Bonding Tester
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REASONS FOR BONDING TESTS?

Aircraft are very complex electrically and structurally:

They

> can be struck by lightning
> are exposed to external fields and electrostatic charging
> are exposed to large temperature differences
> are liable to corrosion due to large environmental variations
> have to be suitably treated to minimize or prevent damage

Due to the above factors it is essential that NDT Conductivity Testing is carried out to ensure structural and electrical integrity!

In the age of Digital FLY BY WIRE control systems it has become more important than ever to ensure flight safety by performing accurate regular inspection. The control system must always work.

Aircraft although similar to a Faraday cage differ in that lightning strikes (lightning current) create electromagnetic fields, which, when coupled through openings into the wiring and equipment, cause high voltages. This can have serious consequences such as power supply interruption, malfunction of the computers or total shutdown of certain equipments and/or systems. Additional damage can occur to composite structures by lightning current flow via components e.g. flaps, valves, joints, pipe connections and equipment connector plugs.

Aircraft are exposed to a large number of environmental challenges: lightning strikes, electromagnetic fields (radar, wireless and television, cosmic radiation), bird strikes, storm, hail, rain, humidity, rapid extreme pressure and temperature changes which result in vibration and shock loading, all of which have an adverse effect on aircraft life and performance.

Electrostatic charges are generally created by flight through clouds by aircraft and in dust laden low level air by helicopters. To prevent unintentional electrical discharge between aircraft components, all parts including the antennas should be conductively connected to one another in order to prevent...
DAMAGE LIMITATION AND PREVENTION

Equipments and their wiring must be screened and grounded in order to protect the flight critical aircraft components and systems from damage. As the grounding of an aircraft cannot be performed in the normal way, the whole aircraft itself is used as ground.

In addition special methods and materials are used during manufacture to prevent corrosion as far as is possible. Critical areas are protected by using special sealing material and paint.

The fuel tanks must have a redundant electrical bonding to ensure prevention of the possibility of an explosion if normal bonding fails i.e. failsafe.

A continuous good electricity conductivity of the aircraft structure, especially of the outer skin, minimises or protects it from damage by lightning strikes or electrostatic discharges. Structures made of fiber composites together with associated equipment and wires are especially prone to damage.

It is very important that junctions, screw connections, connectors, earthing cables, cable ducts, etc. are tested for conductivity, but they are often very difficult to access.

By testing the resistance of screens, equipment, structural components etc. it is possible to detect compliance to regulations during manufacturing processes, or if the connections, despite ageing, meet the requirements.

The performance of these measures in the manufacture and in service phases is naturally subject to stringent quality control.
TESTING

TEST-FUCHS has developed and launched convenient test equipment to meet stringent safety critical requirements of bonding testing.

The tests can be easily carried out by a single operator and it is not required to remove parts or loosen screw connections. All equipments are battery operated, easy to use and compact to ensure easy use in difficult to access points.

Three different types of equipment are offered for testing the following test requirements:

- Bonding Tester
- Loop Resistance Tester
- Anti Static Paint Tester

CALIBRATION

> TEST-FUCHS recommends yearly calibration of these systems to safeguard the system specification compliance.

> Calibration can also be carried out by the customer if he has the necessary competence, equipment and experience. If required, TEST-FUCHS can provide the necessary training and technical information.

> Our experience shows however that most of customers prefer TEST-FUCHS to carry out calibration.

Our calibration record can be seen in the following list.

- 1960 - Establishment of its own calibration laboratory
  Calibration in accordance with instructions of AQAP at the time

- 1996 - Introduction of the ISO 9001
  Calibration in accordance with ISO 9001 Standard

- 2004 - Accreditation as DKD Calibration Laboratory
  Calibration in accordance with DIN EN ISO/IEC 17 025
  Registration no: DKD-K-39301

> Calibration can be carried out at the Customer’s premises or on our premises.

> Calibration carried out on our premises depending on urgency takes, 3 to 5 working days, at the Customer’s, normally 2 to 3 weeks.

> To reduce the Customer’s maintenance staff’s workload we can perform the following maintenance tasks:

- Function testing
- Electrical safety testing to BGV A3
- Integrity testing
- Preventive maintenance
BONDING TESTER - FUNCTION

All conductive aircraft components are electrically connected to one another. These connections must have a minimal electrical resistance to prevent damage in cases of lightning strike or residual current in the aircraft systems.

Test points are the screening, screw connections, earthing straps, and pipes including connections. A test current (e.g. 10A) is fed into the measurement point. Based on the voltage drop the contact resistance is calculated.

TEST-FUCHS Bonding Testers are designed to enable resistance measurements to be easily and accurately measured, especially on extremely low impedance UUTs.

Measuring principle:

Used Test Currents:

- 10ADC Normally
- 100 - 150ADC For tests between wings and fuselage
- 0.1ADC For sensitive UUTs

Typical Connection Resistance:

1-100mΩ

Operational Methods:

The Bonding Testers use the so called 4 wire system method (the KELVIN Method). Thus all the Transition and Cable resistances will be compensated to ensure that the test results are correct.

Testing times:

These are dependant on the type of bonding tester used.

TEST-FUCHS has developed test cables to match any testing requirements. The customer can choose the appropriate length and end connections depending on the area of application. There are A, B and AB cables available. E.g. for a full 4 wire measurement test either an A and a B cable are required or a combined AB cable.
The Bonding Tester >MVP10L-FS< is used for fast and simple inspection of bonding connections. Test currents of up to 10A are injected and the contact resistance is measured using the 4 wire test method.

> Especially light and ergonomic design
> Easy to read large display
> Battery powered, rechargeable in situ or removed
> Has a galvanically isolated interface for remote control or data exchange
> Measurement current up to 10A with impulse current testing, automatic field switching and automatic polarity reversal
> Automatic 4 wire identification
> Can be hand carried, shoulder strap carried or operated placed on a suitable surface

### TECHNICAL DATA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply:</td>
<td>To charge the battery 1/N/PE AC 50Hz 230V ± 10%</td>
</tr>
<tr>
<td>Battery life:</td>
<td>up to 2000 measurement /charging</td>
</tr>
<tr>
<td>Battery:</td>
<td>2 x 7.2V Li-Ion</td>
</tr>
<tr>
<td>Charging time:</td>
<td>6 hours</td>
</tr>
<tr>
<td>Test current:</td>
<td>0.1A; 1A; 10A</td>
</tr>
<tr>
<td>Test voltage:</td>
<td>max. 8V</td>
</tr>
<tr>
<td>Pulse duration:</td>
<td>1sec, 3sec</td>
</tr>
<tr>
<td>Measurement mode:</td>
<td>2 or 4 wire measurement</td>
</tr>
<tr>
<td>Resolution:</td>
<td>from 1μΩ on</td>
</tr>
<tr>
<td>Accuracy:</td>
<td>± 0.2% of full scale and ± 0.2% of reading</td>
</tr>
<tr>
<td>Measurement range:</td>
<td>1mΩ, 10mΩ, 100mΩ, 600mΩ, 1Ω, 6Ω, 10Ω, 60Ω, 600Ω, 6kΩ, 60kΩ, 600kΩ for each measurement current</td>
</tr>
<tr>
<td>Measured value storage:</td>
<td>1000 measurement</td>
</tr>
<tr>
<td>Dimensions:</td>
<td>approx 25 x 13 x 16cm</td>
</tr>
<tr>
<td>Weight of equipment:</td>
<td>approx 2.8kg</td>
</tr>
</tbody>
</table>

### INCLUDED IN STANDARD SCOPE OF DELIVERY:

- **Battery package**
  2 Batteries “SWIT S-8970"
  (TEST-FUCHS item no. 106220138)

- **Power supply unit incl. powercable** for battery charging „S306287“
  (TEST-FUCHS item no. 103070362)

- **Shoulder strap „1472“**
  (TEST-FUCHS item no. 106330923)

### NOTE:

The required Measurement Cables are not included in the standard scope of delivery.
Optional Accessories for Bonding Tester

**>MVP10L-FS<**

**Transport case „EXPLORER“** (TEST-FUCHS item no. 107101335)

- Very robust, stackable
- Lined with foam
- Storage compartment for: Bonding Tester <mvp10l-fs>, Accessories, Documentation
- Dimensions: approx 58 x 44 x 16cm
- Weight: approx 5kg

**Battery Package (2 Batteries „SWIT S-8970“** (TEST-FUCHS item no. 106220138)

- Manufacturer: SWIT
- Model: S-8970
- Output voltage: 7.2V
- Power: 47.5Wh
- Intermediate charging possible (no memory effect)
- The equipment is fitted with 2 batteries

**External Charger for 2 Batteries incl. Power Cable** (TEST-FUCHS item no. 106220111)

- Manufacturer: SWIT
- Model: SC-3602F
- Input: AC 100 - 240V; 50 / 60Hz
- Output: DC 7 - 8.4V; 1.8A
- Possible to charge 2 batteries at the same time
Recommended Standard Measurement Cables for Bonding Tester

**NOTE:**
For operation at least a measurement cable A and a measurement cable B are required. The measurement cables are each delivered in a labeled cable bag.

**PKL668-9** (Measurement cable B) (TEST-FUCHS item no. 103240297)

The measurement cable is suitable for a fast bonding testing on stiff UUTs.

- **Type:** Test pin with spring mounted test prod
- **Max current:** max. 10A
- **Cable length:** 3m
- **Test pin handle:** ø 30 x 170mm
- **Test prod:** ø 6 x 95mm

**PKL668-12** (Measurement cable A) (TEST-FUCHS item no. 103240298)

The measurement cable is suitable for the ground connection at the UUT. Each current and voltage poles are connected fixed with the structure.

- **Type:** Ground connection cable with 2 alligator clips
- **Max current:** max. 10A
- **Cable length:** 5m
- **Safety tapper:** 2 x XKK-1001

**FURTHER MEASUREMENT CABLES**

**PKL668-2** (Measurement cable A+B) (TEST-FUCHS item no. 103240198)

The measurement cable is suitable for testing single screw connections. When placing the test prod on a measurement point, make sure all four contact points sit well. The measurement is carried out single-handed.

- **Type:** 4 wire test pin for miniature UUTs (screw head)
- **Max current:** max. 10A
- **Cable length:** 2.5m
- **Test pin handle:** ø 16 x 70mm
- **Test prod:** ø 8 x 12mm
PKL668-3 (Measurement cable A+B) (TEST-FUCHS item no. 103240316)

This measurement cable is suitable for connection testing of pressed metallic screens. The measurement is carried out single-handed.

Type: 4 wire test prod, spring mounted
Max current: max. 10A
Cable length: 2.5m
Test pin handle: 30 x 22 x 145mm
Test prod: ø 7 x 22mm

PKL668-4 (Measurement cable A+B) (TEST-FUCHS item no. 103240296)

The measurement cable is suitable for general applications, where contact point to be measured is less than 12mm wide. The measurement is carried out single-handed.

Type: 4 wire test prod, spring mounted
Max current: max. 10A
Cable length: 2.5m
Test pin handle: 30 x 22 x 145mm
Test prod: ø 7 x 22mm

PKL668-14 (Measurement cable A) (TEST-FUCHS item no. 103240310)

This measurement cable is suitable for a fast bonding testing on stiff UUTs.

Type: Test pin with spring mounted test prod
Max current: max. 10A
Cable length: 3m
Test pin handle: ø 30 x 170mm
Test prod: ø 6 x 95mm

SPECIAL MODELS OR OTHER CABLE LENGTHS ARE AVAILABLE ON REQUEST!
The Bonding Tester <MVP10R-FS> is designed for fast and simple inspection of bonding. Test currents of up to 10A are injected and the contact resistance is measured using the 4 wire test method.

The 19” rack design enables the tester to be incorporated into a special to type test system.

> Easy to read large display
> Has a galvanically isolated interface for remote control or data exchange
> Measurement current up to 10A with impulse current testing, automatic field switching and automatic polarity reversal
> Automatic 4 wire identification
> Two off connector sockets are fitted to the front and rear of the equipment

**TECHNICAL DATA**

<table>
<thead>
<tr>
<th>Power connection: 1/N/PE AC 50Hz 230V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal current: 0.7A</td>
</tr>
<tr>
<td>Test current: 0.1A; 1A; 10A</td>
</tr>
<tr>
<td>Test voltage: max. 8V</td>
</tr>
<tr>
<td>Pulse duration: 1sec, 3sec</td>
</tr>
<tr>
<td>Measurement mode: 2 or 4 wire measurement</td>
</tr>
<tr>
<td>Resolution: from 1μΩ on</td>
</tr>
<tr>
<td>Accuracy: ± 0.2% of full scale and ± 0.2% of reading</td>
</tr>
<tr>
<td>Measurement range: 1mΩ, 10mΩ, 100mΩ, 600mΩ, 1Ω, 6Ω, 10Ω, 60Ω, 600Ω, 6kΩ, 60kΩ, 600kΩ for each measurement current</td>
</tr>
<tr>
<td>Dimensions: approx 45 x 25 x 13 cm</td>
</tr>
<tr>
<td>Weight of equipment: approx 5.4kg</td>
</tr>
</tbody>
</table>

**INCLUDED IN STANDARD SCOPE OF DELIVERY:**

- Power cable (TEST-FUCHS item no. 103240028)
- <MVP10R-FS> (TEST-FUCHS item no. 151020024)

**OPTIONAL ACCESSORIES:**

- Power cable (TEST-FUCHS item no. 103240028)
- 19” Housing (TEST-FUCHS item no. 107100466)

**NOTE:**

The required Measurement Cables are not included in the standard scope of delivery. All accessories are in the brochures of the “bonding tester <MVP10L-FS>”.

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Test Equipment, Bonding Tester

>PA-MVP11<

The Bonding Tester >PA-MVP11< can be used for inspection of bondings using a test current of up to 200A continuous current.

- Usable on all aircraft types
- Display and operating controls are laid out in an easy to use manner
- A GRP - carrying case is provided to ensure the tester is not damaged during the transport
- The tester is compactly designed

**TECHNICAL DATA**

<table>
<thead>
<tr>
<th>Current measurement with digital ammeter:</th>
<th>Output current:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range: 0 - 200A</td>
<td>0 - 200ADC</td>
</tr>
<tr>
<td>Accuracy: ± 0.5% of full scale</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voltage drop measurement digital voltmeter:</th>
<th>Power connection:</th>
<th>Back-up fuse:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range: 0 - 2000mV</td>
<td>1/N/PE AC 50Hz 230V</td>
<td>16A</td>
</tr>
<tr>
<td>Accuracy: ± 0.5% of full scale</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Dimensions: approx 63 x 49 x 39cm
- Weight incl. test cable: approx 53kg

**INCLUDED IN STANDARD SCOPE OF DELIVERY:**

- 2 Measurement cables with alligator clip (each 10m)
- 2 Test cables for 200A (each 10m)
- 1 Power cable
- 2 Safety tapper
- 5 Cable bags
LOOP RESISTANCE TESTER - FUNCTION

Electrical cables are screened at both ends and designed to form an electrical loop in which the current flows through the cable and back through the screen. As a result, a magnetic field appears which is eliminated by the voltage build-up. If the loop resistance is kept at a minimum, then the maximum level of safety has been reached. The loop resistance of non-electrical loops (pipes and flaps with multiple ground connections) can also be measured in this way.

The Loop Resistance is tested accurately with easy to use equipment.

TEST-FUCHS Loop Resistance Testers are designed to enable loop resistance measurements to be easily and accurately carried out.

MEASURING PRINCIPLE:

Typical Loop Resistance:

2-100 mΩ

Operational Method:

Transformer principle with supply and measurement Clamps

Supply Frequency:

1 kHz oder 2kHz (special design)

The supply Clamp induces a current flow in the Bonding Loop to be tested. A second clamp measures the current in the loop. The applied voltage together with the measured current, phase selective, when calculated gives the measured impedance. As the loops are not always accessible, special to type or adaptable measurement Clamps could be required.

TEST-FUCHS has developed impedance measurement Clamps for test purposes. A unique feature (not available on the market) is the combination of supply and current measurement Clamps, which are screened from one another.

As an alternative more economical solution, split standard Clamps can be supplied.

Measurement Clamps are available with a variety of openings and the cable lengths can of course be supplied in accordance with the customer’s requirements.
Impedance Measurement Equipment >IM2-FS<

The Impedance Measurement Equipment >IM2-FS< is designed for fast and simple checking of loop impedance.

- Especially light and practical design
- Very large, easy to read display
- Battery powered, rechargeable in situ or removed
- Has a galvanically isolated interface for remote control or data exchange
- Automatic residual current compensation
- Range is switched automatically
- Used in conjunction with combined or separate measurement Clamps
- Search mode for rapid location of faulty connections

**TECHNICAL DATA**

<table>
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<tr>
<th>Feature</th>
<th>Specification</th>
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</thead>
<tbody>
<tr>
<td>Power operation:</td>
<td>1/N/PE AC 50Hz 230V ± 10%</td>
</tr>
<tr>
<td>Battery:</td>
<td>14.4V Li-Ion</td>
</tr>
<tr>
<td>Charging time:</td>
<td>6 hours</td>
</tr>
<tr>
<td>Measurement range:</td>
<td>depends on Clamps e.g. 20mΩ, 200mΩ</td>
</tr>
<tr>
<td>Data storage:</td>
<td>90 measured values</td>
</tr>
<tr>
<td>Max. resolution:</td>
<td>0.1mΩ</td>
</tr>
<tr>
<td>Output voltage:</td>
<td>max 70V</td>
</tr>
<tr>
<td>Output current:</td>
<td>max 1A</td>
</tr>
<tr>
<td>Measurement frequency:</td>
<td>1kHz ± 10Hz</td>
</tr>
<tr>
<td>Accuracy:</td>
<td>± 5% of full scale ± 4 digit</td>
</tr>
<tr>
<td>Dimensions:</td>
<td>approx 25 x 28 x 16cm</td>
</tr>
<tr>
<td>Weight of equipment:</td>
<td>approx 5kg</td>
</tr>
</tbody>
</table>

**INCLUDED IN STANDARD SCOPE OF DELIVERY:**

1 Battery “SWIT S-80805” (TEST-FUCHS item no. 106220098)

Self test UUT
- M882067 100mΩ (TEST-FUCHS item no. 103130581)
- M882071 10mΩ (TEST-FUCHS item no. 103130582)

Measurement cable set “S307073” with two banana plugs and test prods for Search Mode (TEST-FUCHS item no. 103191770)

Shoulder strap “1472” (TEST-FUCHS item no. 106330923)

Power supply unit incl. power cable for charging “S306287” (TEST-FUCHS item no. 103070362)

**NOTE:**
Measurement Clamps are not included in the standard scope of delivery and have to be ordered in accordance with customer requirements.
Optional Accessories for Impedance Measurement Equipment >IM2-FS<

**Transport case “FREIGHTAINER PLUS”** (TEST-FUCHS item no. 107101334)

Very robust, provided with transport roller  
Lined with foam  
Storage compartment for:  
- Impedance Measurement Equipment <IM2-FS>  
- Charger  
- 2 Batteries  
- Cable bags  
Dimensions: approx 60 x 45 x 18 cm  
Weight: approx 9kg

**Battery** (TEST-FUCHS item no: 106220098)

Manufacturer: SWIT  
Model: S-8080S  
Output voltage: 14,4V  
Power: 88Wh  
Intermediate charging possible (no memory effect)  
Diagnostic display

**Charger for Battery incl. Power Cable** (TEST-FUCHS item no: 106220099)

Manufacturer: SWIT  
Model: SC-3025  
Input: AC 100 - 240V; 50 / 60Hz  
Output: DC 14 - 20V; 1,9A  
Possible to charge 2 batteries at the same time
Recommended Standard Measurement Clamps for Impedance Measurement Equipment >IM2-FS<

**Note:**
For operation at least one Combined Measurement Clamp or two Single Measurement Clamps are required. The Measurement Clamps are delivered in labeled cable bags.

### IMPEDANCE MEASUREMENT CLAMP <IMZ1>
(TEST-FUCHS item no. 103130395)

- Robust design, symmetric Clamps
- Capable of being used with cables or metal rails up to a diameter of approx 70 mm
- Spring loaded to closed (operating) position
- Combined Supply and Measurement Clamps
- Shielded cable
- "Measure" button on the Electronic Unit

### TECHNICAL DATA

| Frequency: | for test equipments with 1 or 2kHz |
| Resistance range: | 20mΩ, 200mΩ |
| UUT diameter: | max. 70mm |
| Accuracy: | ± 5% of full scale ± 4 digit |
| Repetition accuracy of UUT variations position in clamp opening: | ± 3% of full scale ± 1mΩ |

| Overall dimension (without cable): | Width: approx 120mm |
| Depth: approx 40mm |
| Height: approx 260mm |
| Jaws opening: | approx 70mm |
| Weight: | approx 1.6kg |
| Cable length: | 3m |
IMPEDEANCE MEASUREMENT CLAMP <IMZ7>
(TEST-FUCHS item no. 150020514)

> Symmetric design
> Small measuring head
> Capable of being used with cables in a confined area of up to approx 26mm dia
> Spring loaded to closed (operating) position
> Combined Supply and Current Measurement Clamps
> Symmetric windings for high repetition accuracy
> "Measure" button
> Shielded cable

**TECHNICAL DATA**

| Frequency: | for test equipments with 1 or 2kHz |
| Resistance range: | 20mΩ, 200mΩ |
| UUT diameter: | max. 26mm |
| Accuracy: | ± 5% of full scale ± 4 digit |
| Repetition accuracy of UUT variations position in clamp opening: | ± 2% of full scale ± 1mΩ |

| Overall dimension (without cable): | Width: approx 58mm |
| Depth: | approx 31mm |
| Height: | approx 120mm |
| Jaws opening: | approx 31mm |
| Weight: | approx 500g |
| Cable length: | 3m |
Further Measurement Clamps

**IMPEDEANCE MEASUREMENT CLAMP <IMZ2>**
(TEST-FUCHS item no. 150020003)

- Robust design non-circular measurement Clamps
- The front face is narrower than the other parts of the jaws
- Capable of being used on cables in a confined area of up to approx 50mm dia
- Spring loaded to closed (operating) position
- Combined Supply and Current Measurement Clamps
- Shielded cable
- "Measure" button on the Electronic Unit

**TECHNICAL DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>for test equipments with 1 or 2kHz</td>
</tr>
<tr>
<td>Resistance range</td>
<td>20mΩ, 200mΩ</td>
</tr>
<tr>
<td>UUT diameter</td>
<td>max. 50mm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 5% of full scale ± 4 digit</td>
</tr>
<tr>
<td>Repetition accuracy of UUT variations position in clamp opening</td>
<td>± 3% of full scale ± 1mΩ</td>
</tr>
<tr>
<td>Overall dimension (without cable)</td>
<td></td>
</tr>
<tr>
<td>Width</td>
<td>approx 95mm</td>
</tr>
<tr>
<td>Depth</td>
<td>approx 50mm</td>
</tr>
<tr>
<td>Height</td>
<td>approx 255mm</td>
</tr>
<tr>
<td>Jaws opening</td>
<td>approx 50mm</td>
</tr>
<tr>
<td>Weight</td>
<td>approx 1.8kg</td>
</tr>
<tr>
<td>Cable length</td>
<td>3m</td>
</tr>
</tbody>
</table>
IMPEDEANCE MEASUREMENT CLAMP <IMZ3>
(TEST-FUCHS item no. 150020004)

> Robust design non-circular measurement Clamps
> Jaws are narrower on the lower side
> Capable of being used on cables in a confined area of up to approx 55mm dia
> Spring loaded to closed (operating) position
> Combined Supply and Current Measurement Clamps
> Shielded cable
> "Measure" button on the Electronic Unit

TECHNICAL DATA

<table>
<thead>
<tr>
<th>Frequency:</th>
<th>for test equipments with 1 or 2kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance range:</td>
<td>20mΩ, 200mΩ</td>
</tr>
<tr>
<td>UUT diameter:</td>
<td>max. 50mm</td>
</tr>
<tr>
<td>Accuracy:</td>
<td>± 5% of full scale ± 4 digit</td>
</tr>
<tr>
<td>Repetition accuracy of UUT variations position in clamp opening:</td>
<td>± 3% of full scale ± 1mΩ</td>
</tr>
</tbody>
</table>

| Overall dimension:       | Width: approx 105mm               |
| (without cable)          | Depth: approx 40mm                |
|                          | Height: approx 270mm              |
| Jaws opening:            | approx 55mm                       |
| Weight:                  | approx 1.5kg                      |
| Cable length:            | 3m                                |
IMPEDANCE MEASUREMENT CLAMP <IMZ4>
(TEST-FUCHS item no. 103130444)

> Robust design non-circular measurement Clamps
> Especially narrow design with short handles
> Capable of being used on cables in a confined area of up to approx 60 mm dia
> Spring loaded to closed (operating) position
> Combined Supply and Current Measurement Clamps
> Shielded cable
> “Measure” button at the Electronic Unit

TECHNICAL DATA

<table>
<thead>
<tr>
<th>Frequency: for test equipments with 1 or 2kHz</th>
<th>Overall dimension: (without cable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance range: 10mΩ, 200mΩ</td>
<td>Width: approx 85mm</td>
</tr>
<tr>
<td>UUT diameter: max. 60mm</td>
<td>Depth: approx 37mm</td>
</tr>
<tr>
<td>Accuracy: ± 5% of full scale ± 4 digit</td>
<td>Height: approx 175mm</td>
</tr>
<tr>
<td>Repetition accuracy of UUT variations position in clamp opening: ± 5% of full scale ± 1mΩ</td>
<td>Jaws opening: approx 60mm</td>
</tr>
<tr>
<td></td>
<td>Weight: approx 1.5kg</td>
</tr>
<tr>
<td></td>
<td>Cable length: 3m</td>
</tr>
</tbody>
</table>
SUPPLY CLAMP  <IMZ5>
(TEST-FUCHS item no. 150020064)

CURRENT MEASUREMENT CLAMP  <SMZ5>
(TEST-FUCHS item no. 150020065)

> Modified LEM PR 1201ACI
> An IMZ5 Supply Clamp and a SMZ5 Current Measurement Clamp are required for testing
> Capable of being used on cables and metal rails of up to approx 55mm dia
> Spring loaded to closed (operating) position
> Modified Split Standard Clamps
> An integrated “Measure” button is fitted to the Supply Clamp
> Both Clamps have arrows showing the current direction

SUPPLY CLAMP IMZ5

CURRENT MEASUREMENT CLAMP SMZ5

TECHNICAL DATA

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency:</td>
<td>for test equipments with 1 or 2kHz</td>
</tr>
<tr>
<td>Resistance range:</td>
<td>20mΩ, 200mΩ</td>
</tr>
<tr>
<td>UUT diameter:</td>
<td>max. 55mm</td>
</tr>
<tr>
<td>Accuracy:</td>
<td>± 5% of full scale ± 4 digit</td>
</tr>
<tr>
<td>Repetition accuracy of UUT variations position in clamp opening:</td>
<td>± 3% of full scale ± 1mΩ</td>
</tr>
<tr>
<td>Overall dimension:</td>
<td>Width: approx 106mm</td>
</tr>
<tr>
<td></td>
<td>Depth: approx 40mm</td>
</tr>
<tr>
<td></td>
<td>Height: approx 230mm</td>
</tr>
<tr>
<td>Jaws opening:</td>
<td>approx 55mm</td>
</tr>
<tr>
<td>Weight:</td>
<td>approx 1.6kg</td>
</tr>
<tr>
<td>Cable length:</td>
<td>3m</td>
</tr>
</tbody>
</table>
SUPPLY CLAMP  <IMZ6>  
(TEST-FUCHS item no. 150020590)

CURRENT MEASUREMENT CLAMP  
<SMZ6>  
(TEST-FUCHS item no. 150020589)

SET CONSISTS OF <IMZ6> + <SMZ6>  
(TEST-FUCHS item no. 150020591)

> Modified FLUKE i200
> For measurement both a Supply and a Current Measuring Clamps are required
> Capable of being used on cables and metal rails of up to approx 20mm dia
> Spring loaded to closed (operating) position
> Modified Split Standard Clamps
> An integrated “Measure” button is fitted to the Supply Clamps
> Both Clamps have arrows showing the current direction

TECHNICAL DATA

<table>
<thead>
<tr>
<th>Frequency: for test equipment with 1 or 2kHz</th>
<th>Overall dimension: (without cable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance range: 20mΩ, 200mΩ</td>
<td>Width: approx 50mm</td>
</tr>
<tr>
<td>UUT diameter: max. 20mm</td>
<td>Depth: approx 30mm</td>
</tr>
<tr>
<td>Accuracy: ± 5% of full scale ± 4 digit</td>
<td>Height: approx 135mm</td>
</tr>
<tr>
<td>Repetition accuracy of UUT variations position in clamp opening: ± 3% of full scale ± 1mΩ</td>
<td>Jaws opening: approx 21mm</td>
</tr>
<tr>
<td></td>
<td>Weight: approx 1.6kg</td>
</tr>
<tr>
<td></td>
<td>Cable length: 3m</td>
</tr>
</tbody>
</table>
**IMPEDEANCE MEASUREMENT CLAMP <IMZ8>**

(TEST-FUCHS item no. 150020608)

- Symmetric design
- Small measurement head
- Capable of being used on cables in a confined area of up to approx 36mm dia
- Spring loaded to closed (operating) position
- Combined Supply and Current Measurement Clamps
- Symmetric windings for high Repetition Accuracy
- "Measure" button

**TECHNICAL DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>for test equipment with 1 or 2kHz</td>
</tr>
<tr>
<td>Resistance range</td>
<td>20mΩ, 200mΩ</td>
</tr>
<tr>
<td>UUT diameter</td>
<td>max. 36mm</td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 5% of full scale ± 4 digit</td>
</tr>
<tr>
<td>Repetition accuracy of UUT</td>
<td>± 3% of full scale ± 1mΩ</td>
</tr>
<tr>
<td>Overall dimension:</td>
<td>Width: approx 72mm</td>
</tr>
<tr>
<td></td>
<td>Depth: approx 31mm</td>
</tr>
<tr>
<td></td>
<td>Height: approx 134mm</td>
</tr>
<tr>
<td></td>
<td>Jaws opening: approx 40mm</td>
</tr>
<tr>
<td></td>
<td>Weight: approx 1.4kg</td>
</tr>
<tr>
<td></td>
<td>Cable length: 3m</td>
</tr>
</tbody>
</table>
IMPEDANCE MEASUREMENT CLAMP <IMZ9>
(TEST-FUCHS item no. 150020613)

- Symmetric design
- Small measurement head
- Capable of being used on cables in a confined area of up to approx 66mm dia
- Spring loaded to closed (operating) position
- Combined Supply and Current Measurement Clamp
- Symmetric windings for high Repetition Accuracy
- "Measure" button

**TECHNICAL DATA**

<table>
<thead>
<tr>
<th>Frequency: for test equipment with 1 or 2kHz</th>
<th>Overall dimension: (without cable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance range: 20mΩ, 200mΩ</td>
<td>Width: approx 106mm</td>
</tr>
<tr>
<td>UUT diameter: max. 66mm</td>
<td>Depth: approx 38mm</td>
</tr>
<tr>
<td>Accuracy: ± 5% of full scale ± 4 digit</td>
<td>Height: approx 160mm</td>
</tr>
<tr>
<td>Repetition accuracy of UUT variations-position in clamp opening: ± 2% of full scale ± 1mΩ</td>
<td>Jaws opening: approx 68mm</td>
</tr>
<tr>
<td></td>
<td>Weight: approx 850g</td>
</tr>
<tr>
<td></td>
<td>Cable length: 3m</td>
</tr>
</tbody>
</table>
ANTISTATIC PAINT TESTING - FUNCTION

In order to dissipate electrostatic charges, all outer non-conductive surfaces of the aircraft are painted with a conductive coating (antistatic paint). On top of this coat a non-conductive, anti-corrosion paint is applied.

The antistatic paint must be tested for conductivity as well as its adhesion without damaging coatings. These measurements are carried out with special flexible (to match aircraft contours) measuring heads which are used in conjunction with Test-Fuchs Antistatic Paint Tester <IA2>.

TEST-FUCHS Antistatic Paint Tester enables quick, easy and accurate testing of the surfaces and volume resistances of aircraft exterior surfaces.

Composition of Antistatic Paint:

![Diagram of antistatic paint composition]

**Measurement mode S1:**
- Measurement of surface resistance through insulating layers:

**Measurement mode B1:**
- Measurement of resistance from the measurement point of the structure connection (volume resistance):

**Typical measured values:**
20 KOhm to 2 MOhm (volume resistance)

**Measurement frequency:**
20 kHz

TEST-FUCHS has developed Flexible Measuring Heads for Aircraft Contours.
Antistatic Paint Tester >IA2<

The Anti Static Paint Tester is designed for fast and simple testing of conductive layers and their bonding.

- Light, practical, robust Test Equipment
- Battery powered, rechargeable in situ or removed
- Measurement of surface resistance through insulated layers (Mode S1)
- Measurement of contact resistance (Mode B1) to the structure connection through insulated layers
- Automatic field switching
- Has a galvanically isolated interface for remote control or data exchange
- Specific measuring heads conforming to curved surfaces
- Visual and acoustic signals for over/under limit values

TECHNICAL DATA

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power operation with power supply:</td>
<td>1/N/PE AC 50Hz 230V ± 10%</td>
</tr>
<tr>
<td>Battery life:</td>
<td>&gt; 200 measurements</td>
</tr>
<tr>
<td>Battery:</td>
<td>7.2V Li-Ion</td>
</tr>
<tr>
<td>Charging time:</td>
<td>6 hours</td>
</tr>
<tr>
<td>Measurement mode:</td>
<td>S1: Surface-Surface and B1: Surface-Structure</td>
</tr>
<tr>
<td>Measuring frequency:</td>
<td>20kHz</td>
</tr>
<tr>
<td>Accuracy:</td>
<td>± 10% of reading ± 2 digit</td>
</tr>
<tr>
<td>Measurement range S1:</td>
<td>Depends on sensor (see data sheet)</td>
</tr>
<tr>
<td>Measurement range B1:</td>
<td>Depends on sensor (see data sheet)</td>
</tr>
<tr>
<td>Dimensions:</td>
<td>approx 25 x 13 x 16cm</td>
</tr>
<tr>
<td>Weight:</td>
<td>approx 2.5kg</td>
</tr>
</tbody>
</table>

INCLUDED IN STANDARD SCOPE OF DELIVERY:

- 1 Self test plate B1 <S306294> (TEST-FUCHS item no. 103230133)
- 1 Bonding cable PKL320-1 length: 5m (TEST-FUCHS item no. 103240311)
- 1 Battery „SWIT S-8970“ (TEST-FUCHS item no. 106220110)
- Shoulder strap „1472“ (TEST-FUCHS item no. 106330923)
- Power supply unit incl. power cable for charging „S306287“ (TEST-FUCHS item no. 103070362)

NOTE:

The required Measuring Head is not included in the standard scope of delivery but can be ordered separately, see next pages.
Optional Accessories

Antistatic Paint Tester ▶IA2◀

**Transport case „EXPLORER“** (TEST-FUCHS item no. 107101335)

- Very robust, stackable
- Lined with foam
- Storage compartment for:  
  - Antistatic Paint Tester ▶IA2◀  
  - Accessory  
  - Documentation
- Dimensions: approx 58 x 44 x 16cm
- Weight: approx 5kg

**Battery** (TEST-FUCHS item no. 106220110)

- Manufacturer: SWIT
- Model: S-8970
- Output voltage: 7.2V
- Power: 47.5Wh
- Intermediate charging possible (no memory effect)
- The equipment is fitted with one battery

**External Charger for 2 Batteries incl. Power Cable** (TEST-FUCHS item no. 106220111)

- Manufacturer: SWIT
- Model: SC-3602F
- Input: AC 100 - 240V, 50 / 60Hz
- Output: DC 7 - 8.4V, 1.8A
- Possible to charge 2 batteries at the same time
Recommended Standard Measuring Head for Antistatic Paint Tester \(>\text{IA2}<\)

\(<\text{IATP3}>\) Specially optimized for use in Measurement Mode B1 (TEST-FUCHS item no. 150020603)

- **Dimensions:** Ø 76 x 130mm
- **Connecting cable:** 3m
- **Measurement range:** B1: 20\(\Omega\) to 2M\(\Omega\)
- **Accuracy:** ±10% ±2 digit of reading
- **MAX-LED at head:** YES
- **Measurement button:** YES
- **Max. paint thickness:** 1mm
- **Maximum radius of the test surface:** 200mm
- **Contact pressure:** 0.2 to 2kg (2 to 20N) alternative
- **Special feature:** Skydrol resistant

**FURTHER MEASURING HEADS AND BONDING CABLES**

\(<\text{IATP1}>\) For universal use in Measurement Mode B1 and S1 (TEST-FUCHS item no. 150020055)

- **Dimensions:** Ø 76 x 130mm
- **Connecting cable:** 3m 3m
- **Measurement range S1:** 112k\(\Omega\)/sq to 470M\(\Omega\)/sq
- **Measurement range B1:** 5k\(\Omega\) to 10M\(\Omega\)
- **Accuracy:** ±10% ±4 digit of reading
- **MAX-LED at head:** YES
- **Measurement button:** YES
- **Max. paint thickness:** 0.5mm (50 k\(\Omega\) to 1M\(\Omega\))
- **Maximum radius of the test surface:** 200mm
- **Contact pressure:** 1kg constant (10N) required

**Bonding Cable Extension 5 m PKL320-2** (TEST-FUCHS item no. 103240318)

**Measuring Head Cable Extension 10 m PKL320-3** (TEST-FUCHS item no. 103240319)

**SPECIAL DESIGNS ARE AVAILABLE ON REQUEST!**
Bonding and Loop Resistance Tester >BLRT1<

The Bonding and Loop Resistance Tester >BLRT1< is a combined test equipment consisting of a 10A 4 wire Bonding Tester and an Impedance Tester.

- Easy to read large display
- Has a galvanically isolated interface for remote control or data exchange
- Automatic range switching
- Battery powered, rechargeable in situ or removed

BONDING TESTING
- 10A operation via pulsed current measurement
- Automatic 4 wire identification

LOOP TESTING
- Automatic residual current compensation
- Display of impedance Z, ohmic resistance R and inductance L
- Used in conjunction with combined or separate measurement Clamps
- Search mode for rapid location of faulty connections

TECHNICAL DATA

<table>
<thead>
<tr>
<th><strong>Power operation:</strong></th>
<th>1/N/PE AC 50Hz 230V ± 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Battery life:</strong></td>
<td>up to 2000 meas./charging</td>
</tr>
<tr>
<td><strong>Battery:</strong></td>
<td>2 x 7.2V Li-Ion</td>
</tr>
<tr>
<td><strong>Charging time:</strong></td>
<td>6 hours</td>
</tr>
<tr>
<td><strong>Dimensions:</strong></td>
<td>approx 25 x 28 x 16cm</td>
</tr>
<tr>
<td><strong>Weight of equipment:</strong></td>
<td>approx 7kg</td>
</tr>
</tbody>
</table>

BONDING

- Test current: 0.1A; 1A; 10A
- max. 8V
- Pulse duration: 1sec, 3sec
- Measurement ranges: 1Ω; 10Ω; 10mΩ; 100mΩ; 600mΩ; 1kΩ; 6kΩ; 10kΩ; 60kΩ; 600kΩ; 6MΩ for each measurement current

LOOP

- Measurement ranges: depends on Clamps e.g. 20mΩ, 200mΩ
- Max. resolution: 0.1mΩ
- Meas. frequency: 1kHz ± 100Hz
- Accuracy: ±5% of full scale ± 4 digit

INCLUDED IN STANDARD SCOPE OF DELIVERY:

- Battery package (2 Batteries „SWIT S-8970“) (TEST-FUCHS item no. 10622038)
- Self test UUT „M882067“ 100mΩ (TEST-FUCHS item no. 10310581)
- „M882071“ 10mΩ (TEST-FUCHS item no. 10310582)
- „M882070“ 10Ω (TEST-FUCHS item no. 10310580)
- „M882072“ 1kΩ (TEST-FUCHS item no. 10310583)
- „M882073“ 10kΩ (TEST-FUCHS item no. 10310584)
- „M882074“ 60kΩ (TEST-FUCHS item no. 10310585)
- „M882075“ 600kΩ (TEST-FUCHS item no. 10310586)
- „M882076“ 6MΩ (TEST-FUCHS item no. 10310587)
- „M882077“ 1MΩ (TEST-FUCHS item no. 10310588)
- „M882078“ 10MΩ (TEST-FUCHS item no. 10310589)
- „S307073“ Measurement Cable set with two banana plugs and test prods for Search Mode (TEST-FUCHS item no. 10307036)
- Shoulder strap „1472“ (TEST-FUCHS item no. 10630932)
- Adapter for Surge Measurement PKLS23-1 (TEST-FUCHS item no. 10324032)

NOTE:
The required Measurement Cables are not included in standard scope of delivery.
Optional Accessories for Bonding and Loop Resistance Tester >BLRT1<

**Transport case „FREIGHTAINER PLUS“ (TEST-FUCHS item no. 107101334)**

- Very robust, provided with transport roller
- Dad with foam
- Storage compartment for:
  - Bonding and Loop Resistance Tester <BLRT1>
  - Charger
  - 2 Batteries
  - Cable bags
- Dimensions: approx 60 x 45 x 18 cm
- Weight: approx 9kg

**Battery Package (2 Batteries „SWIT S-8970“) (TEST-FUCHS item no. 106220138)**

- Manufacturer: SWIT
- Model: S-8970
- Output voltage: 7.2V
- Power: 47.5Wh
- Intermediate charging possible (no memory effect)
- The equipment is fitted with 2 batteries

**External Charger for 2 Batteries incl. Power Cable (TEST-FUCHS item no. 106220111)**

- Manufacturer: SWIT
- Model: SC-3602F
- Input: AC 100 - 240V; 50 / 60Hz
- Output: DC 7 - 8.4V; 1.8A
- Possible to charge 2 batteries at the same time

**NOTE:**
The required Measurement Cables and Measurement Clamps are not included in the standard scope of delivery. All accessories are in the brochures Bonding Tester <MVP10L-FS> and the Impedance Measurement Equipment <IM2-FS>.