VolTron 1000 – SMD Style

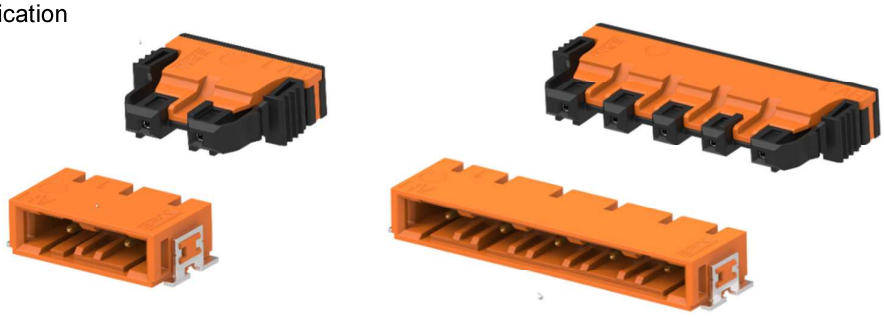
1. SCOPE

1.1. Content

This specification covers the performance, testing and quality requirements of the SMD - version of a VolTron 1000 connector for use in high voltage applications.

The qualification testing has been carried out representatively with the 2-pin and 5-pin 90°version.

1.2. Qualification



When tests are performed on the subject product line, procedures specified in 3.5 shall be used.

All inspections shall be performed using the applicable inspection plan and product drawing.

All test groups are performed according to the requirements defined within VW75174, VW80332, USCAR2, USCAR37.

1.3. Qualification Test Results

Products have passed successful qualification according to 2.2

2. APPLICABLE DOCUMENTS AND FORMS

The following documents and forms constitute a part of this specification to the extent specified herein. Unless otherwise indicated, the latest edition of the document applies.

In the event of conflict between the requirements of this specification and the product drawings, the product drawings shall take precedence. In the event of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

2.1. TE Documents

- 114-94917: Application Specification
- 501-19324: Qualification Test Report
- 501-137659: Temperature/ Vibration Test and Mechanical shock test
- C-544840-E PCB-Layout requirement – recommended (mandatory)
- TBD: Packaging Specification (TBD)

2.2. Industry Documents (applicable standards)

- DIN/IEC 60512: Electromechanical components for electronic equipments, basic testing procedures and measuring methods
- DIN EN 60068: Environmental tests
- IPC/JEDEC J-STD-020: Moisture/Reflow Sensitivity Classification for Non-hermetic Solid State Surface Mount Devices.
- VW 75174: Motor Vehicle Connectors – Tests (2018-10; 2010-04; 2004-10)
- VW 80332: Motor Vehicle High-Voltage Contacts (2019-01)
- USCAR2: Performance Specification for Automotive Electrical Connector Systems to SAE/USCAR-2 (2013-02)
- USCAR37: High Voltage Connector Performance - Supplement to SAE/ USCAR-2 (2008-08)

3. REQUIREMENTS

3.1. Design and Construction

Product shall be of the design, construction, materials and physical dimensions specified on the applicable product drawing.

The product has the following ratings (operating):

- Rated impulse voltage: 2500 Vdc for 1000 Vdc (operating voltage)
- mating cycles: ≥ 20
- Maximum operating altitude above sea level: 5000 m
- **The product has to be used in an IP protected enclosure**
- Pollution degrees 2 addition: restricted to a non-condensing environment.
  - (Not permitted: Condensation; Icing; rainfall; water; water drops)
- Moisture: Not permitted
- CPA-function: No
- Plastics Material group for all housings:
  - CTI > 600
  - Material-class: I
  - UL 94-V0
- *It is not intended to repair the female and male connector due to the installation situation*
- **THE CONNECTOR SHALL ONLY BE TOUCHED, PLUGGED AND / OR REMOVED IN A "POWER-FREE CONDITION" (see C-544840-E Drawing Layout requirement).**

Storage conditions:

- Male connectors: max. Temperature 30 °C / max. moisture 60% RH

3.2. Materials

Female housing 2-pin/ 5-pin	PA66-GF30 (black)
Female Cover 2-pin/ 5-pin	PPA-HT H FR HF (orange)
Female contact	CuNi2Si
Plating connection area	Sn over Ni
Plating contact area	Au over PdNi over Ni
Male housing	PPA-HT H FR HF (black/ orange)
Male contact	CuNi2Si
Plating connection (solder terminal) area	Sn over Ni
Plating contact area	Au flash over PdNi over Ni

3.3. Ratings

Part number	Name	Wire range*	Voltage	Current	Temp. range
524191-E	Female connector 2-pin black encoding, 6.2 SRC-A crimp	Cable Electroair KZ 06 AWG22 (7x0,25) Conductor: Stranded copper wire, silver-plated Insulation: PTFE tapes	1000 Vdc	Original design target min.: 0.5 A Actual: current carrying capability See derating	-40 °C to +150 °C.
524192-E	Female connector 2-pin orange encoding 6.2 SRC-A crimp				
524197-E	Female connector 5-pin black encoding, 6.2 SRC-A crimp				
524198-E	Female connector 5-pin orange encoding 6.2 SRC-A crimp				
524226-E	Male connector 2-pin black encoding 6.2 SRC-A SMT angled	-			
524227-E	Male connector 2-pin orange encoding 6.2 SRC-A SMT angled	-			
524232-E	Male connector 5-pin black encoding 6.2 SRC-A SMT angled	-			
524233-E	Male connector 5-pin orange encoding 6.2 SRC-A SMT angled	-			
464762-E 464763-E	Female contact	AWG22			
817149-E	Cable Electroair KZ 06 Conductor: Stranded copper wire, silver-plated Insulation: PTFE tapes (Aeronautic and Defence NF C 93-523) (Flame retardant: IEC 60332-1-2 / EN 60332-1-2 /NF C 32-070 test C2, FAR 25)	AWG22 (7x0,25)	1000 Vdc		-90 °C to +200 °C.

* the following cable have been approved in combination with the VolTron 1000

3.4. Quality Assurance Provision

3.4.1. Test Condition

Unless otherwise specified, all tests shall be performed at ambient environmental conditions.

Temperature	15 – 35 °C
Relative humidity	25 - 75%
Atmospheric pressure	86 – 106 kPa

3.5. Test Requirements and Procedures Summary

* [TGXX]: Numbering based on the test groups according to VW75174 and VW80332

	TEST DESCRIPTION	REQUIREMENT	PROCEDURE
3.5.1.	Initial examination of product / Visual inspection [TG0] [TG1]*	Meets requirements of product drawing (drawing conformity)	DIN EN 60512-1-1 DIN EN 60512-1-2
3.5.2.	Final examination of product	Meets visual requirements	
3.5.3.	Heat resistance to reflow soldering	20 - 40 sec. at max. temp. 260 °C	IPC / JEDEC J-STD 020

	ELECTRICAL		
3.5.4.	Volume resistance in contact area (RC) [TG0]*	R = R_C + 2x R_{CA} < 16 mΩ	DIN EN 60512-2-1
	Volume resistance in connection area (RCA) [TG0]*		DIN EN 60512-2-1
3.5.5.	Insulation resistance [TG0]*	R_{Isol} > 100 MΩ at U = 500 V, t = 60 s R_{Isol} > 200 MΩ at U = 1000 V, t = 60 s	DIN EN 60512-3-1 Standard housing, pitch 6.2 mm Only potentials to each other. VW80332 only measurement task 1 is applicable
3.5.6.	Dielectric withstanding voltage	Neither creeping discharge nor flashover shall occur. Current leakage: < 10 mA (2150 Vdc = 1 mA) (4800 Vdc = 2 mA)	Dielectric strength is determined in mated condition, without applied foil wrap 2150 Vdc for 1 min. - VW80303 4800 Vdc for 1 min. - USCAR37 (1600 + 3.2 x 1000 Vdc = 4800 Vdc)
3.5.7.	Current heating, derating [TG12]*	Current excess temperature Derating without housing	DIN EN 60512-5-1 DIN EN 60512-5-2 Ambient temperature is measured in 50 mm distance to the hottest point: Contact point between the female and the male contact
3.5.8.	Influence of the contact housing on the derating [TG13]*	Current overtemperature with contact housing Derating with contact housing See figures chapter 4.1	DIN EN 60512-5-1 DIN EN 60512-5-2
3.5.9.	Thermal time constant [TG14]*	See diagram thermal time constant, chapter 4.2	T_{Test}= 80 °C/ $I_{nom.}$= 8.56 A

		MECHANICAL	
3.5.10.	Contact overlap [TG4]*	Primary- and secondary locking: Contact overlap ≥ 1 mm	Theoretical proof (CAD)
3.5.11.	Handling and functional reliability of the contact housings [TG7]*	Distinctiveness of the unequipped contact housings Keying-Efficiency: F_{COD} ≥ 80 N Polarization-Efficiency: F_{POL} ≥ 80 N Holding force of the contact housing latching/locking Retention Force: F_{Hold} ≥ 100 N Insertion Force: F_{In} ≤ 75 N	DIN EN 60512-13-5 DIN EN 60512-15-6
3.5.12.	Insertion and holding forces of the contact parts in the contact housing [TG8]*	Contact insertion force: F_{in} ≤ 6,0 N Contact retention force, primary lock: F_{prim} > 30 N Contact retention force, secondary lock: F_{sec} > 30 N	
3.5.13.	Pin insertion angle/misuse-proofing (scoop-proofing) [TG9]*	Scoop proof testing of contact housing: Skewed Insertion, that damages the contacts, is not possible. Koshiri-Protection is provided.	Theoretical proof (CAD)
3.5.14.	Contacts: conductor pull-out strength [TG10]*	Conductor pull-out strength: F_{pull} > 75 N	Only with crimp connection. AWG22 wires (ELECTROAIR KZ06) according to IEC 60332-1
3.5.15.	Contacts: Insertion and removal forces, number of mating cycles [TG11]* Plugging and removal force	Mating force variation ≤ 25% to first cycle permitted Number of mating cycle: Au: min. 100 cycles	Insertion and extraction force, without additional lubricants

3.5.16.	Dynamic loading [TG17]* Volume resistance: Dynamic load, broadband noise: Shock durability testing: Volume resistance:	See chapter 4.3 $R_{initial}$ < 16 mΩ No current interruption (> 1 µs / >7 Ohm) R_{final} < 16 mΩ	VW75174: severity level 2 /temperature profile 2 cable fastening referring VW80332 in distances of 100 mm and 250 mm DIN EN 60512-2-1 DIN EN 60068-2-64 DIN EN 60068-2-27 DIN EN 60512-2-1
3.5.17.	Temperature/ vibration [1)] Volume resistance: Volume resistance:	See figure chapter 4.4 $R_{initial}$ < 15 mΩ No current interruption (> 1 µs / >7 Ohm) R_{final} < 15 mΩ	Only 5-pin: (524197-E / 524232-E) Temperature profile see chapter 4.4 refer USCAR-2, Vibration profile chapter 4.4
3.5.18.	Mechanical shock [1)]	See figure chapter 4.5 No current interruption (> 1 µs / >7 Ohm)	Only 5-pin: (524197-E / 524232-E) Shock profile chapter 4.5

1) In many cases, real-world environmental stress (singularly or in combination) cannot duplicate practically or in reliably in test laboratories. Therefore, users should not assume that a connector system that passes laboratory test would also pass testing on system or component level or on field/fleet verification trials. Risk level is highly dependent on customer's design for mitigation in vibration. Therefore, the customer must take appropriate measures to reduce vibrations depending on the application.

	ENVIRONMENTAL		
3.5.19.	Mechanical and thermal relaxation behavior [TG5]*		DIN EN 60068-2-2 /Test B Measured indirectly via retention force with gauge Aging in dry heat: 1 - 1000 h at 150 °C
3.5.20.	Electrical stress test [TG15]* Volume resistance: Temperature/ current cycle endurance test: Damp heat, cyclic: Temperature/ current cycle endurance test: Volume resistance:	 $R_{initial}$ < 16 mΩ R_{final} < 16 mΩ	The DUTs are inserted and extracted 2 times DIN EN 60512-2-1 DIN EN 60068-2-30 DIN EN 60512-2-1
3.5.21.	Environmental simulation [TG19]* Volume resistance: Temperature shock: Temperature change: Aging in dry heat: Industrial climate: Damp heat, cyclic: Dynamic load, broadband noise: Mechanical shock testing: Volume resistance:	 $R_{initial}$ < 16 mΩ R_{final} < 16 mΩ	 DIN EN 60512-2-1 DIN EN 60068-2-14, Test Na DIN EN 60068-2-14, Test Nb DIN EN 60068-2-2, Test Nb DIN EN 60512-11-7 DIN EN 60068-2-30, variant 2 DIN EN 60068-2-64 DIN EN 60068-2-27 DIN EN 60512-2-1
3.5.22.	Climatic load of the housing [TG20]* Insulation resistance: Aging in dry heat: Aging in damp heat, constant: Insulation resistance: Low-temperature aging: Extracting and inserting: Aging in dry heat: Drop test in the unplugged state:	R_{Isol} > 100 MΩ at U = 500 V, t = 60 s at U = 1000 V, t = 60 s R_{Isol} > 100 MΩ at – 20 °C: passed	VW80332 additional to measure with 1000 Vdc DIN EN 60512-3-1 DIN EN 60068-2-2, Test B DIN EN 60068-2-30 DIN EN 60512-3-1 DIN EN 60068-2-1 DIN EN 60068-2-2, Test B Drop test in accordance with VW75174 (2004-10)

3.5.23.	Long-term temperature aging [TG21]* Volume resistance: Long-term aging in dry heat: Volume resistance: Drop test: Contact extraction force:	 $R_{initial}$ < 16 mΩ R_{final} < 16 mΩ F_{Hold} ≥ 55 N	 DIN EN 60512-2-1 DIN EN 60068-2-2, Test B 1000 h at 150 °C DIN EN 60512-2-1 Drop in accordance with VW75174 (2004-10)
3.5.24.	Resistance to chemicals [TG22]* Insulation resistance: Resistance to chemicals: Insulation resistance:	R_{Isol} > 100 MΩ at U = 500 V, t = 60 s at U = 1000 V, t = 60 s R_{Isol} > 100 MΩ	VW80332 additional to measure with 1000 Vdc DIN EN 60512-3-1 according to VW 75174 (2018-10), used chemicals see Appendix 4.6 DIN EN 60512-3-1

3.6. Product Qualification and Requalification Test Sequence

Test groups and sequences are to be carried out in accordance with VW75174 and VW 80332.
More information can be found in 501-19324.

4. APPENDIX

4.1. Influence of the contact housing on the derating [TG13]*

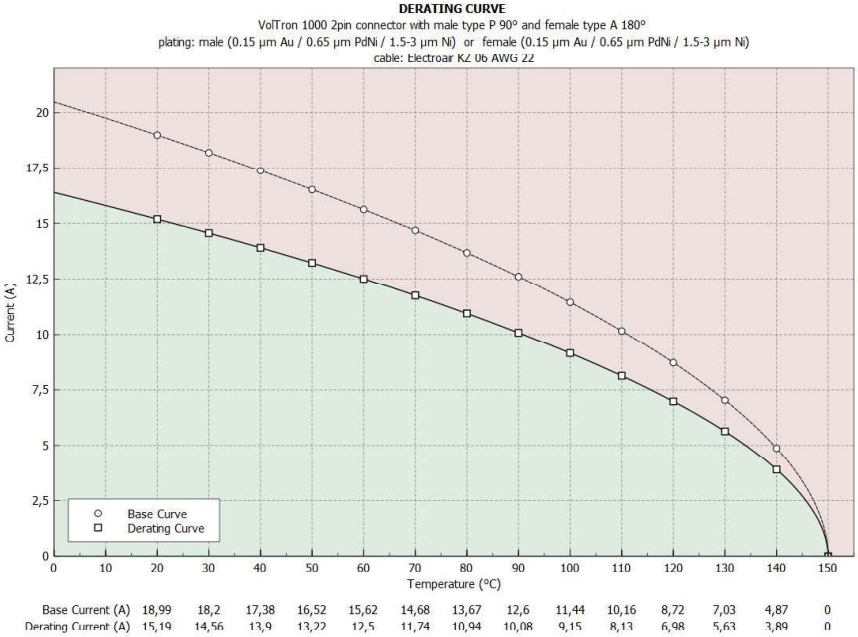


Figure 1: Derating curve 2-pin, ID: 524191 + 524226

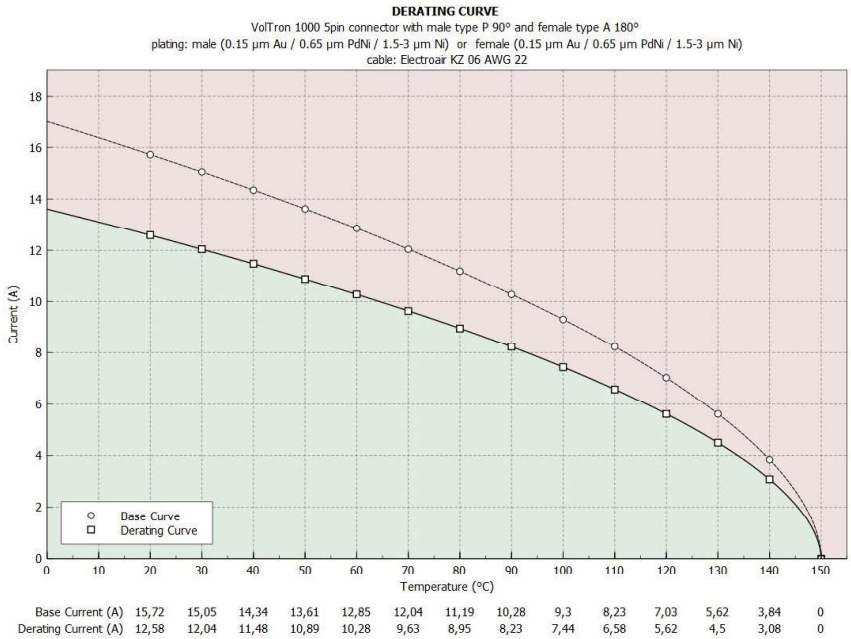


Figure 2: Derating curve 5-pin, ID: 524197 + 524232

4.2. Thermal time constant [TG14]*

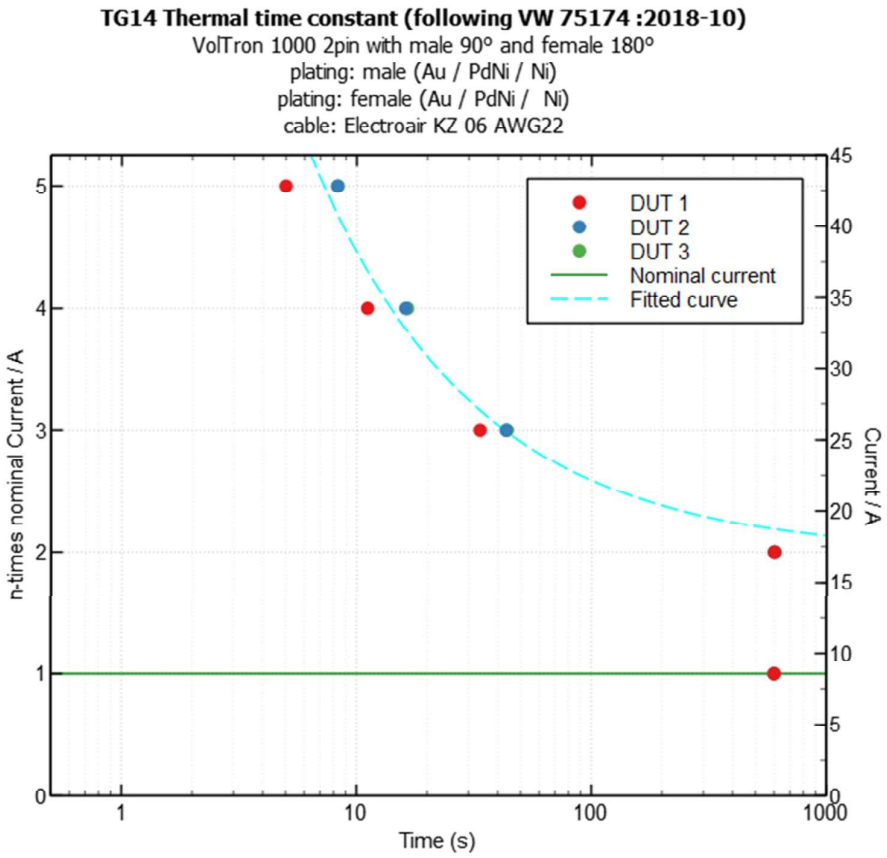


Figure 3: Thermal time constant: Current over time diagram

The values of DUT 2 and DUT 3 are very similar that's why these data points in Figure 3 are on top of each other.

4.3. Test setup [TG 17]*: VW75174

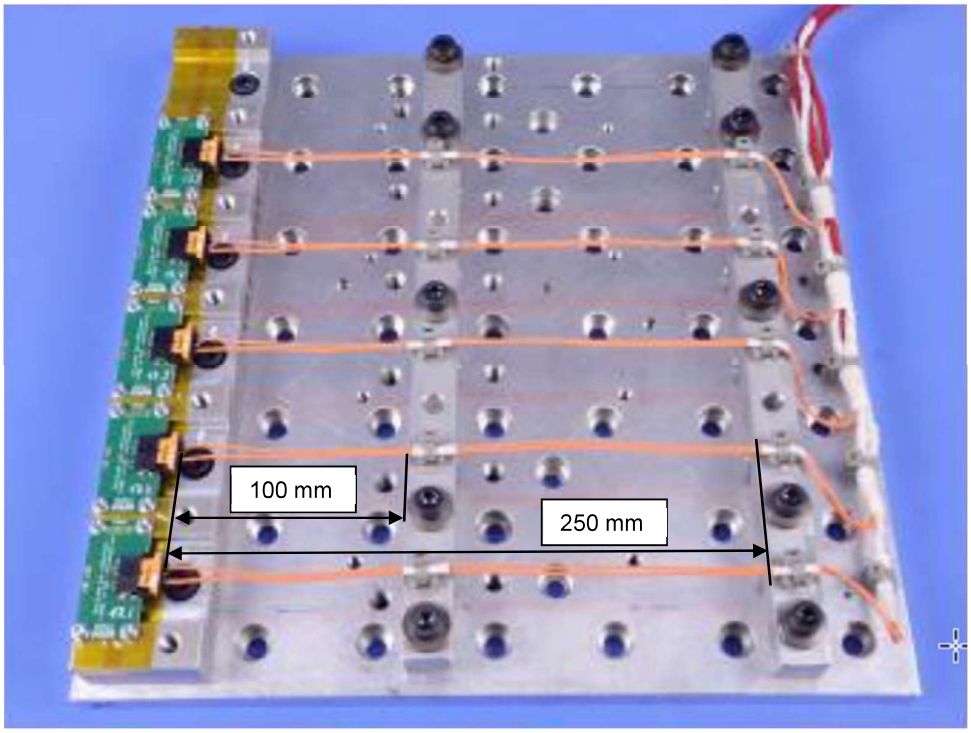


Figure 4: cable fastening distances of 100 mm and 250 mm

Severity	TC	Noise with TC		Vibration excitation, sinusoidal, with TC	Number of shocks
2. "Body" sealed	0 min/20 °C 60 min/-40 °C 150 min/-40 °C 300 min/120 °C 420 min/120 °C 480 min/20 °C	20 h per axis; RMS value of acceleration: 27.8 m/s^2		No sine wave	a [a] = 30 g t [b] = 6 ms sinusoidal half-wave No. of shocks: 6 000
		Hz [c]	(m/s2)2/Hz [d]		
		10	20		
		55	6.5		
		180	0.25		
		300	0.25		
		360	0.14		
		1000	0.14		

a) Acceleration
b) Cycle duration
c) Frequency
d) Power density spectrum

Table 1: Test profile TG17 – VW75174

4.4. Test setup - temperature/ vibration

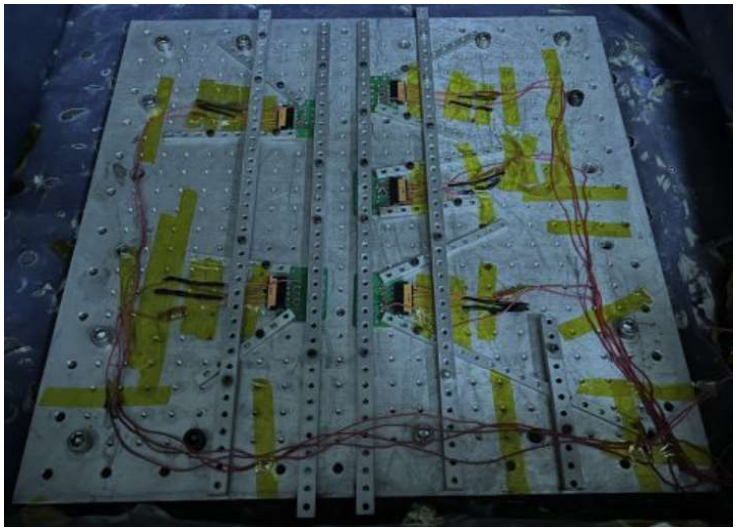


Figure 5: cable fastening distances according to customer specifications

Time(min)	Temperature(℃)
30	-40~90
40	90
10	90~125
120	125
40	125~-40
120	-40
Temperature Condition	

Table 2: temperature cycle (refer to USCAR-2 Rev 6)

Frequency (Hz)	PSD $(m/s^2)^2/Hz$	RMS (m/s^2)	Test axis	Test time
10	10	96.6	X,Y,Z	22h/axis
100	10			
300	0.51			
500	5			
2000	5			
Vibration Condition				

Table 3: vibration cycle

4.5. Test setup - Mechanical shock

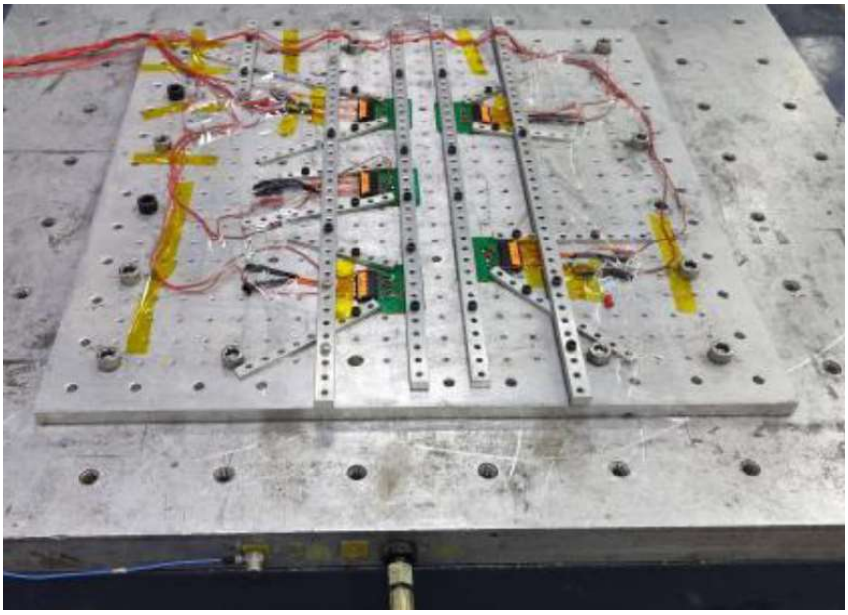


Figure 6: cable fastening distances according to customer specifications

Shock shape	Acceleration (m/s^2)	Pulse width (ms)	Test direction	Number of shock
Half sine pulse	500	6	±X, ±Y, ±Z,	10 times per direction

Table 4: mechanical shock cycle

4.6. Overview of used chemicals [TG22]*

No.	Chemical agent	Used chemical agent
1	Cold-cleaning agent / cockpit cleaning agent	presto Motorkaltreiniger
2	Penetrating oil	WD 40 Aerosol, Spray Applicator
3	Undiluted washer fluid antifreeze	Klarblick -60 °C
4	Isopropanol	2-Propanol
5	Grease	Interflon Fin Food Grease EP

Table 5: used chemical agents

5. REVISION HISTORY TABLE

LTR	Revision record	Drafted	Approved	Signature	Date
A	Initial Release	Gerhard Luck	Oberschelp		21 June 2023