AVL Active Load Cabinet™ for Inverter Hardware Development

Key product to perform a wide range of high-voltage functional tests for R&D applications

CHALLENGES WHEN DESIGNING THE INVERTER HARDWARE

The key component of an electrified powertrain is the inverter, which is a power electronics-based minicomputer. Its main task is to convert DC current from the battery into a rotating multi-phase AC current (or vice versa), and to control the torque of the e-motor.

In the early development phase of the inverter hardware (HW), stationary operating points are used to stress the inverter and to design and qualify the HW accordingly. For this purpose, passive loads consisting purely of inductance are currently used which stress the unit under test (UUT) exclusively with reactive power.
This has some major limitations when executing tests:

1. The installed components like diodes and switches are not stressed like in a real vehicle.
2. The DC side of the UUT is not stressed with active power.

To conclude, that means that a passive load cannot reproduce realistic conditions.

OUR SOLUTION: THE ACTIVE LOAD CABINET

The AVL Active Load Cabinet (ALC) is an active load which can be used to perform high-voltage functional tests of inverters (UUT). Thanks to its open communication interfaces, the ALC can be easily integrated into the lab / the test setup.
The Active Load Cabinet enables robust inverter functional tests within short test times and according to the UUT's voltage and power requirements. These functional tests allow for a paralleled development, independently from the UUT's software, and provide the opportunity to detect failures at an early stage – before HW and SW integration.

The AVL Active Load Cabinet provides the following operating modes : the R-L mode (R = resistance, L = inductance), and the one-phase current source mode. In R-L mode, the ALC acts as an adjustable ohmic inductive load. Due to this fact, the testing of the UUT's power electronics is enabled under more realistic conditions.

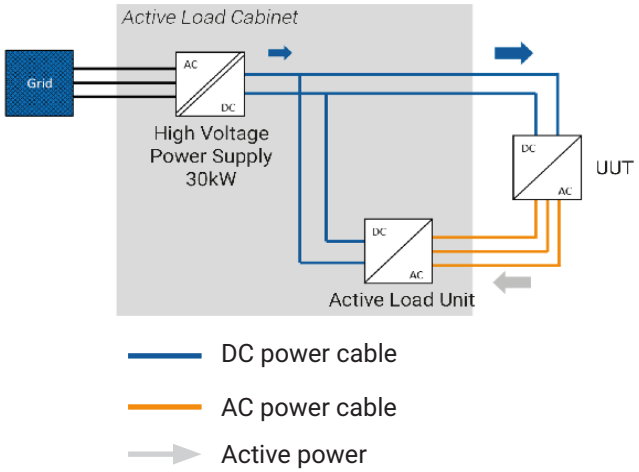
Optionally, the ALC can be used as one-phase current source to e.g. calibrate the UUT internal sensors or to test the connectors.

By implementing the new four-quadrant mode, the ALC enables the UUT to be tested within all four quadrants, meaning motor and generator operation.

THE ADDED VALUE

1. Fast UUT commissioning enabled by the easy test setup capability: only 4 parameters must be defined to start the testing process.
2. Easy and fast adjustment of several parameters: R and L can be parametrized via mouse click during operation.
3. Minimum facility requirements: only 30kW AC connection for power and water connection for cooling is needed.
4. Wide range of applications thanks to additional options like current source and four-quadrant mode operation.
5. Realistic testing with active power: 4-quadrant-mode allows operation in all four quadrants of the torque/speed plane.

ACTIVE LOAD CABINET



The ALC and the UUT are connected to the same DC link: the power supply unit installed in the ALC supplies both: the UUT and the ALC itself.

TECHNICAL DATA

Recommended min. UUT DC Voltage in VDC	300
Maximum UUT DC Voltage in VDC	1,000
Phase current, nominal in ARMS	280 or 560
Phase current, maximal in ARMS (Overload)	400 or 800 for 34 s (up to 900V)
Power (AC) in kW	Depending on the operating point and UUT
Ratio overload capacity - nominal load	1:20 at nominal load
Maximum power loss (ALC + UUT) in kW	30 or 60
Switching frequency UUT in kHz	up to 20
Fundamental frequency in Hz	up to 1.000
Adjustable virtual load resistance in Ohm	0... 100
Adjustable virtual load inductance in µH	50... 1,000
Interfaces	Automation system: Ethercat, Ethernet, XCPonEthernet Safety system: Profinet (optional)
Rotor position sensor options	Digital encoder sensor emulator, active magnetic sensor emulator, resolver sensor emulator

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