

A New Method for Automatic Insulation Testing and Assessment of Partial Discharge Inception and Extinction Voltages of LV Electric Windings Driven by PWM Converters

Objective:

Simulation of the stresses in winding insulations of electric machines with steep fronted voltage transients (dV/dt), generated through PWM converter control:

- Assessment of PD inception and PD extinction voltages after IEC 60034-18-41 and 61934
- Efficient and fully automatic measurement method, suitable for line production condition

Solution

- Offline system with programmable surge/impulse generator
- PD reception with new micro wave sensor system (ECG, Mitsubishi; RM Prüftechnik)

Features:

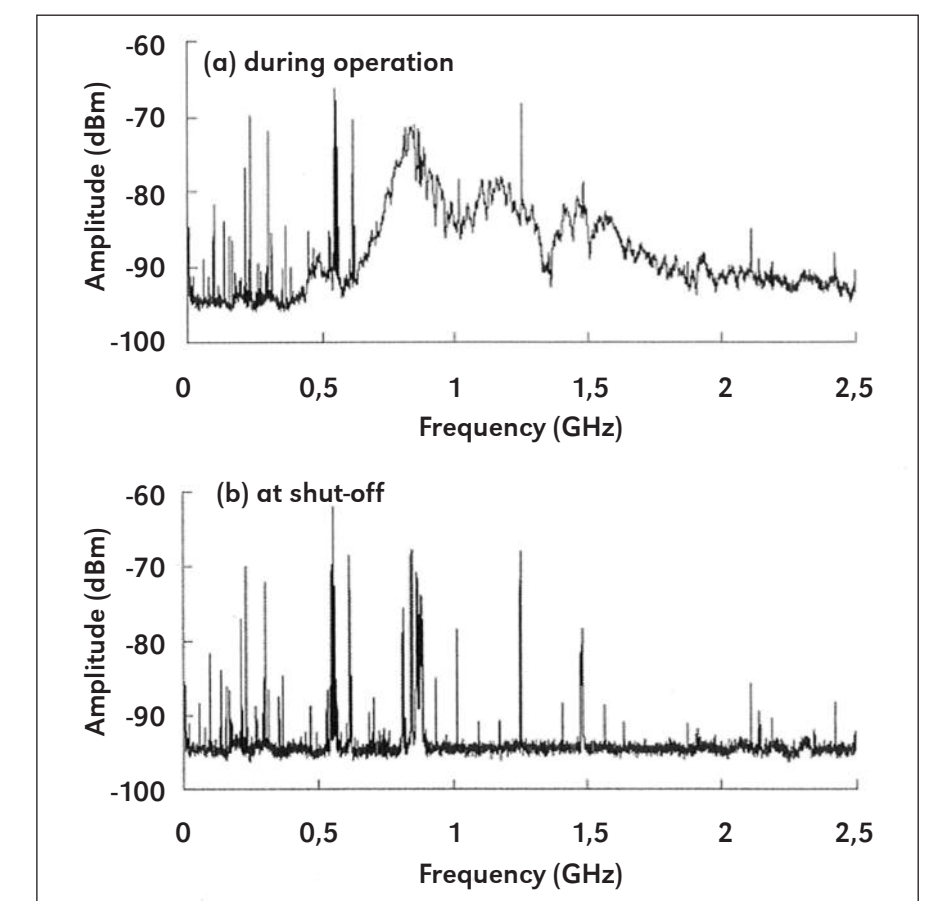
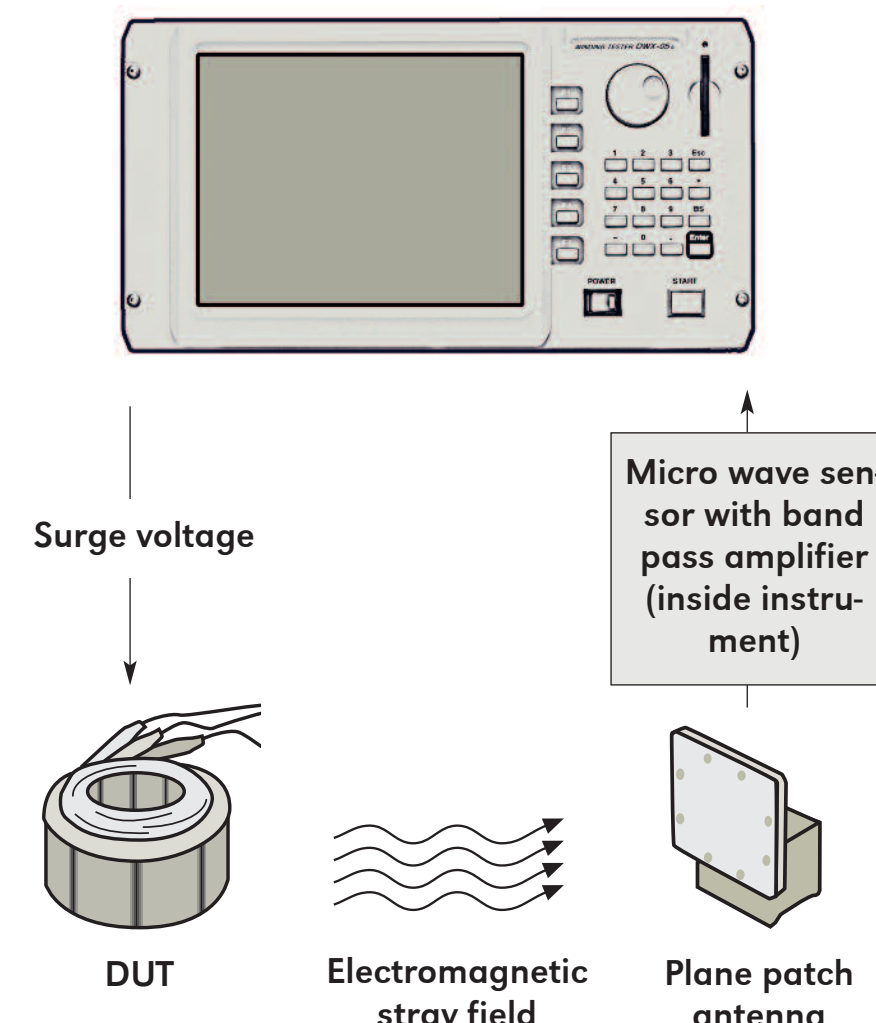
- Digital surge generator with very fast pulse rise times (100 – 250 ns) up to 6, 10, 15 or 20 kV
- New system consisting of a small patch antenna and a micro wave sensor with signal filter circuit for recording the high frequent waves in the EM stray field which are generated by the PD
- Graphical display of test results with indirect qualification of PD amount and magnitude
- **No shielding cage necessary, therefore high usefulness under manufacturing conditions!**
- Test algorithm with automatic voltage ramping to obtain PDIV and PDEV
- Assessment of the RPDIV and RPDEV (repetitive PD inception and extinction voltages) according IEC 60034-18-41 by threshold setting; data output for statistics
- Designed for integration in complex test systems and production machines

Applications:

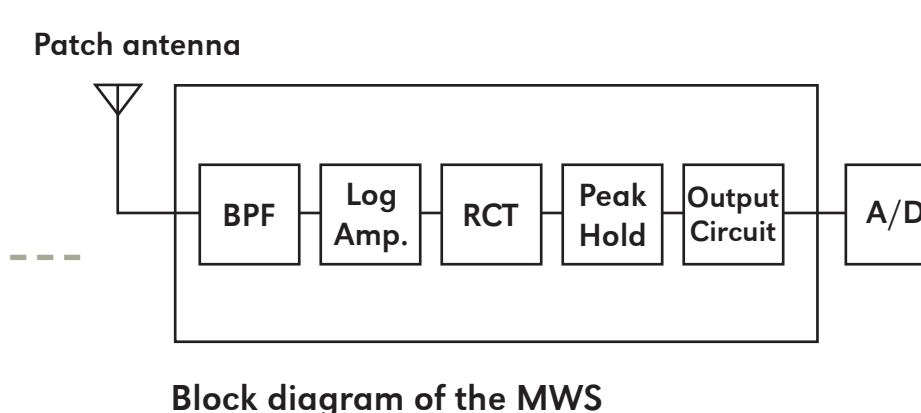
- QC, lab and design of LV electric machines and HV form coils
- Condition monitoring of used machines and their compatibility with PWM drives
- Usable for any other electric windings
- **Imperative importance for the reliability and durability of the power train of electric vehicles** (additional stresses for the insulation due to quick temperature changes and vibration)

Recommended PD reception methods in IEC 61934:

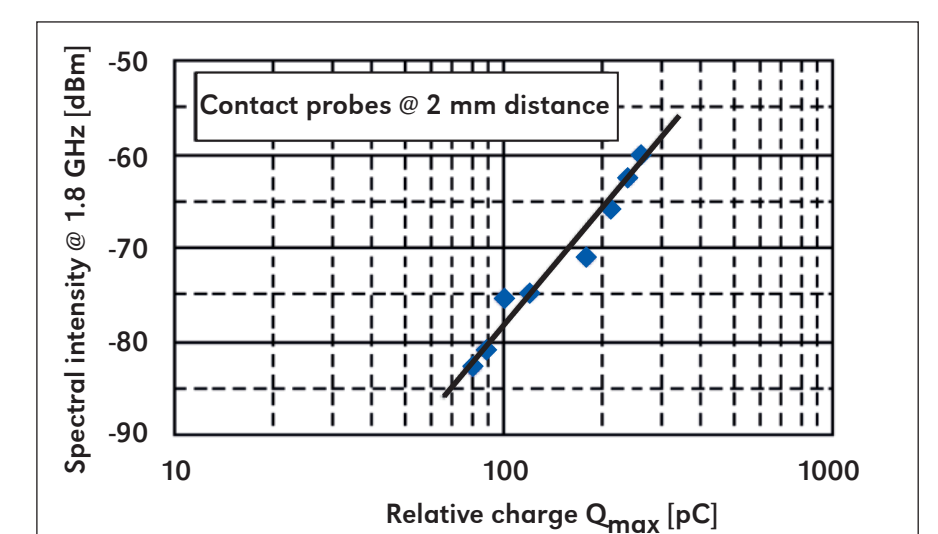
- Capacitive coupling: signal frequencies partially in the range of the applied surge impulse – damage of the electronic circuit possible
- RF current transformers: cannot be fully separated from noise, limited frequency response
- Touch free reception via RF antennas: classical circuits are very noise sensitive; online methods cannot give conclusive info about the remaining margin in the insulation system and the effects of aging



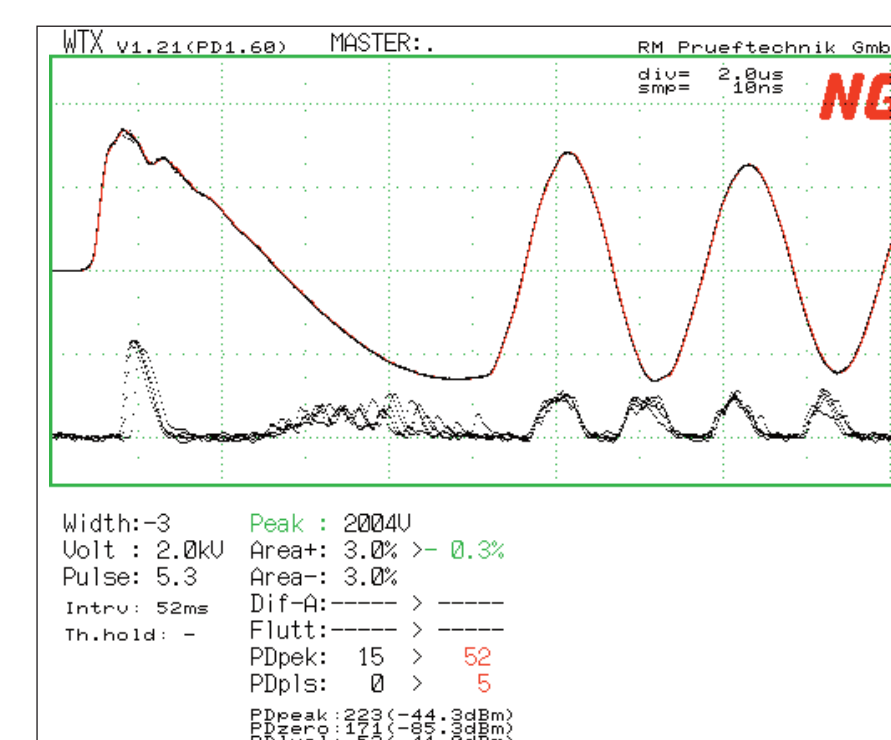
PD signal and noise of a turbo generator recorded with micro wave sensor



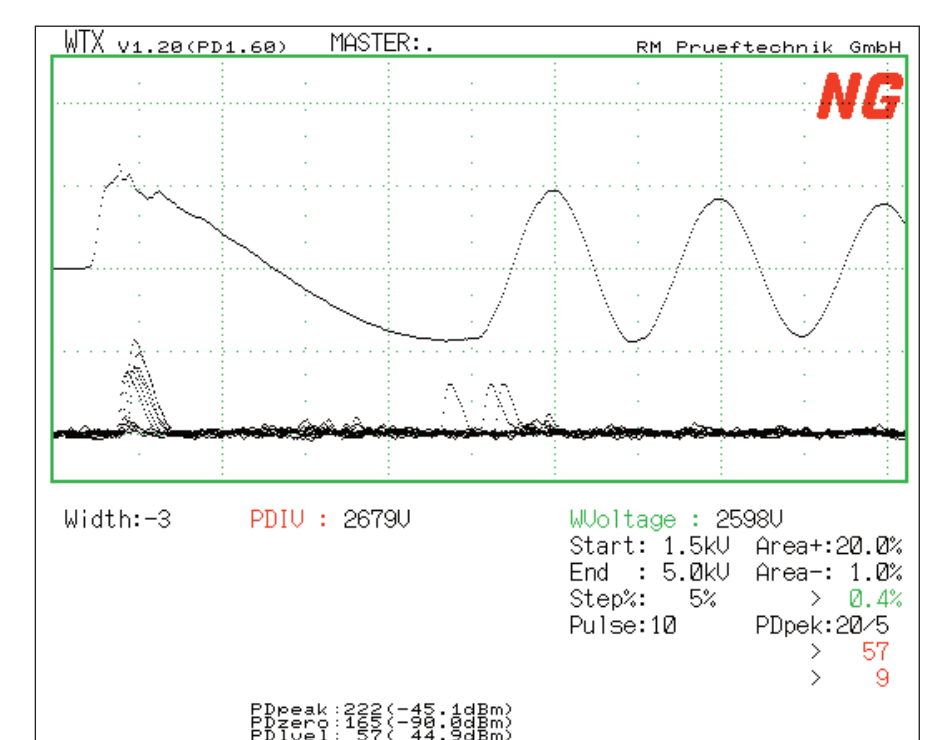
Block diagram of the MWS



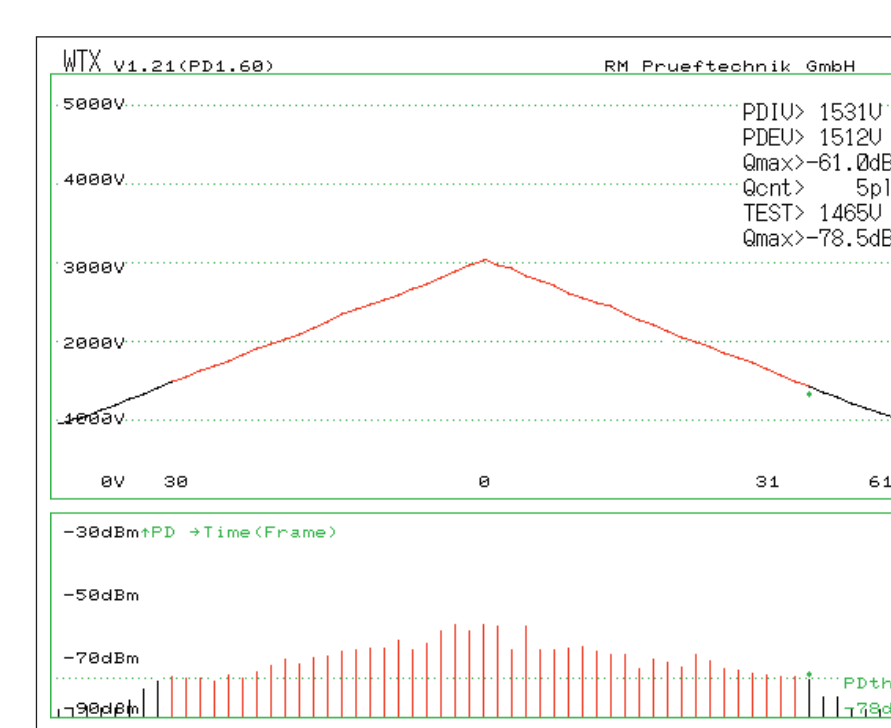
Sensitivity check at contact probes (MWS vs. capacitive system)



Automatic Pass/Fail test with occurring PD



Example of a PDIV test with display of the PDIV, charging voltage and the relative charging magnitude



PDIV-PDEV graph, showing number of pulses over threshold limit

