This test report contains the results of five single vibration tests.  
The measured values were taken from the test reports S30593a\_eng,  
S40746, S40850, U41253 and U50157.

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 <sup>2</sup> ) <sup>2</sup> /Hz -6 dB/Oct
rms value 5 Hz – 150 Hz	7,9 m/s <sup>2</sup>
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 <sup>2</sup> ) <sup>2</sup> /Hz -9 dB/Oct -6 dB/Oct
rms value 5 Hz – 250 Hz	42,5 m/s <sup>2</sup>
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 <sup>2</sup>
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 <sup>2</sup>
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<sub>DC</sub> 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 <sup>2</sup>	QTC 2,5-PE	yes
	QTC 2,5-TWIN	yes
	QTC 2,5-TWIN-PE	yes
	QTC 2,5-HESI (5x20)	yes
	QTCS 2,5	yes
	QTCS 2,5-TWIN	yes
	QTCS 2,5-PE	yes
	QTCS 2,5-TWIN-PE	yes
	QTCU 2,5	yes
	QTCU 2,5-TWIN	yes
	QTCU 2,5-PE	yes
	QTCU 2,5-TWIN-PE	yes
	QTTCBU 1,5	yes
	QTTCBU 1,5-PE	yes
Category 2 5 Hz to 250 Hz rms value 42,5 m/s <sup>2</sup>	QTC 1,5	yes
	QTC 1,5-TWIN	yes
	QTC 1,5- QUATTRO	yes
	QTTCB 1,5	yes
	QTC 1,5-MT	yes
	QTC 1,5-TG	yes
	QTTCB 1,5-PV	yes
	QTC 1,5-PE	yes
	QTC 1,5-TWIN-PE	yes
	QTC 1,5-QUATTRO-PE	yes
	QTTCB 1,5-PE	yes
	QTC 2,5	yes
	QTC 2,5-MT	yes
	QTC 2,5-TG	yes

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

Requirements fulfilled:

Severity	Type	Pass
Category 1B 50 m/s <sup>2</sup> 30 ms	QTC 2,5-PE	yes
	QTC 2,5-TWIN	yes
	QTC 2,5-TWIN-PE	yes
	QTC 2,5-HESI (5x20)	yes
	QTCS 2,5	yes
	QTCS 2,5-TWIN	yes
	QTCS 2,5-PE	yes
	QTCS 2,5-TWIN-PE	yes
	QTCU 2,5	yes
	QTCU 2,5-TWIN	yes
	QTCU 2,5-PE	yes
	QTCU 2,5-TWIN-PE	yes
	QTTCBU 1,5	yes
	QTTCBU 1,5-PE	yes
Category 2 300 m/s <sup>2</sup> 18 ms	QTC 1,5	yes
	QTC 1,5-TWIN	yes
	QTC 1,5- QUATTRO	yes
	QTTCB 1,5	yes
	QTC 1,5-MT	yes
	QTC 1,5-TG	yes
	QTTCB 1,5-PV	yes
	QTC 1,5-PE	yes
	QTC 1,5-TWIN-PE	yes
	QTC 1,5-QUATTRO-PE	yes
	QTTCB 1,5-PE	yes
	QTC 2,5	yes
	QTC 2,5-MT	yes
	QTC 2,5-TG	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 QTC 1,5...

QTC 1,5 / A= 1,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,30	1,31	1,29
2	1,31	1,32	1,29
3	1,29	1,29	1,26
4	1,30	1,32	1,29
5	1,31	1,34	1,33
average	1,302	1,316	1,292
maximum	1,31	1,34	1,33
result	P	P	P

QTC 1,5 / A= 0,25 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	4,13	3,91	4,07
2	4,18	3,98	4,14
3	4,00	3,87	3,97
4	4,20	3,99	4,16
5	3,95	3,79	3,93
average	4,092	3,908	4,054
maximum	4,20	3,99	4,16
result	P	P	P

QTC 1,5 / A= 1,5 mm<sup>2</sup> flexible  
(Pre-treatment: Connection of 1,5 mm<sup>2</sup> solid for 100 times)

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,30	1,29	1,31
2	1,29	1,30	1,32
3	1,27	1,30	1,31
4	1,30	1,30	1,33
5	1,27	1,28	1,29
average	1,286	1,294	1,312
maximum	1,30	1,30	1,33
result	P	P	P

QTC 1,5 / A= 0,25 mm<sup>2</sup> flexible  
(Pre-treatment: Connection of 1,5 mm<sup>2</sup> solid for 10 times)

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	4,37	3,99	4,40
2	5,10	4,20	4,64
3	4,40	3,88	4,60
4	4,80	4,74	4,04
5	5,22	4,25	4,96
average	4,778	4,212	4,528
maximum	5,22	4,74	4,96
result	P	P	P

QTC 1,5 / A= 0,25 mm<sup>2</sup> flexible  
(Pre-treatment: Connection of 0,25 mm<sup>2</sup> solid for 100 times)

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	4,14	3,89	4,03
2	4,16	3,76	3,87
3	4,70	4,22	4,66
4	4,20	3,81	4,03
5	4,48	4,05	4,31
average	4,336	3,946	4,180
maximum	4,70	4,22	4,66
result	P	P	P

QTC 1,5-TWIN / A= 1,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,41	1,41	1,46
2	1,34	1,34	1,36
3	1,34	1,37	1,40
4	1,37	1,38	1,38
5	1,37	1,39	1,43
average	1,366	1,378	1,406
maximum	1,41	1,41	1,46
result	P	P	P

QTC 1,5-TWIN / A= 0,25 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	4,44	4,07	4,34
2	4,23	3,86	4,22
3	4,39	4,04	4,26
4	4,90	4,20	4,54
5	4,49	3,94	4,10
average	4,490	4,022	4,292
maximum	4,90	4,20	4,54
result	P	P	P

QTC 1,5-QUATTRO / A= 1,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,48	1,54	1,55
2	1,46	1,48	1,50
3	1,46	1,46	1,49
4	1,48	1,55	1,57
5	1,49	1,52	1,54
average	1,474	1,510	1,530
maximum	1,49	1,55	1,57
result	P	P	P

QTC 1,5-QUATTRO / A= 0,25 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	4,68	4,21	4,21
2	5,19	4,40	4,53
3	4,44	4,10	4,10
4	4,93	4,31	4,43
5	5,04	4,40	4,41
average	4,856	4,284	4,336
maximum	5,19	4,40	4,53
result	P	P	P

QTTCB 1,5 / A= 1,5 mm<sup>2</sup> flexible

1 <sup>st</sup> level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 30 g/18 ms
1	1,58	1,74	1,73
2	1,59	1,63	1,64
3	1,58	1,64	1,64
4	1,60	1,69	1,70
5	1,58	1,62	1,61
average	1,586	1,664	1,664
maximum	1,60	1,74	1,73
result	P	P	P

2 <sup>nd</sup> level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 30 g/18 ms
1	1,28	1,32	1,33
2	1,26	1,3	1,32
3	1,27	1,33	1,33
4	1,29	1,39	1,38
5	1,25	1,24	1,25
average	1,270	1,316	1,322
maximum	1,29	1,39	1,38
result	P	P	P

QTTCB 1,5 / A= 0,25 mm<sup>2</sup> flexible

1 <sup>st</sup> level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 30 g/18 ms
1	4,41	4,03	4,18
2	5,03	4,43	4,56
3	4,52	4,02	4,23
4	4,66	4,09	4,23
5	4,30	3,98	4,10
average	4,584	4,110	4,260
maximum	5,03	4,43	4,56
result	P	P	P

2 <sup>nd</sup> level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 30 g/18 ms
1	4,36	3,93	4,08
2	4,24	3,76	3,86
3	4,44	4,02	4,11
4	4,40	3,94	4,09
5	4,39	3,95	4,14
average	4,366	3,920	4,056
maximum	4,44	4,02	4,14
result	P	P	P

QTTCB 1,5-PV / A= 1,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,81	1,86	1,90
2	1,75	1,80	1,80
3	1,78	1,81	1,85
4	1,74	1,81	1,82
5	1,80	1,83	1,86
average	1,776	1,822	1,846
maximum	1,81	1,86	1,90
result	P	P	P

QTC 1,5-MT / A= 0,25 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	2,15	2,18	2,23
2	2,14	2,15	2,20
3	2,01	1,97	2,01
4	2,09	2,05	2,13
5	2,09	2,07	2,12
average	2,096	2,084	2,138
maximum	2,15	2,18	2,23
result	P	P	P

QTC 1,5-TG with P-DI / A= 1,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	2,12	2,14	2,17
2	2,10	2,10	2,13
3	2,14	2,21	2,29
4	2,10	2,06	2,10
5	2,12	2,13	2,19
average	2,116	2,128	2,176
maximum	2,14	2,21	2,29
result	P	P	P

QTC 1,5 with FBS 2-5 / A= 1,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,87	1,80	1,83
2	1,87	1,87	1,90
3	1,77	1,77	1,83
4	1,92	1,94	2,05
5	1,81	1,79	1,84
average	1,848	1,834	1,890
maximum	1,92	1,94	2,05
result	P	P	P

QTC 1,5-TWIN with FBS 2-5 / A= 1,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	2,01	1,98	2,09
2	2,00	1,99	2,02
3	2,03	2,03	2,08
4	2,08	2,01	2,09
5	2,03	2,04	2,11
average	2,030	2,010	2,078
maximum	2,08	2,04	2,11
result	P	P	P

QTC 1,5-QUATTRO with FBS 2-5 / A= 1,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	2,04	1,98	2,10
2	2,06	2,08	2,11
3	2,02	1,93	2,00
4	2,13	1,97	2,01
5	2,13	2,00	2,09
average	2,076	1,992	2,062
maximum	2,13	2,08	2,11
result	P	P	P

QTTCB 1,5 with FBS 2-5 / A= 1,5 mm<sup>2</sup> flexible

1 <sup>st</sup> level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 30 g/18 ms
1	2,34	2,35	2,43
2	2,44	2,34	2,40
3	2,41	2,35	2,49
4	2,44	2,41	2,49
5	2,42	2,33	2,36
average	2,410	2,356	2,434
maximum	2,44	2,41	2,49
result	P	P	P

2 <sup>nd</sup> level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 30 g/18 ms
1	1,75	1,68	1,76
2	1,74	1,67	1,71
3	1,81	1,72	1,75
4	1,77	1,68	1,70
5	1,84	1,61	1,66
average	1,782	1,672	1,716
maximum	1,84	1,72	1,76
result	P	P	P

QTC 1,5-PE / A= 1,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,03	0,95	1,00
2	1,04	0,94	0,98
3	1,05	0,99	1,06
4	1,05	0,97	1,03
5	1,00	0,99	1,02
average	1,034	0,968	1,018
maximum	1,05	0,99	1,06
result	P	P	P

QTC 1,5-TWIN-PE / A= 1,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,08	1,04	1,15
2	1,03	1,07	1,12
3	1,02	1,02	1,06
4	1,06	1,04	1,09
5	1,07	1,09	1,13
average	1,052	1,052	1,110
maximum	1,08	1,09	1,15
result	P	P	P

QTC 1,5-QUATTRO-PE / A= 1,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to mounting rail)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,00	1,14	1,01
2	1,01	1,11	1,03
3	1,03	1,12	1,05
4	1,03	1,15	1,06
5	1,00	1,11	1,03
average	1,014	1,126	1,036
maximum	1,03	1,15	1,06
result	P	P	P

QTTCB 1,5-PE / A= 1,5 mm<sup>2</sup> flexible

1 <sup>st</sup> level	contact resistance [mΩ] (terminal to mounting rail)		
test sample	before test	after vibration, random	after shock 30 g/18 ms
1	0,97	1,00	1,01
2	1,02	1,03	1,04
3	1,04	1,11	1,13
4	1,02	1,18	1,17
5	0,98	0,99	1,00
average	1,006	1,062	1,070
maximum	1,04	1,18	1,17
result	P	P	P

2 <sup>nd</sup> level	contact resistance [mΩ] (terminal to mounting rail)		
test sample	before test	after vibration, random	after shock 30 g/18 ms
1	1,10	1,13	1,16
2	1,19	1,20	1,22
3	1,18	1,26	1,28
4	1,20	1,29	1,31
5	1,15	1,19	1,20
average	1,164	1,214	1,234
maximum	1,20	1,29	1,31
result	P	P	P

### 2.2.3.2 Terminal blocks QTC 2,5...

QTC 2,5 / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	0,96	0,97	0,97
2	0,95	0,94	0,94
3	0,93	0,92	0,92
4	0,96	0,95	0,95
5	0,97	0,95	0,95
average	0,954	0,946	0,946
maximum	0,97	0,97	0,97
result	P	P	P

QTC 2,5 / A = 0,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	2,05	2,07	2,08
2	1,98	2,09	2,08
3	2,00	1,98	2,04
4	1,97	1,97	2,02
5	1,89	1,95	1,95
average	1,978	2,012	2,034
maximum	2,05	2,09	2,08
result	P	P	P

QTC 2,5 with FBS 2-6/ A= 2,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,49	1,36	1,41
2	1,51	1,41	1,49
3	1,41	1,33	1,37
4	1,44	1,35	1,38
5	1,56	1,41	1,45
average	1,482	1,372	1,420
maximum	1,56	1,41	1,49
result	P	P	P

QTC 2,5 with FBS 5-6/ A= 2,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,79	1,48	1,55
2	1,45	1,45	1,52
average	1,620	1,465	1,535
maximum	1,79	1,48	1,55
result	P	P	P

QTC 2,5-TWIN / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,09	1,08	1,09
2	1,07	1,06	1,07
3	1,07	1,07	1,07
4	1,06	1,05	1,05
5	1,08	1,08	1,07
average	1,074	1,068	1,070
maximum	1,09	1,08	1,09
result	P	P	P

QTC 2,5-MT / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,71	1,74	1,69
2	1,69	1,70	1,70
3	1,73	1,75	1,74
4	1,69	1,73	1,72
5	1,83	1,92	1,95
average	1,730	1,768	1,760
maximum	1,83	1,92	1,95
result	P	P	P

QTC 2,5-TG / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,89	1,90	1,96
2	1,82	1,86	1,86
3	1,74	1,76	1,75
4	1,78	1,83	1,85
5	1,86	1,95	1,97
average	1,818	1,860	1,878
maximum	1,89	1,95	1,97
result	P	P	P

QTC 2,5-HESI (5x20) / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	2,89	2,91	2,95
2	2,88	2,90	2,93
3	2,83	2,85	2,87
4	2,82	2,86	2,97
5	2,83	2,86	2,88
average	2,850	2,876	2,920
maximum	2,89	2,91	2,97
result	P	P	P

QTC 2,5-PE / A = 2,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	1,08	1,12	1,14
2	1,09	1,14	1,15
3	1,10	1,17	1,19
4	1,11	1,14	1,18
5	1,07	1,11	1,14
average	1,090	1,136	1,160
maximum	1,11	1,17	1,19
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	0,99	0,99	1,01
2	0,91	0,90	0,92
3	0,94	0,95	0,97
4	0,95	0,91	0,94
5	0,91	0,87	0,88
average	0,940	0,924	0,944
maximum	0,99	0,99	1,01
result	P	P	P

QTC 2,5-PE / A = 0,5 mm<sup>2</sup> flexible

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	2,71	2,97	2,97
2	2,92	3,01	3,11
3	2,80	2,98	3,01
4	2,84	3,06	3,07
5	2,92	3,09	3,20
average	2,838	3,022	3,072
maximum	2,92	3,09	3,20
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	1,72	1,92	1,91
2	1,69	1,69	1,75
3	1,63	1,69	1,72
4	1,76	1,86	1,85
5	1,76	1,88	1,96
average	1,712	1,808	1,838
maximum	1,76	1,92	1,96
result	P	P	P

QTC 2,5-TWIN-PE / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 30 g/18 ms
1	1,05	1,05	1,05
2	1,04	1,04	1,04
3	1,05	1,05	1,05
4	1,05	1,05	1,05
5	1,06	1,05	1,06
average	1,050	1,048	1,050
maximum	1,06	1,05	1,06
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	0,76	0,74	0,75
2	0,79	0,76	0,77
3	0,77	0,76	0,76
4	0,78	0,77	0,77
5	0,78	0,77	0,77
average	0,776	0,760	0,764
maximum	0,79	0,77	0,77
result	P	P	P

### 2.2.3.3 Terminal blocks QTCS 2,5...

QTCS 2,5 / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,85	0,89	0,84
2	0,83	0,91	0,82
3	0,88	0,92	0,86
4	0,83	0,88	0,83
5	0,82	0,89	0,81
average	0,842	0,898	0,832
maximum	0,88	0,92	0,86
result	P	P	P

QTCS 2,5-TWIN / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,89	0,83	0,89
2	0,91	0,82	0,92
3	0,93	0,88	0,92
4	0,89	0,84	0,90
5	0,91	0,81	0,91
average	0,906	0,836	0,908
maximum	0,93	0,88	0,92
result	P	P	P

QTCS 2,5-PE / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,80	0,77	0,79
2	0,83	0,82	0,83
3	0,82	0,81	0,82
4	0,79	0,78	0,79
5	0,78	0,81	0,81
average	0,804	0,798	0,808
maximum	0,83	0,82	0,83
result	P	P	P

test sample	contact resistance [mΩ] (fast connection to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,68	0,67	0,68
2	0,70	0,69	0,70
3	0,69	0,69	0,69
4	0,66	0,69	0,69
5	0,68	0,68	0,68
average	0,682	0,684	0,688
maximum	0,70	0,69	0,70
result	P	P	P

QTCS 2,5-TWIN-PE / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,98	0,95	0,93
2	0,92	0,92	0,94
3	0,89	0,88	0,89
4	0,99	0,94	0,95
5	0,93	0,92	0,95
average	0,942	0,922	0,932
maximum	0,99	0,95	0,95
result	P	P	P

test sample	contact resistance [mΩ] (fast connection to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,83	0,83	0,85
2	0,83	0,84	0,84
3	0,82	0,82	0,83
4	0,84	0,84	0,84
5	0,81	0,80	0,80
average	0,826	0,826	0,832
maximum	0,84	0,84	0,85
result	P	P	P

### 2.2.3.4 Terminal blocks QTCU...

QTCU 2,5 / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,75	0,75	0,76
2	0,78	0,78	0,78
3	0,79	0,80	0,80
4	0,78	0,78	0,78
5	0,75	0,75	0,74
average	0,770	0,772	0,772
maximum	0,79	0,80	0,80
result	P	P	P

QTCU 2,5-TWIN / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,87	0,86	0,87
2	0,87	0,87	0,87
3	0,86	0,86	0,87
4	0,91	0,92	0,92
5	0,91	0,91	0,92
average	0,884	0,884	0,890
maximum	0,91	0,92	0,92
result	P	P	P

QTTCBU 1,5 / A = 1,5 mm<sup>2</sup> rigid

1 <sup>st</sup> level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,36	1,36	1,36
2	1,36	1,36	1,36
3	1,32	1,32	1,32
4	1,33	1,31	1,31
5	1,36	1,36	1,36
average	1,346	1,342	1,342
maximum	1,36	1,36	1,36
result	P	P	P

QTTCBU 1,5 / A = 1,5 mm<sup>2</sup> rigid

2 <sup>nd</sup> level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,02	1,02	1,02
2	1,03	1,02	1,02
3	1,02	1,03	1,03
4	1,03	1,02	1,01
5	1,03	1,03	1,03
average	1,026	1,024	1,022
maximum	1,03	1,03	1,03
result	P	P	P

QTCU 2,5-PE / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,79	0,78	0,79
2	0,78	0,78	0,78
3	0,75	0,74	0,75
4	0,75	0,75	0,75
5	0,75	0,74	0,76
average	0,764	0,758	0,766
maximum	0,79	0,78	0,79
result	P	P	P

test sample	contact resistance [mΩ] (screw connection to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,53	0,53	0,53
2	0,54	0,54	0,54
3	0,54	0,54	0,54
4	0,58	0,58	0,58
5	0,52	0,52	0,53
average	0,542	0,542	0,544
maximum	0,58	0,58	0,58
result	P	P	P

QTCU 2,5-TWIN-PE / A = 2,5 mm<sup>2</sup> rigid

test sample	contact resistance [mΩ] (terminal to terminal)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,89	0,89	0,89
2	0,90	0,90	0,90
3	0,90	0,90	0,90
4	0,86	0,86	0,86
5	0,90	0,89	0,90
average	0,890	0,888	0,890
maximum	0,90	0,90	0,90
result	P	P	P

test sample	contact resistance [mΩ] (screw connection to mounting rail)		
	before test	after vibration, random	after shock 5 g/30 ms
1	0,53	0,53	0,54
2	0,55	0,54	0,55
3	0,53	0,53	0,53
4	0,54	0,54	0,54
5	0,53	0,52	0,54
average	0,536	0,532	0,540
maximum	0,55	0,54	0,55
result	P	P	P

QTTCBU 1,5- PE / A = 1,5 mm<sup>2</sup> rigid

1 <sup>st</sup> level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,29	1,29	1,30
2	1,27	1,26	1,27
3	1,24	1,23	1,24
4	1,27	1,27	1,28
5	1,27	1,27	1,28
average	1,268	1,264	1,274
maximum	1,29	1,29	1,30
result	P	P	P

2 <sup>nd</sup> level	contact resistance [mΩ] (terminal to terminal)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	1,04	1,03	1,04
2	1,02	1,01	1,01
3	1,03	1,03	1,04
4	1,02	1,02	1,03
5	1,03	1,03	1,04
average	1,028	1,024	1,032
maximum	1,04	1,03	1,04
result	P	P	P

QTTCBU 1,5- PE / A = 1,5 mm<sup>2</sup> rigid

1 <sup>st</sup> level	contact resistance [mΩ] (terminal to mounting rail)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	0,59	0,59	0,61
2	0,61	0,60	0,60
3	0,62	0,60	0,60
4	0,59	0,59	0,58
5	0,63	0,62	0,62
average	0,608	0,600	0,602
maximum	0,63	0,62	0,62
result	P	P	P

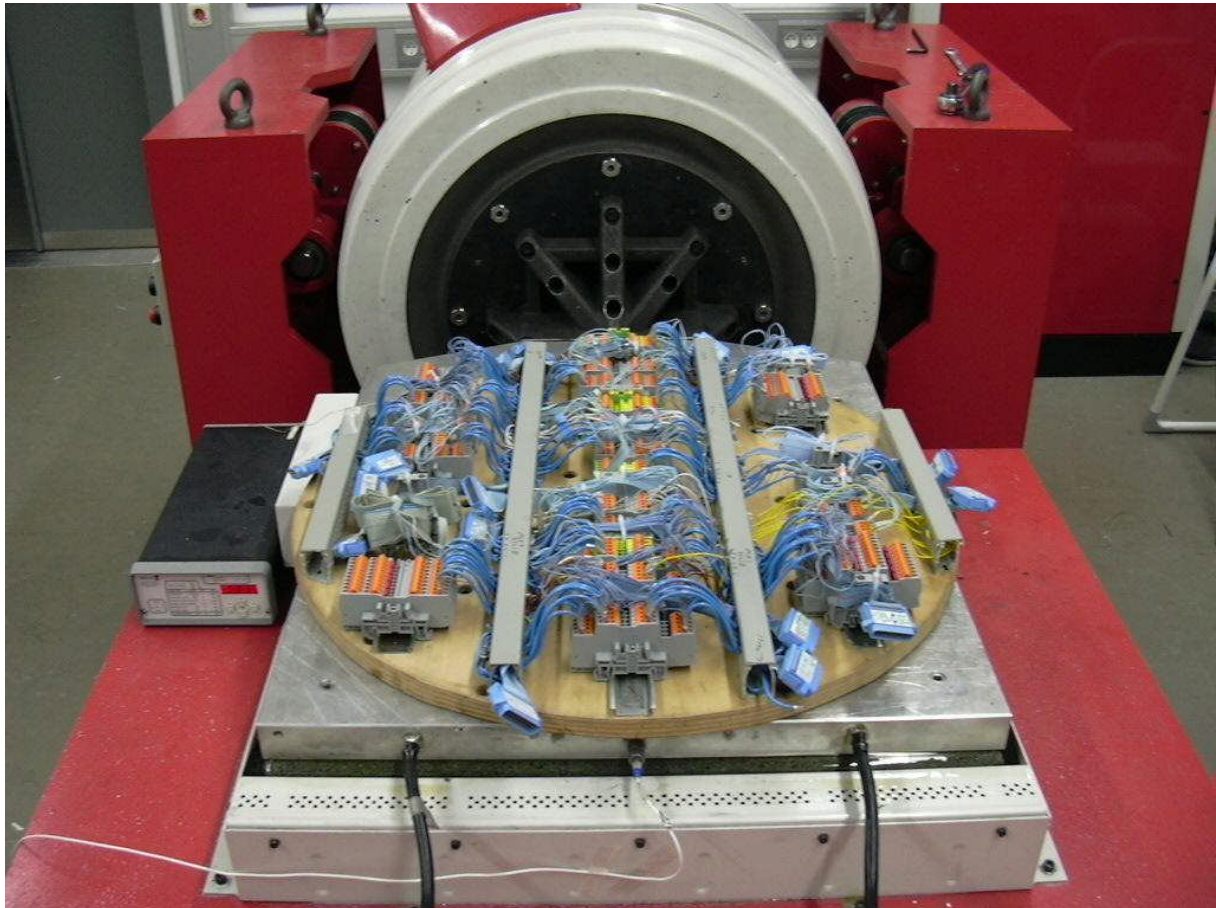
2 <sup>nd</sup> level	contact resistance [mΩ] (terminal to mounting rail)		
test sample	before test	after vibration, random	after shock 5 g/30 ms
1	0,92	0,94	1,02
2	0,91	0,92	0,95
3	0,95	0,97	0,98
4	1,03	1,10	1,11
5	0,92	0,95	0,95
average	0,946	0,976	1,002
maximum	1,03	1,10	1,11
result	P	P	P

### 3 List of measuring instruments

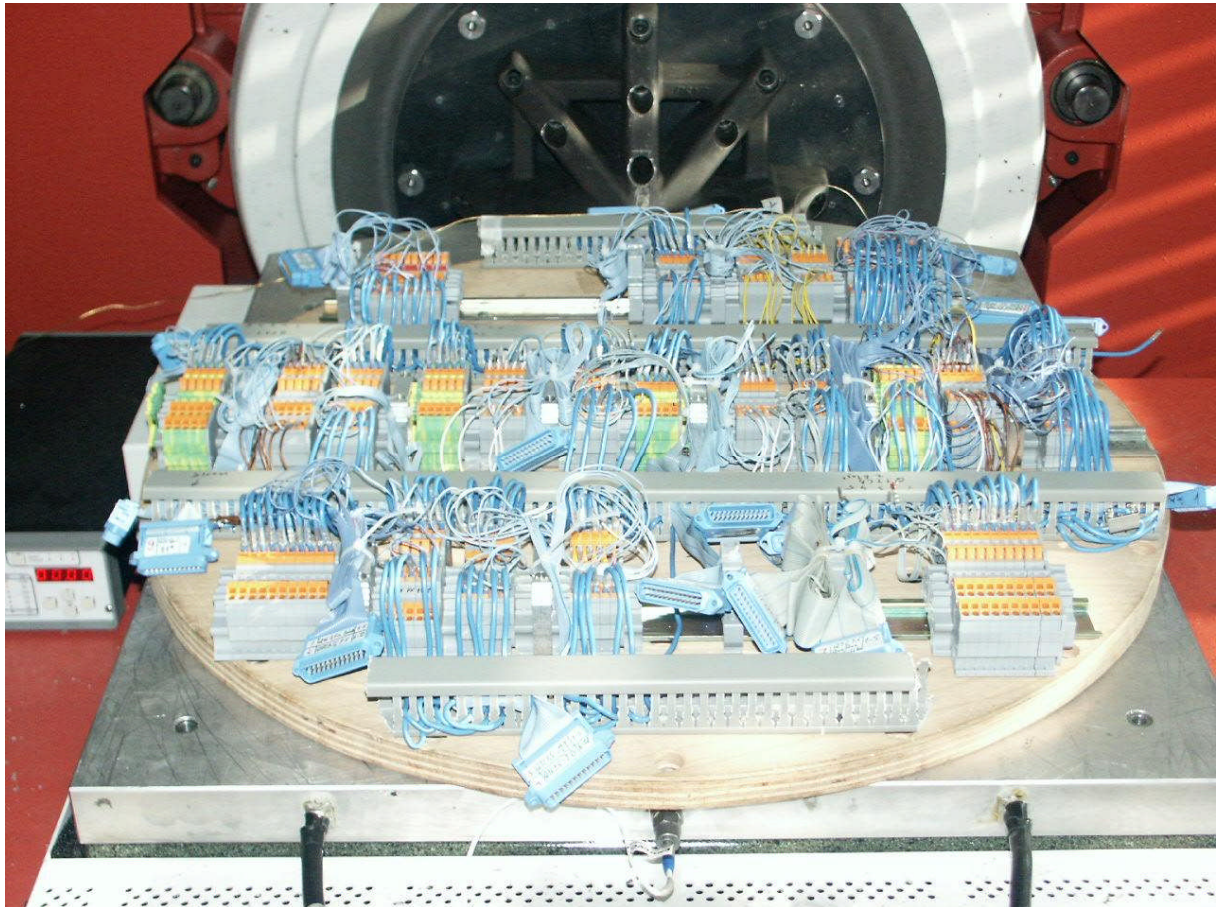
Measuring instrument	Type	PM-No.
Vibration test system	LDS V 850-440 LPT 600	490082
Vibration test system	LDS V 875-640 LPT 900	490022
Vibration test system	LDS V 895-640 LPT 900	490101
Oscilloscope	HP 54645A	490028
DC-supply	TOE 8852 / 51706	490001
Milliohmmeter	MR 1012P	Phoenix Contact
Measuring point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



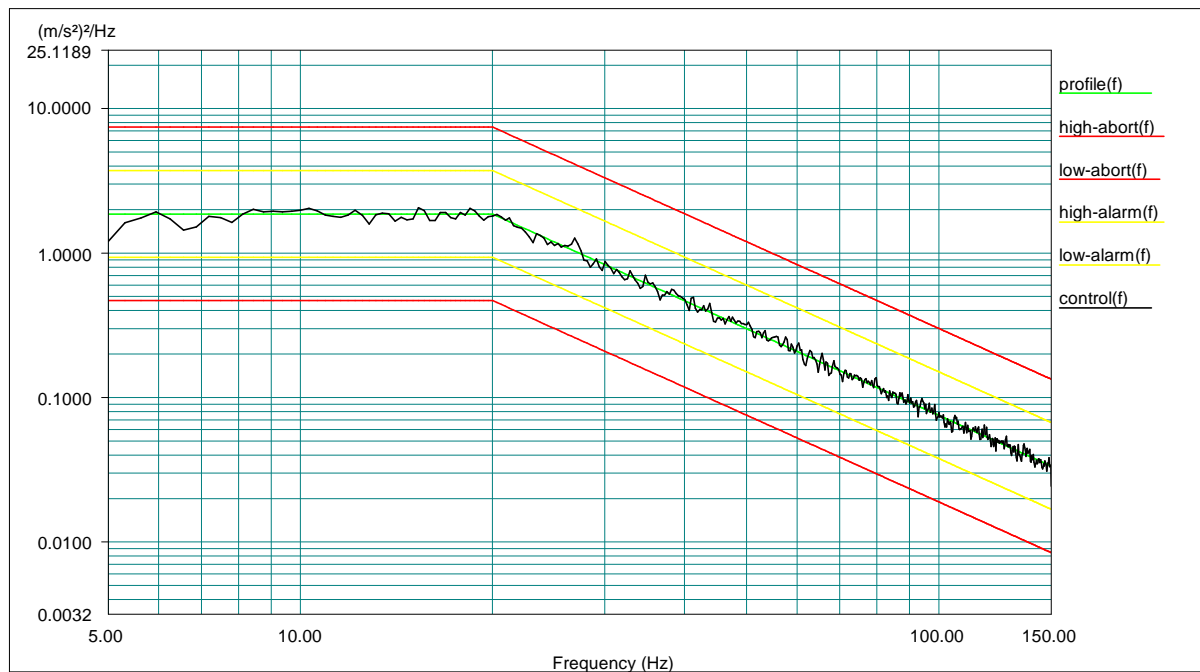
## 5 Oscillation profiles

### 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 Aug 26,2004 17-52-19



Level: 100 %

Control RMS: 7.715364 m/s<sup>2</sup>

Demand RMS: 7.762140 m/s<sup>2</sup>

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

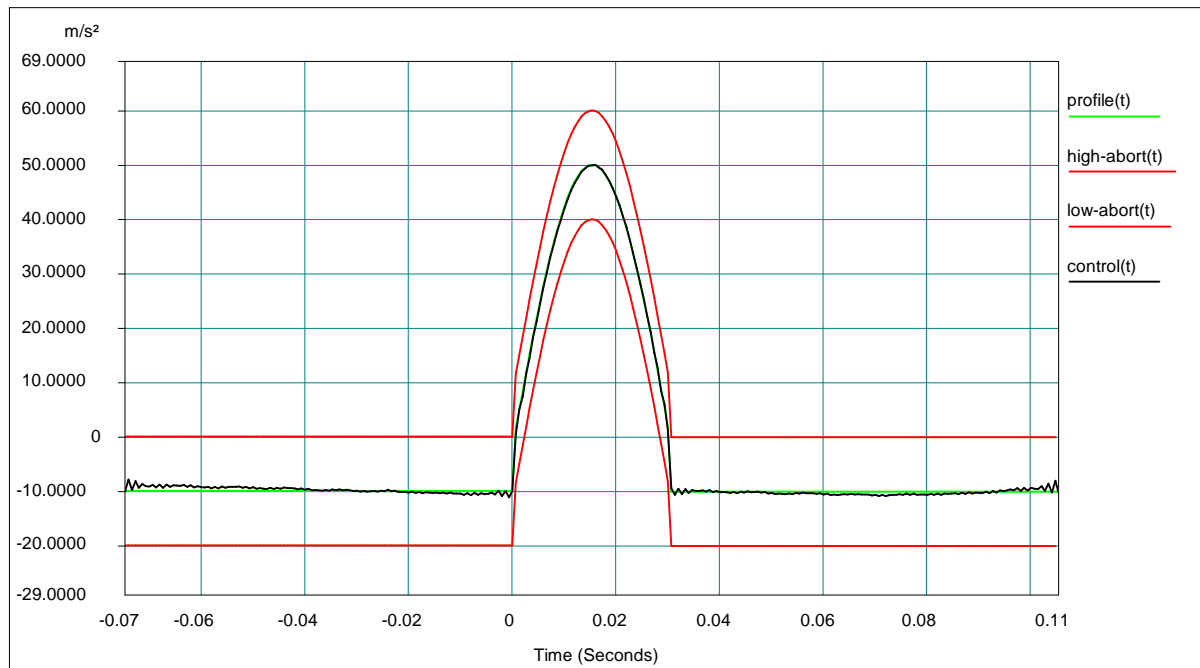
Data saved at 10:55:10 PM, Thursday, August 26, 2004

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

Project File Name: Shock Cat. 1B.prj  
Profile Name: 50m/s<sup>2</sup> 30ms

Test Type: Classical Shock

Run Folder: .\RunDefault Sep 03,2004 10-10-13



Level: 100 %	Block Size: 1024	Elapsed Pulses: 11
Frame Time: 0.682667 Seconds	Control Peak: 50.017582 m/s <sup>2</sup>	Control RMS: 9.259351 m/s <sup>2</sup>
dT: 0.000667 Seconds	Demand Peak: 50.000000 m/s <sup>2</sup>	Demand RMS: 9.224827 m/s <sup>2</sup>
Pulse Type: Half Sine	Amplitude: 50.000000 m/s <sup>2</sup>	Full Level Elapsed Pulses: 3
		Remaining Pulses: 7

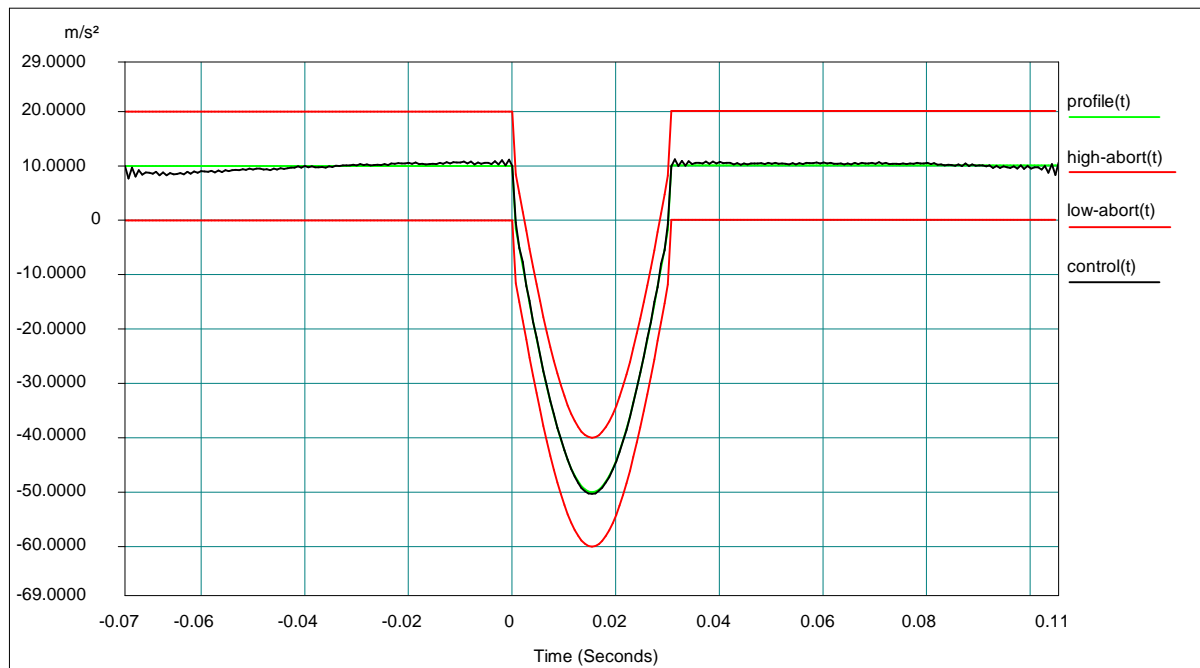
Data saved at 10:10:47 AM, Friday, September 03, 2004

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

Project File Name: Shock Cat. 1B.prj  
Profile Name: 50m/s<sup>2</sup> 30ms

Test Type: Classical Shock

Run Folder: .\RunDefault Sep 03,2004 10-10-13

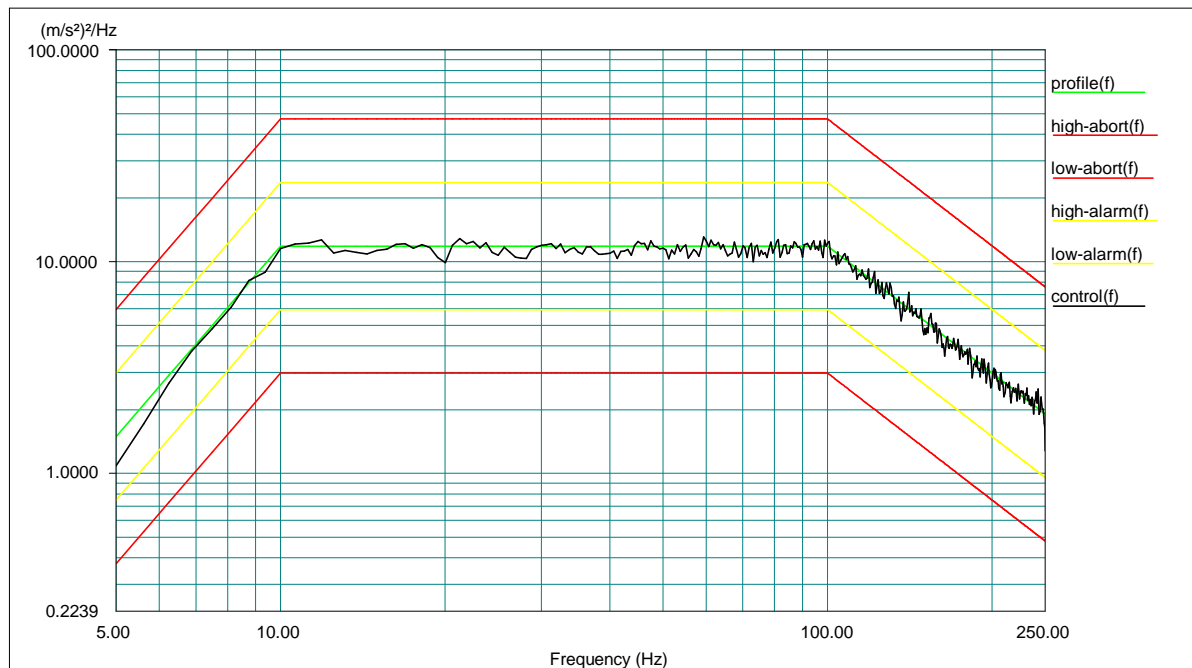


Level: 100 %	Block Size: 1024	Elapsed Pulses: 18
Frame Time: 0.682667 Seconds	Control Peak: 50.318710 m/s <sup>2</sup>	Control RMS: 9.278947 m/s <sup>2</sup>
dT: 0.000667 Seconds	Demand Peak: 50.000000 m/s <sup>2</sup>	Demand RMS: 9.224827 m/s <sup>2</sup>
Pulse Type: Half Sine	Amplitude: 50.000000 m/s <sup>2</sup>	Full Level Elapsed Pulses: 6
		Remaining Pulses: 0

Data saved at 10:11:00 AM, Friday, September 03, 2004

## 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 07,2003 08-55-49

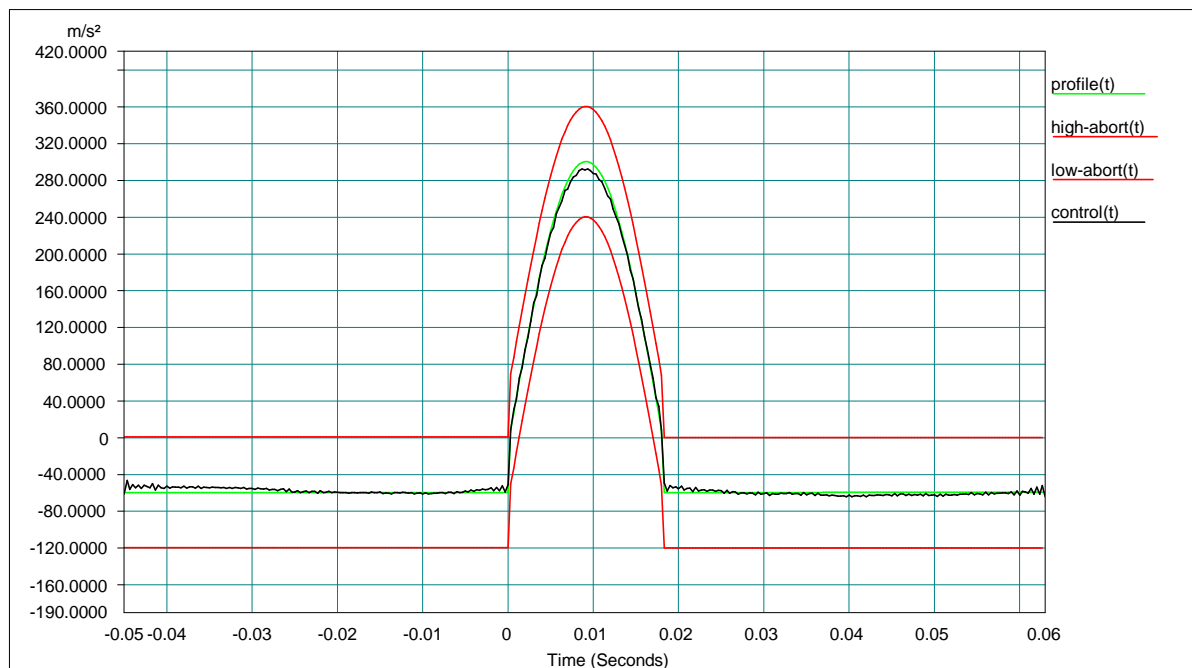


Level: 100 %  
 Control RMS: 41.986378 m/s² Full Level Elapsed Time: 05:00:00 Lines: 400 Frame Time: 1.600000 Seconds  
 Demand RMS: 42.474407 m/s² Remaining Time: 00:00:00 DOF: 154 dF: 0.625000 Hz

Data saved at 01:59:45 PM, Monday, July 07, 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 10,2003 14-33-42  
 Profile Name: 300m/s<sup>2</sup> 18mSec

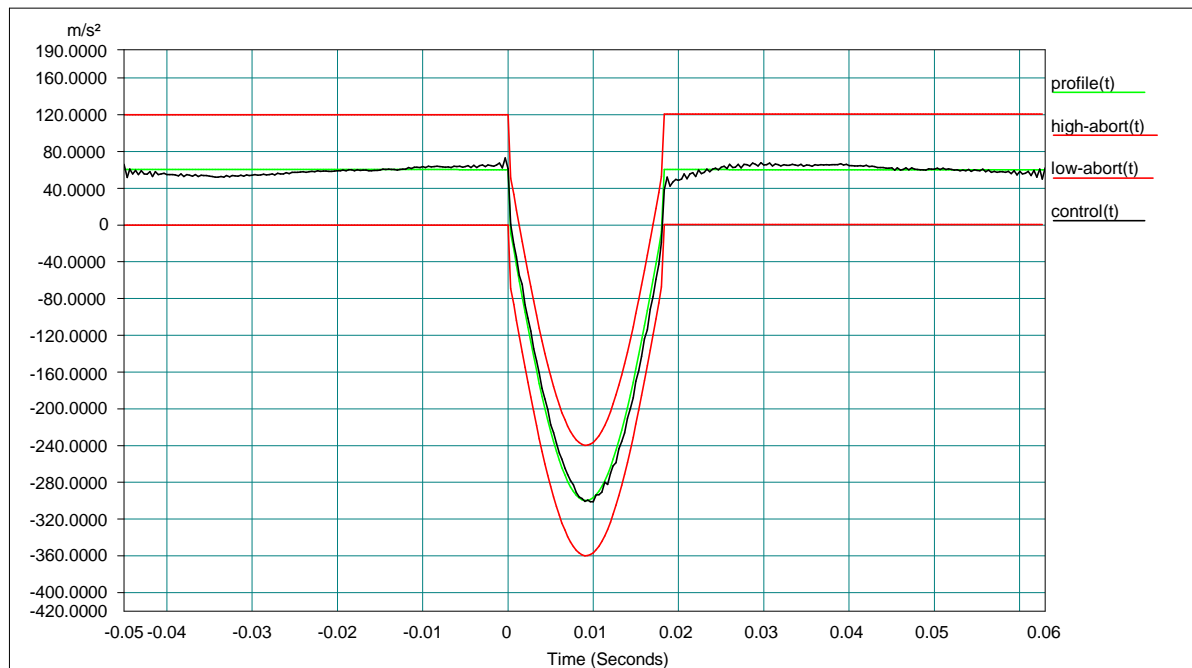


Level: 100 %	Block Size: 1024	Elapsed Pulses: 17	
Frame Time: 0.341333 Seconds	Control Peak: 291.945129 m/s <sup>2</sup>	Control RMS: 60.110031 m/s <sup>2</sup>	Full Level Elapsed Pulses: 3
dT: 0.000333 Seconds	Demand Peak: 300.000000 m/s <sup>2</sup>	Demand RMS: 60.667191 m/s <sup>2</sup>	Remaining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

Data saved at 02:34:16 PM, Thursday, July 10, 2003

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

Project File Name: 30g\_18ms.prj  
 Profile Name: 300m/s<sup>2</sup> 18mSec Test Type: Classical Shock Run Folder: .\RunDefault Jul 10,2003 14-33-42



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

Data saved at 02:34:16 PM, Thursday, July 10, 2003