



Product Service

**Choose certainty.
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Technical Report No.

713120769A

dated

05.10.2018

Client: REEL Reinheimer Elektronik GmbH
Schmalheck 18

35625 Hüttenberg

Manufacturer and / or
location of
manufacturing: see client

Unit under test
(UUT): Planar Antenna

Test specification: Client test specification: Class factory standard CN 05 0215-1,3.1.4
Liebherr Ref.No 10689825-LHN02
Toyota RU0091 7608757-001

Vibration test to DIN EN 60068-2-64: 2009 with contemporaneous temperature
application to DIN EN 60068-2-14: 2010
Shock test to DIN EN 60068-2-27: 2010
Temperature test to DIN EN 60068-2-1: 2008
Temperature test to DIN EN 60068-2-2: 2008
Temperature change to DIN EN 60068-2-14: 2010
Temperature shock test to DIN EN 60068-2-14: 2010
Climatic test to DIN EN 60068-2-30: 2006
Corrosion test to DIN EN 60068-2-11: 2000
Sealing test re. test of degree of protection provided by enclosure
to ISO 20653: 2013
Chemical resistance test to Claas CN 05 0215-1,34.3,
Liebherr 10689825-LHN02



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Test scope: Verification of suitability for intended application according the under position 3 detailed test specification

Test result: **UUT 1 and 30:** The visual inspection showed no deficiencies or damages. Function tests of the customer at his location showed all UUT in function (see Pos.9). The presented units met the requirements.

UUT 31 – 34 and UUT 41 - 50: The visual inspection showed no corrosion and no penetration of saline solution.

UUT 51 – 70: The visual inspection showed no ingress of dust and water. The presented units met the requirements of IP69K.

UUT 77 – 82: The visual inspection showed no ingress of water. The presented units met the requirements of IP54.

UUT 71 – 76: The visual inspection showed no ingress of dust and water. The presented units met the requirements of IPX7.

UUT 83 -87: There was no change or damage on surface and seal visible.

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1 Unit under test (UUT)

1.1 The units under test were planar combination antennas:

The following table shows the UUT for test procedure 1 – 8 climatic, temperature, vibration tests:

UUT No.	Identity No.	Type	Platine	Supplementary Information
1	3	K71LFR	PLA_003 U	screwlength 26 WP
2	4	F71LGAR	PLA_003 GA Rev	screwlength 26 WP
3	5	F71LGAR	PLA_003 GA Rev	screwlength 26 WP
4	6	F70LGAW	PLA_003 GA Rev	LBH IP54
5	7	M70ZXR	PLA_004	Standard
6	8	M70XFR	PLA_003 U	Standard
7	9	M71XFR	PLA_033	Standard
8	10	M71ZXR	PLA_033	Standard
9	11	K71LGAR	PLA_003GA Rev	FAKRA / WP
10	11	K71LGAR	PLA_003GA Rev	SMA / WP
11	12	M71LXR	PLA_033	KTL / WP
12	12	M71LXR	einseitige Platine	KTL / WP / R118
13	13	K70ZGAR	PLA_003GA	crimped soldering lugs
14	14	F70LGVR	PLA_003GV	Spacer Plastik (PA6)
15	15	K71LGVR	PLA_003GV Rev	Standard
16	16	K71LGVR	PLA_003GV Rev	Standard
17	17	K70LFW	einseitige Platine	Standard
18	18	K70XBRW	PLA 034 F	IP54
19	19	K70XL1L2R	GPS L1/L2	WP IP69K
20	20	M90LXW	PLA_005_LTE	Standard

UUT 1 and UUT 3, function was monitored with the customers equipment during the test 1 - 5 (The results are not part of this report).

The following table shows additional test objects for vibration tests:

UUT No.	Identity-No	Type	Platine
21	21	GEH71	PLA003_GA spacer new
22	22	GEH70D/W/M	PLA004_GA spacer new
23	23	Metal floor AL14	-
24	23	Metal floor AL14	-
25	24	Plastic floor old	for rail
26	24	Plastic floor old	for rail

The following table shows the UUT also for test procedure 1 – 8 climatic, temperature, vibration tests:

UUT No.	Identity-No	Type	Platine
27	No.1 29.01.2018	F71LGAR_0021_087_86_ 104_CL10.4_BL	PLA_003_GA_REV2 Serienstandard
28	No.8 30.01.2018	K71LFR_0016_087_104_ CL11.4_BL	PLA_003U
29	No.7 30.01.2018	F70LGAD_0100_089_88_ 103_LI1.0	PLA_003_GA_REV2 Serienstandard
30	No.5 29.01.2018	F70XFR_Directional Coupler	PLA_026

UUT 27 and UUT 28, function was monitored with the customers equipment during the test 1 - 8. (The results are not part of this report).

For vibration tests all UUT were mounted on a fixture supplied by the customer.

The following table shows the UUT (empty housing of planar antennas) for test procedure corrosion test:

UUT No.	Identity-No	Housing	Description
31	1.3	GEH98	1 x cable LowLoss
32	1.4		
33	2.3		5 x cable LowLoss
34	2.4		
41	1.1	GEH70R	Threaded base plastic
42	1.2		3 x cable LowLoss
43	2.1		Threaded base Alu
44	2.2		3 x cable LowLoss
45	1.1_R118		Threaded base Alu (KTL)
46	1.2_R118		Cover R_118 3 x cable LowLoss
47	1.1	GEH71	3 x cable Dacar Leoni
48	1.2		
49	2.1		3 x cable Dacar Leoni
50	2.2		twist protection

The following table shows the UUT (empty housing of planar antennas) for test procedure degree of protection IP69K:

UUT No.	Identity-No	Housing	Description	
51	45	GEH98 / 17mm	1 x cable LowLoss	IP6X
52	46	GEH98/R118 40mm	1 x cable LowLoss	IPX9K
53	47	GEH98 / 17mm	5 x cable LowLoss	IP6X
54	48	GEH98/R118 40mm	5 x cable LowLoss	IPX9K
55	49	GEH70 W/D/M	3 x cable Dacar 302	IP6X
56	50	GEH70 W/D/M	1 x cable Dacar 302	IPX9K
57	51	GEH70 W/D/M	1 x cable Low Loss	IP6X
58	52	GEH70 W/D/M	2 x cable standard RG174	IPX9K
59	53	GEH70 W/D/M	2 x cable Low Loss	IP6X
60	54	GEH70 W/D/M	1 x cable standard RG174	IPX9K
61	55	GEH70R	2 x cable Low Loss	IP6X
62	56	GEH70R / KTL 40mm	1 x cable Low Loss	IPX9K
63	57	GEH70R / PW	2 x cable Low Loss	IP6X
64	58	GEH70R / KTL 17mm	2 x cable Low Loss	IPX9K
65	59	GEH70R / KTL 40mm R118	3 x cable Low Loss	IP6X
66	60	GEH70R / KTL 17mm R118	2 x cable Low Loss	IPX9K
67	61	GEH71 / 26mm	1 x Dacar 302	IP6X
68	62	GEH71 / 17mm	2 x Dacar 302	IPX9K
69	63	GEH71 / 17mm	3 x Dacar 302	IP6X
70	64	GEH71 / 26mm	3 x Dacar 302	IPX9K

The following table shows the UUT (empty housing of planar antennas) for test procedure degree of protection IPX7:

UUT No.	Identity-No	Housing	Description	
71	65	GEH70 W/D/M	3 x cable Dacar 302	IPX7
72	66	GEH70 W/D/M	1 x cable Dacar 302	IPX7
73	67	GEH70 W/D/M	1 x cable LowLoss	IPX7
74	68	GEH70 W/D/M	2 x cable standard RG 174	IPX7
75	69	GEH70 W/D/M	3 x cable Low Loss	IPX7
76	70	GEH70 W/D/M	1 x cable standard RG 174	IPX7

The following table shows the UUT (empty housing of planar antennas) for test procedure degree of protection IP54:

UUT No.	Identity-No	Housing	Description	
77	71	GEH70 W/D/M	3 x cable Dacar 302	IP54
78	72	GEH70 W/D/M	1 x cable Dacar 302	IP54
79	73	GEH70 W/D/M	1 x cable LowLoss	IP54
80	74	GEH70 W/D/M	2 x cable standard RG 174	IP54
81	75	GEH70 W/D/M	3 x cable Low Loss	IP54
82	76	GEH70 W/D/M	1 x cable standard RG 174	IP54

The following table shows the UUT (housing cover with seal) for test procedure chemical resistance test:

UUT No.	Material
83 (10 parts)	GEH-PA6 seal TPE stand., black
84 (10 parts)	GEH-PA6 seal TPE stand., grey
85 (10 parts)	GEH-PA6 seal TPE stand., yellow
86 (10 parts)	GEH-PC/ABS seal R118, black
87 (10 parts)	Cable SPL001_BE



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2 Order

2.1 Date of order, initial of client

Company REEL Reinheimer Elektronik GmbH orders from TÜV SÜD Product Service GmbH by mail dated 05.11.2017, to test a.m. UUT.

2.2 Receipt of UUT

The samples 1 – 20 and 31 – 50 were delivered by the client on 13.11.2017.
The samples 21 – 26 were delivered by the client on 14.12.2017.
The samples 27 – 30 and 83 – 87 were delivered by the client on 29.01.2018.
The samples 1 – 30 were delivered by the client on 03.04.2018 after function test.
The samples 51 – 70 were delivered by the client on 08.06.2018.
The samples 71 – 82 were delivered by the client on 02.05.2018.

2.3 Reconsignment of UUT

The samples 1 – 30 were taken by the client for the function test on 19.03.2018.
The samples 31 – 50 were taken by the client on 14.12.2017.
The samples 1 – 30 were finally taken by the client on 03.05.2018.
The samples 51 – 70 and 77 – 82 were taken by the client on 10.07.2018.
The samples 71 – 76 and 83 – 87 were sent by mail on 28.08.2018.

3 Test specification

3.1 Test procedure

1. Temperature change test
2. Storage Dry heat
3. Storage Cold
4. Temperature shock test
5. Climatic test, damp heat cyclic
6. Vibration test with contemporaneous temperature
7. Shock test 1
8. Shock test 2
9. Degree of protection IP X9K
10. Corrosion test
11. Chemical resistance test

3.2 Temperature test

3.2.1 Temperature change test

Class factory standard CN 05 0215-1;3.1.4

Start temperature:	+20°C
Low temperature:	-40°C
Transition:	60 min
Dwell time:	90 min
High temperature:	+85°C
Transition:	150 min
Dwell time:	110 min
End temperature:	+20°C
Transition:	70 min
Number of cycles:	18
Total test duration:	144 h



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3.2.2 Temperature test – Storage Dry Heat

Class factory standard CN 05 0215-1;3.1.4

Temperature: +85°C
Test duration: 240 h

3.2.3 Temperature test – Storage Cold

Liebherr Ref.No 10689825-LHN02

Temperature: -40°C
Test duration: 8 h

3.2.4 Temperature shock test

Class factory standard CN 05 0215-1;3.1.4

High temperature: +105°C
Dwell time: 30 min
Low temperature: -40°C
Dwell time: 30 min
Number of cycles: 100
Total test duration: 100 h



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3.3 Climatic test

3.3.1 Damp heat, cyclic

Toyota RU0091 7608757-001

Cycle duration: 24 h
Loop: Step-No.: 3 to 8
Number of loops: 6
Total test duration: 148 h (including pre and post conditioning)

Test step No.	Temperature set value [°C]	Humidity set value [rel. h.]	Duration [h:min]
1	+25	60	0:05
2	+25	97	1:00
3	+55	97	3:00
4	+55	93	0:15
5	+55	93	9:00
6	+55	97	0:15
7	+25	97	3:00
8	+25	97	8:30
9	+25	75	1:00
10	+25	75	2:00

3.4 Vibration test

3.4.1 Vibration test, random

Class factory standard CN 05 0215-1;3.1.4, Toyota RU0091 7608757-001

Frequency range:	5 Hz to 200 Hz	
Spectral		
acceleration density:	5 Hz	0,1 (m/s ²) ² /Hz
	10 Hz	0,2 (m/s ²) ² /Hz
	20 Hz	0,36 (m/s ²) ² /Hz
	30 Hz	0,36 (m/s ²) ² /Hz
	200 Hz	0,3 (m/s ²) ² /Hz
	500 Hz	0,36(m/s ²) ² /Hz
	501 Hz	0,001 (m/s ²) ² /Hz
	2000	0,001 (m/s ²) ² /Hz
Acceleration:	12,8 m/s ² _{rms}	
Test duration:	50 h / axis, in 3 axes	

Contemporaneous temperature

High temperature:	+85°C
Dwell time:	90 min
Low temperature:	-40°C
Dwell time:	110 min
Transition:	1 K/min
Number of cycles:	6,25
Total test duration:	50 h



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3.5 Shock test

3.5.1 Shock test endurance 1

Toyota RU0091 7608757-001

Type of shock: halfsine
Acceleration: 40 g
Shock duration: 10 ms
Number of shocks: 50 000 shocks each in both directions on three mutually perpendicular axes of the UUT

3.5.2 Shock test endurance 2

Class factory standard CN 05 0215-1;3.1.4

Type of shock: halfsine
Acceleration: 30 g
Shock duration: 18 ms
Number of shocks: 1000 shocks each in both directions on three mutually perpendicular axes of the UUT

3.6 Corrosion tests

3.6.1 Salt mist test

Class factory standard CN 05 0215-1;3.1.4, Liebherr Ref.No 10689825-LHN02

Salt solution: 5 % NaCl-solution
Temperature: 35 °C
Test duration: 672 h



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3.7 Degree of protection

3.7.1 IP 5X

- Protected against access to hazardous parts with a wire
- Protection against dust

The wire with 1.0 mm diameter shall be pressed with 1 N against every opening of the housing.

The access probe of 1 mm Ø shall not penetrate

Housing category 2

Housing in normal operating position without connection to a vacuum pump

Test dust: talcum powder

Test duration: 8 h

Ingress of dust is not totally prevented but dust shall not penetrate in a quantity to interfere with satisfactory operation of the apparatus or to impair safety.

3.7.2 IP 6X

- Protected against access to hazardous parts with a wire
- Dust tight

The wire with 1.0 mm diameter shall be pressed with 1 N against every opening of the housing.

The access probe of 1 mm Ø shall not penetrate.

Housing of UUT connected to a vacuum pump with a low air pressure at ≤ 2 kPa (≤ 20 mbar)

Test dust: talcum powder ($< 75 \mu\text{m}$)

Test duration: 8 h; flow rate of air volume < 40 -fold per h

No ingress of dust.

3.7.3 IP X4

- Protected against splashing water

Water splashed against the enclosure from any direction shall have no harmful effects or impair performance

Water flow rate:	1,75 l/min, with 25 nozzles 0.07 l/min $\pm$ 5 % per nozzle (average)
Oscillating tube:	r = 400 mm
Oscillating angle:	$\pm$ 180° from vertical
Test duration:	10 min

3.7.4 IP X7

- Protected against the effects of temporary immersion in water

Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water under standardized conditions of pressure and time.

Water shall not penetrate in a quantity causing harmful effects if the enclosure is immersed in water temporarily under specified pressure and time conditions.

Enclosure < 850 mm -	
lowest point of enclosure:	1000 mm below the surface of water
Enclosure $\geq$ 850 mm -	
highest point of enclosure:	150 mm below the surface of water
Test duration:	30 min

3.7.5 IP X9K

- Protection against water during high-pressure/steam-jet cleaning

Water which is directed against the enclosure from any direction shall not have any harmful effects or impair performance.

Distance nozzle to UUT:	100 mm to 150 mm
Water flow rate:	14 l/min to 16 l/min
Water temperature:	80°C $\pm$ 5°C
Water pressure:	8000 kPa to 10000 kPa
Spray in position:	0°, 30°, 60°, 90°
Test duration:	30 s each position
UUT on turntable:	Speed (5 $\pm$ 1) rpm

3.8 Chemical resistance test

Claas CN 05 0215-1,34.3

The test fluids were applied separately and consecutively. The test fluids were sprayed or applied using a brush to the test objects (UUT). This was followed by specified storage duration and temperature:

The samples have been stored 22 hours at room temperature or at +85°C in a climatic chamber:

Step No.	Temperature set point	Time
	[°C]	[h:min]
1	+23	0:00
2	+85	1:00
3	+110	22:00
4	+23	1:00
5	+20	2:00

After completion of the duration the sample was, if necessary, mechanically cleaned using a water or alcohol-moist cloth. This was followed by the inspection of the surfaces.

4 Test equipment

Equipment	Type	Ser. No.	Manufacturer	Cali-brated until
Shaker S2	SA 30-R 16A	n/a	Unholtz-Dickie	—
Vibration control sys-tem	V Win II	n/a	Unholtz-Dickie	09/2018
Shaker S4	V9-440 HPT 1500 CSP	182/11	Ling Dynamic Systems	—
Vibration control system	V Win II	n/a	Unholtz-Dickie	06/2018
Signal conditioner	133	AG 88	Endevco	09/2018
Signal conditioner	133	AG 99	Endevco	09/2018
Accelerometer	4382	11053; 07-10/10-05-001	Brüel & Kjaer	12/2018
Accelerometer	4382	30556; 07-10/10-10-016	Brüel & Kjaer	04/2019
Accelerometer	4514-B-004	64319; 07-10/10-13-018	Brüel & Kjaer	11/2018
Climatic Chamber K3	PL-4 KPH	14020550	Espec	07/2019
Climatic Chamber K9	PL-3J	15005229	Espec	09/2018
Climatic Chamber K10	PL-3J	15005221	Espec	09/2018
Temperature shock chamber TS2	TSS-70/130	044022	CTS	07/2019
Temperature shock chamber TS3	TSA-201 SW	153003512	Espec	07/2019
Recording instrument	4103 M	PL1208000681; 07-10/21-12-001	Eurotherm Ches- sell	—
Thermocouple element	NiCrNi	6; 07-10/40-04-006	n/a	—



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Equipment	Type	Ser. No.	Manufacturer	Calibrated until
Thermocouple element	2K-K06/09-TM	5; 07-10/40-13-005	Electronic Sensor	—
Salt spray chamber Corrosion 4	TCC2240K	63074	Tira	05/2018
Recording instrument	Winkratos	4.00.07		
Dust chamber 1	DST 2100	38011	Primus & Brandt GmbH	—
Flow rate measuring instrument	FMA 1718	284319-1 (07-10/41-11-001)	Omega	02/2020
Mass flow rate measuring instrument	FMA 1728	278430-1 (07-10/41-11-002)	Omega	02/2020
Test probe	wire: diameter 1,0 mm	SD01003 07-10/99-10-001	Primus & Brandt GmbH	06/2019
Force sensing device	M5-10	3484278; 07-10/15-12-001	Mark-10 Corporation	07/2019
Flow meter	DA10A11	106392; 07-10/41-09-001	ABB	08/2018
Oscillating tube X4	n/a	n/a	TÜV SÜD Product Service	n/a
Immersion tank X7	Deepness 1,10 m	n/a	TÜV SÜD Product Service	n/a

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Accredited Test Laboratory

Deutsche Akkreditierungsstelle GmbH
(DAkkS):
Reg.Nr. D-PL-11321-02-00



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Equipment	Type	Ser. No.	Manufacturer	Cali-brated until
IPX9K System	Turntable	2092	Own Construction	-
High Pressure Cleaner	Kränzle Therm 1165-1	2093	Kränzle	-
High Pressure Flat Jet	1/4" Typ 2507	2416	Lechler	-
High Pressure Flat Jet	1/4" Typ 2507	2417	Lechler	-
High Pressure Flat Jet	1/4" Typ 2507	2418	Lechler	-
High Pressure Flat Jet	1/4" Typ 2507	2419	Lechler	-

All measuring equipment is calibrated regularly according the calibration instructions of TÜV SÜD PRODUCT SERVICE GmbH. All calibrations are traced back to national standards.

5 Test sequence

Test date: from 13.11.2017 to 14.12.2017

No.	Test specification	Period	Notes
1	Temperature change test	13.11.2017 to 19.11.2017	UUT 1 – 20 No notes
2	Storage dry heat	20.11.2017 to 30.11.2017	
3	Storage cold	30.11.2017 to 01.12.2017	
4	Temperature shock test	04.12.2017 to 08.12.2017	Partial damage to cable and rubber seal
5	Climatic test, Damp heat, cyclic	08.12.2017 to 14.12.2017	No notes

Test date: from 30.01.2018 to 12.03.2018

No.	Test specification	Period	Notes
6	Temperature change test	30.01.2018 to 05.02.2018	UUT 27 – 30 The UUT was monitored with the customer's equipment.
7	Storage dry heat	05.02.2018 to 15.02.2018	
8	Storage cold	15.02.2018 to 16.02.2018	
9	Temperature shock test	27.02.2018 to 05.03.2018	Monitoring failed
10	Climatic test, Damp heat, cyclic	06.03.2018 to 12.03.2018	No notes

Test date: from 01.04.2018 to 24.04.2018

No.	Test specification	Run	Axis	Notes
11	Vibration, random, with temperature overlay	1814-1	Z	UUT 1 - 30 Stopped at 10:51 h (signal short over range)
		1814-2		39:14 h, no notes
		1814-3	X	50 h, no notes
		1815-1	Y	Stopped at 3:01 h
		1815-2		47:00 h, no notes
12	Shocks 40g /10ms ± 50000	1815-3	Y	+35014 positive pulses
		1815-3b		+14986 positive pulses, -50000 negative pulses
		1815-4	X	+1999 positive pulses, abort
		1815-5		+13330 positive pulses, abort
		1815-6		+3481 positive pulses, abort
		1816-7		+11949 positive pulses, abort
		1818-8		+15552 positive pulses, -50000 negative pulses
		1816-9	Z	± 50000 pulses
13	Shocks 30g /18ms ± 1000	1817-5	X	No notes
		1817-6	Y	
		1817-7	Z	



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Test date: from 14.11.2017 to 18.07.2018

No.	Test specification	Period	Notes
1	Corrosion test, Salt mist test	14.11.2017 to 14.12.2017	UUT 31 – 34, UUT 41 -50: No corrosion and no penetration of saline solution were visible.
2	Degree of protection against solid bodies - IP 54	23.05.2018 to 30.05.2018	UUT 77- 82: There was no penetration of dust or water visible.
3	Degree of protection against solid bodies - IP 6X	25.05.2018 to 29.05.2018	UUT 51, 53, 55, 57, 59, 61, 63, 65, 67, 69: There was no penetration of dust visible.
4	Degree of protection against solid bodies - IP X7	23.05.2018 to 28.08.2018	UUT 71 - 76: There was no penetration of water visible
5	Degree of protection against solid bodies - IP X9K	19.06.2018	UUT 52, 54, 56, 58, 60, 62, 64, 66, 68, 70: There was no penetration of water visible.
6	Chemical resistance test	06.07.2018 to 18.07.2018	UUT 83 - UUT 87: There was no change on the surfaces detectable. See results in the following table

Chemical resistance test - results:

UUT / material	Testliquid	Temp.	Result
GEH-PA6 seal TPE stand., black	Diesel fuel	+85°C	Low residue, removable no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			
SPL001_BE			
GEH-PA6 seal TPE stand., black	Biodiesel	+85°C	Low residue, removable no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			Low residue, not completely removable, no change visible
SPL001_BE			Low residue, removable no change visible
GEH-PA6 seal TPE stand., black	Engine oil	+85°C	Low residue, removable no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			Low residue, not completely removable, no change visible
SPL001_BE			Low residue, removable no change visible
GEH-PA6 seal TPE stand., black	Transmission fluid	+85°C	Low residue, removable no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			Low residue, not completely removable, no change visible
SPL001_BE			Low residue, removable no change visible
GEH-PA6 seal TPE stand., black	Hydraulic fluid	+85°C	Low residue, not completely removable, no change on surface visible, seals dissolved
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			
SPL001_BE			
GEH-PA6 seal TPE stand., black	Grease	+85°C	Massive residue, not completely removable, no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			
SPL001_BE			



Product Service

UUT / material	Testliquid	Temp.	Result
GEH-PA6 seal TPE stand., black	Antifreeze fluid	+85°C	Low residue, removable no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			
SPL001_BE			
GEH-PA6 seal TPE stand., black	Urea / Add Blue	+85°C	Urea residue, removable no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			
SPL001_BE			
GEH-PA6 seal TPE stand., black	Cold cleaning agent	RT	Massive residue, removable, no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			
SPL001_BE			
GEH-PA6 seal TPE stand., black	Contact spray	+85°C	Low residue, removable no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			
SPL001_BE			
GEH-PA6 seal TPE stand., black	Ammonia Hydroxide	RT	Massive residue, removable, no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			
SPL001_BE			
GEH-PA6 seal TPE stand., black	Liquid fertilizer lime	RT	Massive residue, removable, no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			
SPL001_BE			
GEH-PA6 seal TPE stand., black	NPG-fertilizer	RT	Massive residue, removable, no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			
SPL001_BE			
GEH-PA6 seal TPE stand., black	Agricultural chemicals	RT	Massive residue, removable, no change visible
GEH-PA6 seal TPE stand., grey			
GEH-PA6 seal TPE stand., yellow			
GEH-PC/ABS seal R118, black			
SPL001_BE			

Editor: Norbert Drescher

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Mannheim Branch
Dudenstraße 28
68167 Mannheim
Germany

Accredited Test Laboratory

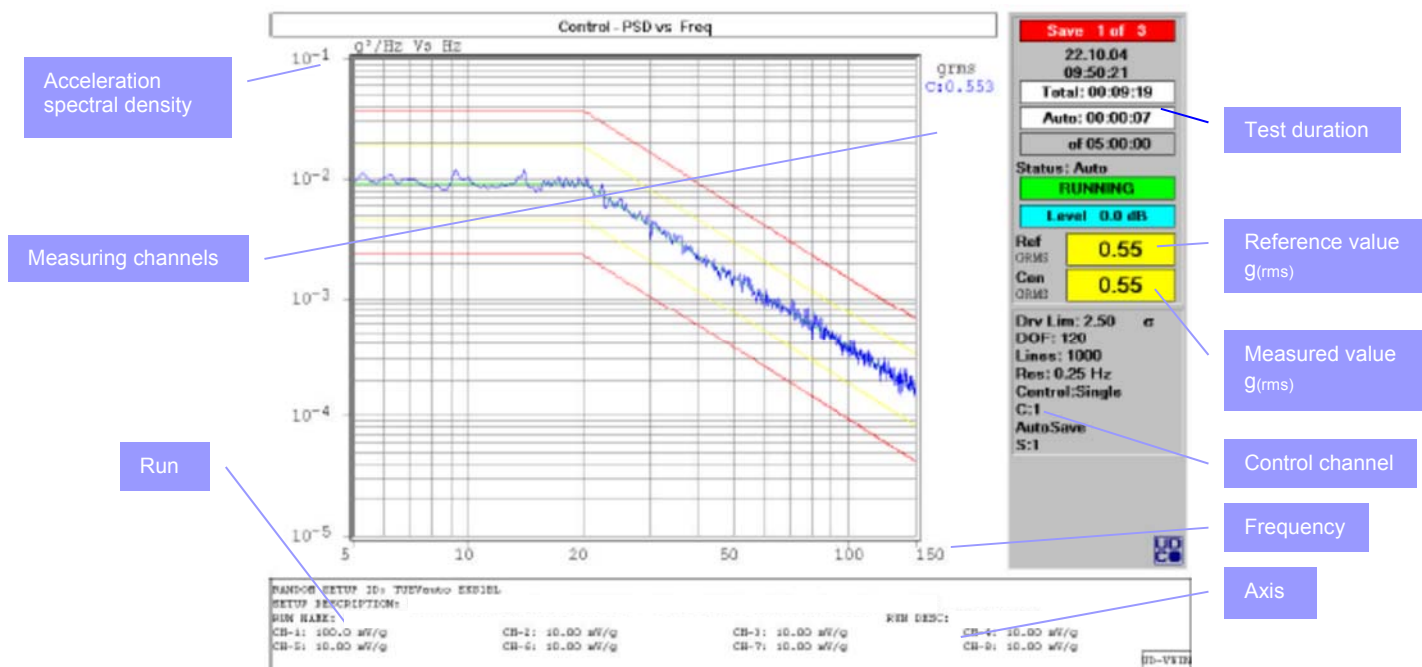
Deutsche Akkreditierungsstelle GmbH
(DAkKS):
Reg.Nr. D-PL-11321-02-00

Test liquids:

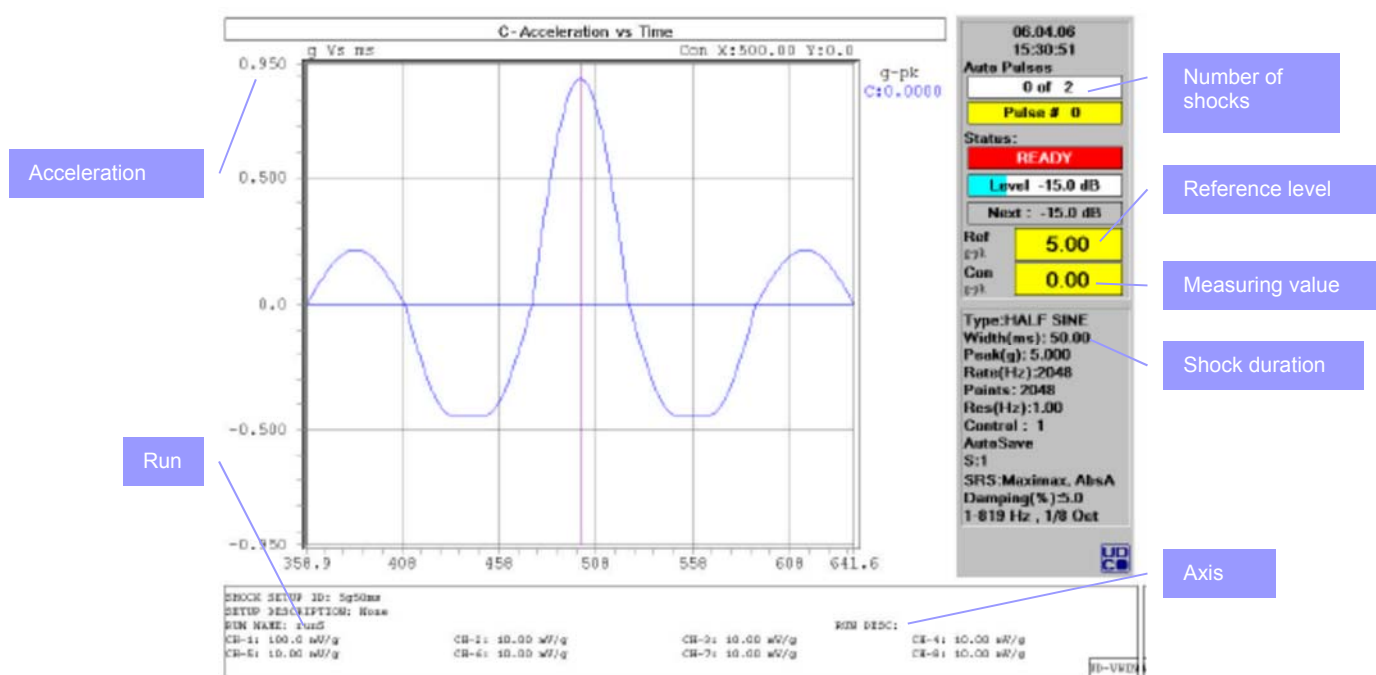
	Test liquid	Manufacturer / supplier	Discription
1	Diesel fuel	BP – ARAL, Bochum	Diesekraftstoff nach DIN EN 590
2	Biodiesel	LB Lohmann Brennstoffe GmbH, Schönebeck	Rapsoelmethylester
3	Engine oil	ROWE GmbH, Worms	Hightec Synth RS SAE 0W40
4	Transmission fluid	Deutsche Castrol Ver- triebsgesellschaft mbH, Hamburg	Castrol EP80W
5	Hydraulic fluid	Liqui Moly GmbH, Ulm-Lehr	ATF III
6	Grease	Inter-Union Technohandel GmbH, Landau	Nigrin – Mehrzweckfett DIN 51802, DIN 51825 Teil 2
7	Antifreeze fluid	Mitan Minaraloel GmbH, Ankum	Car Alpine C11 Ethylenglycole, Inhibitors, Water
8	Ad Blue	-	-
9	Cold cleaning agent	Coparts Autoteile GmbH, Essen	Car 1, Kaltreiniger
10	Contact spray	WD-40 Company, Bad Homburg	WD-40 Multifunktions- Korrosionsschutzmittel
11	Ammonia Hydroxide	Hedding Chemikalien, Stuttgart	Ammoniaklösung 25%
12	Liquid fertilizer lime	Hornbach	Kartenkalk-Lösung
13	NPG-fertilizer	Hornbach	NPG-Dünger
14	Agricultural chemi- cals	Cuxin	Universaldünger Plus

6 Legend of measuring diagrams

6.1 Vibration test, random



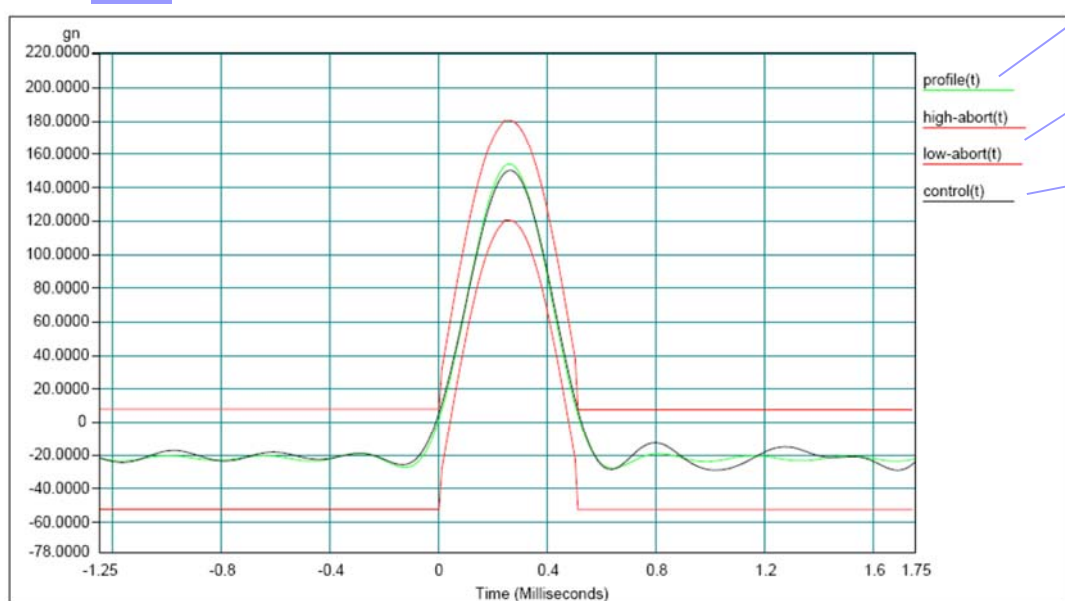
6.2 Shock test



Datum/Kunde/Prüfobjekt: 11.03.09/Musterkunde/Muster
Run/Achse: Run9/Y-Achse
Project File Name: 150g-Z-Achse.prj
Test Type: Classical Shock

Run

Axis



Reference

Limits

Measuring value

Level: 100 %
Control Peak: 149.732483
Demand Peak: 153.576935
Pulse Type: Half Sine

Elapsed Pulses: 15
Control RMS: 18.718262
Demand RMS: 18.745657
Amplitude: 150.000000

Full Level Elapsed Pulses: 3
Remaining Pulses: 7
Pulse Width: 0.500000 ms

Number of shocks

Acceleration

Shock duration

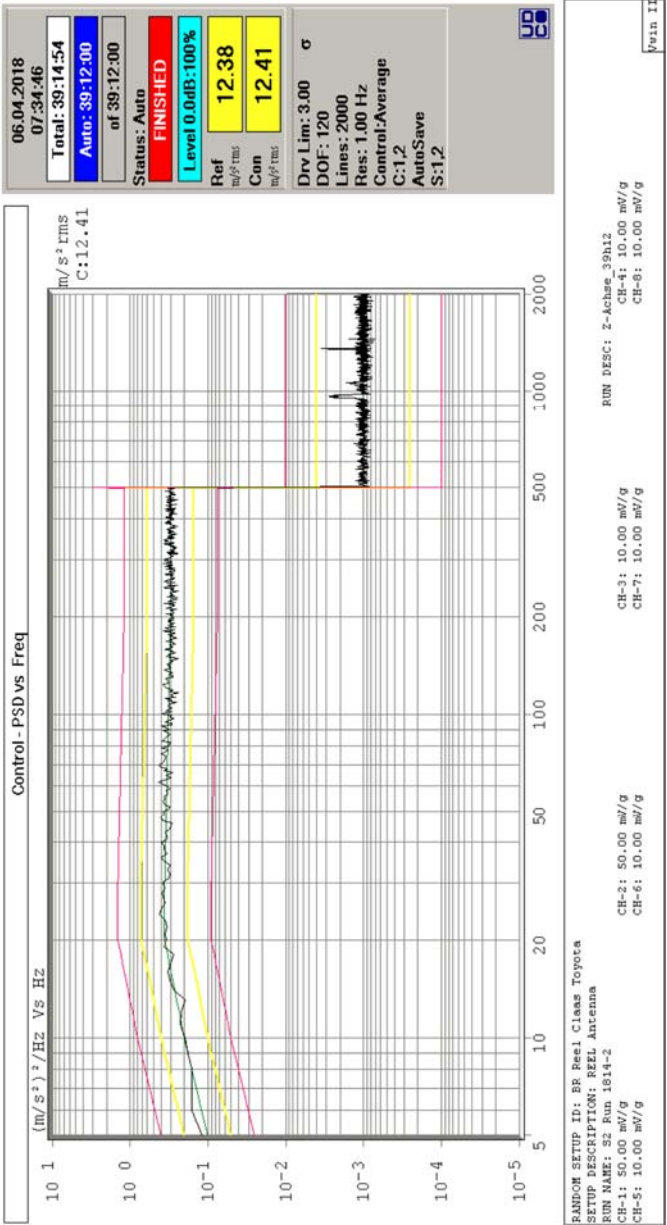
Note: Before applying the test shocks several reference shocks of a lower level (- 12 dB / - 6 dB) were applied as equipment test. This explains the different number of shocks in the measuring diagrams.

7.1 Measuring diagrams of the vibration test, random

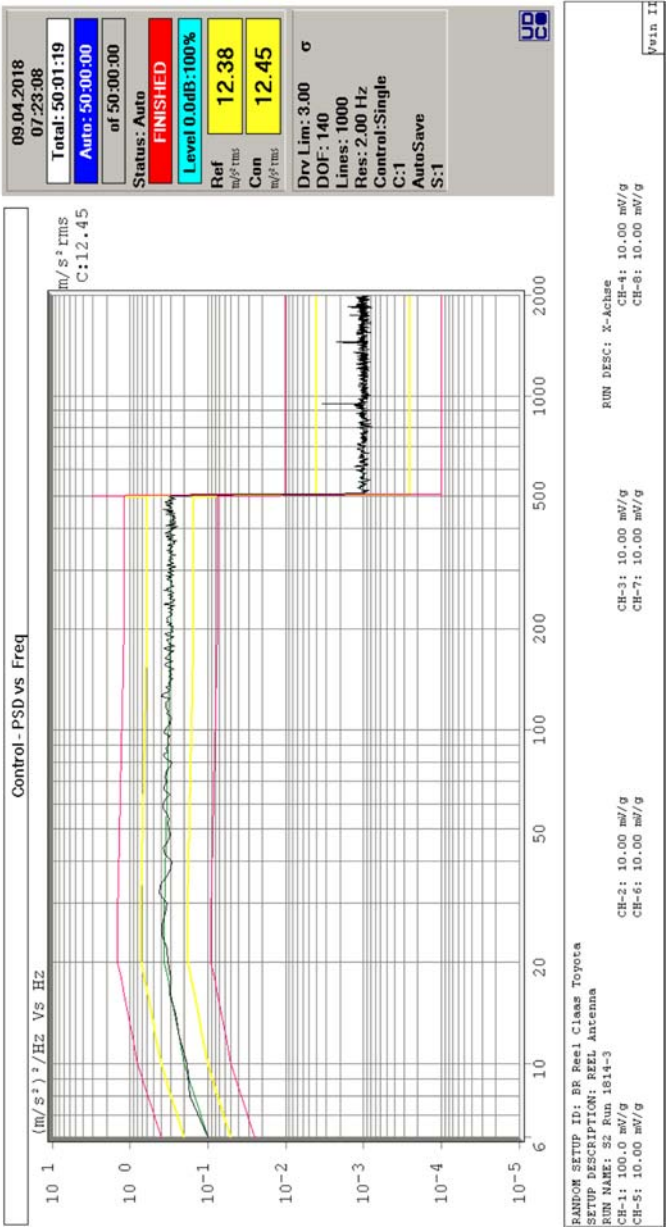
Run 1814-1, Z-Axis, Part 1



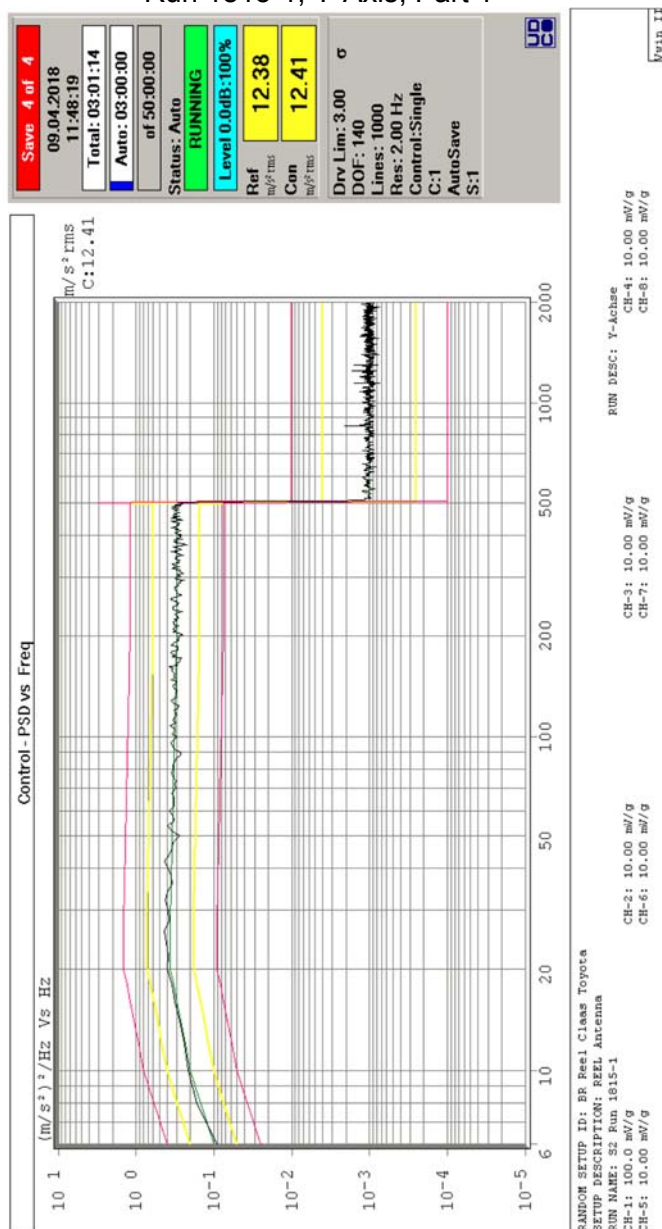
Run 1814-2, Z-Axis, Part 2



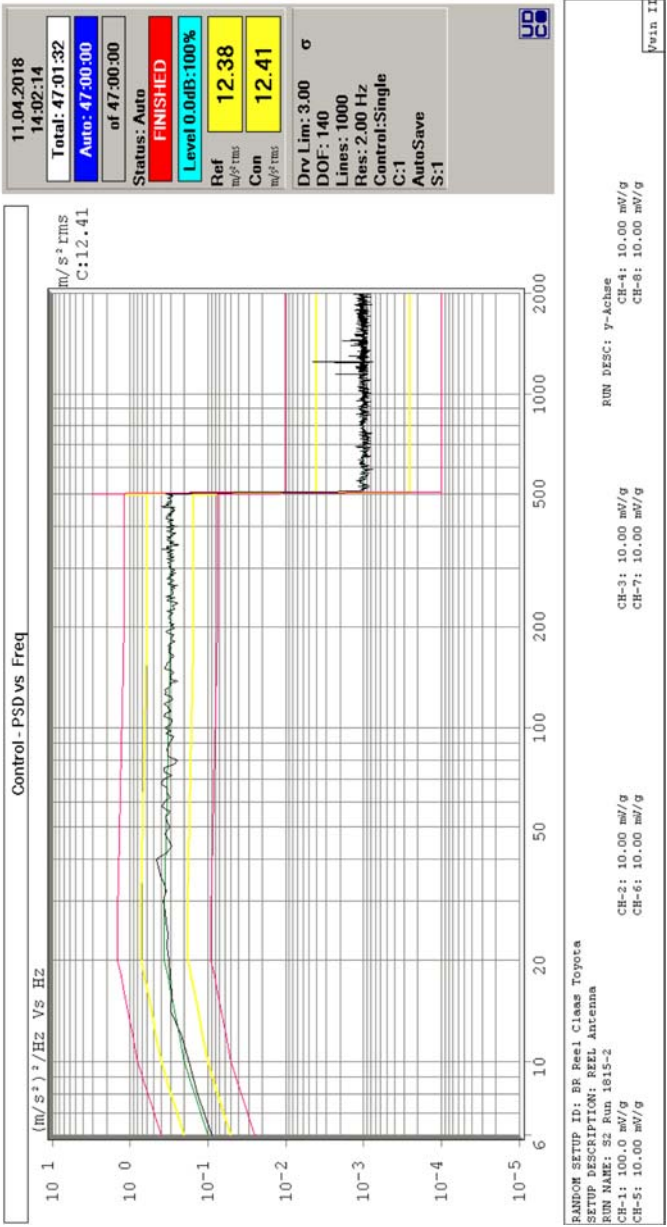
Run 1814-3, X-Axis



Run 1815-1, Y-Axis, Part 1

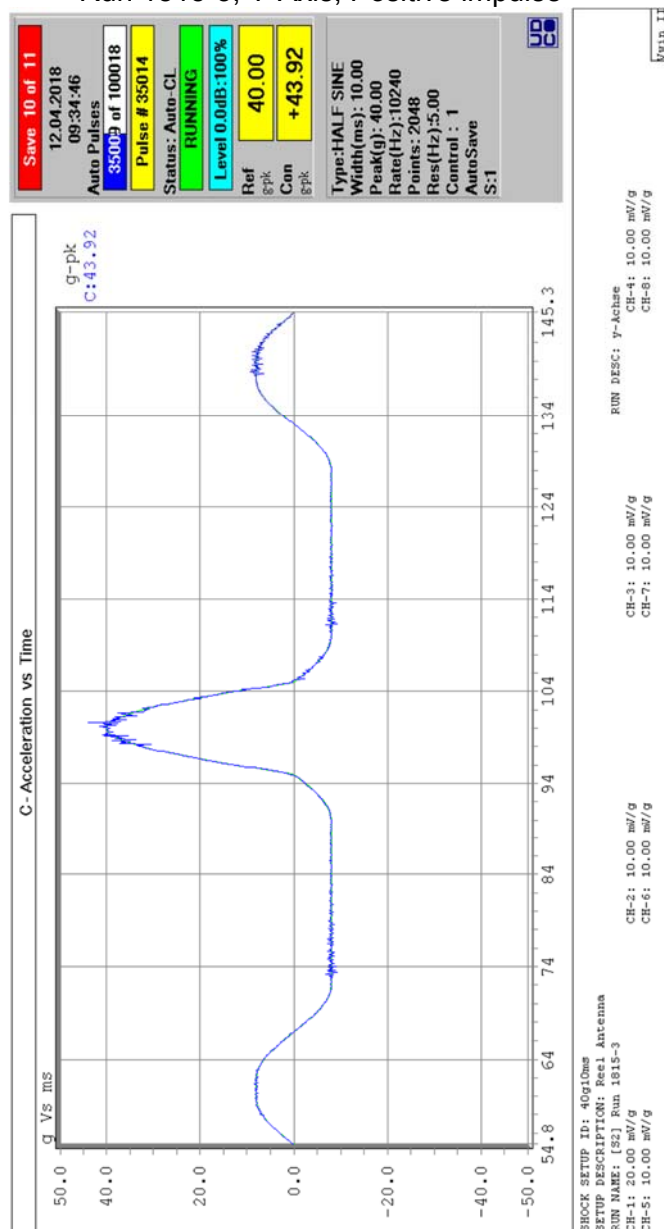


Run 1815-2, Y-Axis, Part 2

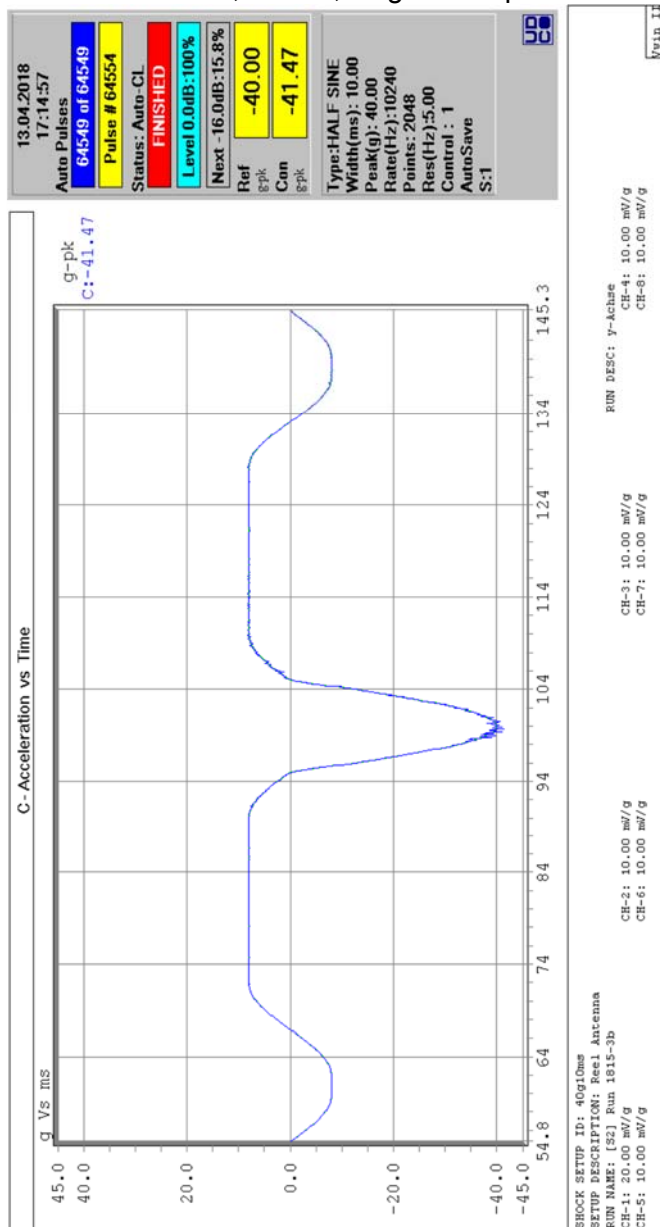


7.2 Measuring diagrams of the shock tests 1

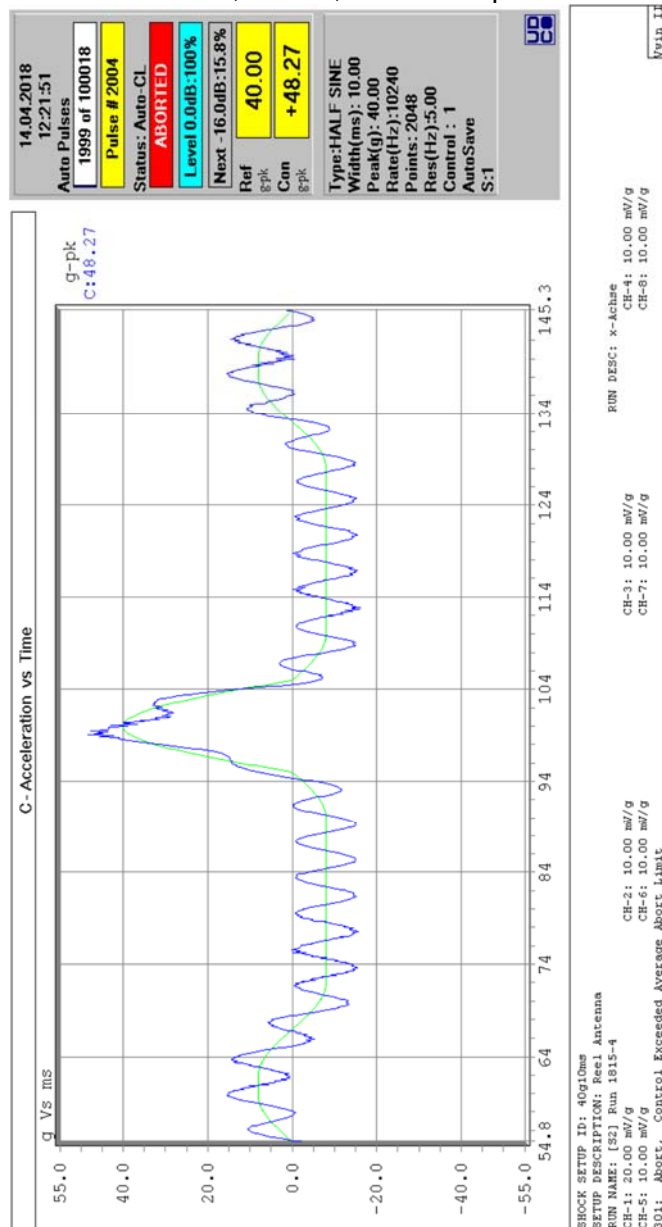
Run 1815-3, Y-Axis, Positive impulse



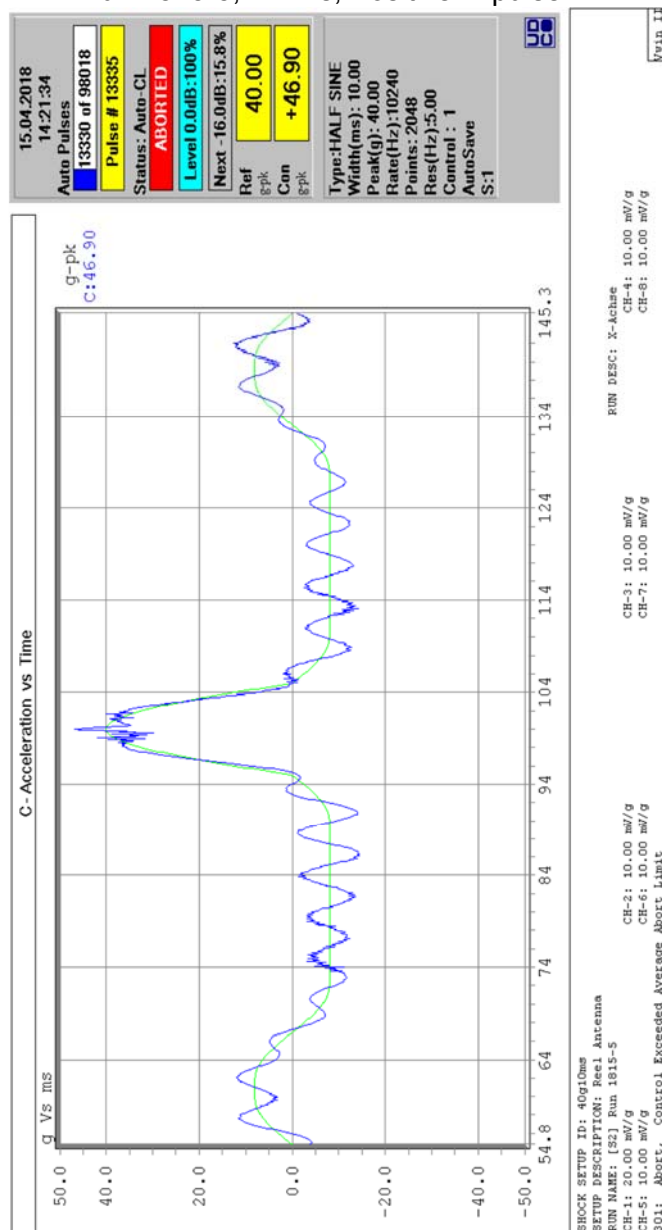
Run 1815-3b, Y-Axis, Negative impulse



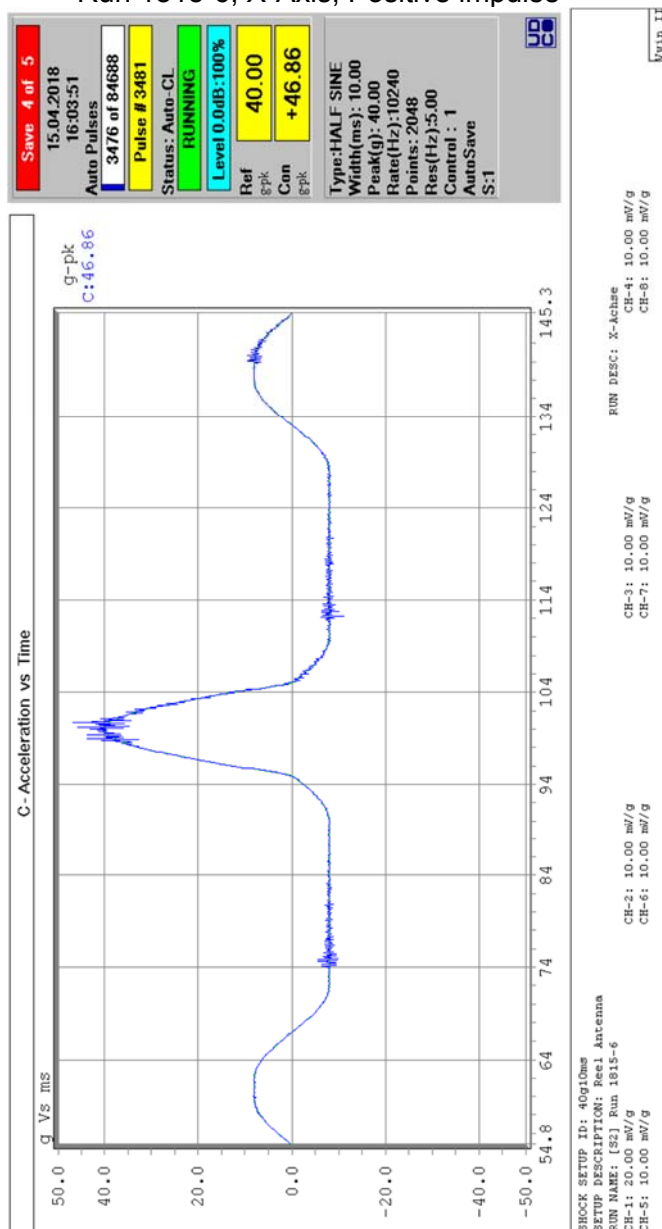
Run 1815-4, X-Axis, Positive impulse



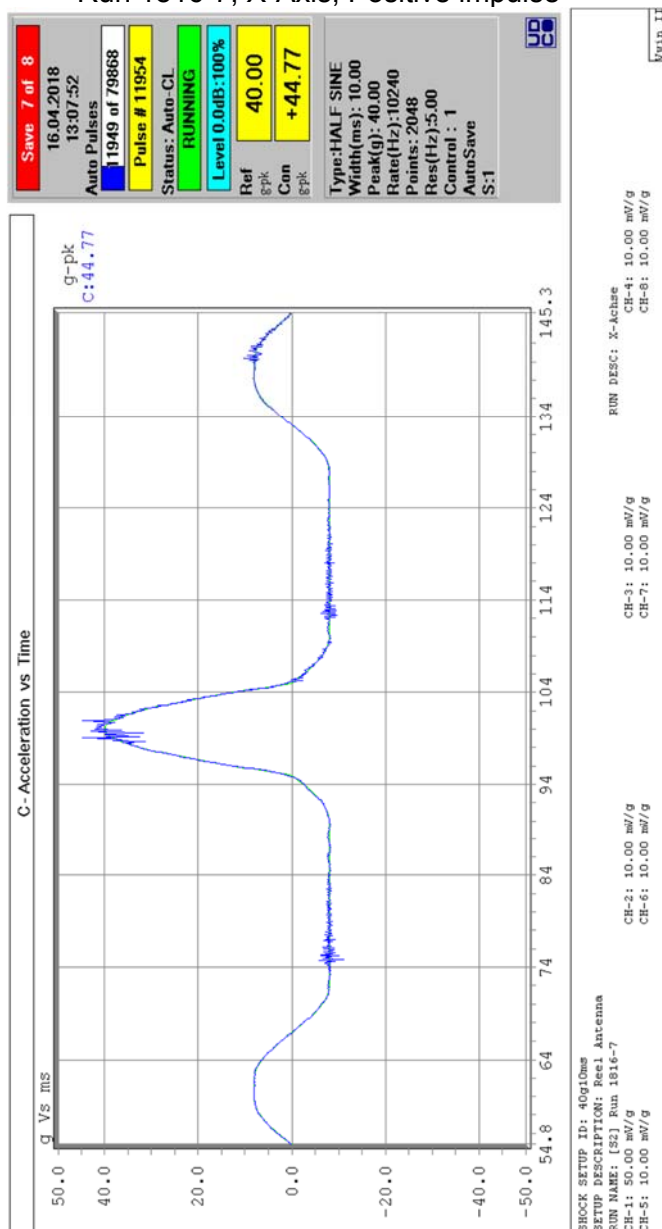
Run 1815-5, X-Axis, Positive impulse



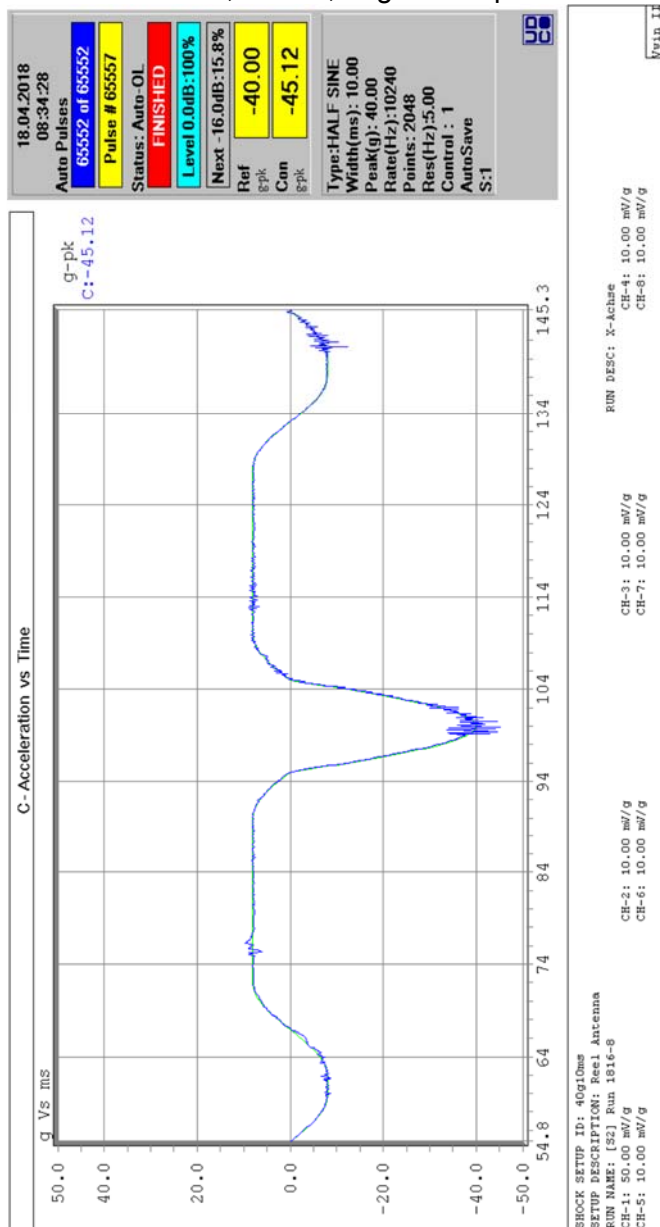
Run 1815-6, X-Axis, Positive impulse



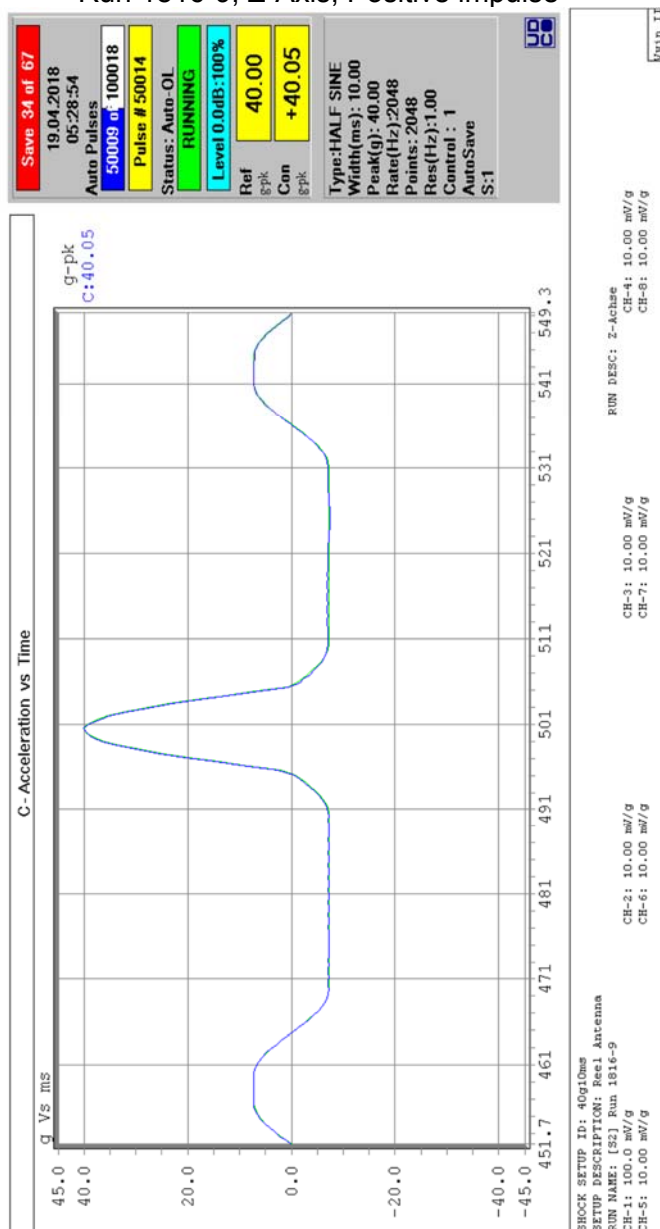
Run 1816-7, X-Axis, Positive impulse



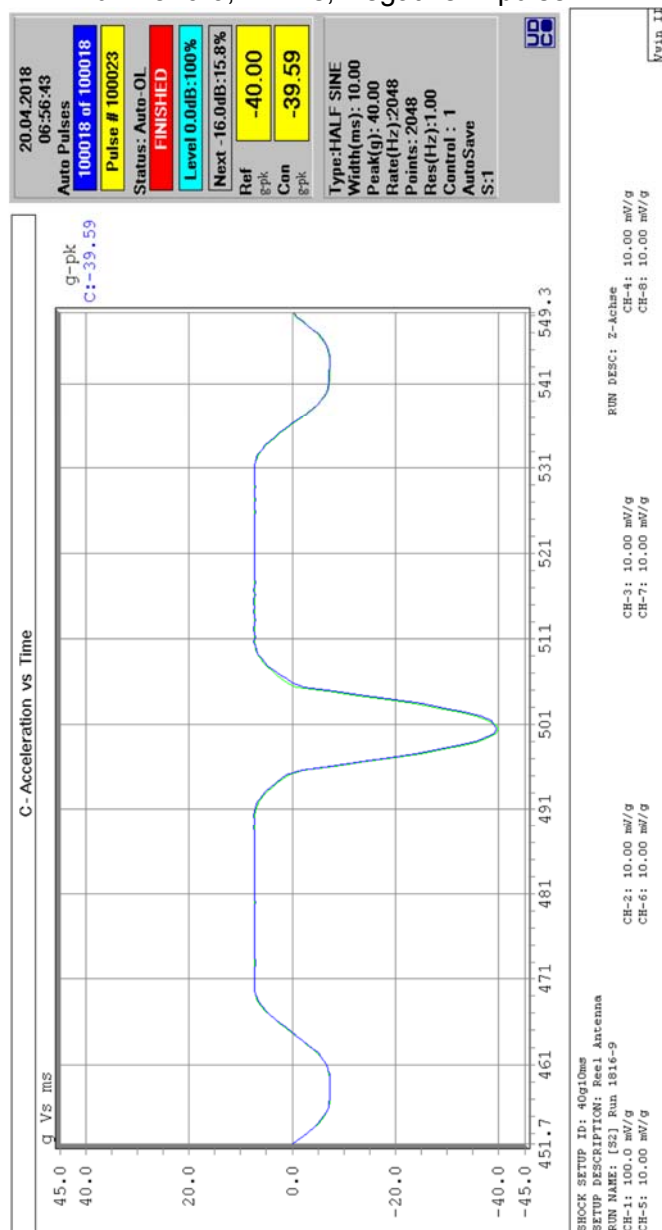
Run 1816-8, X-Axis, negative impulse



Run 1816-9, Z-Axis, Positive impulse

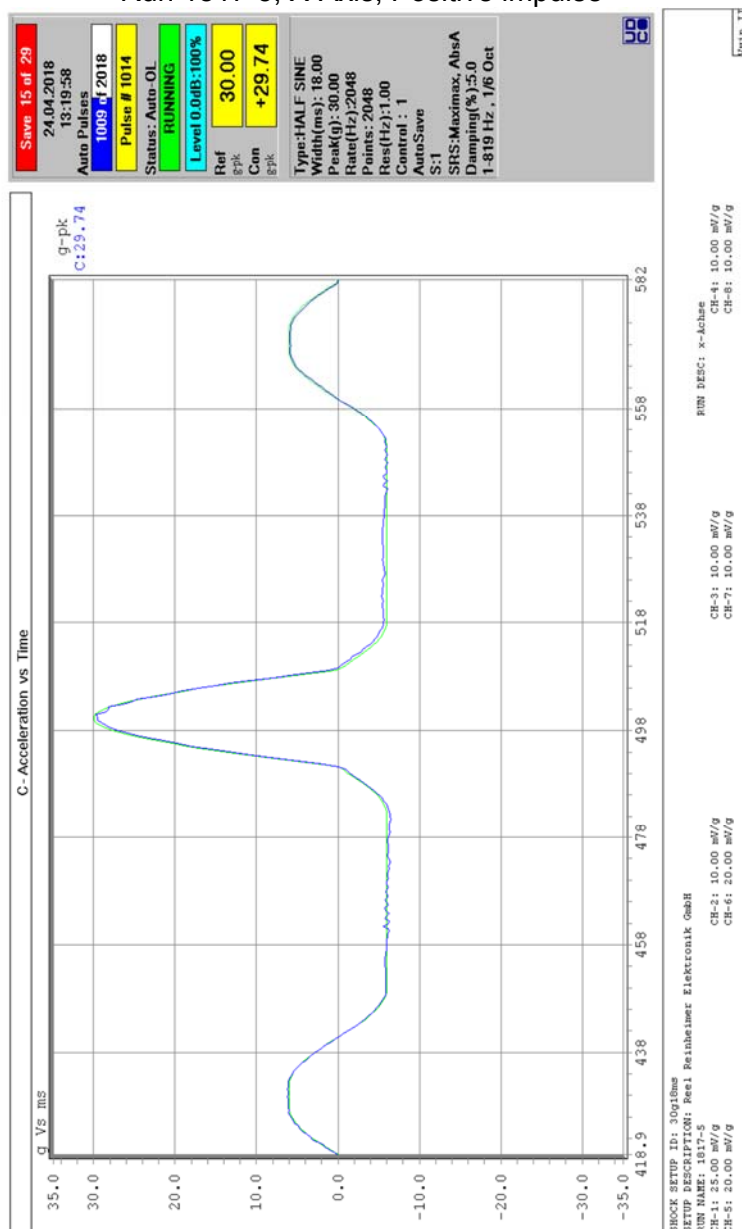


Run 1816-9, Z-Axis, Negative impulse



7.3 Measuring diagrams of the shock tests 2

Run 1817-5, X-Axis, Positive impulse



C- Acceleration vs Time

g-plk
C:-29.44

24.04.2018 13:52:54 Auto Pulses	2018 of 2018	Pulse # 2023	Status: Auto-OL	FINISHED	Level 0.0dB:100%	Next -12.0dB:25.1%	Ref 87%	-30.00	Com 87%	-29.44
---------------------------------------	--------------	--------------	-----------------	----------	------------------	--------------------	------------	--------	------------	--------

Type: HALF SINE
Width(ms): 18.00
Peak(g): 30.00
Rate(Hz): 2048
Points: 2048
Res(Hz): 1.00
Control : 1
AutoSave
S:1
SRS:Maximax, AbsA
Damping(%):5.0
1-819 Hz , 1/8 Oct

SHOCK SETUP ID: 30g18ms
SETUP DESCRIPTION: Reel Reinheimer Elektronik GmbH
RUN NAME: 1817-5
CH-1: 25.00 mV/g
CH-5: 20.00 mV/g
CH-2: 10.00 mV/g
CH-7: 10.00 mV/g
CH-3: 10.00 mV/g
CH-6: 10.00 mV/g
PIN DESC: x-Achse
CH-4: 10.00 mV/g
CH-8: 10.00 mV/g

C-Acceleration vs Time

g-pk
C:29.44

g Vs ms

35.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-35.0

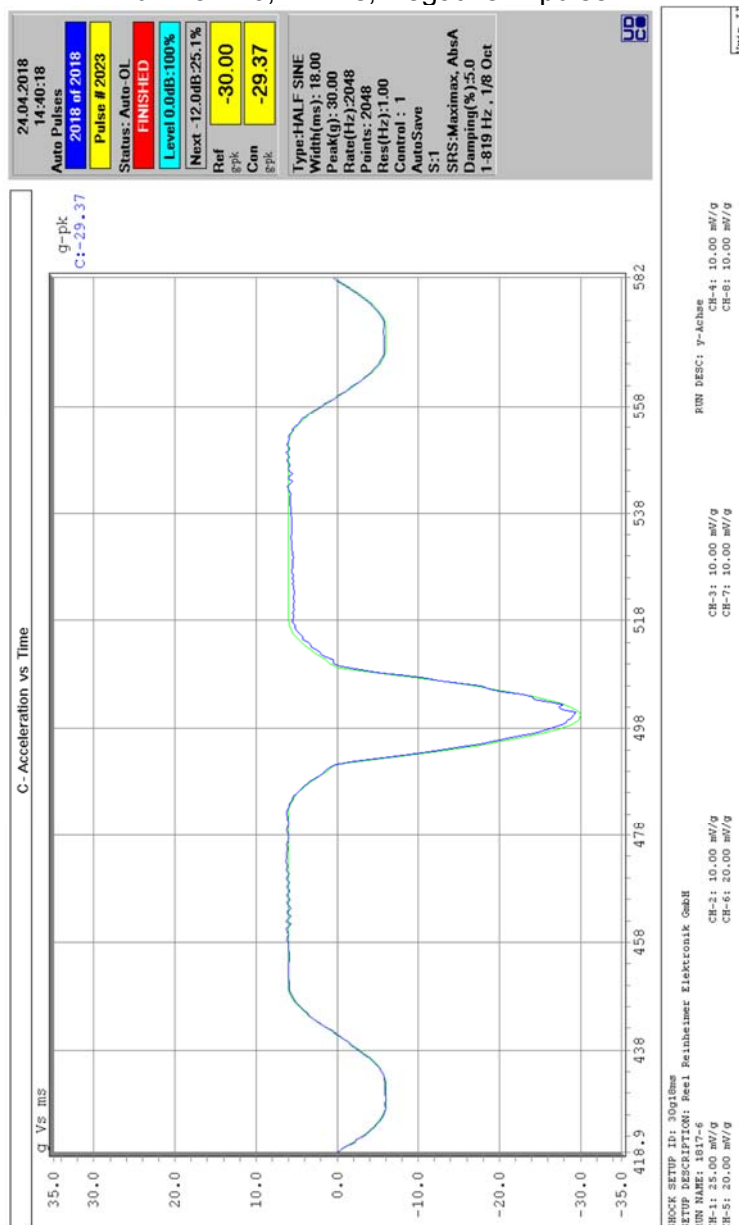
418.9 438 458 478 498 518 538 558 582

Save 15 of 29
24.04.2018 14:15:13
Auto Pulses
Pulse # 1014
Status: Auto-OL
RUNNING
Level 0.0dB: 100%
Ref 30.00
Con +29.44
87pk
87pk

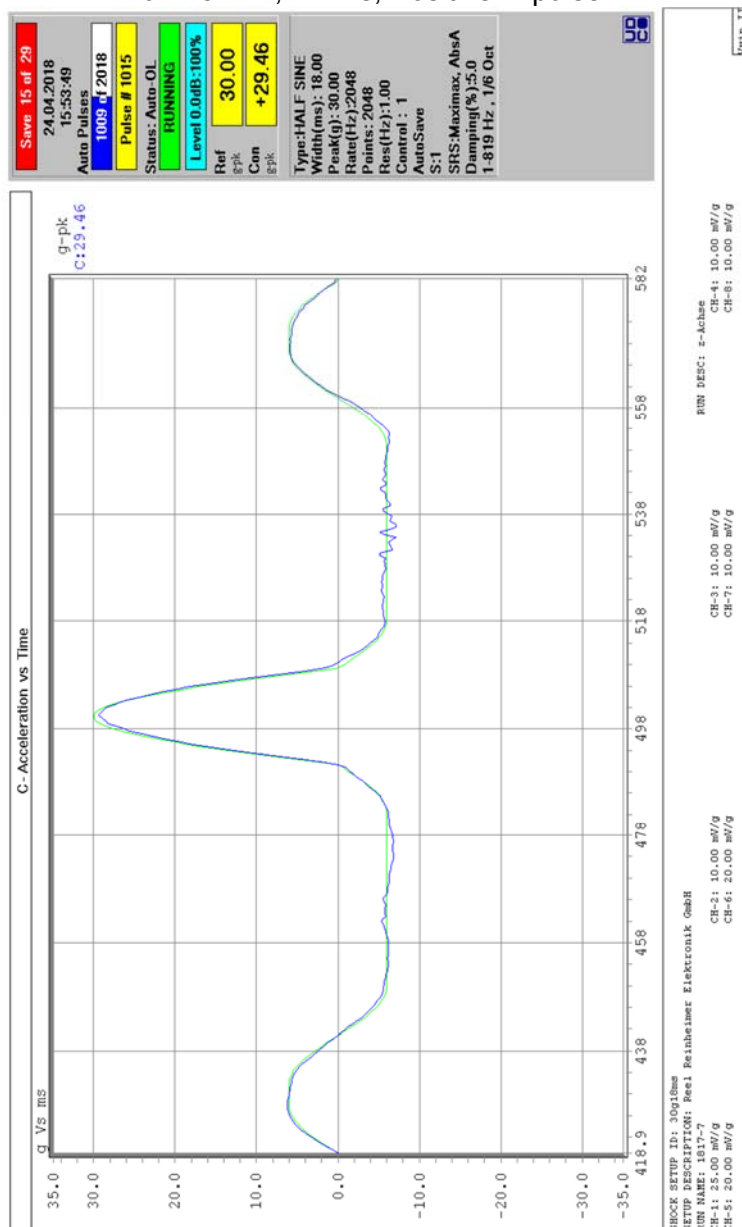
Type: HALF SINE
Width(ms): 18.00
Peak(g): 30.00
Rate(Hz): 2048
Points: 2048
Res(Hz): 1.00
Control: 1
AutoSave
S:1
SRS: Maximax, AbsA
Damping(%) : 5.0
1-819 Hz, 1/6 Oct

SHOCK SETUP ID: 30018ms
SETUP DESCRIPTION: Reel Reinheimer Elektronik GmbH
RUN NAME: 1817-6
UN-1: 25.00 mV/g
CH-1: 20.00 mV/g
UN-2: 10.00 mV/g
CH-2: 10.00 mV/g
UN-3: 10.00 mV/g
CH-3: 10.00 mV/g
UN-4: 10.00 mV/g
CH-4: 10.00 mV/g
UN-5: 20.00 mV/g
CH-5: 20.00 mV/g
UN-6: 10.00 mV/g
CH-6: 10.00 mV/g
UN-7: 10.00 mV/g
CH-7: 10.00 mV/g
UN-8: 10.00 mV/g
CH-8: 10.00 mV/g
UN-9: 10.00 mV/g
CH-9: 10.00 mV/g
UN-10: 10.00 mV/g
CH-10: 10.00 mV/g
UN-11: 10.00 mV/g
CH-11: 10.00 mV/g
UN-12: 10.00 mV/g
CH-12: 10.00 mV/g
UN-13: 10.00 mV/g
CH-13: 10.00 mV/g
UN-14: 10.00 mV/g
CH-14: 10.00 mV/g
UN-15: 10.00 mV/g
CH-15: 10.00 mV/g
UN-16: 10.00 mV/g
CH-16: 10.00 mV/g
UN-17: 10.00 mV/g
CH-17: 10.00 mV/g
UN-18: 10.00 mV/g
CH-18: 10.00 mV/g
UN-19: 10.00 mV/g
CH-19: 10.00 mV/g
UN-20: 10.00 mV/g
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CH-21: 10.00 mV/g
UN-22: 10.00 mV/g
CH-22: 10.00 mV/g
UN-23: 10.00 mV/g
CH-23: 10.00 mV/g
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CH-24: 10.00 mV/g
UN-25: 10.00 mV/g
CH-25: 10.00 mV/g
UN-26: 10.00 mV/g
CH-26: 10.00 mV/g
UN-27: 10.00 mV/g
CH-27: 10.00 mV/g
UN-28: 10.00 mV/g
CH-28: 10.00 mV/g
UN-29: 10.00 mV/g
CH-29: 10.00 mV/g
UN-30: 10.00 mV/g
CH-30: 10.00 mV/g
UN-31: 10.00 mV/g
CH-31: 10.00 mV/g
UN-32: 10.00 mV/g
CH-32: 10.00 mV/g
UN-33: 10.00 mV/g
CH-33: 10.00 mV/g
UN-34: 10.00 mV/g
CH-34: 10.00 mV/g
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CH-80: 10.00 mV/g
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CH-99: 10.00 mV/g
UN-100: 10.00 mV/g
CH-100: 10.00 mV/g

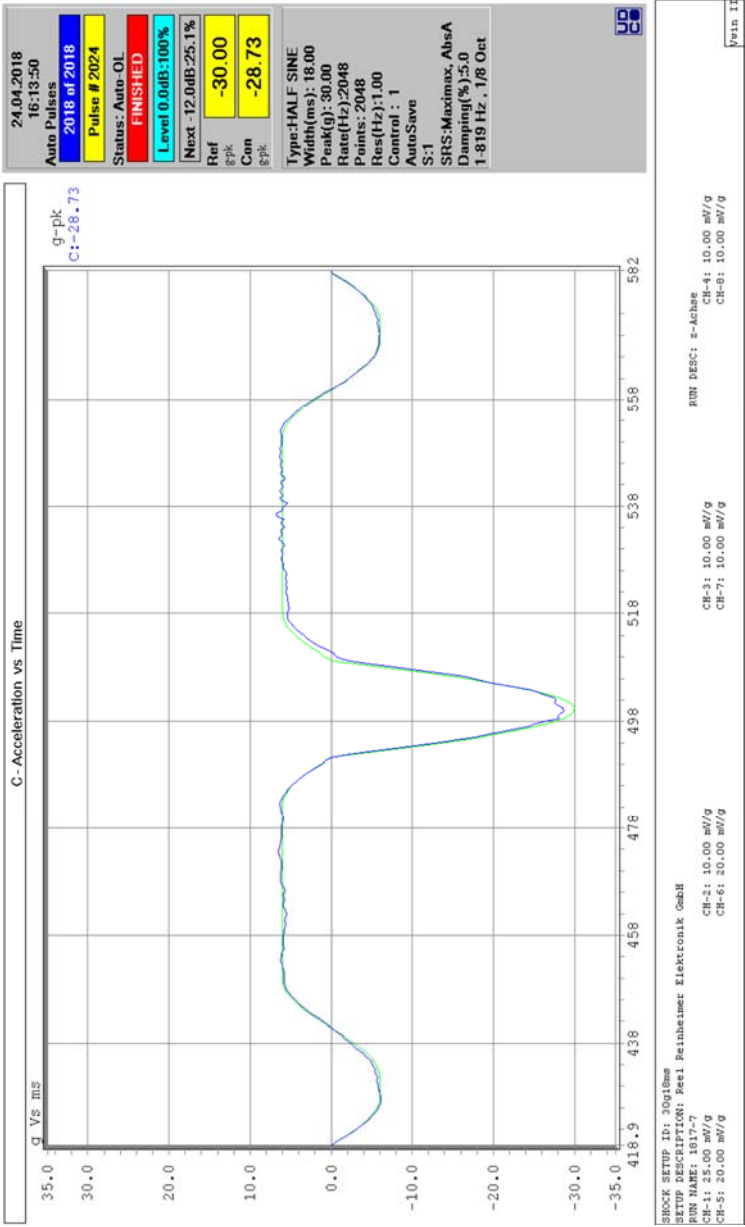
Run 1817-6, Y-Axis, Negative impulse



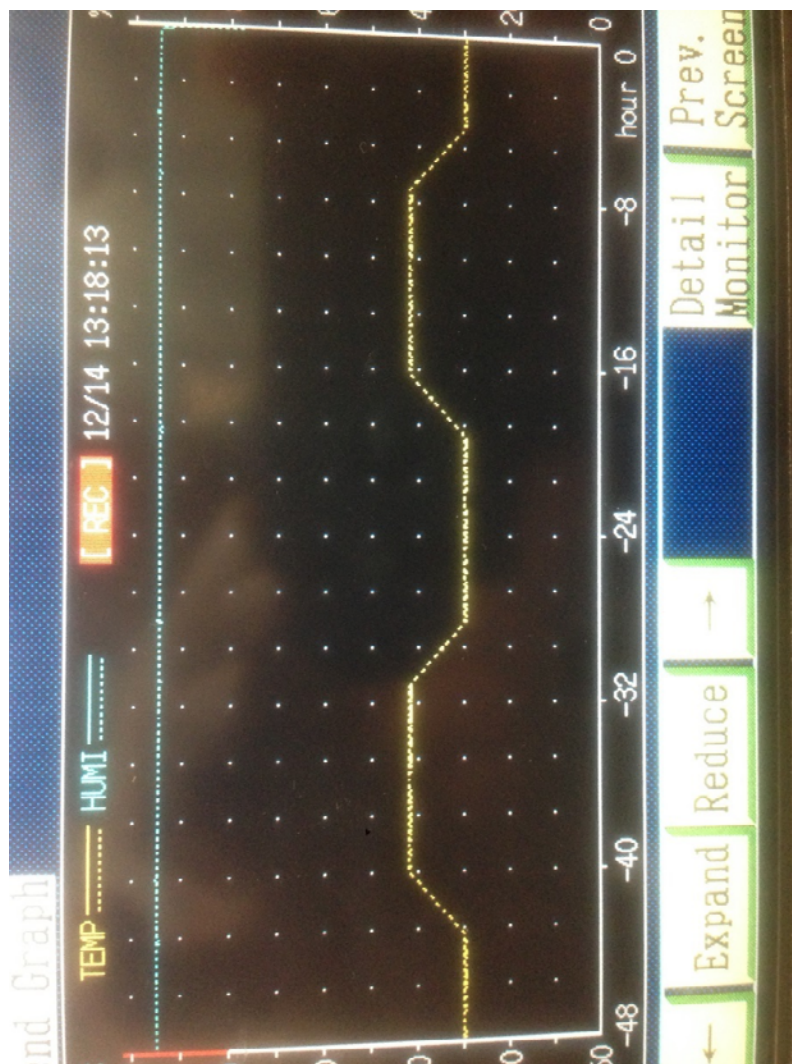
Run 1817-7, Z-Axis, Positive impulse



Run 1817-7, Z-Axis, Negative impulse

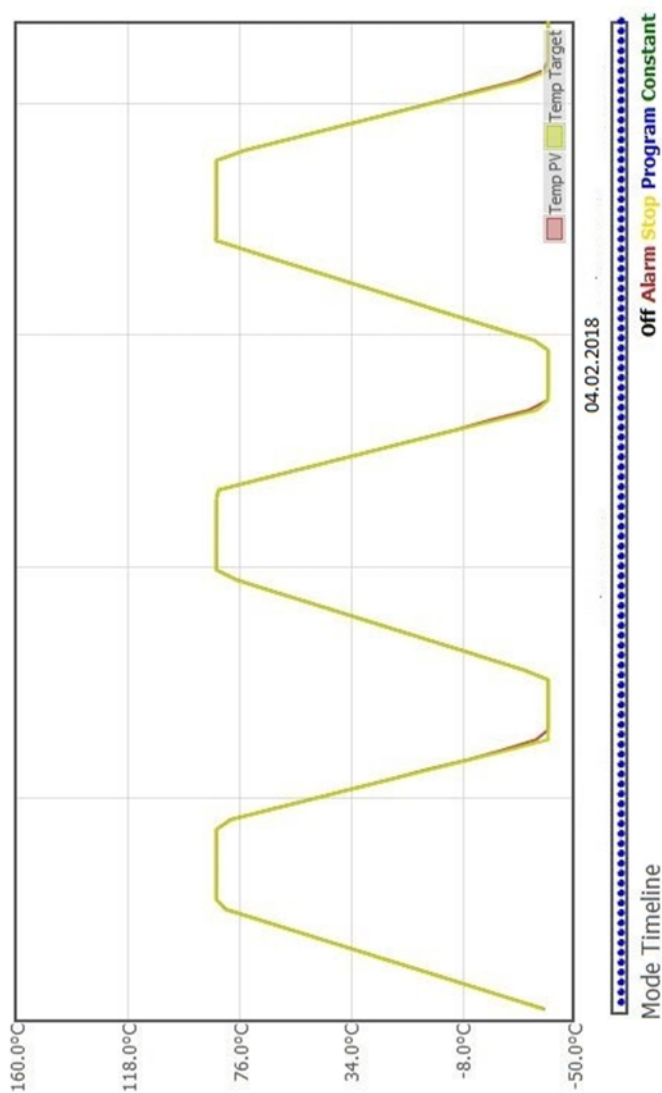


7.4 Measuring diagrams of the climatic tests - exemplary

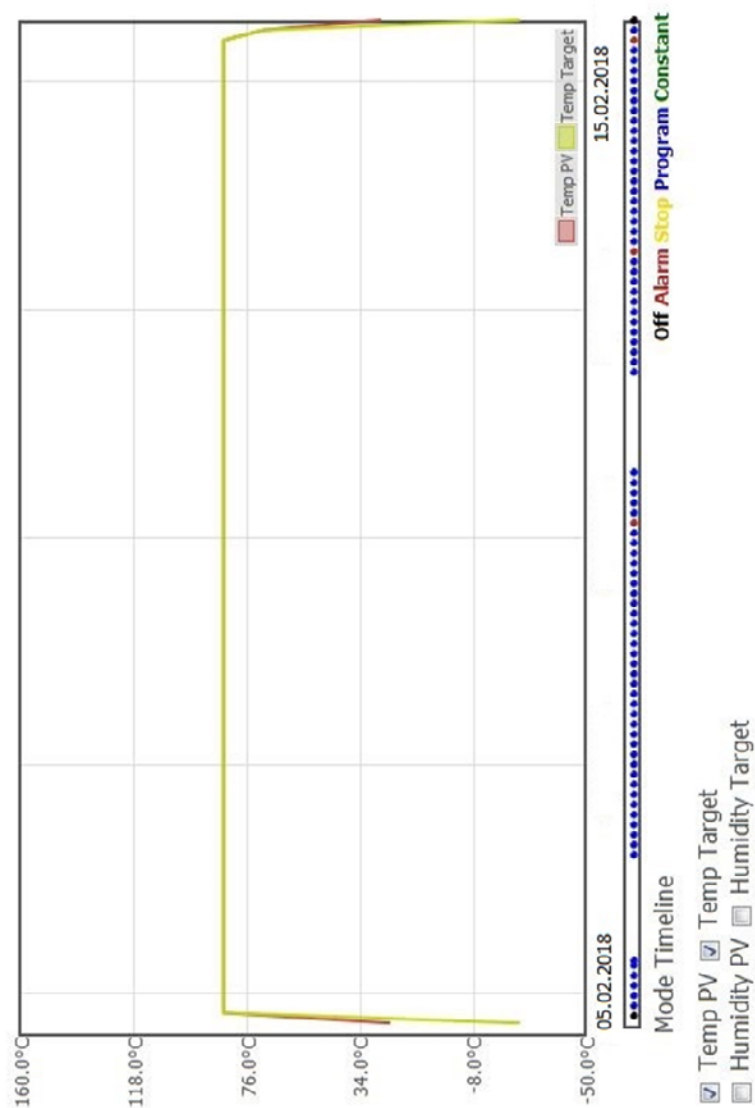


7.5 Measuring diagrams of the temperature tests / temperature shock tests

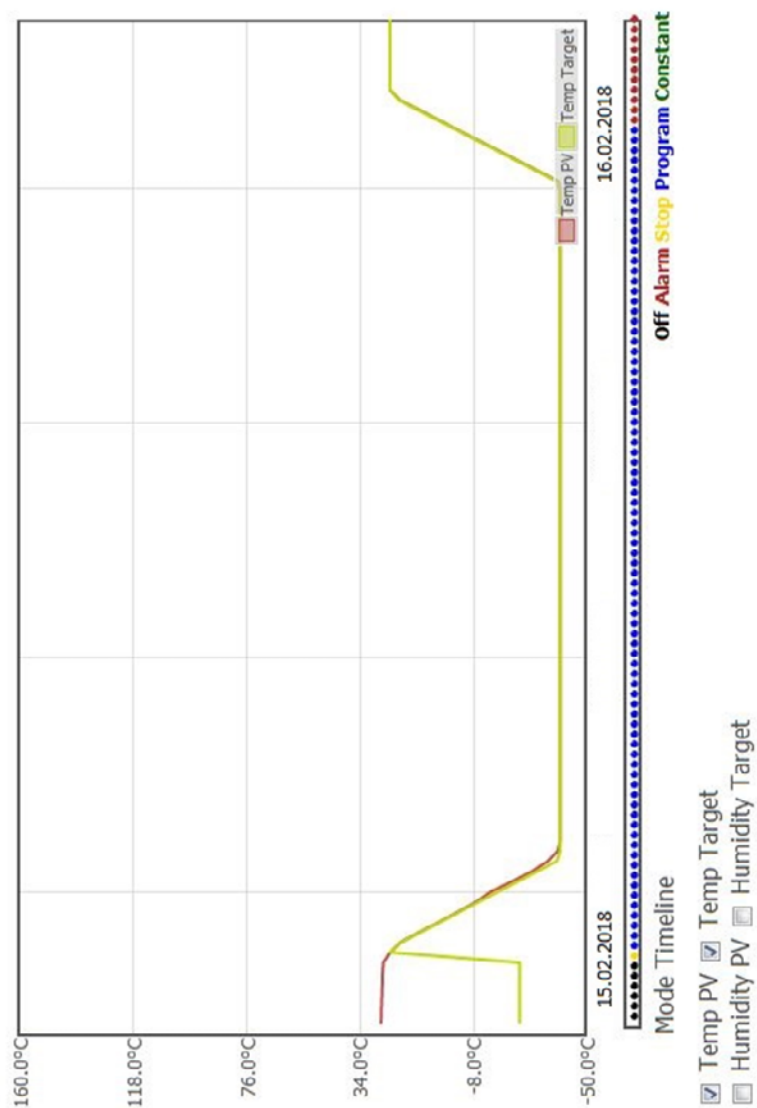
7.5.1 Temperature change test - partial



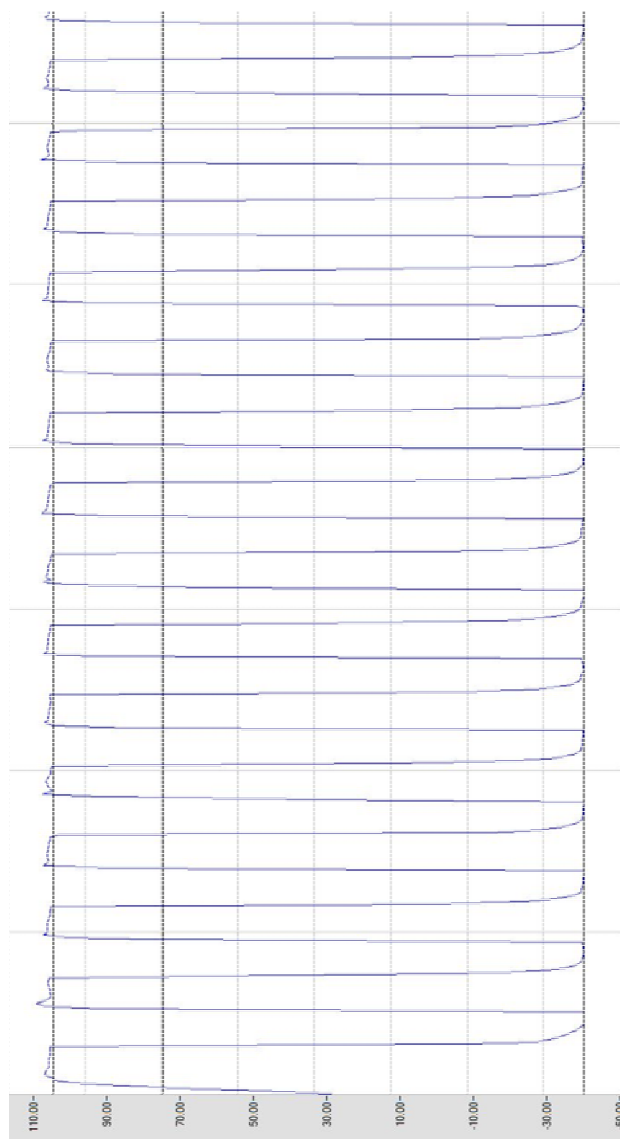
7.5.2 Storage dry heat



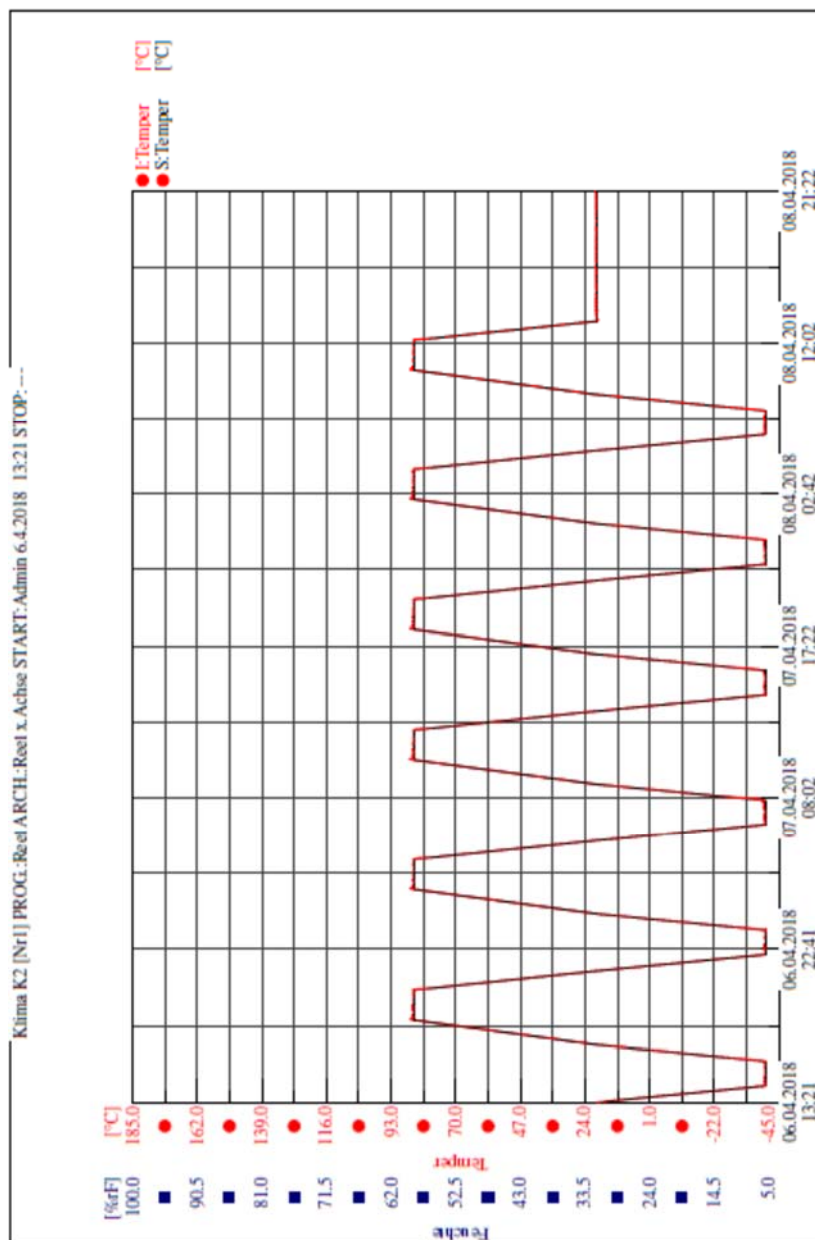
7.5.3 Storage cold



7.5.4 Temperature shock test - exemplary



7.5.5 Contemporaneous temperature during vibration



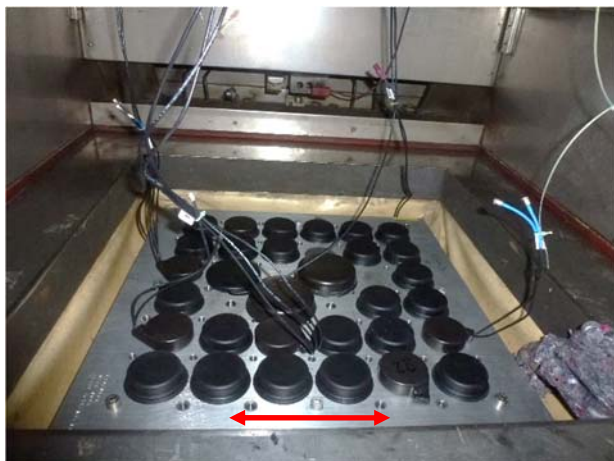
8 Photo documentation



1. UUT in the climatic chamber



2. UUT in the temperature shock chamber



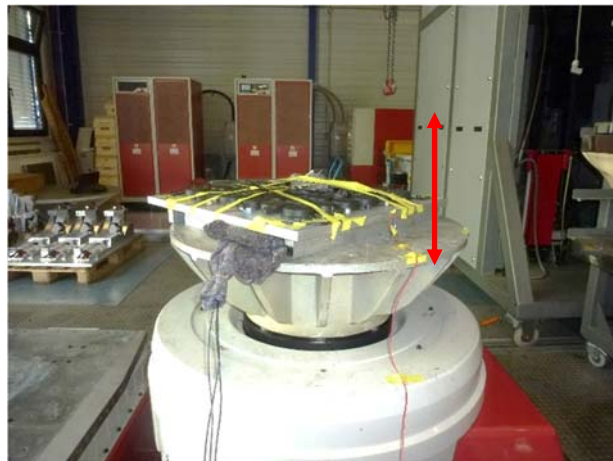
3. UUT during vibration with temperature overlay on slip-table in climatic chamber in X-and Y-axis



4. UUT during vibration with temperature overlay on head-expander in climatic chamber in Z-axis



5. Monitoring of the client



6. UUT during shock tests on head-expander in Z-axis



7. UUT during shock tests on slip-table in X- and Y-axis



8. UUT in the salt spray chamber



9. UUT before IP 5X in the dust chamber



10. UUT after IP 5X in the dust chamber



11. UUT during IP X4



12. UUT during IP X4



13. UUT after IP 54, no penetration of dust or water visible



14. UUT before IP 6X in the dust chamber



15. UUT before IP 6X in the dust chamber



16. UUT after IP 6X in the dust chamber



17. UUT after IP6X in the dust chamber



18. UUT after IP 6X, no penetration of dust visible



19. UUT after IP 6X, no penetration of dust visible



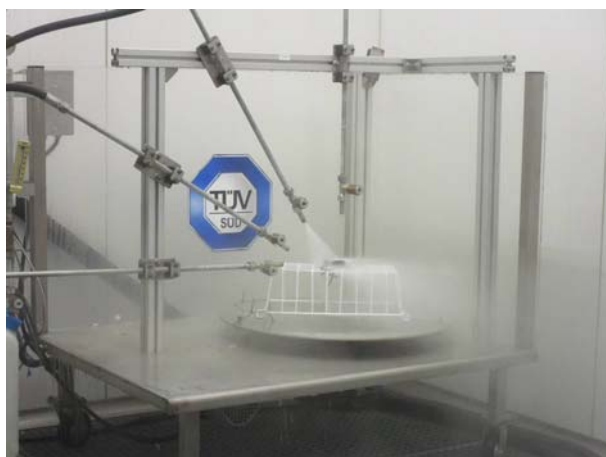
20. UUT after IP 6X, no penetration of dust visible



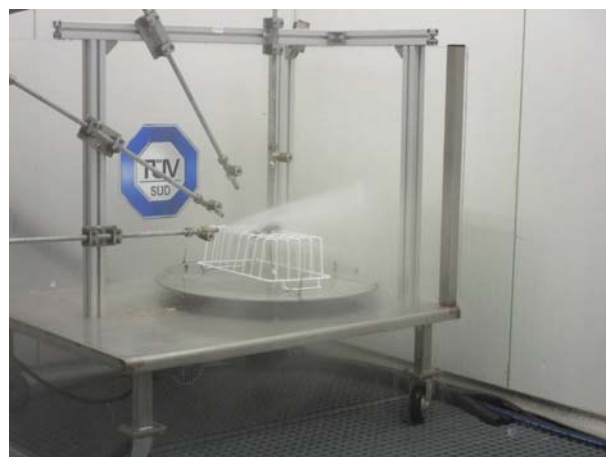
21. UUT during IP X7 in the inversion tank



22. UUT after IP X7, no penetration of water visible



23. UUT during IP X9K



24. UUT during IP X9K



25. No penetration of water visible



26. No penetration of water visible



27. UUT during chemical resistance test in the climatic chamber



28. UUT during chemical resistance test in the climatic chamber



29. Chemical resistance test, UUT after 22 h at 85°C I the climatic chamber



30. Chemical resistance test, UUT after 22 h at 85°C I the climatic chamber



31. Chemical resistance test, UUT after 22 h at room temperature



32. Chemical resistance test, UUT after 22 h at room temperature



33. Chemical resistance test, UUT cleaned after chemical resistance test, no change visible

Verified
Signature



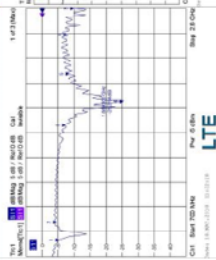
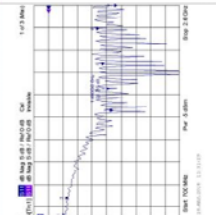
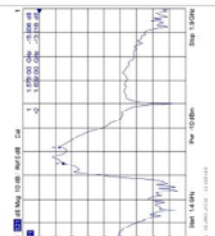
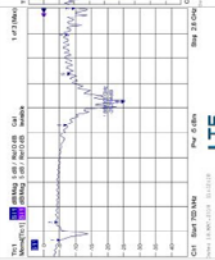
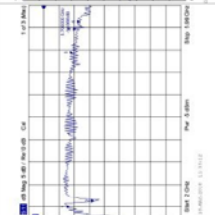
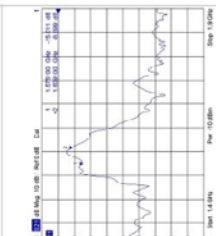
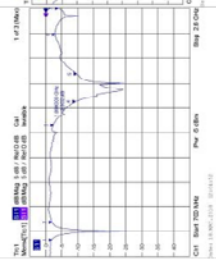
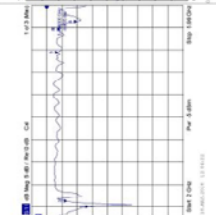
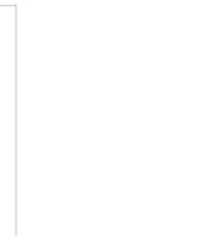
Bernhard Abel
Technical Certifier

Edited
Signature

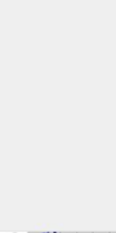
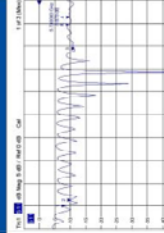
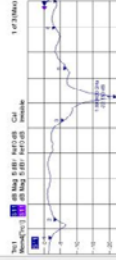
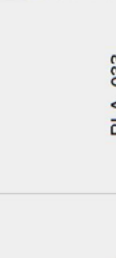
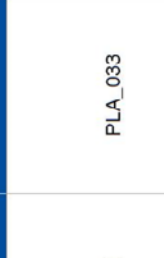


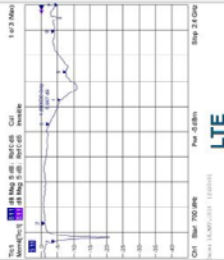
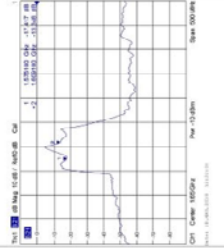
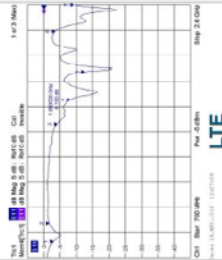
Norbert Drescher
Test Engineer

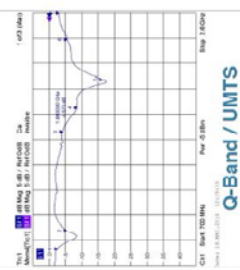
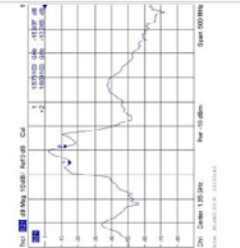
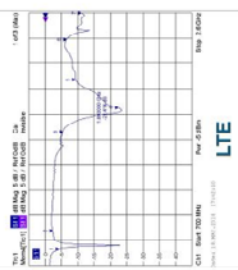
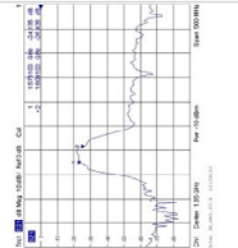
9 Test results of the customer

UUT No.	Ident. No.	Type	Platine	Messdaten GSM	Messdaten W-LAN	Messdaten GNSS / Navigation
1	3	K71LFR	PLA003_U	 Test: 08 May 12:00:00 - 12:00:05 Modem: 08 May 12:00:00 - 12:00:05 Carrier: 08 May 12:00:00 - 12:00:05 Power: 08 May 12:00:00 - 12:00:05 LTE	 Test: 08 May 12:00:00 - 12:00:05 Modem: 08 May 12:00:00 - 12:00:05 Carrier: 08 May 12:00:00 - 12:00:05 Power: 08 May 12:00:00 - 12:00:05	 Test: 08 May 12:00:00 - 12:00:05 Modem: 08 May 12:00:00 - 12:00:05 Carrier: 08 May 12:00:00 - 12:00:05 Power: 08 May 12:00:00 - 12:00:05
2	4	F71LGAR	PLA003 GA REV	 Test: 08 May 12:00:00 - 12:00:05 Modem: 08 May 12:00:00 - 12:00:05 Carrier: 08 May 12:00:00 - 12:00:05 Power: 08 May 12:00:00 - 12:00:05 LTE	 Test: 08 May 12:00:00 - 12:00:05 Modem: 08 May 12:00:00 - 12:00:05 Carrier: 08 May 12:00:00 - 12:00:05 Power: 08 May 12:00:00 - 12:00:05	 Test: 08 May 12:00:00 - 12:00:05 Modem: 08 May 12:00:00 - 12:00:05 Carrier: 08 May 12:00:00 - 12:00:05 Power: 08 May 12:00:00 - 12:00:05
3	5	F71LGAR	PLA003 GA REV	 Test: 08 May 12:00:00 - 12:00:05 Modem: 08 May 12:00:00 - 12:00:05 Carrier: 08 May 12:00:00 - 12:00:05 Power: 08 May 12:00:00 - 12:00:05 LTE	 Test: 08 May 12:00:00 - 12:00:05 Modem: 08 May 12:00:00 - 12:00:05 Carrier: 08 May 12:00:00 - 12:00:05 Power: 08 May 12:00:00 - 12:00:05	 Test: 08 May 12:00:00 - 12:00:05 Modem: 08 May 12:00:00 - 12:00:05 Carrier: 08 May 12:00:00 - 12:00:05 Power: 08 May 12:00:00 - 12:00:05

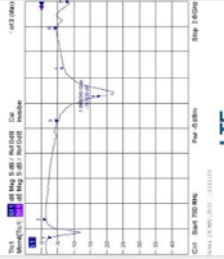
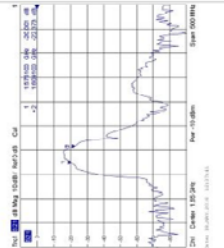
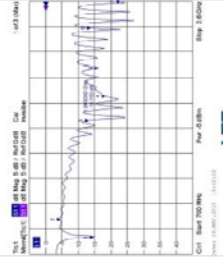
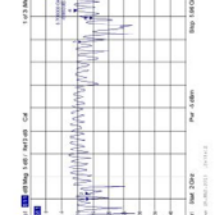
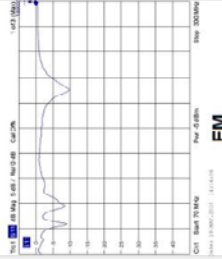
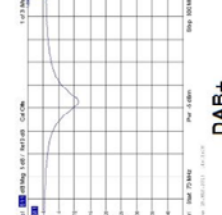
Editor: Norbert Drescher
Date of issue: 05.10.2018
Report No.: 713120769A
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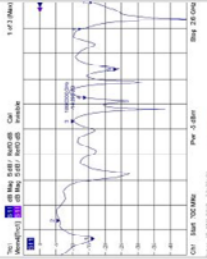
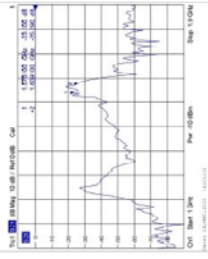
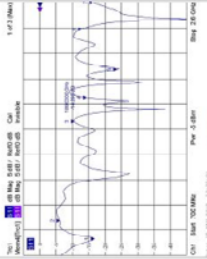
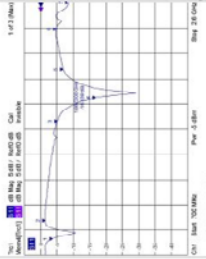
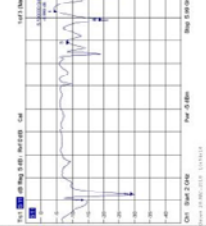
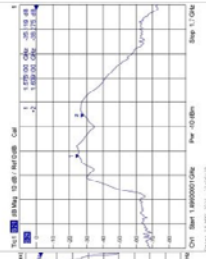
UUT No.	Ident. No.	Type	Platine	Messdaten GSM	Messdaten W-LAN	Messdaten GNSS / Navigation
7	9	M71XFR	PLA_033			
8	10	M71ZXR	PLA_033			
9	11	K71LGAR	PLA_003GA Rev			

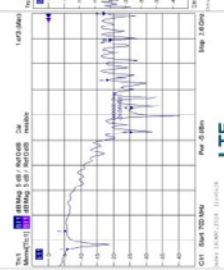
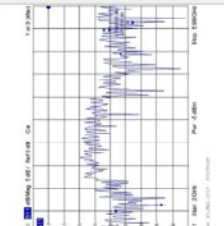
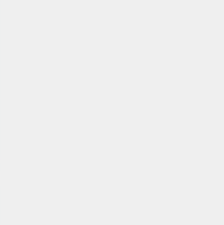
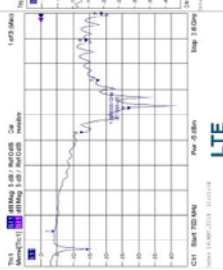
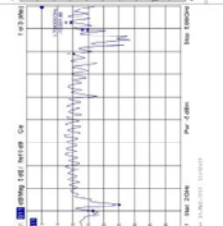
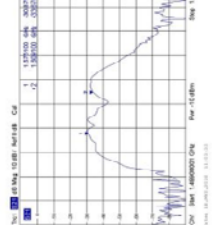
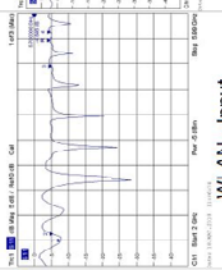
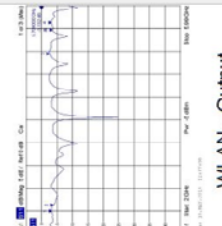
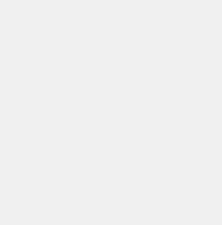
UUT No.	Ident. No.	Type	Platine	Messdaten GSM	Messdaten W-LAN	Messdaten GNSS / Navigation
10	11	K71LGAR	PLA_003GA Rev	 Test: 18 May 11:05 / AutoOff - Cal Ch1: 1800 MHz Per: 0.000s Step: 2.000s LTE		 Test: 18 May 11:05 / AutoOff - Cal Ch1: 1800 MHz Per: 0.000s Step: 2.000s
11	12	M71LXR	PLA_033	 Test: 18 May 11:05 / AutoOff - Cal Ch1: 1800 MHz Per: 0.000s Step: 2.000s LTE		
12	12	M71LXR	einseitige Platine	 Test: 18 May 11:05 / AutoOff - Cal Ch1: 1800 MHz Per: 0.000s Step: 2.000s LTE		

UUT No.	Ident. No.	Type	Platine	Messdaten GSM	Messdaten W-LAN	Messdaten GNSS / Navigation
13	13	K70ZGAR	PLA_003 GA	 Q-Band / UNITS		
14	14	F70LGAR	PLA_003GA			
15	15	K71LGVR	PLA_003GV Rev	 LTE		

inspection antenna emitter fixing ABH001

UUT No.	Ident. No.	Type	Platine	Messdaten GSM	Messdaten W-LAN	Messdaten GNSS / Navigation
16	16	K71LGV/R	PLA_003GV Rev	 Plot showing GSM spectrum for UUT 16. The y-axis is labeled 'dBm' and ranges from -40 to 140. The x-axis is labeled 'MHz' and ranges from 880 to 960. The plot shows a signal at approximately 900 MHz with a peak level of about 120 dBm. The plot is titled 'GSM' and 'Plot 1'.		 Plot showing GNSS spectrum for UUT 16. The y-axis is labeled 'dBm' and ranges from -40 to 140. The x-axis is labeled 'MHz' and ranges from 1575 to 1600. The plot shows a signal at approximately 1575 MHz with a peak level of about 120 dBm. The plot is titled 'GNSS' and 'Plot 1'.
17	17	K70LFW	einseitige Platine	 Plot showing GSM spectrum for UUT 17. The y-axis is labeled 'dBm' and ranges from -40 to 140. The x-axis is labeled 'MHz' and ranges from 880 to 960. The plot shows a signal at approximately 900 MHz with a peak level of about 120 dBm. The plot is titled 'GSM' and 'Plot 1'.	 Plot showing W-LAN spectrum for UUT 17. The y-axis is labeled 'dBm' and ranges from -40 to 140. The x-axis is labeled 'MHz' and ranges from 2400 to 2480. The plot shows a signal at approximately 2450 MHz with a peak level of about 120 dBm. The plot is titled 'W-LAN' and 'Plot 1'.	
18	18	K70XBRW	PLA 034 F	 Plot showing GSM spectrum for UUT 18. The y-axis is labeled 'dBm' and ranges from -40 to 140. The x-axis is labeled 'MHz' and ranges from 880 to 960. The plot shows a signal at approximately 900 MHz with a peak level of about 120 dBm. The plot is titled 'GSM' and 'Plot 1'.	 Plot showing W-LAN spectrum for UUT 18. The y-axis is labeled 'dBm' and ranges from -40 to 140. The x-axis is labeled 'MHz' and ranges from 2400 to 2480. The plot shows a signal at approximately 2450 MHz with a peak level of about 120 dBm. The plot is titled 'W-LAN' and 'Plot 1'.	

UUT No.	Ident. No.	Type	Platine	Messdaten GSM	Messdaten W-LAN	Messdaten GNSS / Navigation
19	19	K70XL1L2R	GPS L1/L2			
20	20	M90LXW	PLA_005_LTE			
21	No. 1 29.01. 2018	F71LGAR_0021_87_8 6_104_CL10.4_BL	PLA003_GA_REV2 Serienstand			

UUT No.	Ident. No.	Type	Platine	Messdaten GSM	Messdaten W-LAN	Messdaten GNSS / Navigation
22	No. 8 29.01. 2018	K71LFR_0016_87_10 4_CL11.4_BL	PLA003_U Serienstand	 Plot showing GSM spectrum for UUT 22. The plot displays signal strength across various frequency bands, with a notable peak in the 1800 MHz band.	 Plot showing W-LAN spectrum for UUT 22. The plot displays signal strength across various frequency bands, with a notable peak in the 2.4 GHz band.	 Plot showing GNSS spectrum for UUT 22. The plot displays signal strength across various frequency bands, with a notable peak in the 1.575 GHz band.
23	No. 7 29.01. 2018	F70LGAD_0100_89_8 8_103_ LI1.0	PLA_003GA Rev Serienstand	 Plot showing GSM spectrum for UUT 23. The plot displays signal strength across various frequency bands, with a notable peak in the 1800 MHz band.	 Plot showing W-LAN spectrum for UUT 23. The plot displays signal strength across various frequency bands, with a notable peak in the 2.4 GHz band.	 Plot showing GNSS spectrum for UUT 23. The plot displays signal strength across various frequency bands, with a notable peak in the 1.575 GHz band.
24	No. 5 29.01. 2018	F70XFR_ Directional Coupler	PLA_026	 Plot showing GSM spectrum for UUT 24. The plot displays signal strength across various frequency bands, with a notable peak in the 1800 MHz band.	 Plot showing W-LAN spectrum for UUT 24. The plot displays signal strength across various frequency bands, with a notable peak in the 2.4 GHz band.	 Plot showing GNSS spectrum for UUT 24. The plot displays signal strength across various frequency bands, with a notable peak in the 1.575 GHz band.