KS ENGINEERS

Automotive Testing, Industrial Automation, Building Facilities, Testing Services

www.ksengineers.com

KS ENGINEERS

INNOVATIVE AND FORWARD-LOOKING SOLUTIONS FROM A SINGLE SOURCE

We create optimal solutions for our customers. Passion, long-standing experience and ongoing refinement are our tools. Our work style is proactive and agile throughout all project phases.

AUTOMOTIVE TESTING

Our core expertise: Automotive testing. Long-standing tradition meets innovative ideas.

INDUSTRIAL AUTOMATION

We endeavour to find the best solutions for our customers using the full range of our team's experience and knowledge.

BUILDING FACILITIES

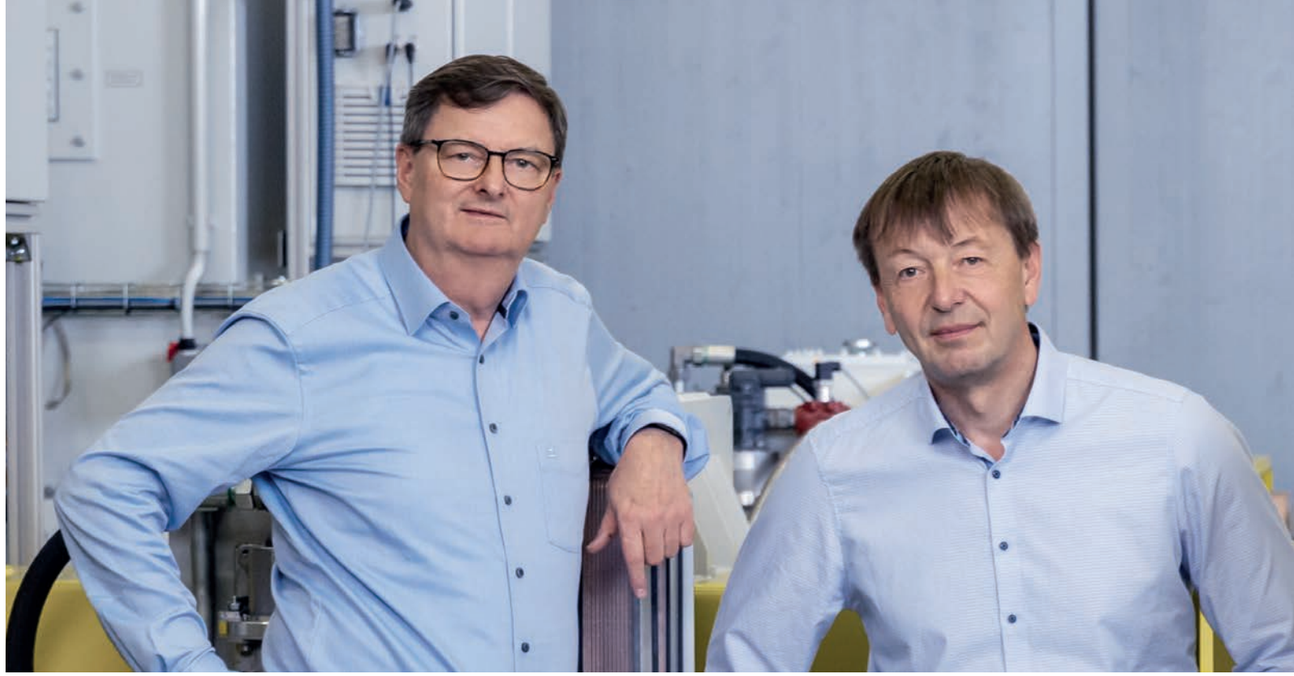
An expert partner for electrical, heating, air conditioning and plumbing. From small jobs to complex, large-scale projects.

TESTING SERVICES

We carry out your testing tasks on our in-house systems and deliver high-quality measurement data and results.

154 m TURNOVER

649 EMPLOYEES

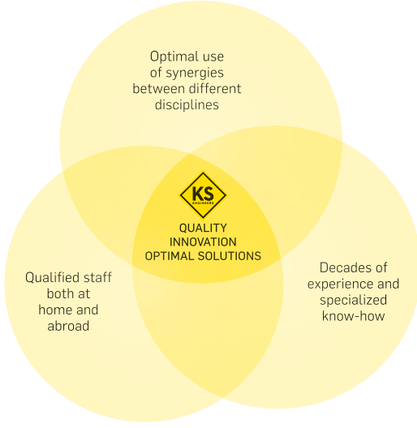


Company management (f.l.t.r.): Dr. Wolfram Rossegger, Karl Baumgartner

OUR MISSION STATEMENT

"We endeavour to find the best solutions for our customers in light of the fundamental conditions they face using the full range of our staff's experience and knowledge. We focus on achieving the goal, work proactively and efficiently throughout the entire project, and treat or customers and partners as equals."

[Dr. Wolfram Rossegger, Managing Director]



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AUTOMOTIVE TESTING

AUTOMOTIVE TESTING

TESTING TECHNOLOGY FOR DRIVE AND ENERGY SYSTEMS

Our core expertise: We deliver testing technology for components and complete systems – all from a single source, from test beds to complete test bays, TBE/TGA and media supply. Consistency in project handling provides optimal solutions for our customers. Passion, long-standing experience and ongoing refinement are our tools.

MANAGEMENT AND AUTOMATION TOOLS

- Tornado Software Suite
- Tornado Test Bed
- Tornado Order Management
- Intelligent Calibration Tool
- ADAC
- MCU
- T-SIM

TESTING TECHNOLOGY

- Engine test beds
- KS-R2R Road to Rig FATS
- Chassis dynamometers
- Test bed systems
- Transmission and powertrain test beds
- Electric motor test beds
- Battery simulation and testing
- Hot gas test beds
- Component test beds

MEDIA SUPPLY AND CONDITIONING SYSTEMS

- Cold/cooling water supply
- Fuel supply
- Gas supply
- Compressed air supply
- Room air conditioning/climate chambers
- Air supply conditioning systems
- Coolant conditioning systems
- Oil conditioning systems
- Fuel conditioning systems and
- Consumption measuring
- Special conditioning systems

MEASURING TECHNOLOGY AND ADDITIONAL COMPONENTS

- KS-R2R Test Wheel
- ACDC Box
- Sensor Box
- KS FSS
- KS OMM
- EIS Module
- KS DPC

THE REALITY OF THE ROAD ON THE TEST BED

KS-R2R COMPLETE VEHICLE TEST BED

The **KS-R2R** test bed is a comprehensive test system for complete vehicles and for powertrains. It enables in-house vehicle proving and application under real driving conditions from early development stages on to the series vehicle. Integration of vehicle, road surface and tyre models, simulation of missing components, as well as testing and adaptation of the assistance systems are all possible, as is testing hybrid or fully electric powertrains.

ADVANTAGES

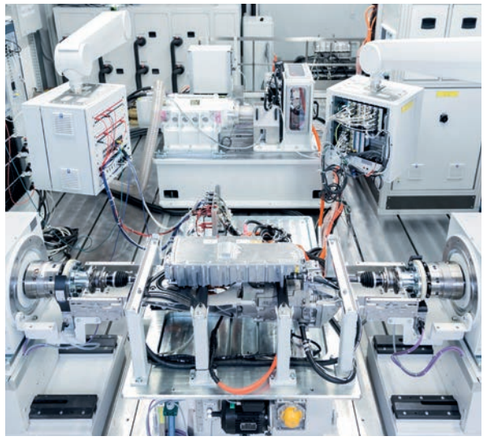
- Powertrain loading identical to on the road
- Assistance systems in the vehicle are active on the test bed
- Vehicle and road parameters can be changed online
- Standardised test cycles can be implemented with ease.
- Entire control circuit clocked at 10 kHz (incl. frequency converter)
- Inertia simulation
- Asynchronous machines can also be used
- Integration of Matlab models
- Interfaces to driving simulation programs such as IPG CarMaker
- Tests are totally reproducible
- Vehicle freedom of motion due to set-up with KS test wheel and longitudinal actuators
- Exceptionally short set-up times due to KS test wheel

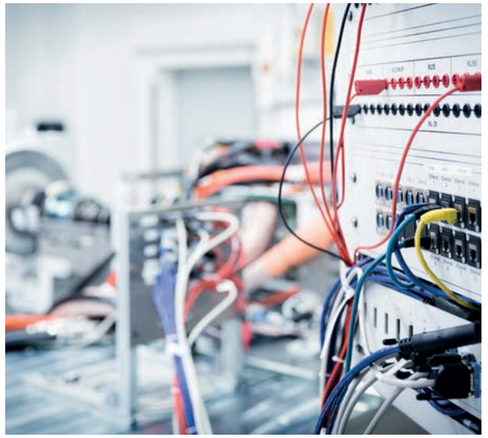
EVERYTHING INTEGRATED

SYSTEM TEST BEDS

Complete system testing, integration of control units, simulation of components, exact and synchronous measurement data acquisition and processing at up to 10 kHz.

KS system test beds combine our best products and extensive know-how from all the disciplines represented in our firm. They enable the highest degree of flexibility with respect to the testing tasks to be carried out and the set-up options, both in terms of specimen set-up and possible test scenarios. All of the assemblies, control instruments and additional components of the equipment under test can be integrated on the test bed either physically or by simulation through corresponding hardware or software measures, depending on the needs.

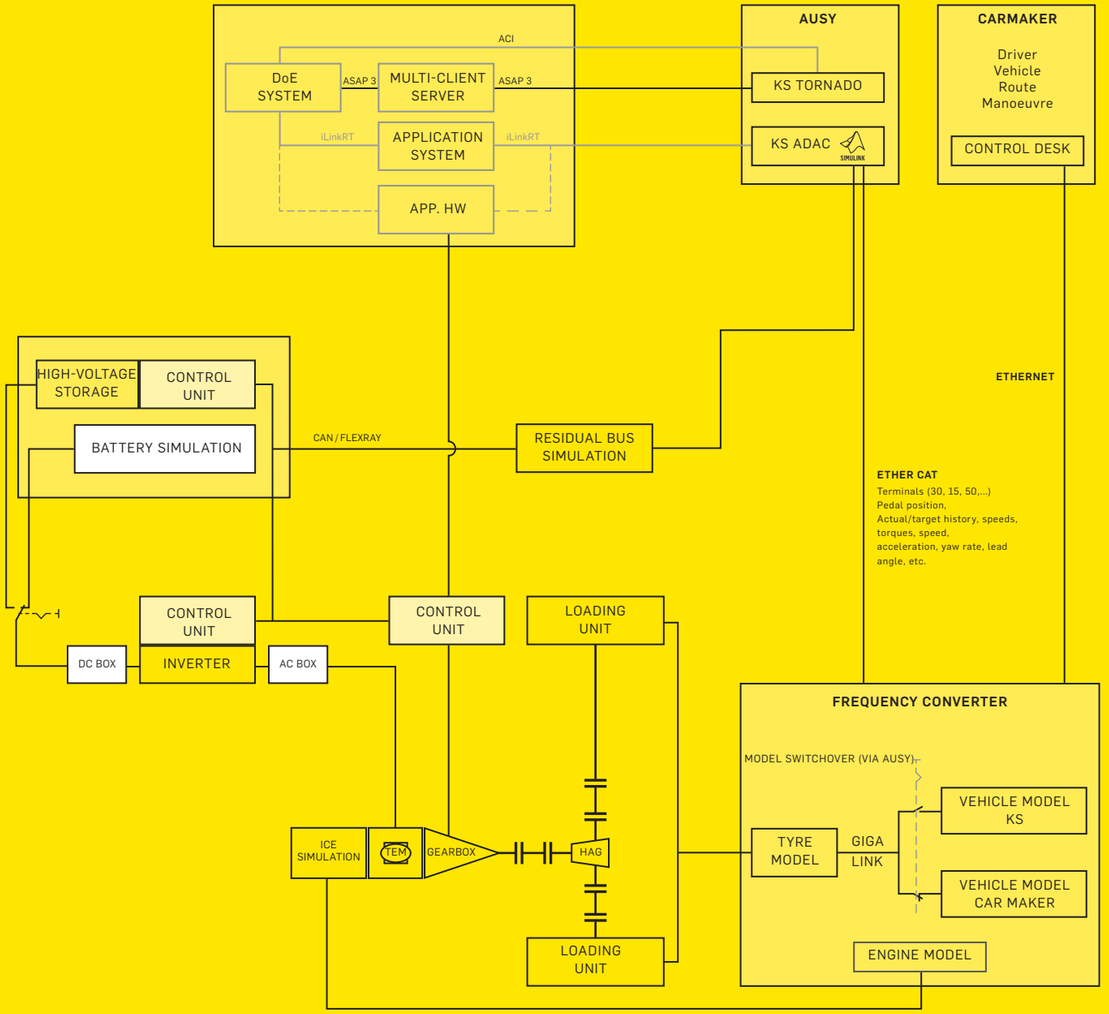




PROPERTIES:

- ICE simulation incl. torsional vibration simulation
- Variables set-up
- Hybrid drive systems
- Performance analysis
- Restbus simulation
- HIL integration
- Interfaces to control instruments
- Integration of MATLAB/Simulink models, e.g. for vehicle, wheel/tyre, powertrain components, ICE, battery, inverter, etc.
- Interfaces to integration and test platforms (e.g. CarMaker)
- Interfaces to DoE systems (e.g. ICT)

Flexible integration of all components – as hardware or by simulation, synchronous signal processing and generation.

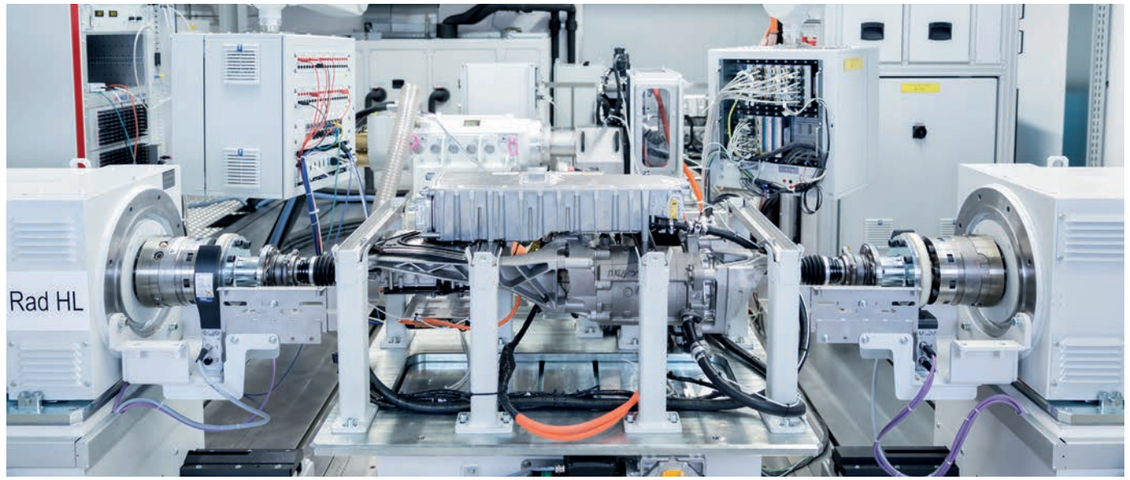



KS
ENGINEERS
AUTOMOTIVE
TESTING

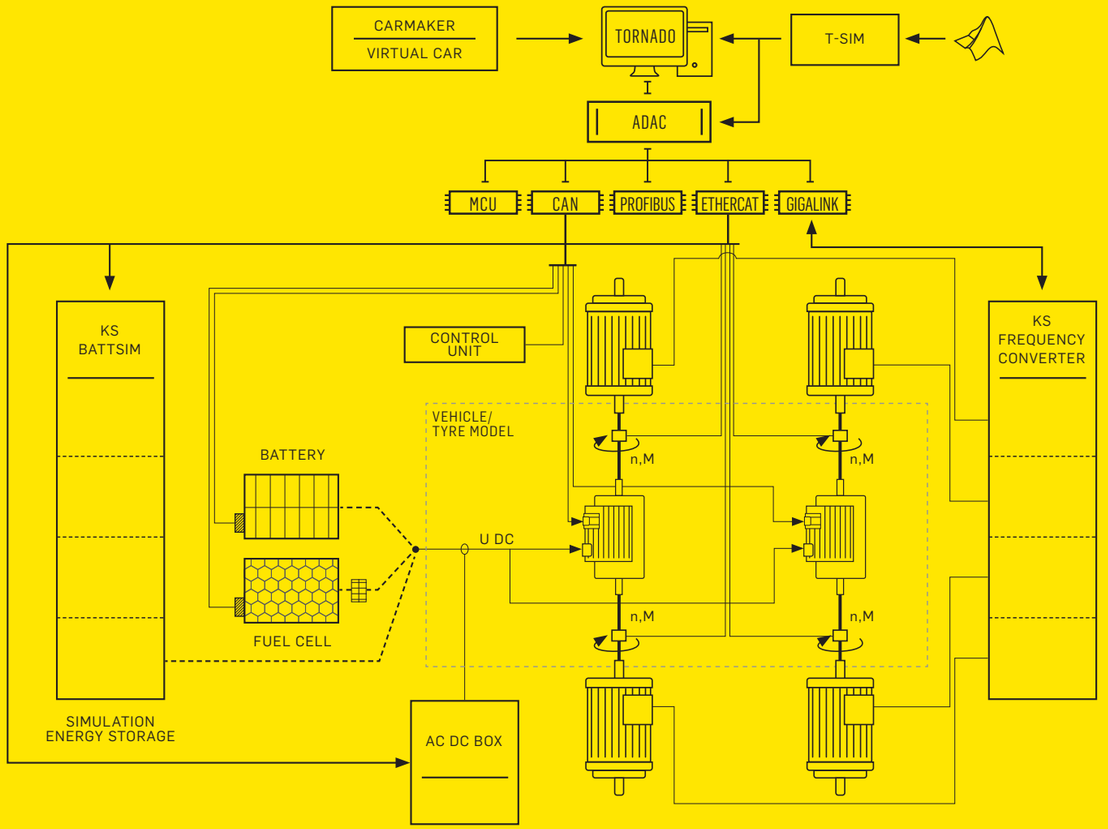
FLEXIBILITY IN EVERY DEVELOPMENT PHASE

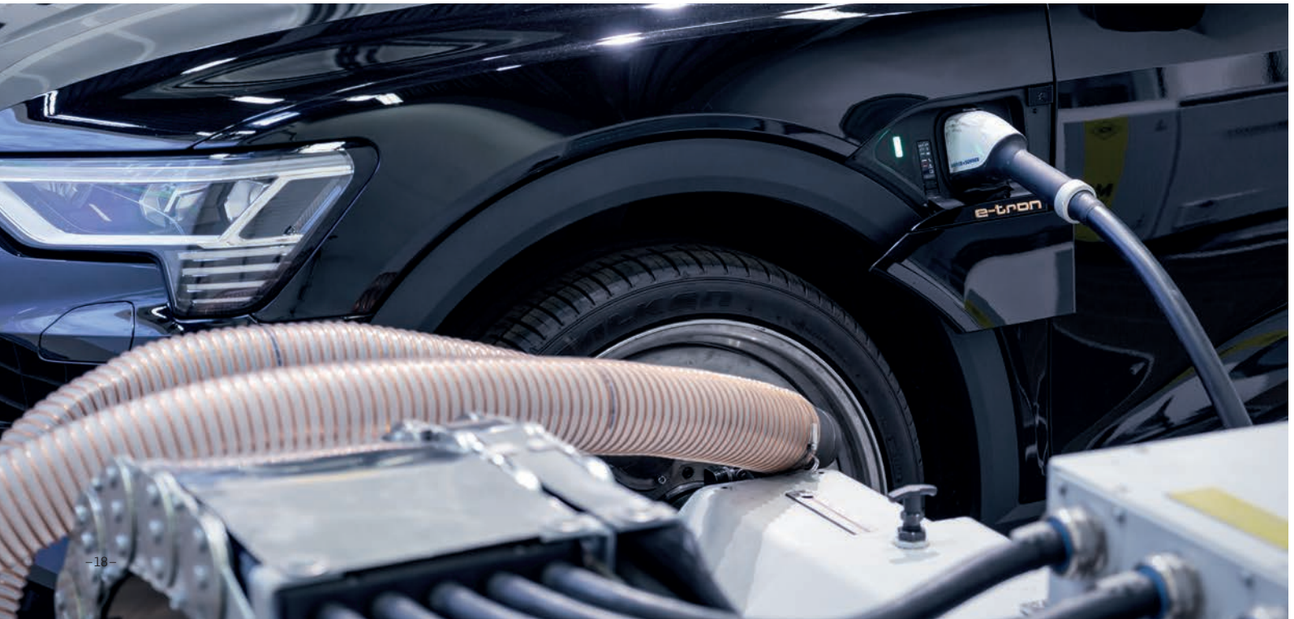
KS-R2R POWERTRAIN TEST BEDS

Complete system testing, integration of control units, simulation of components, exact and synchronous measurement data acquisition and processing at up to 10 kHz. Fast control via R2R frequency converter technology, synchronicity of all axes, exact replication of powertrain vibration, total control of strain and reversing play and real torque distribution all make testing at the highest level possible: “Hot” braking, incorporation of Matlab models and interfaces to “virtual car” simulation programs, such as CarMaker, are included.



Drivability tests and testing of energy management concepts already in early development phases using the flexible and realistic R2R testing system.





PUTTING THE FUTURE ONTO THE TEST BED

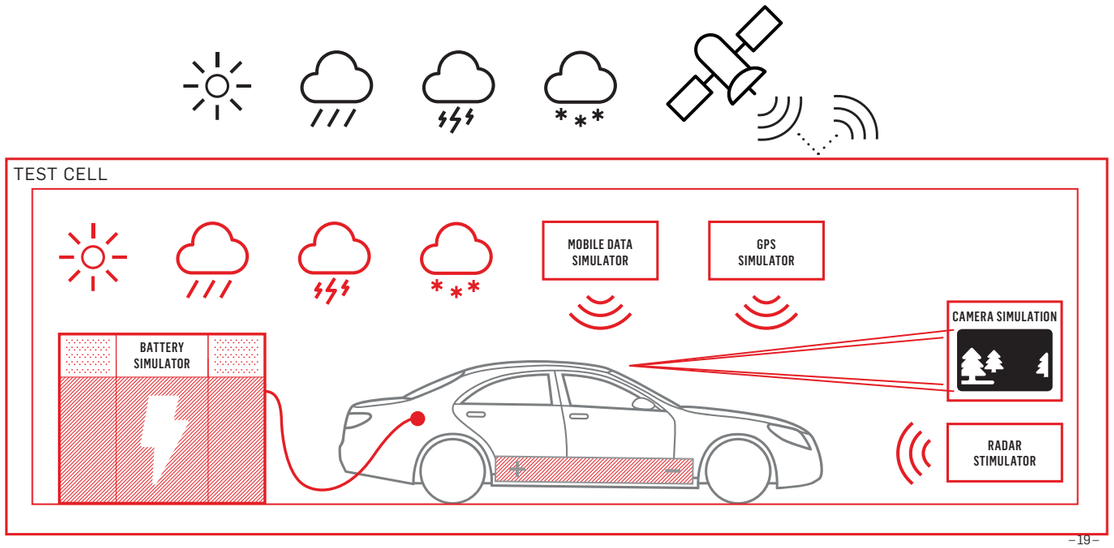
ADAS TESTING AND SYSTEM VALIDATION

FEATURES

- Environmental simulation
- Sensor simulation (bypassing or stimulation)
  - Camera HIL
  - Radar target stimulator
  - GNSS spoofing
- Battery charging stations
- Robotics, automated operation of all onboard elements

USE CASES

- System validation of ADAS functionality:
  - Line detection
  - Number plate recognition
  - Lane departure warning system
  - Emergency brake assist
- Testing range and charging stop strategy
- AC and DC charging in various climate conditions



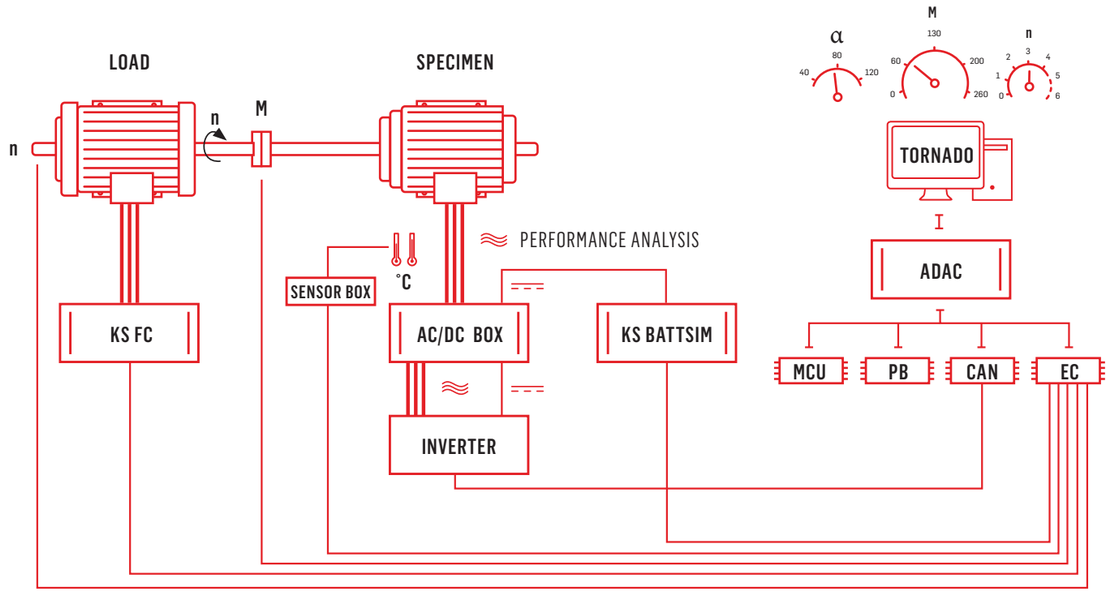
FIELD STRENGTHS

ELECTRIC MOTOR TEST BEDS

In these days of hybrid drives and fully electric powertrains, electric motors are tremendously important. High power densities and compact designs, enormous thermal loads, high speed ranges and robustness represent challenges motor developers and manufacturers face as a result of the requirements associated with applications in the automotive industry. New developments and refinements alike can be tested with no constraints using our electric motor test beds, so they support engineers in the continuous improvement of electric drives as well.

PROPERTIES:

- Speeds up to 40,000 rpm
- Low-vibration design
- Control-technology compensation of residual vibration
- KS frequency converter technology
- Highly dynamic control
- Precision performance analysis



ACDC BOX:

- Voltage measurement, 100 kHz, 1-1500 V
- Current measurement, 100 kHz, 0 - 1 kA
- TRMS results
- Performance analysis
- Phase switching
- Short-circuit and idle testing
- Safe switchover and shutdown
- Easy contacting options
- Flexible low-voltage and high-voltage taps

PERFECT COMBINATION

KS-INVTEST

Combination of battery simulation and machine emulation based on the KS-AMPS platform - realized in one device :
The KS Electric Machine Emulator (KS-EME) enables testing of inverters in an early stage of development or it can be used as a development platform (PowerHIL) for corresponding control concepts. In combination with our battery simulator, the KS-BattSim as a highly dynamic source and sink, a flexible overall system is created with both the highest possible dynamics and at the same time a large power spectrum – all in one system.

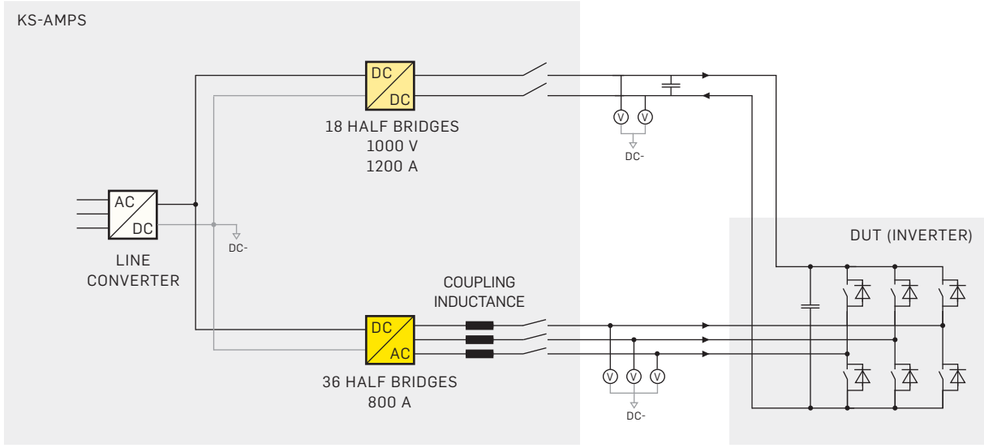
BENEFITS:

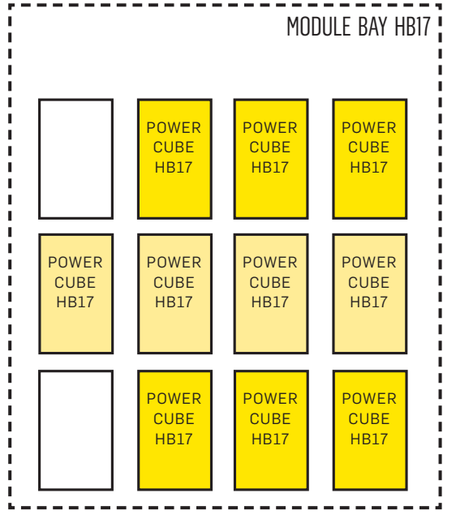
- Closed powerflow within the device
- Low grid connection power
- Only one 50 Hz transformer/mains converter with approx. 20 % of the rated power
- Less space required
- Current ripple emulation including saturation effects
- Error emulation
- Encoder emulation
- Multi-phase machines can be emulated

RATED DATA WITH 10 POWERCUBES

- Battery simulator:
  U_{Batt} = 0 ... 1000 V
  I_{Batt} = 1200 A
  P = 750 kW
  f_s = 900 kHz
- Electric Machine Emulator
  I_{EME} = 800 A
  f_s = typically 800 kHz
  f_0 = 0...5 kHz
  Motor types: ASM, PSSM, EESM

COMBINATION OF BATTSIM AND EME IN ONLY ONE MODULE BAY:

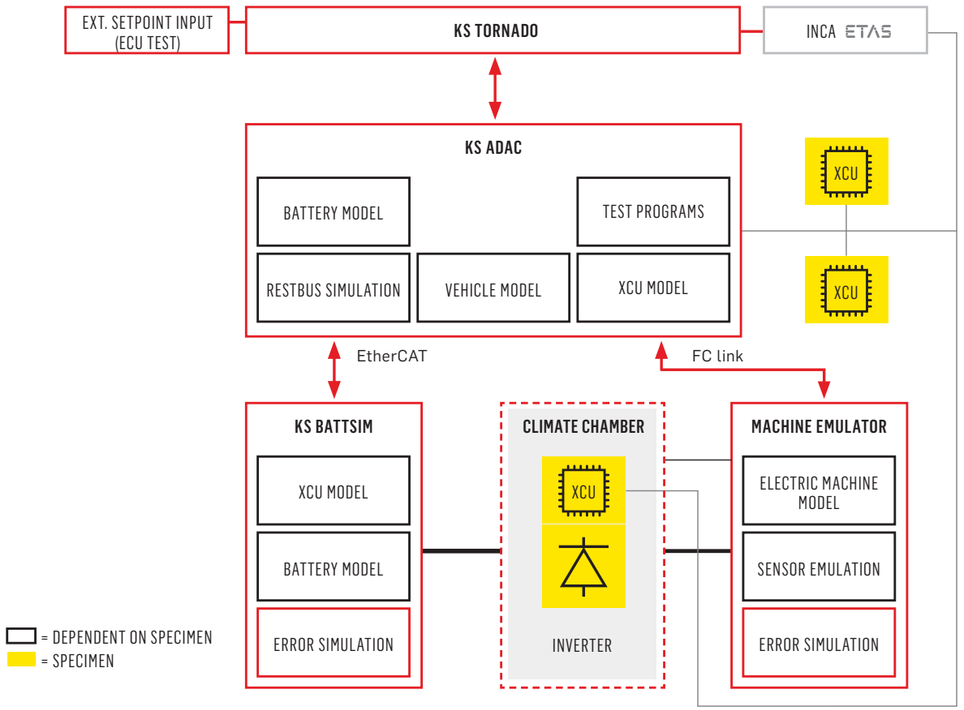




BATTSIM

EME

EXAMPLE OF HIL TEST BED FOR INVERTERS



EFFICIENT TESTING

KS-B2B TEST BEDS FOR E-AXLES

Testing of two e-drive units on one test bed in back-to-back arrangement connected over coupling gearboxes saves costs and time. Fed by a common DC link input power of the test system can be kept low. Expensive dynos and their drives are not required, significantly reducing hardware and space requirements.

TECHNICAL DATA:

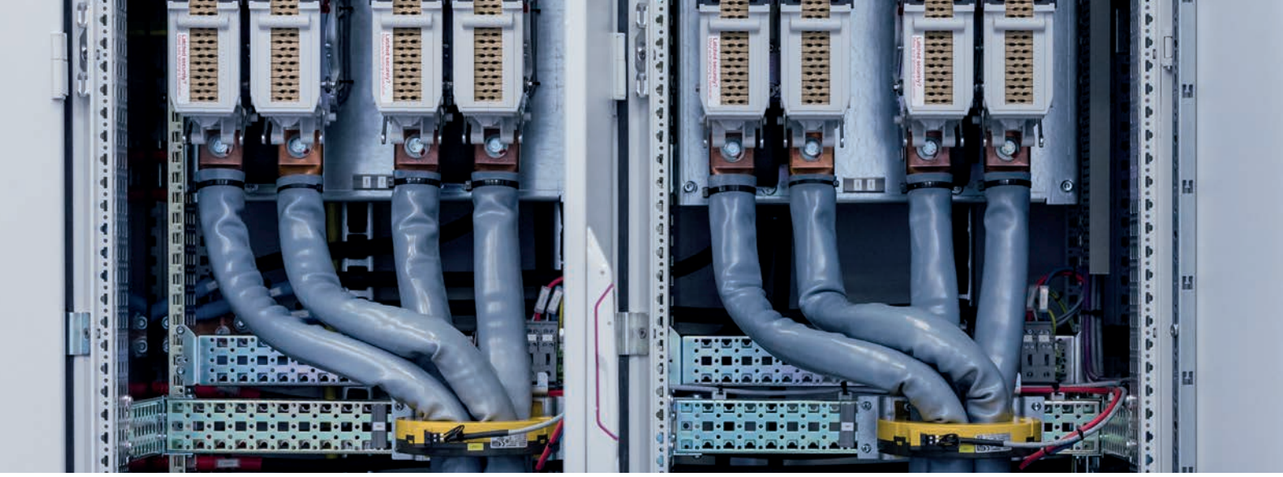
Battery simulation:
- Continious power: up to 440 kW
- Continious current: up to 600 A
- Voltage range: 40 - 1000 V

Climate control:
- Temperature- and humidity controlled climate chamber
- -40 to 120°C air temperature
- 0 to 98 % humidity
- Temperature gradient up to 8°C/min

Coolant conditioning:
- Temperature, pressure and flow controlled
- -40 to 120°C coolant temperature
- Temperature gradient up to 10°C/min

BENEFITS:

- Low supply power
- Low space requirements
- Saves costs and time
- Reduced amount of hardware, no dynos required



DC-SOURCE/SINK

KS-BATTSIM

Powerful and flexible DC source/sink for the dynamic supply and loading of DC energy converters in universal applications.

Our battery simulators are highly dynamic sources and sinks that are used for battery, fuel cell and inverter testing as well as fast charging systems and testers or on power-train test beds. The KS-Battsim is also popular in other areas where dynamic, precise and powerful DC actuators are required. Voltage-stable at dynamic load changes, they fulfil the high requirements of the technological cutting edge. User-friendly interfaces and simple integration of Matlab models round out the system and enable convenient integration into test beds and automation systems.

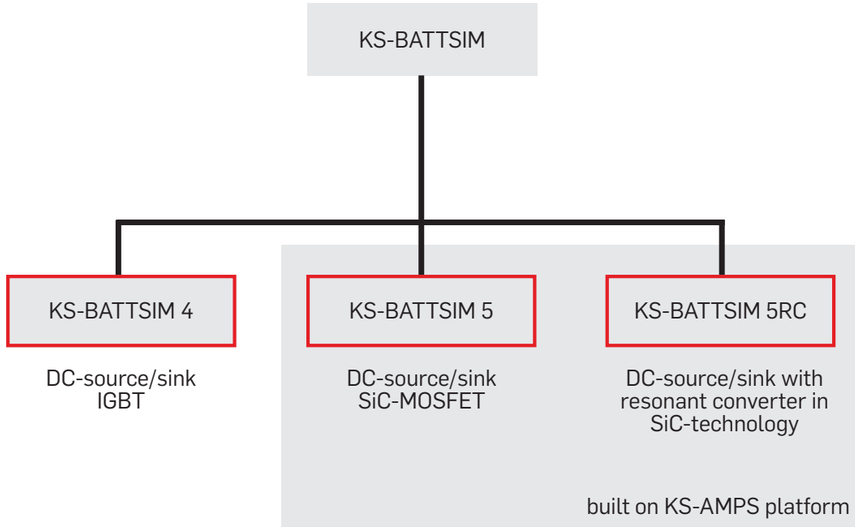
BENEFITS:

- Regenerative
- Bidirectional: charge/discharge
- Delay-free transition between feeding & refeeding
- Maximum dynamics
- Excellent stability during load changes
- SiC-Technology available
- Adjustable dynamics (U-I characteristic)
- Integration of Matlab-Simulink models
- Short-circuit proof
- Ripple function
- Active damping

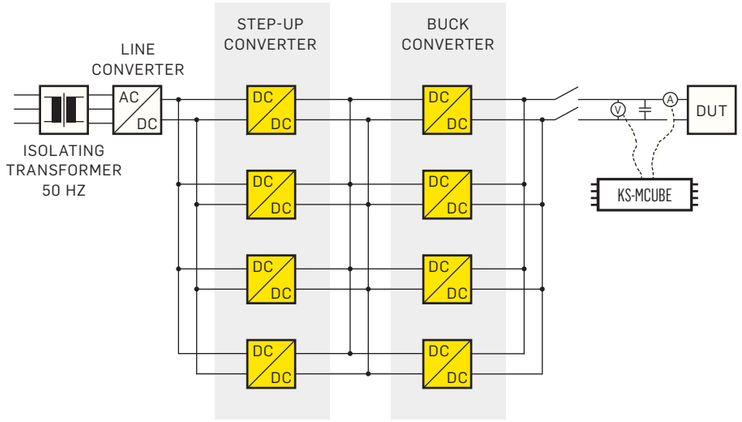
OPTIONS:

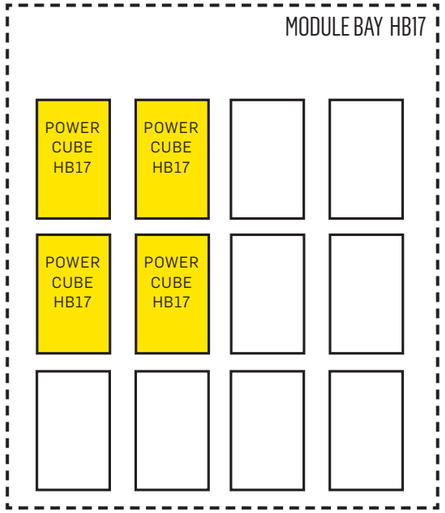
- CAN/CANopen interface
- EtherCAT interface
- RS232 interface
- RS422/RS485 interface
- Electrochemical impedance spectroscopy
- Power charching unit (KS-PCU)
- Deactivatable isolation monitoring
- Highly accurate current measurement
- Operation mode „fuel cell test“
- EMC-ILA compliant

Device models:



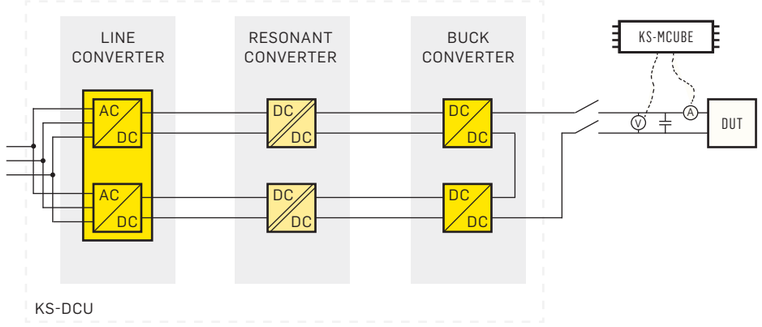
STRUCTURE BATTSIM 5 (SiC):

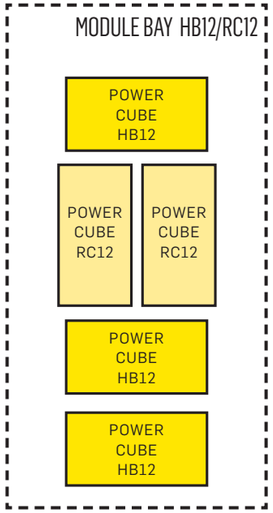




- No additional output-chokes required
- Small capacitor bank with < 1 mF enables high voltage dynamics

STRUCTURE BATTSIM 5RC (SiC):

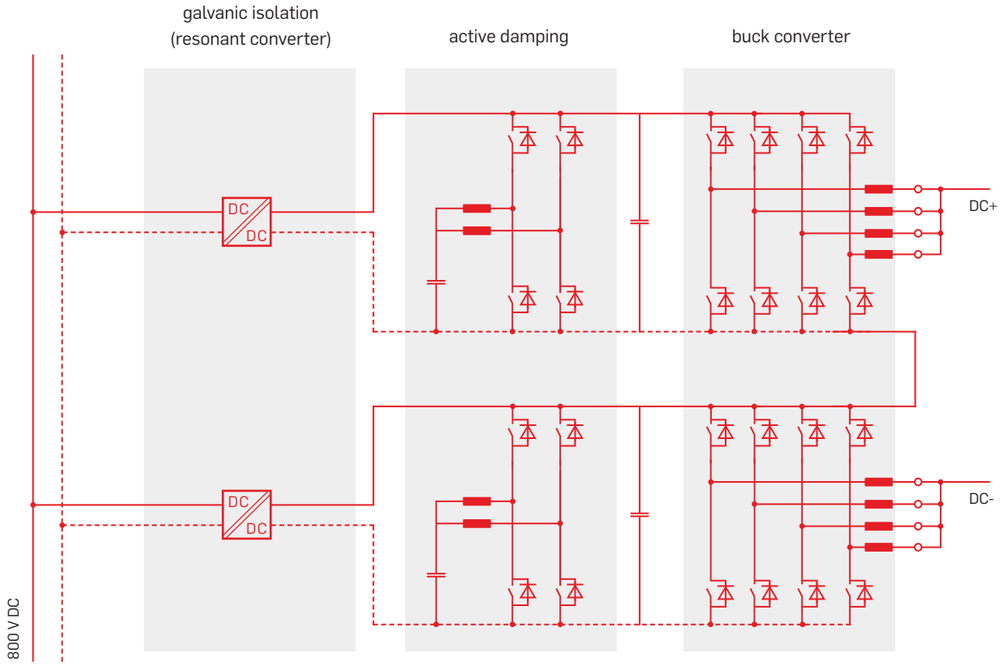




- No 50 Hz transformer required -> compact and light weight
- Outputs with galvanic isolation can be realized

APPLICATION EXAMPLE: BATTSIM 5RC FOR OPERATION AT A DC-GRID

P = 500 kW
I = 1000 A
U = 16 - 1500 V
fs = 160 - 240 kHz



SPECIAL FEATURE: ACTIVE DAMPING

- Each DC actuator can actively dampen oscillations at the DC connection.
- On the one hand, the excitation caused by the DC converter itself is reduced and, on the other hand, oscillations in the DC grid caused by other devices can be actively damped.

KS-POWERCUBE resonant converter

KS-POWERCUBE half-bridge


KS-BATT TEST
BATTERY TESTING SOLUTIONS

OPERATE COMPLETE SYSTEMS EFFICIENTLY

BATTERY TEST BEDS AND TEST BAYS

Problem-solving expertise from a single source. The turnkey battery test bays KS ENGINEERS offers provide comprehensive system solutions for the development of modern high-voltage battery test systems. Know-how from mechanical engineering, electrical engineering, control engineering, electronics and computer science is bundled and focused to deal effectively with the required testing tasks. Careful selection of the system equipment used, such as KS-BattSim, HV & LV components, KS-PCU Power Charging Unit, tempering systems for specimens as well as our TORNADO automation system, fine tunes a test bay to individual needs. Every aspect of a battery system can be examined in high-performance temperature chambers. Extensive safety technology ensures safe system operation at all times. An end-to-end safety concept is created in cooperation with the customer early on in the planning phase. The next step beyond a test bay: Full networking of battery test beds, for example with eDrive powertrain test beds, enables holistic system testing.

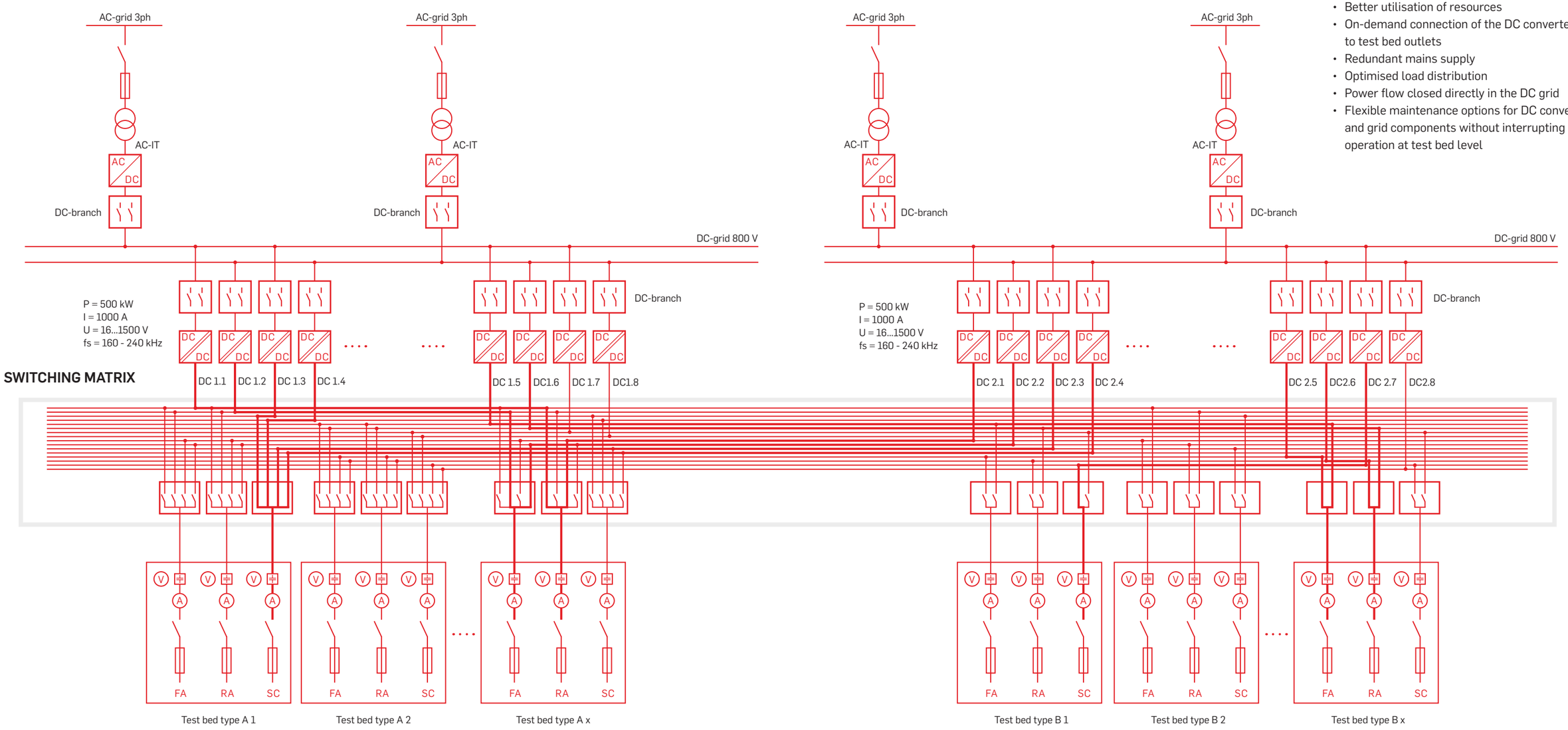
TYPICAL SYSTEM COMPONENTS:

- KS-BattSim highly dynamic current source/sink
- HV (high-voltage) cabinet
- High-voltage connection of test instruments
- High-voltage circuitry
- Error injector for testing the isolation monitoring
- High-voltage test instrument/isolation test instrument
- Plug-in system
- High-voltage contacting (for manual and automatic contacting)
- Low-voltage contacting (for manual and automatic contacting)
- LV cabinet (low voltage)
- Measurement of BMS current and voltage
- CANLAN Box (for restbus simulation)
- Automation cabinet
- KS Tornado test software
- KS ADAC real-time test system
- Fail-safe control system
- UPS

TESTING TASKS AND APPLICATIONS:

- Isolation test / HV tests
- SW flash / SW check
- Restbus simulation
- Interlock test
- Sensor system check
- Charging/ discharging
- Service life test
- Functional test
- Passive discharge test
- HPPC tests (Hybrid Pulse Power Characterization)
- Pre-charging unit function test
- Humidity, heat, cold cycles

APPLICATION EXAMPLE: BATTERY TEST BAY WITH KS-BATTSIM 5RC AND SWITCHING MATRIX



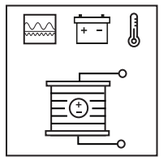
FEATURES:

- Reduction of required DC converters
- Better utilisation of resources
- On-demand connection of the DC converters to test bed outlets
- Redundant mains supply
- Optimised load distribution
- Power flow closed directly in the DC grid
- Flexible maintenance options for DC converters and grid components without interrupting operation at test bed level

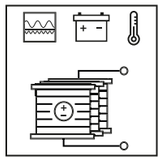
COMPREHENSIVE SOLUTIONS FOR TESTING MODERN ENERGY CONVERTERS

FUEL CELL TESTING SOLUTIONS

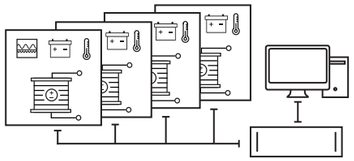
Highly efficient fuel cell systems play a prominent role in terms of future drive concepts and energy storage systems. The reproducible testing of complete fuel cell systems as well as the investigation of individual stacks and BoP components play a decisive role in development. The custom test beds KS Engineers offers, provide the flexibility required to deal with the most diverse scenarios and testing tasks. The use of model-based test strategies with real-time capable, highly realistic simulation models enables testing of fuel cells at any developmental stage.



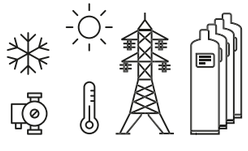
STACK & COMPONENT TESTING



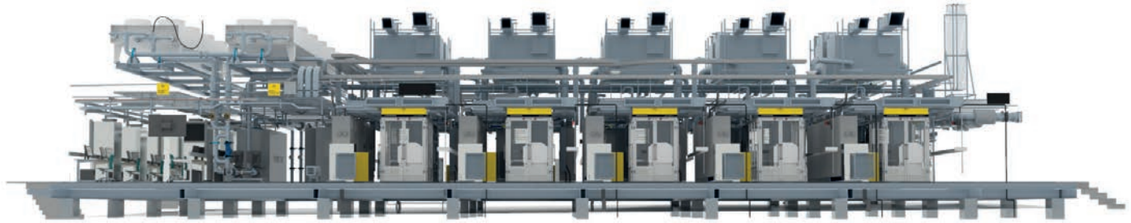
FUEL CELL SYSTEM TESTING



FUEL CELL TEST BAYS

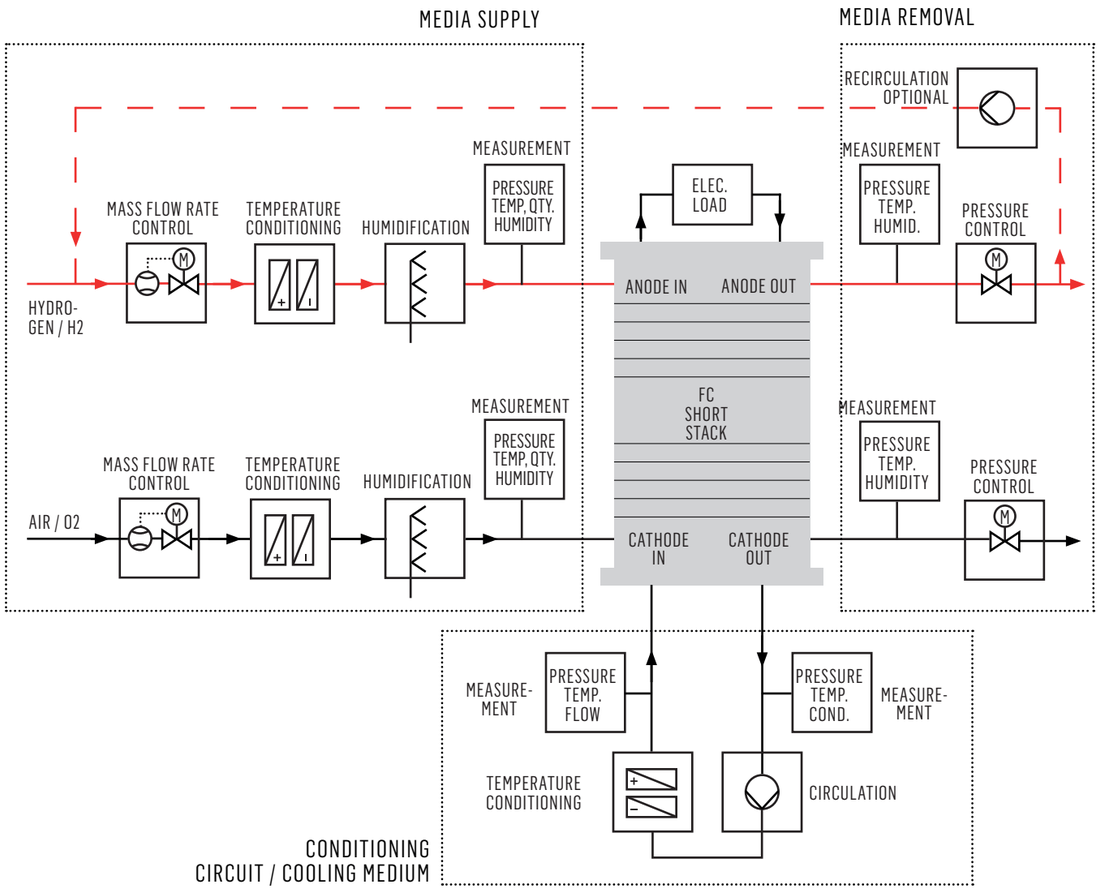


INFRASTRUCTURE AND ENVIRONMENTAL SIMULATION



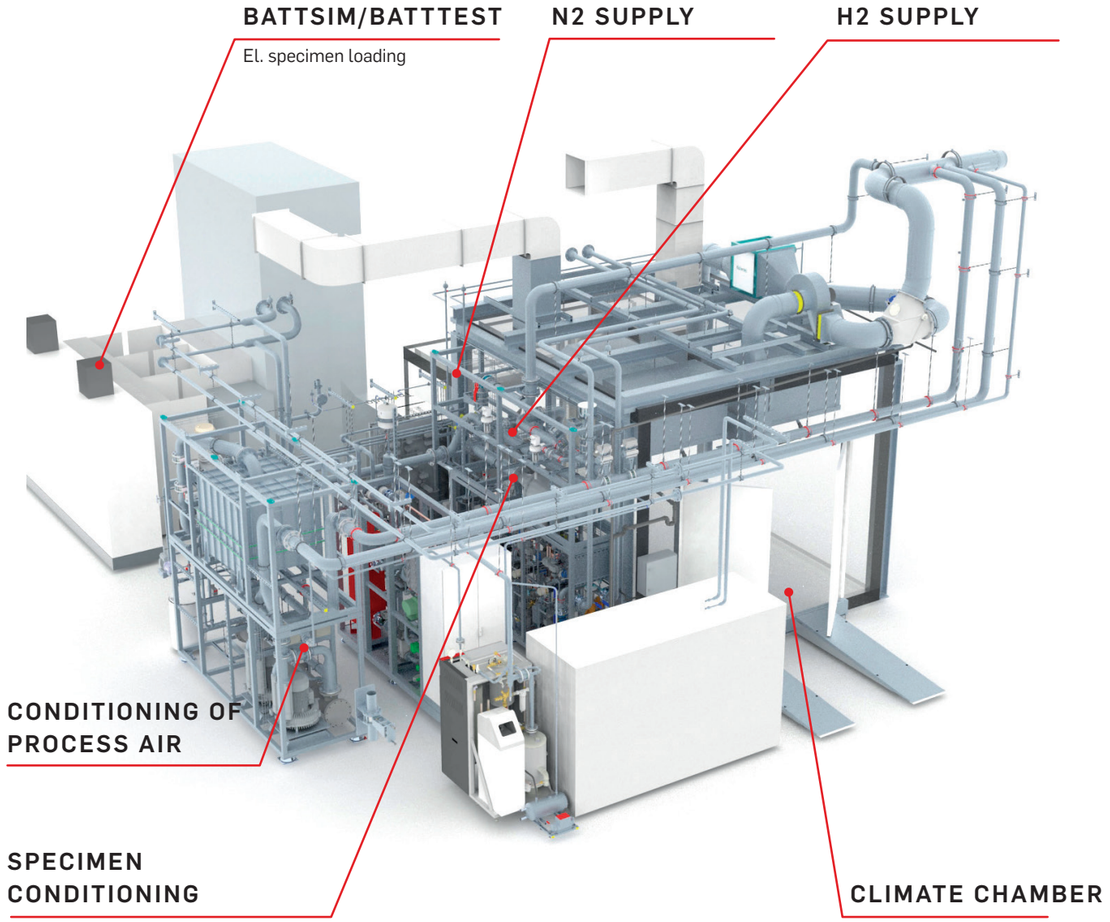
STACK TESTING - SYSTEM OVERVIEW

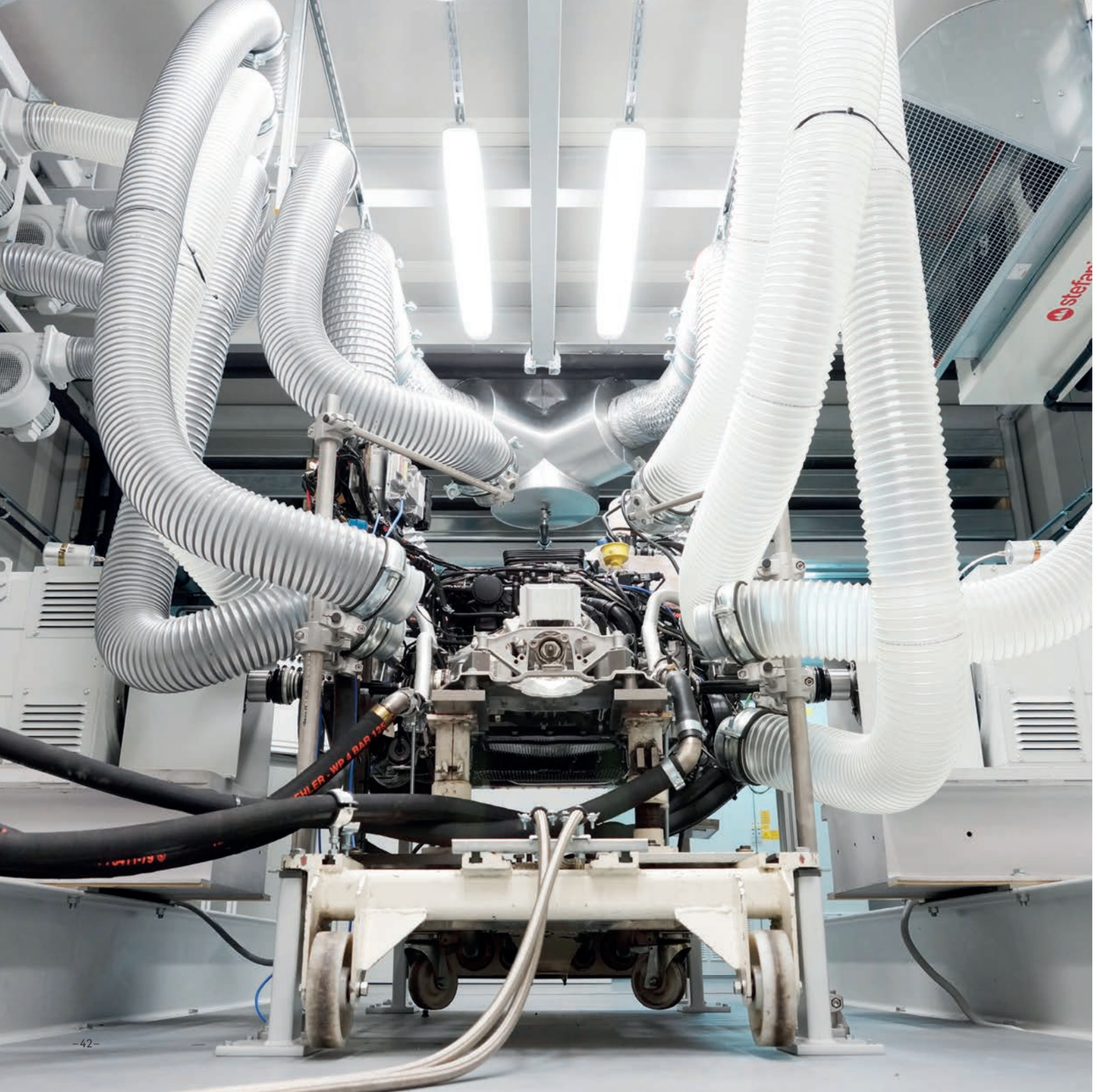
Functional schematic



FUEL CELL SYSTEM TEST BED - EXAMPLE

Typical test bed configuration



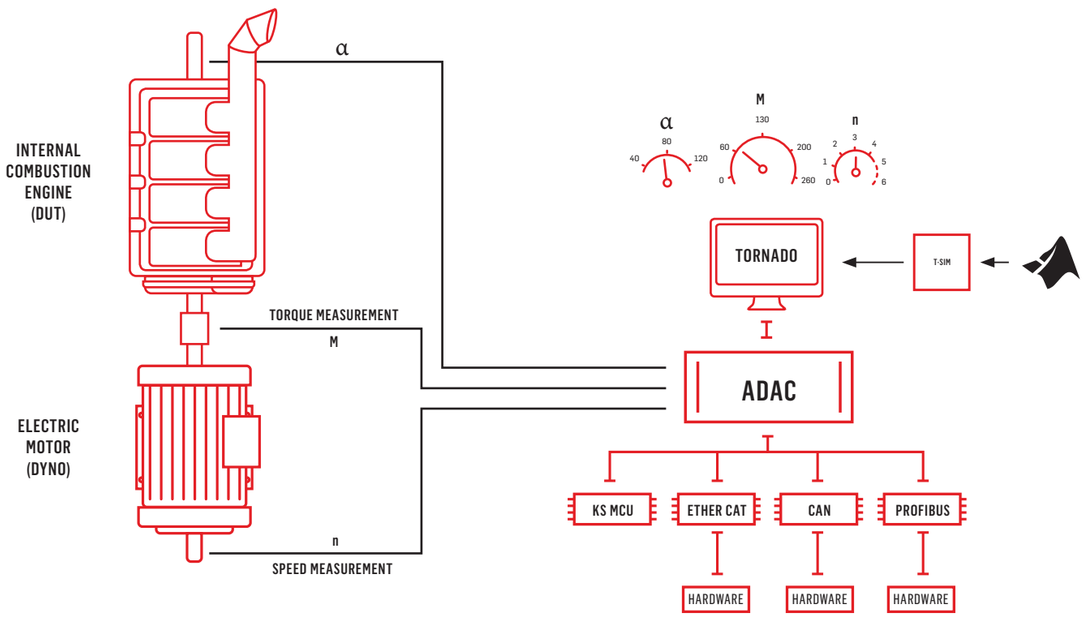


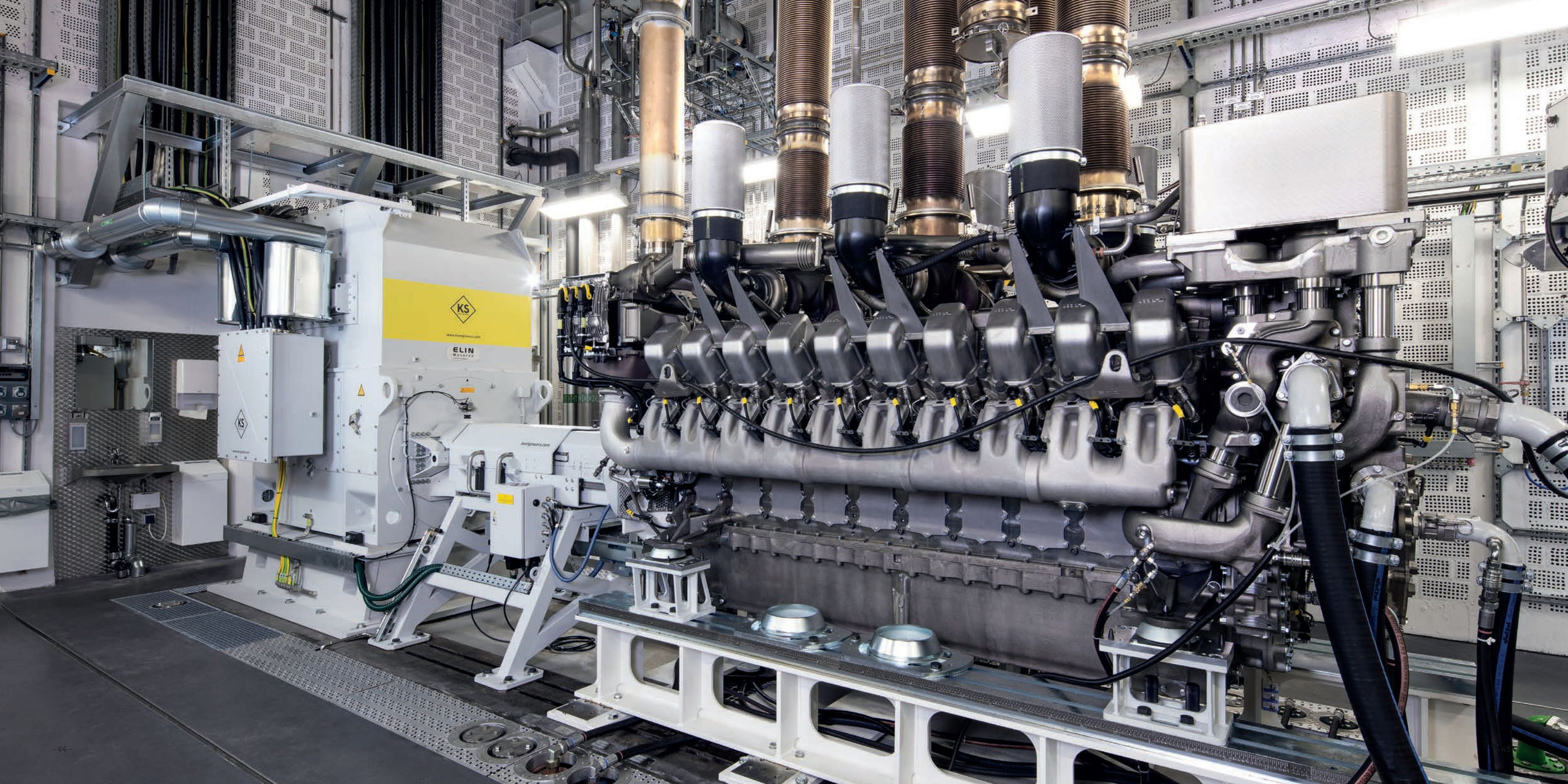
INTERNAL COMBUSTION ENGINES & ALTERNATIVE FUELS

ENGINE TEST BEDS

From small units to large engines. Highly dynamic control, flexible integration of sensor technology and peripherals, test bay management and end-of-line testing.

SYSTEM STRUCTURE

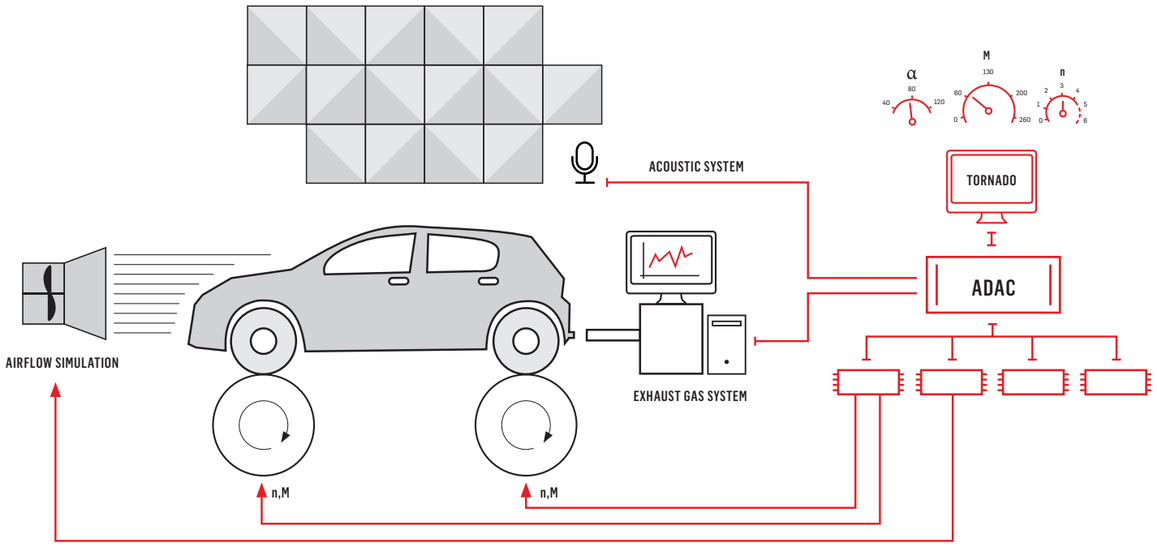



KS
ELIN

ON ALL WHEELS

CHASSIS DYNAMOMETERS

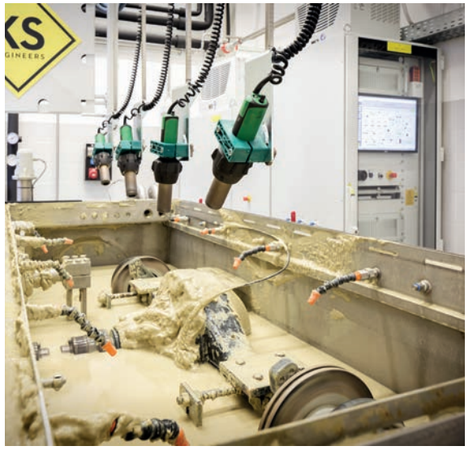
Chassis dynamometers from KS Engineers are optimized to satisfy customer requirements and cover a wide range of applications from R&D to range determination. Technical support throughout all project phases ensures effective testing and efficient project handling. Coupled with our KS Tornado measurement data acquisition and automation system, the chassis dynamometers provide an outstanding technological tool for carrying out standardized tests as well as customer-specific testing tasks. Workflows are supported by numerous measurement and control functions, which ensure easy operability and flexibility, and facilitate open import and export activities to and from control systems.



FOR SPECIFIC CHALLENGES

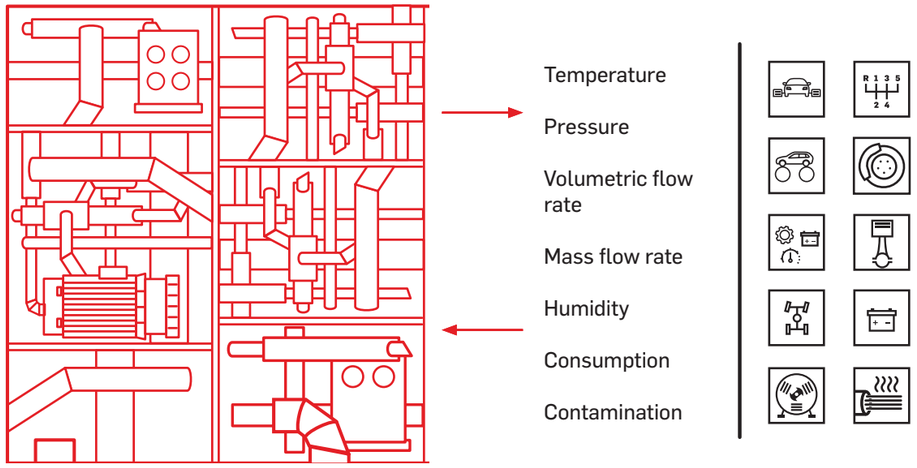
COMPONENTS AND CUSTOM TEST BEDS

The flawless operation, service life and energy efficiency of individual components are of the utmost importance, especially in the overall vehicle system. Failures or malfunctions of individual components are difficult to find once integrated in the overall system and can result in high investments of time and effort as well as costs. The results of design optimizations in the interest of cost and material savings can have unforeseen effects. It pays to subject new developments and improvements to in-depth testing in the early project phases. Physical aspects can be better analysed and understood on the test bed. The array of sensor technology and associated actuators in modern vehicles and other products is truly vast. The components themselves are often complex, equipped with intelligence and integrated with control units via bus systems. The result is a broad and time consuming range of possible test scenarios. It is just as important to include ambient conditions in considerations as interactions with the overall system. Even defining the testing task itself is highly demanding for engineers, who must achieve meaningful results from the often costly test systems. We are pleased to provide support with this as well. We place great emphasis on gaining a solid understanding of the task definition already in the offer phase and interact with the customer in an endeavour to find an optimal and cost-effective solution. Every test system can only be as good as its task definition, and each measurement result only as useful as the clarity of the investigation behind it. To ensure that the test bed financing is kept in an appropriate range but still enables fulfilment of the task without causing unforeseen costs or problems, we seek clear and comprehensive consultation with our customers in advance.



MEDIA CONDITIONING

COMFORTABLE CLIMATE OR ROUGH CONDITIONS



Temperature

Pressure

Volumetric flow rate

Mass flow rate

Humidity

Consumption

Contamination

Our know-how in the area of conditioning systems creates reliable, realistic and reproducible conditions for your testing task.
We design and implement the media conditioning required for your application. When doing so, we can draw from a broad range of systems that have already been realized and are able to tailor these to suit your exact testing task, or we can design an entirely new system for you. We use cutting edge measurement and control engineering throughout. The control signals can be realized via the automation system or can come from an autonomous control unit.

LUBRICATING OIL CONDITIONING SYSTEMS

- 20°C to 150°C
- 1 bar to 16 bar
- 0 to 500 l/h

COOLANT CONDITIONING SYSTEMS

- -40°C to 150°C
- 1 bar to 10 bar
- 0 l/h to 2,000 l/h
- Recooling (compact recooling systems)
- Multiple-circuit systems
- Common-rail systems with supply and return pressure control

FUEL CONDITIONING AND CONSUMPTION MEASURING SYSTEMS

- 20°C to 70°C
- 1 bar to 10 bar
- 0 kg/h to 200 kg/h

CUSTOM CONDITIONING SYSTEMS

- E.g. ethanol, AdBlue, etc.
- In addition, we accommodate your specific requirements concerning the control range and application.

SUPPLY AIR CONDITIONING SYSTEMS

- 15°C to 50°C
- 250 mbar to 1100 mbar absolute
- 8 g/kg to 20 g/kg abs. humidity
- Volumetric flow rate up to 10,000 m^3/h
- Turbocharged:
  25°C to 90°C
  0 bar to 4 bar above atmospheric
  5 g/kg to 15 g/kg abs. humidity
  Mass flow rate up to 500 kg/h
- Constant volume sampling

SPECIMEN CONDITIONING & CLIMATE CELL

CREATE ENVIRON-MENTAL CONDITIONS AS REQUIRED

CLIMATE TEST CHAMBER:

This is designed based on the customer's individual needs in terms of size, performance and safety technology equipment. The climate test chamber typically has two functional areas: The climate chamber area itself, where the specimen is tested under specific temperature and climate conditions, and the equipment room, where the refrigeration and electrotechnical equipment for the system are installed.

TYPICAL CLIMATE CHAMBER PERFORMANCE DATA:

- Temperature range -30 °C...+90 °C
- Temperature deviation ± 0.5 K to ± 1 K; over time
- Rate of temperature change:
  Heating gradient (average) 2 K/min
  (between -25 °C and +55 °C)
  Cooling gradient (average) 2 K/min
  (between +55 °C and -10 °C)
  (measured in the supply air with specimen, without heat radiation)
- Heat compensation min. 10 kW at -30 °C
- Humidity range 5 %...~95 % r.H. (without heat load)

SPECIMEN CONDITIONING

- Different water/glycol circuits that can be controlled individually
- Temperature measurement in the supply line with controlled supply temperature
- Temperature measurement in the return line
- Configurable temperature limiter
- Flow rate measurement in the supply line
- Flow rate control via a three-way mixing valve
- Simple filling and draining of the water/glycol tempering circuit
- Water-cooled refrigeration unit for cooling the circuits

TYPICAL PERFORMANCE DATA PER TEMPERING CIRCUIT:

- Temperature range -30 °C...+80 °C
- Temperature control accuracy +/- 0.5 K over time
- Supply line pressure 0-10 bar
- Pressure control accuracy 0.1 bar
- Volumetric flow rate 1...30 l/min
- Measuring inaccuracy ± 1.5% of measured value
- Heating capacity 15 kW
- Cooling capacity 5 kW over -25 °C / 30 kW over +15 °C

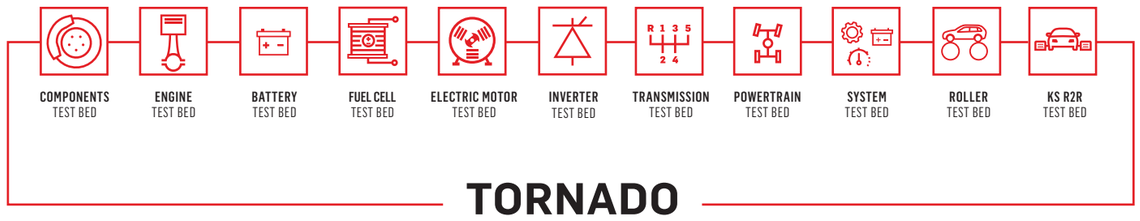
HOLISTIC AUTOMATION

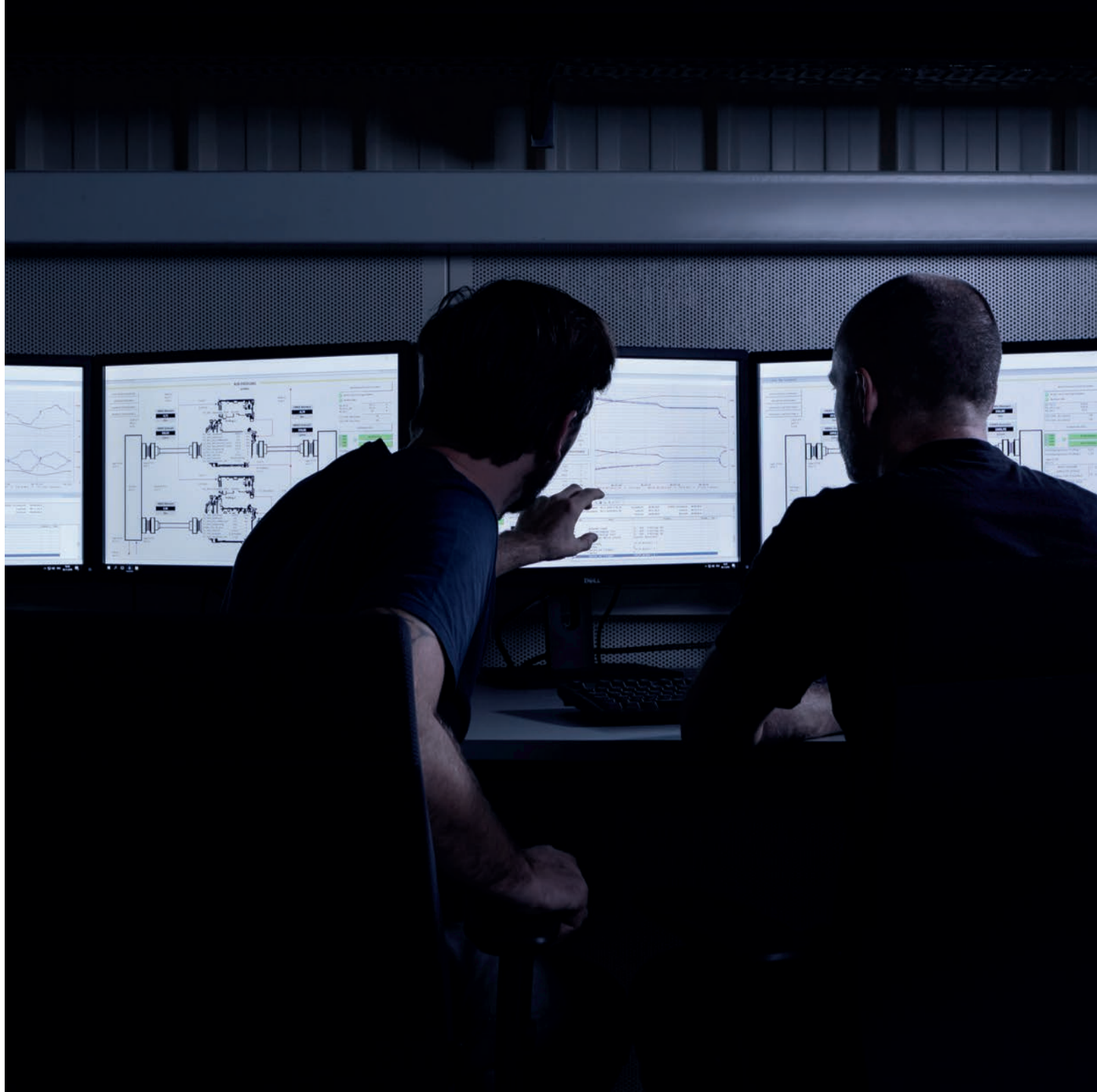
TORNADO SOFTWARE SUITE

Well thought out and sustainable automation of your testing tasks beyond the limitations of test cells and site locations. Tornado Software Suite expands the test bed control system to include test bay management, assignments and multiple options for measuring data management and reporting.

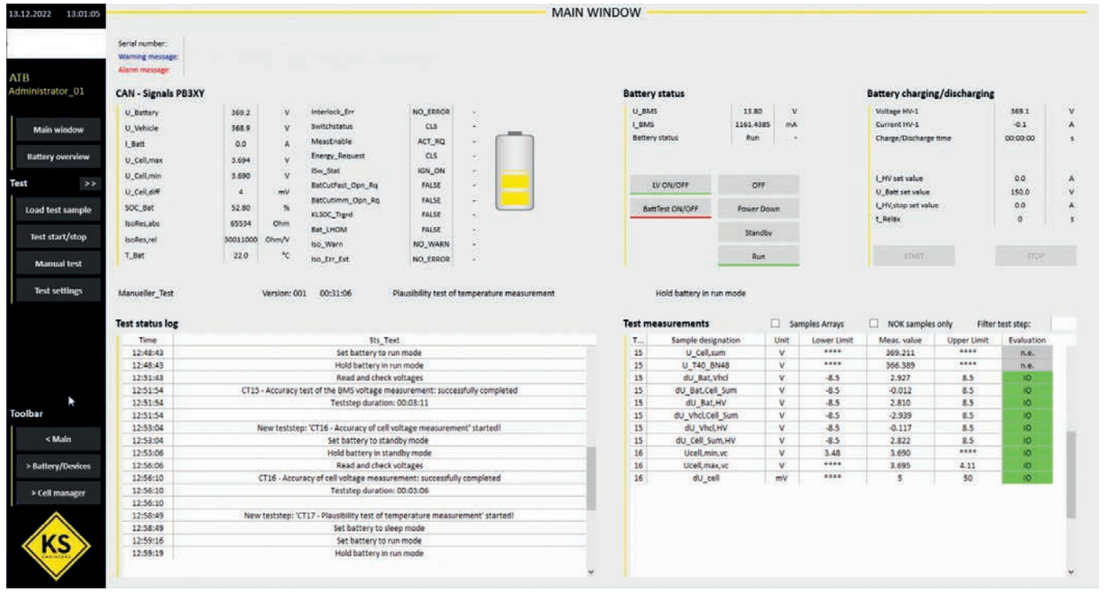
Whether dealing with the efficient automation of test bays, test centres or decentralized sites, Tornado Software Suite is a comprehensive tool which allows the complex tasks involved in systematic test bed automation to be solved easily and effectively. The proven flexibility of the Tornado software architecture allows the system to be adapted ideally to the requirements of testing tasks and test bed management. The test task itself is performed using the core application Tornado Testbed. Uniform functions and test bay architecture are managed by means of extensive services and features of the Tornado host. The Tornado Order Management (TOM) module expands the automation system to include an open assignment system.

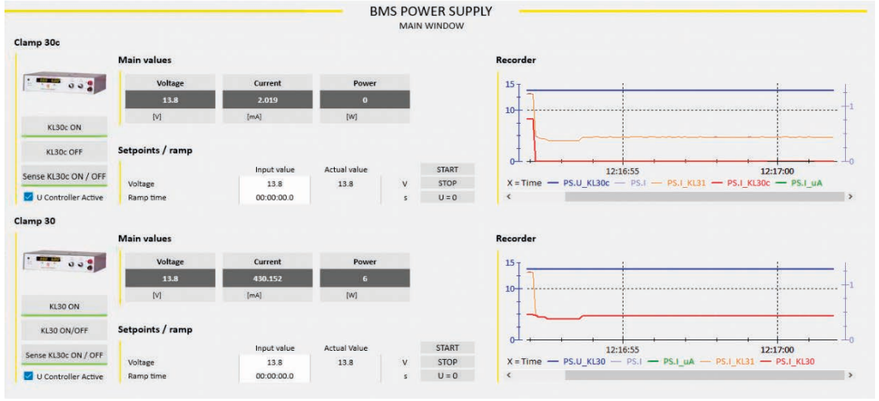
Familiar functions and flexibility in test bed automation thought through to the next level.



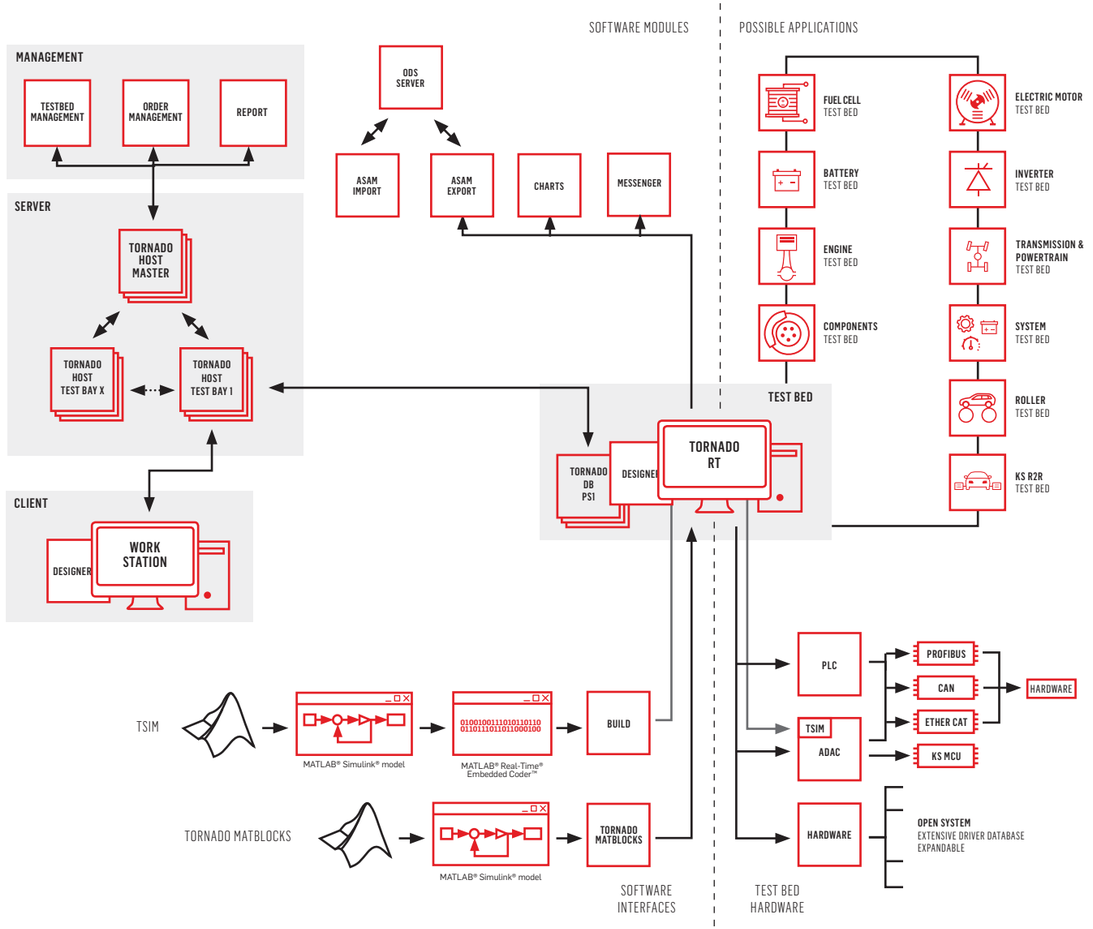


TORNADO – TYPICAL VISUALIZATION





TORNADO SOFTWARE SUITE (SYSTEM OVERVIEW)




KS ENGINEERS
hager

THE INNOVATIVE MODULES FOR OUR CUTTING-EDGE TECHNOLOGICAL PRODUCTS

KS TECHNOLOGY MODULES

KS-R2R FREQUENCY CONVERTER

TOP-FLIGHT MACHINE CONTROL

The KS-R2R frequency converter is an integral part of the high-performance testing technology KS supplies for complex testing requirements. The use of cutting-edge semiconductor modules in combination with fast signal processing and holistic, model-based control engineering facilitates highly dynamic applications. The best possible control performance is achieved using mathematical models of the test bed as well as the latest control algorithms. This system solution is the key to results that have never been seen before in engine, powertrain and complete vehicle testing.

AREAS OF USE AND APPLICATIONS:

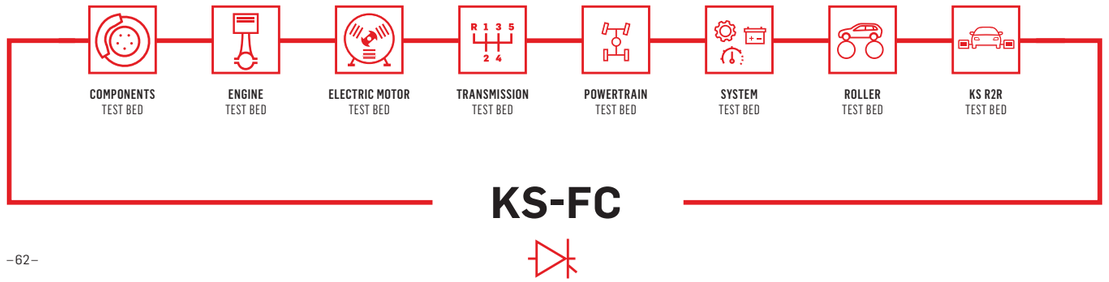
- Model and function-based testing
- ICE simulation on powertrain and system test beds
- Flywheel mass replacement for inertia simulations
- Compensation of unwanted oscillation processes (e.g. for ICE engine start-up, shaft resonances)
- Electric motor test beds (high switching frequencies)
- Split-belt applications

FEATURES:

- Control frequency of up to 10 kHz possible (system clock, overall control loop)
- Torque measurement at 250 MHz
- Small size delivers powerful performance
- Version according to EMV-ILA possible
- Active shaft damping

CONTROL MODES:

- Controller mode “M” (classic)
- Controller mode “Mplus” (inertia compensation, R2R, haptic test, drag lock...)
- Controller mode “n” (classic)
- Controller mode “nplus” (super stiff speed control)
- Virtual additional damping
- Split-belt control




KS
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www.ksengineers.de

SHAPING CURRENT

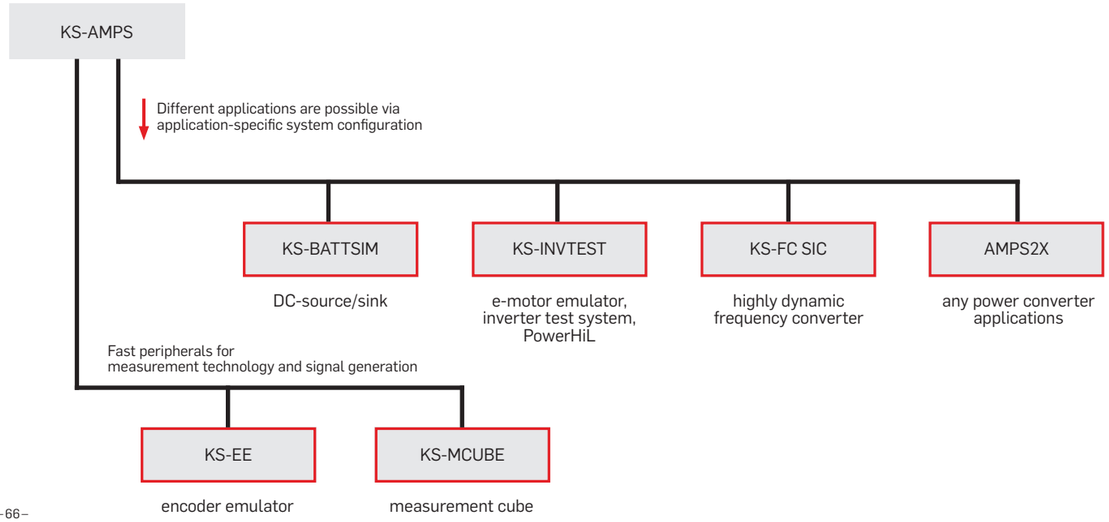
KS-AMPS

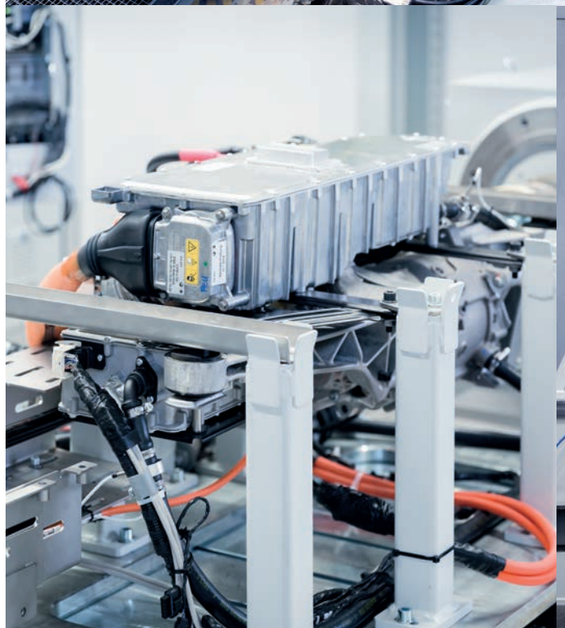
The KS power converter system forms the technological basis of our highly dynamic and flexible DC , AC and dyno controllers.

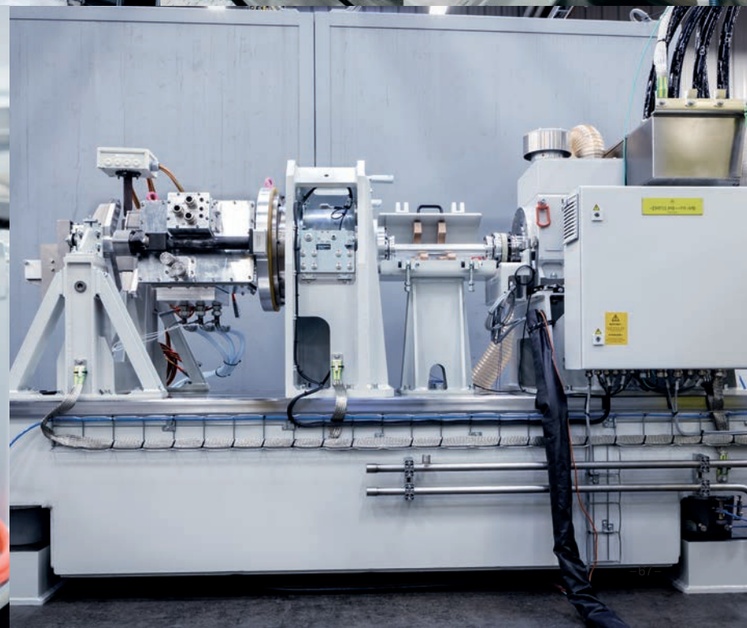
The Advanced Modular Power System (KS-AMPS) is a flexible, highly dynamic power converter system that allows a wide range of applications to be realized simply and with optimization for specific requirements. The modular architecture ensures that functional and power enhancements are uncomplicated: A system solution for battery simulation and testing, electric machine emulation, control of loading units or combination applications as well.

BENEFITS:

- Simple scalability of power and function
- Combined applications possible (e.g. KS-InvTest = battery simulation + e-motor emulation)
- System adaptations are easily possible later on
- Direct, function-based access to the SiC-MOSFET drive signal
- Highly dynamic: System clock 2 MHz and control loop 1 MHz
- Simple and cost-effective maintenance due to modular design







KS-BATTSIM EIS MODULE

ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY

The EIS module is a functional extension of the KS-BattSim for measuring the frequency-related impedance characteristics of the specimen. The system-integrative concept this module employs allows variables to be measured even during charging and discharging processes and thus online diagnosis regarding ageing processes (SOH, SOC).

IMPEDANCE MEASUREMENT FROM 0.01 TO 1,000 HZ:

- U/I measurement at 100 kHz / 24 bit
- THD monitoring

IMPRESSION OF THE EXCITATION:

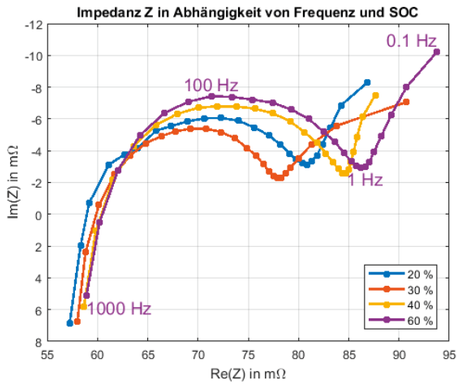
- Adaptive control
- Specification of voltage or current oscillation (default amplitude and frequency)

EIS CAN BE SUPERIMPOSED ON THE DC CURRENT/VOLTAGE SIGNAL:

- Can be integrated into test runs
- Measurements can be made during charging and discharging processes

APPLICATIONS:

- Modelling for batteries and fuel cells
- Investigation of ageing processes, SOH
- Development of real-time diagnostic procedures



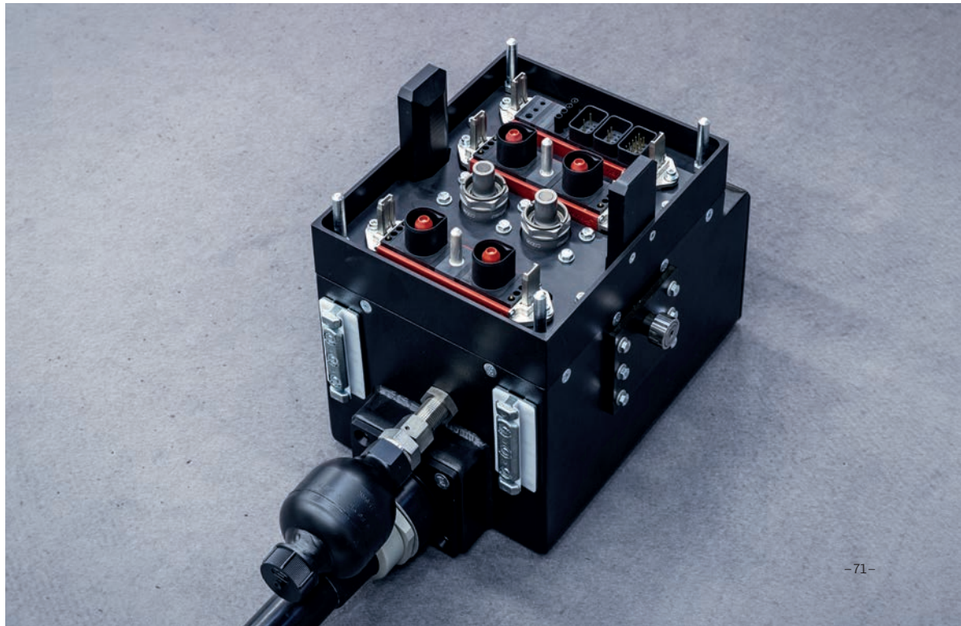
KS-PCU

CHARGE MANAGEMENT ON THE TEST BED

The Power Charging Unit expands the functional range of the KS-BattSim, which then functions as a DC source for quick charging of vehicle batteries. A switchover unit, which supplies the DC quick charging box, is integrated in the system for this purpose.
The DC quick charging box has two parts: a stationary part and a pluggable charging-plug module with the corresponding charging cable for typical charging standards, such as ChaDemo, etc.

There are two ways to operate it:

- Plug and Charge: Charging begins immediately after the plug is connected.
- The charging operation is controlled directly by the automation system, e.g. TORNADO.



KS-TEST WHEEL

UNCOMPLICATED SET-UP

Our test wheel is compatible with all common wheel hubs. Use of the test wheel means the vehicle stands on the vehicle powertrain test bed (R2R) under realistic contact conditions with no outside influences.

Test Wheel 4.1

ADVANTAGES:

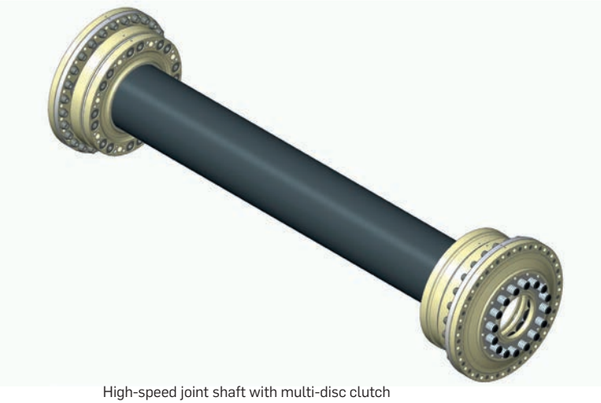
- Realistic contact conditions
- Spring and shock absorber systems are active and loaded realistically
- Supports steering at the test bed
- Easy and quick vehicle set-up
- Vehicle can be manoeuvred in the building
- No unnatural tension or strain applied to the powertrain
- Simple vehicle restraint
- Integrated connection options for brake cooling (airflow)
- Can be combined with longitudinal actuators to simulate longitudinal movements during vehicle acceleration and deceleration

To facilitate the accommodation of large brake systems on powerful vehicles as well as small wheel houses on compact vehicles with a single test wheel, a low-profile tyre is used to achieve a large inner rim diameter with a compact outer wheel diameter. Wheel hub centring is ensured by using an adjustable clamping nut that can compensate tolerances in the wheel hub.

As an option, the test wheel can also be equipped with additional connections for supplying cooling air for the brake disc, and the current brake disc temperature can be measured during test operations by means of a contactless measuring system.

To fix the vehicle to the test bed, it is connected to the test bed floor via a pusher fork with a damper system and lugs on the specimen wheels of the rear or front axle. Different vehicle lengths can be accommodated using the telescopic connection.

High-speed joint shaft with constant velocity ball joint
(max. 30.000 rpm, 1.100 Nm, 770 kW, max. 2,5° per joint)



High-speed joint shaft with multi-disc clutch
(up to 40.000 rpm or 2.400 Nm, 770 kW, up to 0,5° per joint)

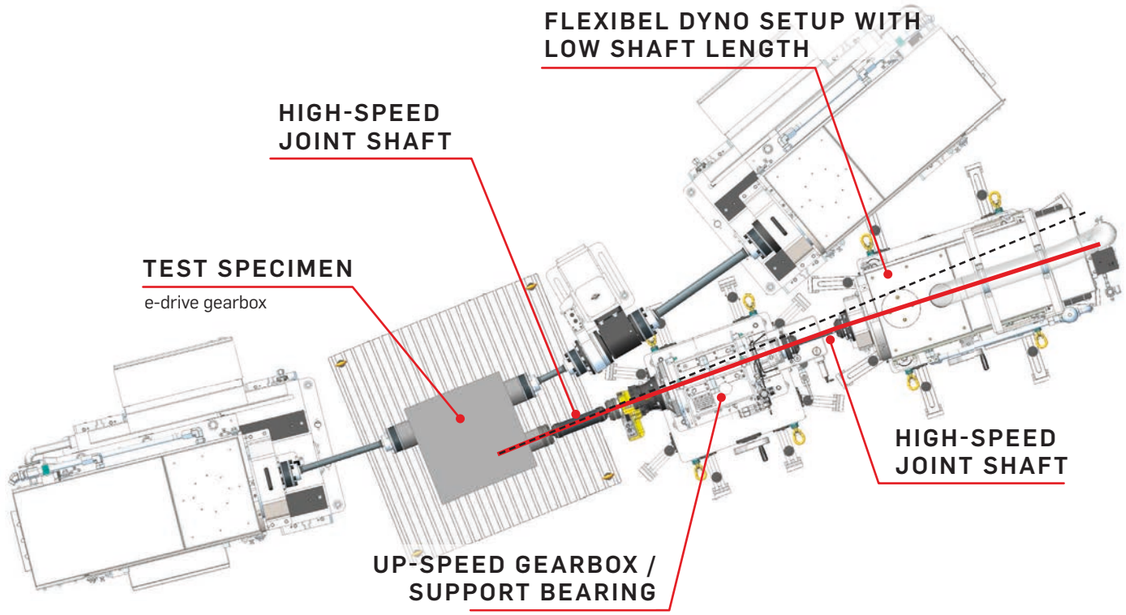
FOR CHALLENGING APPLICATIONS

KS-HIGH SPEED SHAFTS

When testing gearboxes for e-axles, the geometry of the test specimen poses particular challenges for the test bed design. The input and output axles of e-drive gearboxes are usually parallel with small centre distances. With short drive shafts, this could lead to collisions between the input and wheel machines. With the KS-High speed shafts, load machines can be flexibly positioned despite short shaft lentgh and optimum arrangements can be achieved. Together with other KS-High speed elements such as test specimen adapters, support and intermediate bearings, KS-High Speed shafts enable test bed set-ups for speeds up to 40,000 rpm and torques up to 2400 Nm with minimized vibrations and oscillations.

ADVANTAGES:

- Speed up to 40,000 rpm
- Torque up to 2.400 Nm
- Low-vibration design
- Enables compact and flexibel set-ups for e-axle gearbox test beds (diffraction angles up to 2,5° per joint)
- Minimized oscillations and vibrations at e-axle and e-motor test beds
- Low resetting forces and minimum axial forces (low load on the bearing points)



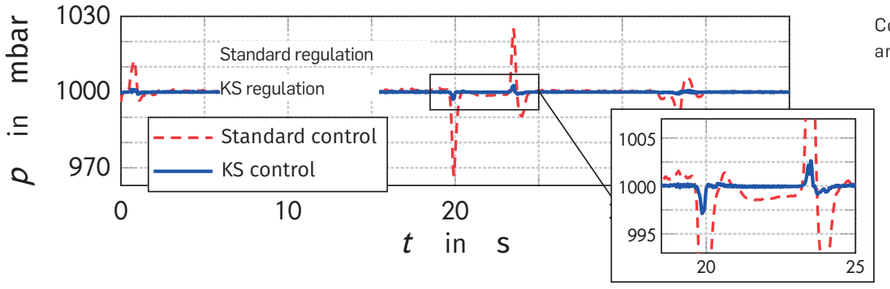
DYNAMIC PRESSURE CONTROL

KS-DPC II

The KS Pressure Control Damper (KS DPC) is a module that meets the highest requirements for pressure control in modern test systems. Through the use of model-based control engineering, intelligent sensor evaluation and fast signal processing, the control performance is ten times greater than that of conventional systems.

FEATURES

- Maximum pressure deviation approx. 2.5 mbar (10x smaller than with standard regulation)
- Model-based control engineering
- KS Sensor Fusion (highly dynamic control)
- Compensation of line influences
- Control frequency of 1 kHz
- Highly dynamic regulation (suitable for dynamic testing tasks such as WHTC, ETC, etc.)
- The best possible control performance
- No damper container required
- Altitude simulation (2.000 m and more)
- Independent control of supply air and extract air
- No connection between intake air and extract air



Comparison of standard and KS regulation

HUMIDITY & TEMPERATURE – HIGHLY DYNAMIC REGULATION

PRECISE PROCESS AIR SUPPLY

KS Engineers offers custom-made conditioning systems for the supply of process air to fuel cell systems. Model-based control circuits in conjunction with increased control frequencies, intelligent sensor evaluation and specially developed, highly dynamic control valves for vaporization enable outstanding control quality in terms of dynamics and precision.

ADVANTAGES:

- Highly dynamic setpoint changes
- Robust interference suppression
- Simulation of dynamically changing environments
- Significant reduction in test point stabilization time and test run time

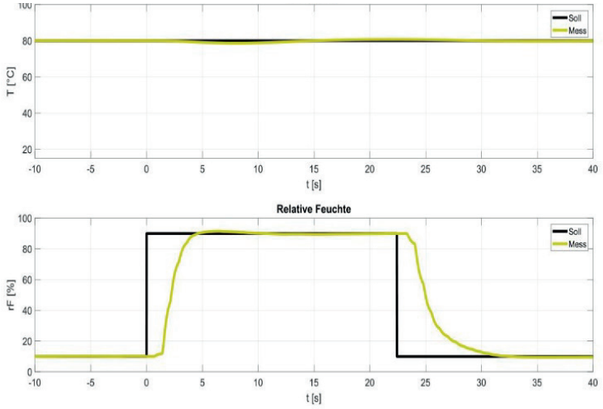


Figure: Development test bed for optimization of the control path

REAL-TIME INSIGHTS

KS-LEC OILTRACER

Oil consumption is an important parameter in the development of high-efficiency internal combustion engines. It is a factor both in terms of the great potential it offers for avoiding particle emissions in the exhaust gas by reducing oil emissions, and for its considerable influence on life-cycle costs in the operation of internal combustion engines. Consequently, exact measurement of oil consumption is becoming increasingly important for research and development.

Conventional measurement methods, such as gravimetric analysis, provide information about static operating states, but obtaining results for dynamic engine operation requires measurements in real time. Until now, continuous methods have been based either on radioactive tracers that are cumbersome to handle, or on non-radioactive tracers that are subject to significant cross influences from the fuel.

What's special about the KS-LEC OilTracer is its ability to perform online measurements based on a new type of tracer. The device is integrated into the test bed measurement equipment, and the oil consumption data can be recorded directly along with other data.

KEY FEATURES, BENEFITS

- Can be used for all types of engines and fuels (petrol & diesel fuels, CNG, synthetic fuels, e-fuels, H2, and others)
- Easy to install and use
- Robust device design
- High measuring accuracy and reproducibility
- Non-radioactive and non-poisonous tracer method
- No cross influences from fuel (e.g. through SO2)
- Patented technique for marking the engine oil using hydrogen/deuterium exchange without influencing the tribological properties
- High-precision, time-resolved measurement of the tracer in the exhaust gas
- No post-processing of the measurement data (the measured value comes directly from the test run)
- The measurement accuracy is set through the proportion of tracer used

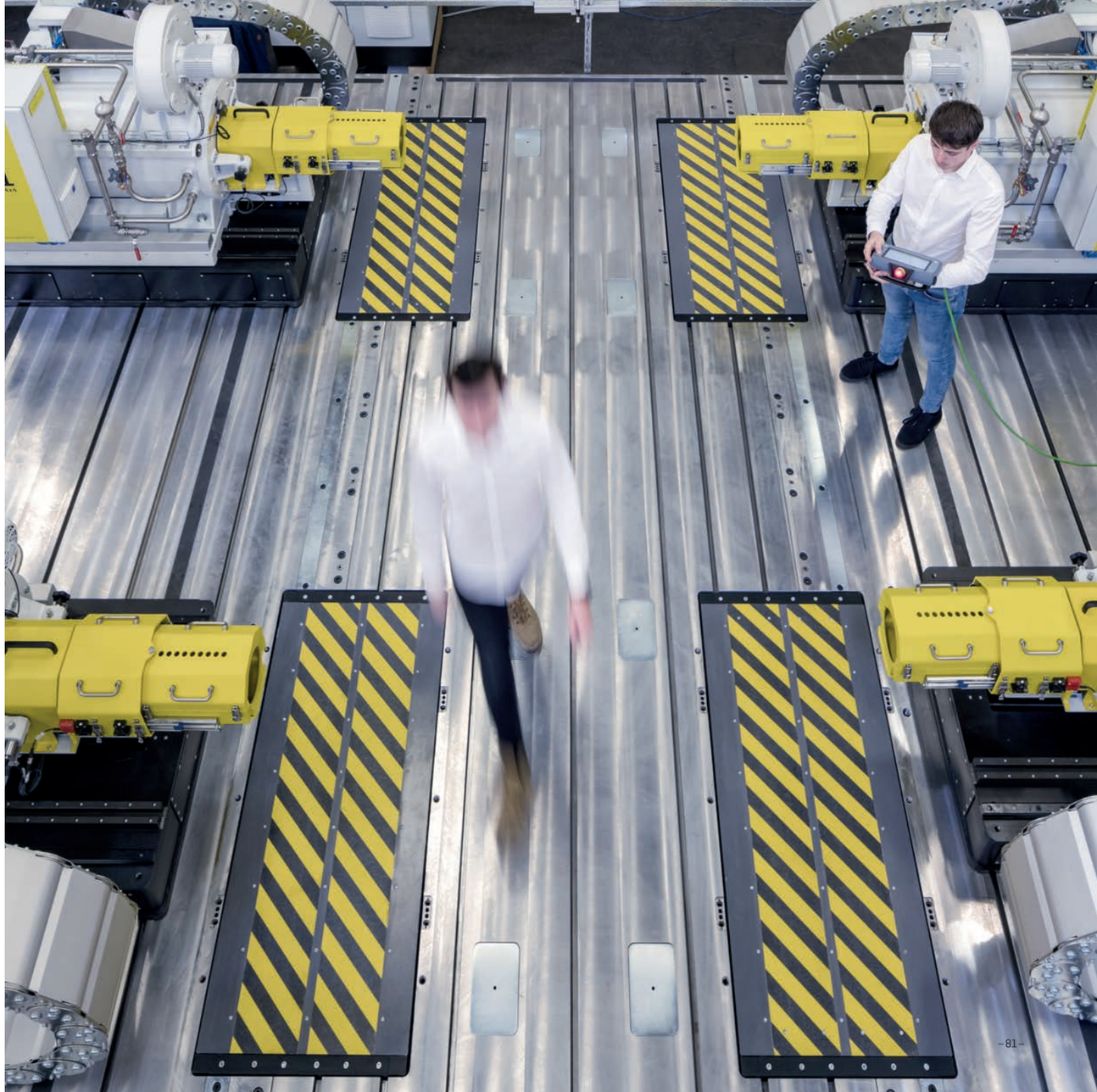
KS-FSS

FUNCTIONAL SAFETY

When it comes to testing future drive systems – for example in conjunction with hydrogen and high-voltage battery systems – but also when operating conventional testing systems, complexity increases due to the interlinking of a wide variety of systems. This also increases the demands placed on system safety. The safe operation of the entire system in compliance with statutory regulations while simultaneously maintaining a flexible operating concept pose a considerable challenge here. With the KS Functional Safety System (KS-FSS), KS Engineers have delivered an integrated operating and safety concept for the individual requirements of each system; starting with the design, then the planning, right through to operation and approval. When it comes to testing future drive systems – for example in conjunction with hydrogen and high-voltage battery systems – and also when operating conventional testing systems, complexity, and thus also the requirements placed on system safety, increase due to the interlinking of a wide variety of systems. The safe operation of the entire system in compliance with statutory regulations while simultaneously maintaining a flexible operating concept pose a considerable challenge here. With the KS Functional Safety System (KS-FSS), KS Engineers have delivered an integrated operating and safety concept for the individual requirements of each system; starting with the design, then the planning, right through to operation and approval.

	CROSS-SYSTEM ASSESSMENT	CONFORMITY		SAFETY TECHNOLOGY
SYSTEM ASSESSMENT	Analysis of system structure, interlinking and subsystems, clarification of the requirements for the operating concept, impact analysis	CE conformity	Risk assessment EN ISO 12100 (SAFEXPERT)	KS Safety Cell Manager
		Performance level verification EN ISO 13849-1 (SISTEMA)	Safety matrix	Control-system protective equipment
SAFETY SERVICES	Documentation	Validation to EN ISO 13849-2	ATEX, WHG Observation	Fire protection Observation	KS-OMM Operating Mode Manager
HARDWARE/ SOFTWARE IMPLEMENTATION	Inherently safe design	KS BattSafe	Guards / safety devices	Interface to safety systems (hardware / software)	KS-SLS Safety Limited Speed

KS-FSS TECHNOLOGY BUILDING BLOCKS

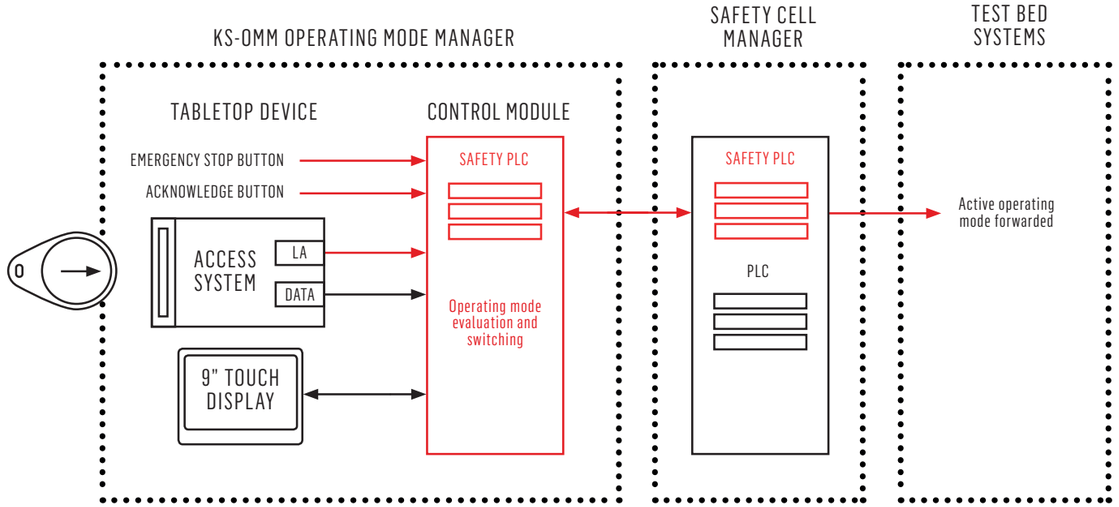


KS-OMM

OPERATING MODE MANAGER

The KS-OMM Operating Mode Manager serves as a flexible unit for operating mode selection and combines the operating mode switch acknowledge button and emergency stop button installed on the test beds. The electronic key system enables maximum access security. A large touch display offers the greatest possible flexibility in terms of configuring and selecting operating modes.

SYSTEM STRUCTURE



TESTING SERVICES

TESTING SERVICES

OUTSOURCE THE TESTING, FOCUS ON THE RESULTS

With our test facilities in Graz and Friedrichshafen and our product range, we can offer testing services for complex and varied challenges in the areas of powertrain technology and energy systems.

Our Testing Center teams handle all demands from development to series validation – whether for conventional drive systems or your visionary ideas for the future.

Testing often needs to be carried out even though the necessary infrastructure does not exist or existing resources are in use. With our in-house testing systems, we offer an alternative solution. Our experienced staff take care of the required testing, including the associated logistics and data management, with a clear focus and dynamic flexibility. State-of-the-art testing technology enables functional testing using different approaches and methodologies for the entire range of development stages.

We work quickly and economically to develop unconventional solutions for you.

IN-HOUSE TEST BEDS

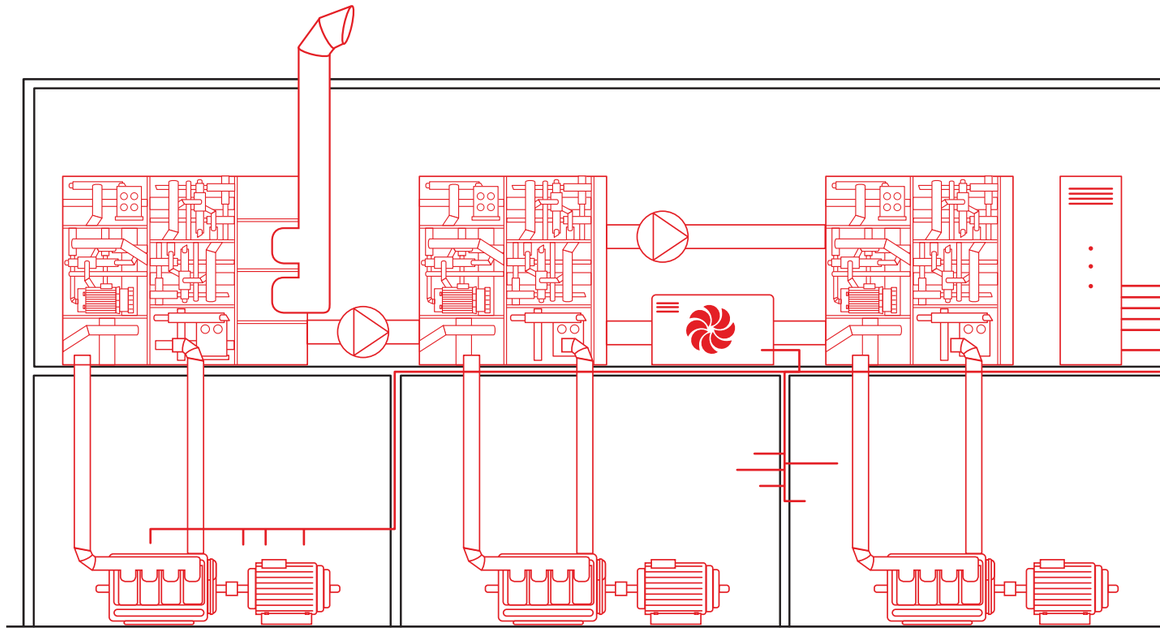
- Classic engine test beds
- R2R complete vehicle test bed
- R2R CV electric drive test bed, 2 machines
- Powertrain test beds, 2 machines
- Back-2-Back Electric Axle Test Beds (B2B)
- KS Fit-Box
- R2R powertrain test bed, 3 machines
- Electric motor test beds
- R2R powertrain test bed, 4/5M (AWD)
- R2R powertrain test bed, 2 machines with ICE

BUILDING FACILITIES

BUILDING SERVICES ENGINEERING

SOPHISTICATED AND EFFICIENT SOLUTIONS.

We seamlessly integrate our decades of experience in the area of building engineering into our testing technology. Whether media supply for individual test cells or the planning and execution of entire test centres – you can obtain everything from a single source, if you like, which is a significant advantage when projects need to be carried out quickly and without complications. Enjoy being well taken care of in the areas of electrical, heating, air condition and plumbing – from small projects right up to complex large-scale projects – by your direct contacts at KS Engineers.



BUILDING SERVICES ENGINEERING

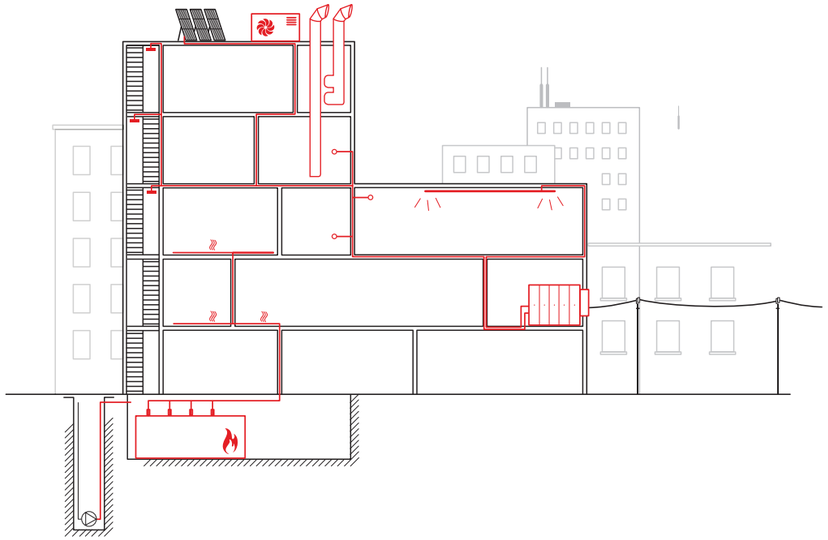
RANGE OF SERVICES

AIR CONDITIONING:

- Refrigeration systems
- Cooling distribution
- Waste heat utilization for refrigeration
- Comfort ventilation
- Solar cooling
- Direct cooling
- Cleanroom technology
- Cooling load calculation
- Central ventilation systems

SANITARY FACILITIES:

- Planning and construction of plumbing systems
- Hot water systems:
  - Water treatment systems
  - Rain water utilization
  - Pressure boosting systems
  - Wastewater systems
  - Separator systems
- Medicinal gases, special gases



ELECTROTECHNOLOGY:

- Power installations:
  - Low-voltage systems
  - Compensation systems
  - UPS systems
  - Lighting systems
  - Lightening protection systems
- Weak current installations
  - Communication technology (EDP, telephony, GSM systems, nurse call systems)
  - Safety technology (fire alarm systems, alarm systems)
- System inspections
  - Initial test
  - Recurring tests
- Project development, planning, consultancy
- PV systems
- Energy management

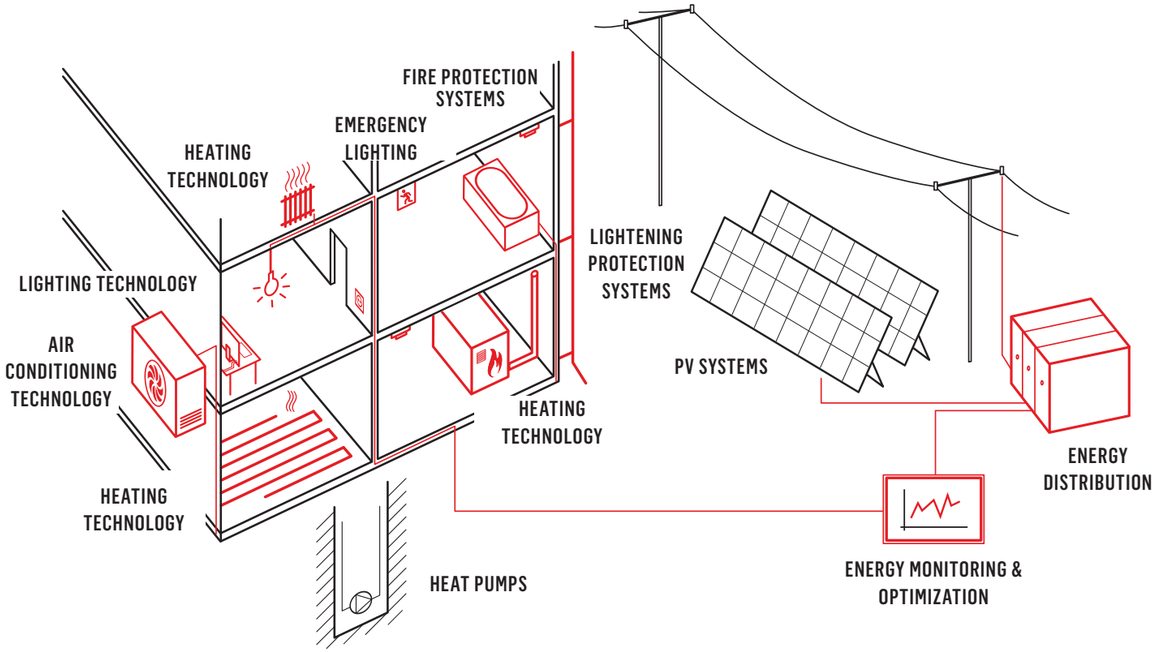
HEATING TECHNOLOGY:

- Heat pump systems
- Gas, oil, biomass furnaces
- Regenerative and alternative energy systems
- Solar systems
- Passive houses
- Steam generation

BUILDING SERVICES ENGINEERING

CLEAN TECHNOLOGY FOR A GOOD CLIMATE.

Your building – our technology: We plan and construct tailored systems to the benefit of people and the environment. No matter whether electricity, heat, cooling, air, or water – we have the right solution for our customers. Cost effectiveness and energy optimization are always the main focus of our work.



KS ENGINEERS.

We create optimal solutions for our customers. Passion, long-standing experience and ongoing refinement are our tools.

AUTOMOTIVE TESTING

Our core expertise: Automotive testing. Long-standing tradition meets innovative ideas.

INDUSTRIAL AUTOMATION

We endeavour to find the best solutions for our customers using the full range of our team's experience and knowledge.

BUILDING FACILITIES

An expert partner for electrical, heating, air conditioning and plumbing. From small jobs to complex, large-scale projects.

TESTING SERVICES

We carry out your testing tasks on our in-house systems and deliver high-quality measurement data and results.

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