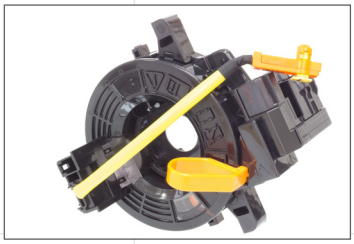
END OF LINE – INSULATION RESISTANCE TESTING IN FULLY AUTOMATED AIRBAG PRODUCTION

RESISTOMAT® 2411 – a versatile solution for max. safety in an emergency

- Extremely fast measurement and 100 % evaluation
- Non-destructive insulation measurement thanks to an innovative contact and measurement principle
- Precision in every respect
- Protected against electromagnetic effects





Task

In fully automated test benches for driver airbags, a **100 % inline insulation resistance test is required** for quality assurance. The insulation resistances between the current-carrying pins of the squib and the metal parts of multistage gas generators (pin-to-pin) must be measured, evaluated, and documented in a traceable manner via the control system. The total cycle time must not exceed 0.7 s (contacting, voltage rise, measurement acquisition, and evaluation).

Solution

The RESISTOMAT® 2411 high-resistance meter is connected to the test object (housing, pin) through the igniter's plug-in socket via spring-loaded gold contacts and a precision pneumatic cylinder. The integrated shorting bar (protection against electrostatic charge) opens the moment contact is made, thereby enabling an isolated single-pin measurement.

Following a short-circuit test performed by the RESISTOMAT® and an integrated cable break test, a test voltage of 500 VDC is applied. The very short ramp phase (charging, measurement, and discharging times) stored in the measurement program enables a valid evaluation result within a few milliseconds. Relative humidity and ambient temperature are documented simultaneously. An "IO" (in-spec) rating is assigned for resistance values greater than 100 MOhm. Insulation values below this threshold are rated as "NIO" (out-of-spec).

In cyclic data transfer, the measured values and result data from the 2411 high-resistance meter's device master data file are transmitted via the PROFINET interface to the higher-level PLC. The transmitted data is additionally stamped with a timestamp as proof of traceability.



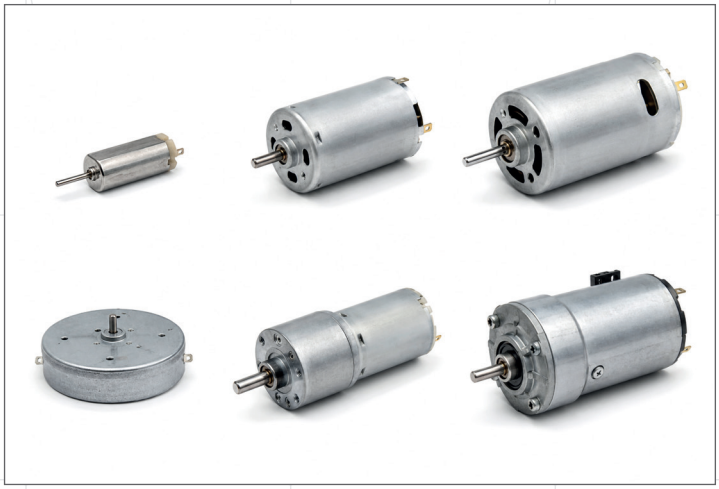
PROFINET®

4837-APPAIR2411EN-5699-111537

INSULATION RESISTANCE TESTING ON DC MOTORS

Product safety without compromise

- 100% control and evaluation
- Short cycle times thanks to measurement and evaluation times of just a few milliseconds
- Integration via fieldbus in a control environment



Task

To ensure the error-free delivery of DC motors, safety and quality risks (e.g., electric shock due to insulation defects or fire hazards, localized overheating due to inadequate insulation) must be ruled out in advance. Causative factors that are rarely detectable visually—such as pinched wires, damage to slot insulation, inadequate impregnation, or soldering or welding defects—should be identified in a timely manner by measuring the insulation resistance between the windings and between the windings and the housing. In addition, these tests serve to safeguard against DC motor-specific stresses (voltage spikes, carbon wear in DC brush motors).

Solution

The high-precision insulation resistance measuring device RESISTOMAT® 2411 is specifically optimized for fully automated 100 % quality control of DC motors. Critical insulation paths between the windings and the housing, as well as between windings, are to be tested fully automatically and reliably. To ensure seamless integration into a high-speed assembly line, the measurement mode and procedures in the RESISTOMAT® have been adapted. A test voltage of 1000 VDC is available. System-critical capacitive charging and discharging times are minimized through device settings.

Evaluation times for motors of less than 80 ms are reliably achieved without any problems. Measured values greater than 2 MOhm are classified as good. Defective motors are immediately rejected. The actual value and the evaluation result are transmitted from the insulation resistance measuring device to the controller via the PROFINET interface in cyclic measurement mode.

Protected against EM interference



USB

EtherNet

PROFINET EtherCAT EtherNet/IP coming soon

4835-APPDC2411EN-5699-111537

FULLY AUTOMATED INSULATION RESISTANCE MEASUREMENT ON ASSEMBLY LINES FOR PRISMATIC BATTERIES

- Integration via fieldbus into a control environment
- Non-destructive ISO measurement using an innovative contact and measurement principle
- 100% control and evaluation
- Short cycle times thanks to measurement and evaluation times of just a few milliseconds

Protected against EM interference



USB

EtherNet

PROFINET EtherCAT EtherNet/IP coming soon

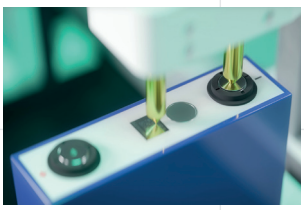
In high-voltage battery systems, it is absolutely essential to ensure 100% insulation between current-carrying and energy-carrying components – such as cells, cell packs, or modules – and the chassis or ground connections in order to eliminate any potential hazards to people, vehicles (fire hazard), or damage to materials and property (defective test specimen insulation, mechanical damage, moisture ingress, etc.) caused by leakage currents.

Task

During an EOL inspection and testing sequence, the insulation resistance of each individual pole of a prismatic cell to a housing test point, along with other parameters, is to be measured quickly, precisely, and fully automatically on a 400-V high-voltage unit while the cell is **de-energized and voltage-free**. The measured values and result data are to be transmitted to the higher-level control system.

Solution

The new RESISTOMAT® 2411 insulation resistance measuring device uses a 4-wire connection method to establish a mechanically and electrically secure connection to the respective contact surfaces (battery terminal, battery terminal, battery case rupture disc) via a pneumatic feed cylinder and specially adapted Kelvin contact pins rated for high voltage. Contact with the anode is made exactly at the center.



Contact made via spring-loaded, rhodium-plated contact pins with an internal force connection (contact force approx. 4 N)

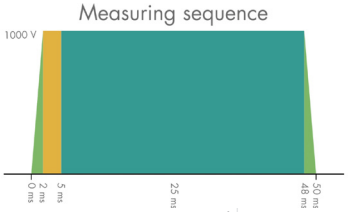
To prevent arcing or sparking during the contact phase, a short-circuit test is performed before applying the test voltage of 750 VDC. The parameters for the measurement sequence and measurement type stored in the measurement program are optimized for a minimum measurement and evaluation time. A minimum threshold value of 490 MOhm is defined for evaluation. All insulation values below this threshold are classified as NIO.



Measurement/evaluation time: approx. 55 ms, including IO/NIO display

To safely and quickly discharge any residual parasitic capacitance on the cell side – caused, for example, by surface insulation material – a minimum discharge time of 2 ms is set in the RESISTOMAT® 2411.

Measuring sequence



Timing Fast Mode

In just a few milliseconds, the measured value and the measurement result are displayed and transmitted to the controller via PROFINET in cyclic operation. Line interruptions are detected immediately and forwarded to the higher-level controller as a detected error message.

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