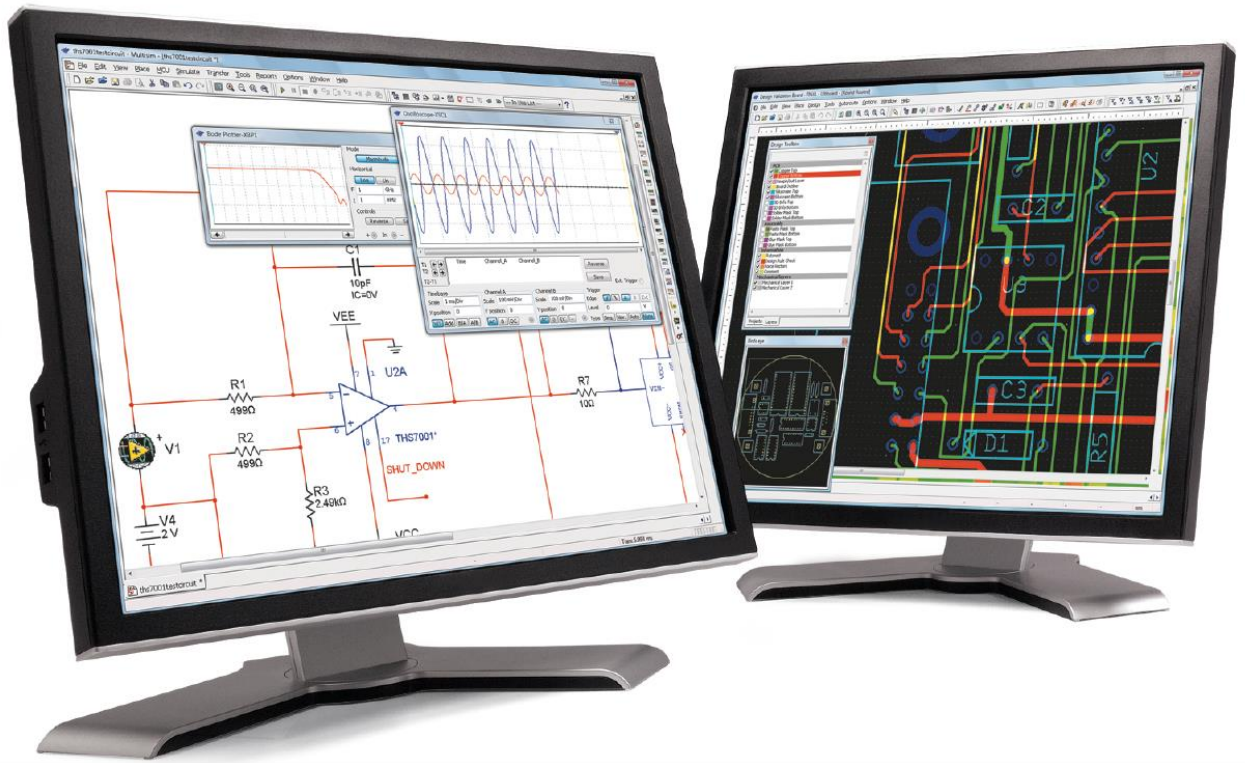

EV Validation Test Solution

Authorized Distributor

Yasrof

Sales & Marketing Engineer

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Jamil

Technical Marketing Engineer

jamil@haliatech.com

+62 823 8618 1620

Agenda

- Accelerating EV Product Performance
- Hardware-in-the-Loop Testing of EV
- Solutions
- Discussion

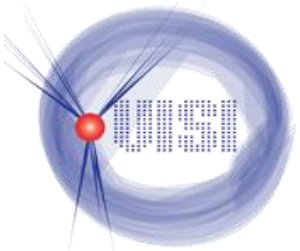
PT Halia Teknologi Nusantara

Vision, Mission and Values

Vision	To become a leading **engineering solutions provider** for **industry**, **education**, and **research**
Mission	To provide our customers with **innovative system integration solution** with emphasis on **quality**, **integrity**, **timeliness**, and **cost effectiveness**.

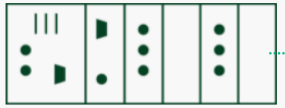
Values	We treat our customers, partners, employees, and shareholders with **respect** and **professionalism** We grow through **creativity**, **invention** and **innovation** We integrate **honesty**, **integrity** and **business ethics** into every aspects of our business

Partners



National Instruments
is now NI.

Key System Components



CHASSIS

As the backbone of a system, the chassis provides power, cooling, and a communication bus to the system, and supports multiple modules or instruments.

CONTROLLER

Integrated or external, the controller contains everything you need to run your system.

MODULES

Each module's individual functions and I/O help the overall system fulfill its requirements.

SOFTWARE

NI software helps you customize and reconfigure systems to solve test requirements that evolve over time.

SERVICES

NI's consulting, integration, hardware, and software services ensure your success.

Types of NI Systems

PC-Based Systems

PC-based measurement and control systems provide electrical and physical measurement capabilities for engineers who need a customizable, accurate, yet cost-effective way of conducting benchtop measurements.

CompactDAQ

CompactDAQ systems provide a customizable solution for engineers to perform electrical and physical measurements either at their benchtop or in a distributed architecture.

CompactRIO

CompactRIO systems provide real-time processing capabilities and sensor-specific conditioned I/O, which is ideal for stand-alone data logging, industrial monitoring, and control applications.

PXI

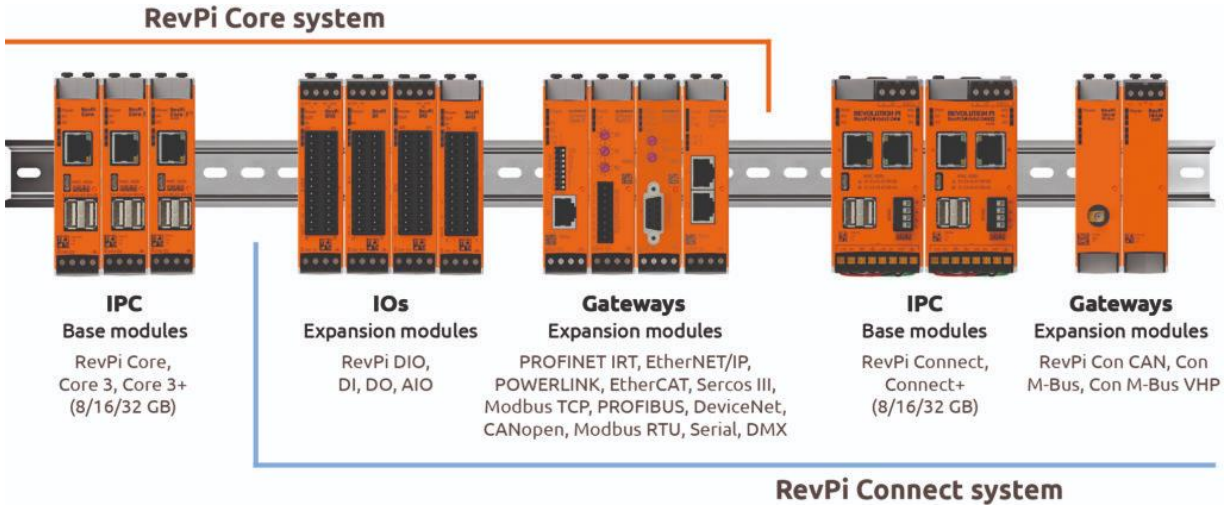
PXI provides an open, high-performance validation and production test approach. It offers a scalable way to meet your software and hardware timing, synchronization, and throughput requirements across all of your instruments.

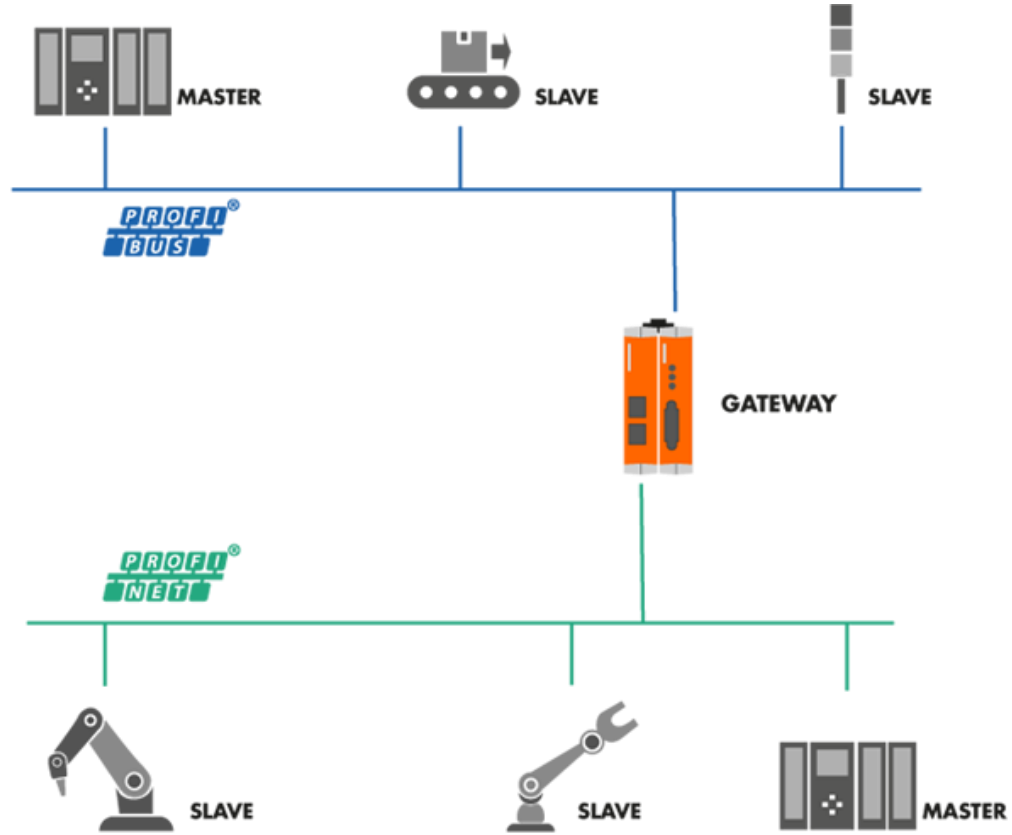
Software

From interactive exploration and test development to systems and data management, NI's software portfolio helps you drive actionable insights at scale while proactively improving product performance.

- LabVIEW →
- Optimal+ →
- TestStand →
- SystemLink™ Software →
- FlexLogger™ Software →
- DIAdem →

KUNBUS GmbH





CTC

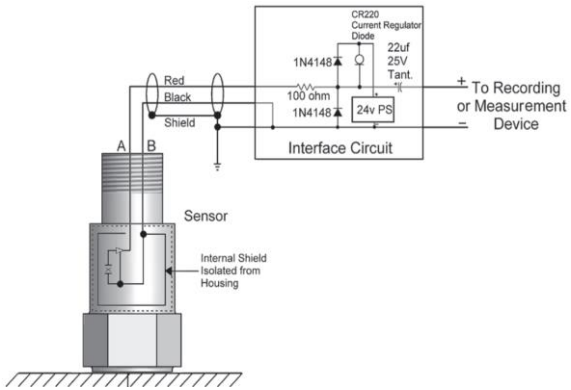
VIBRATION ANALYSIS HARDWARE

PRO

PROTECTION & RELIABILITY INSTRUMENTS

TMP

TEST & MEASUREMENT PRODUCTS



The CTC Line of products is covered by a best-in-class, unconditional lifetime warranty.

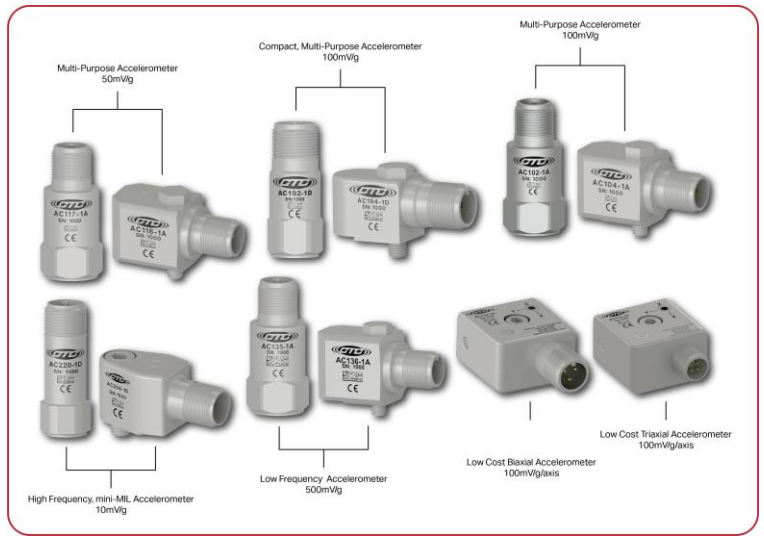
Damage caused by plant fire

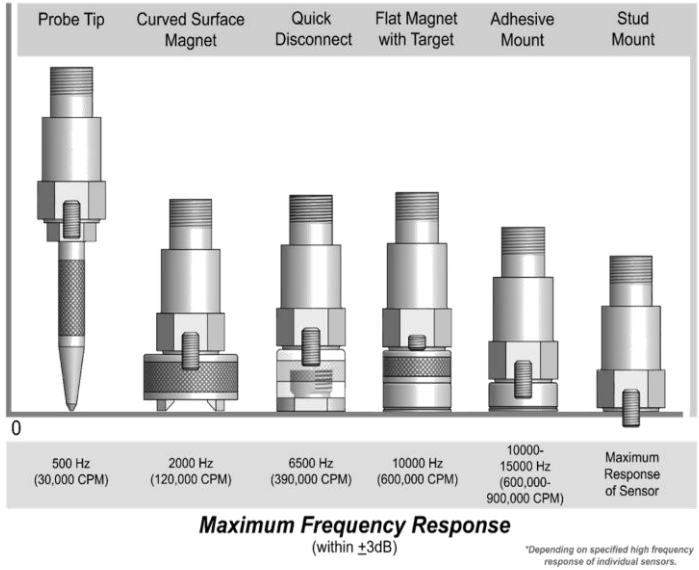
Damage caused by heavy abuse

Damage caused by water

Damage caused by accidental neglect

Damage caused by a variety of outrageous circumstances, including: crushed, run over, exposed to harsh weather and conditions, and many more…





Tektronix®

KEITHLEY
A Tektronix Company

NEW SERIES!

2 Series MSO Mixed Signal Oscilloscope

The 2 Series MSO is a full-featured oscilloscope in a compact, portable form factor that feels like a tablet. The unique set of features makes this scope perfect for students exploring education labs with a help button that provides context-applicable solutions in real-time.

DMM6500 Digital Multimeter

The DMM6500 digital multimeter provides high-performance without high investment. This leading touchscreen bench DMM with built-in premium features is perfect for the classroom, outperforming many industry digital multimeters at the same price point.

2231A-30-3 DC Power Supply

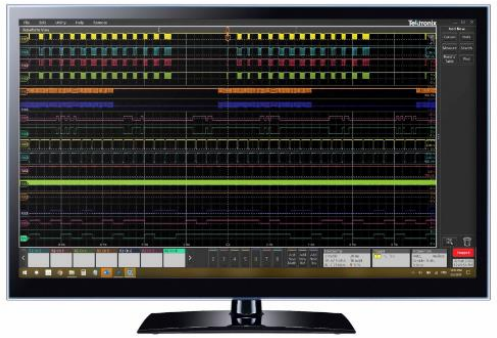
The 2231A-30-3 Multi-channel Programmable DC Power Supply is ideal for testing a wide range of devices throughout the education lab, cost-effectively.

AFG31000 Series Arbitrary Function Generator

This high-performance AFG with built-in arbitrary waveform generation and the largest touchscreen on the market is perfect for the modern teaching lab.

TekScope™ PC Analysis Software

Get the analysis capability of an award-winning oscilloscope on your PC. Analyze waveforms anywhere, anytime. The basic license lets you view and analyze waveforms, perform many types of measurements and decode the most common serial buses - all while remotely accessing your oscilloscope. Advanced license options add capabilities such as multi-scope analysis, more serial bus decoding options, jitter analysis and power measurements.



DC Power Supply

Your application. Our DC power supplies

Benchtop Digital Multimeter (DMM)

Measurement performance to match bench and system applications

Keithley Source Measure Units

Source and measure voltage, current, and resistance in one unit

Keithley Low-Level, Sensitive and Specialty Instruments

Scientists around the world count on sensitive measurement solutions from Keithley

Keithley Switching and Data Acquisition Systems

Solutions for switching and measuring signals with exceptional accuracy.

Keithley Semiconductor Test Systems

Solutions to characterize semiconductor devices, materials & processes.

KEYSIGHT

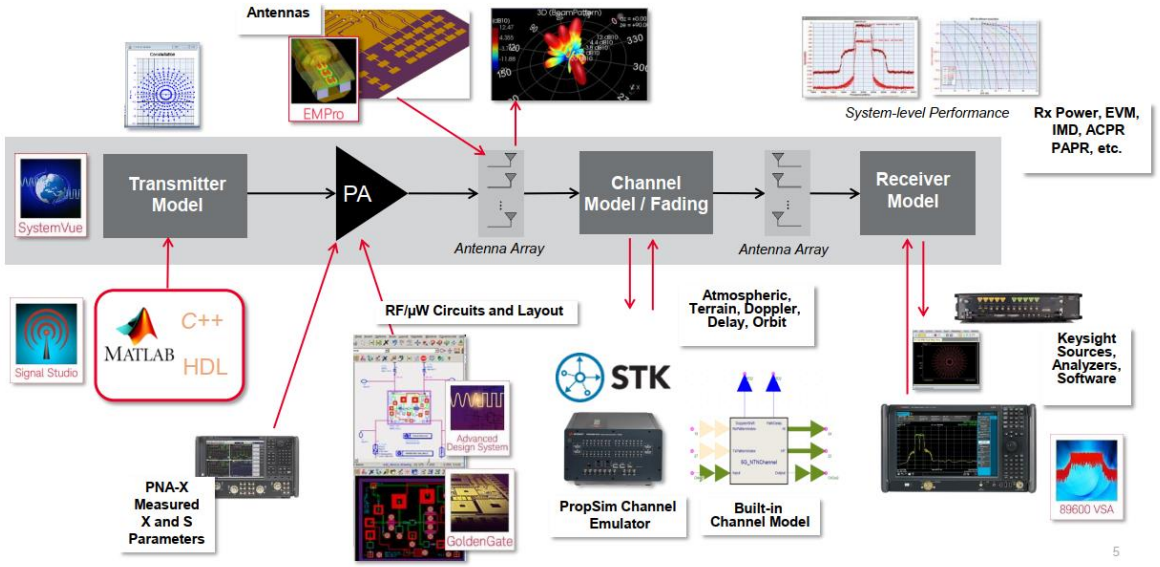
PATHWAVE

PathWave enables agile and connected workflows

A Model-Based System Simulation Platform

COVERING MULTIPLE DOMAINS AND APPLICATIONS

PathWave System Design brings fidelity to your Digital Twin



PathWave Design University Program (Formerly Eesof EDA)

Providing Industry-Grade Software to Support Universities

- Suite of EDA tools that are used by top companies for
  - RF and Microwave, High-Speed Digital Design
  - Power Electronics Design and EMI Analysis
  - System-level Simulation
- Industry-leader with 65% market share[1]
- To be 'industry-ready', students need to understand the full design flow
  - Design and simulation at the component / device level

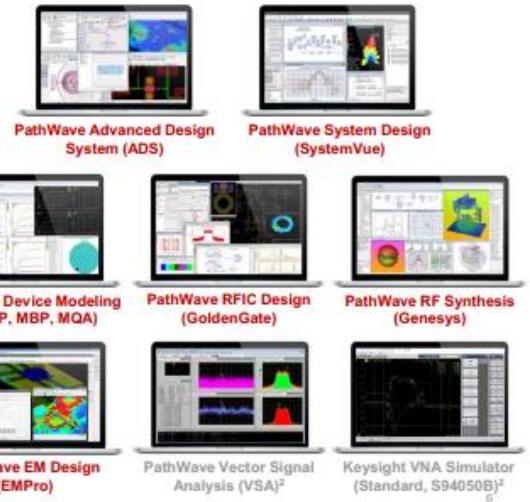
"I am an RF Engineer and was given a project recently that requires a lot of autonomy.

I realized shortly after being assigned the project that the reason I was working on this – whilst other full time RF engineers were not – was because when asked if I knew how to use ADS for this application and other various software, I was able to say yes and clarify exactly what they wanted me to do in each software."

– *Graduate Student, Colorado School of Mines*

[1]In RF Design and Simulation, Source: Pedestal Research (Jan. 2020)
[2]Not branded under 'PathWave Design', - Sold separately. Check with Local sales.

KEYSIGHT



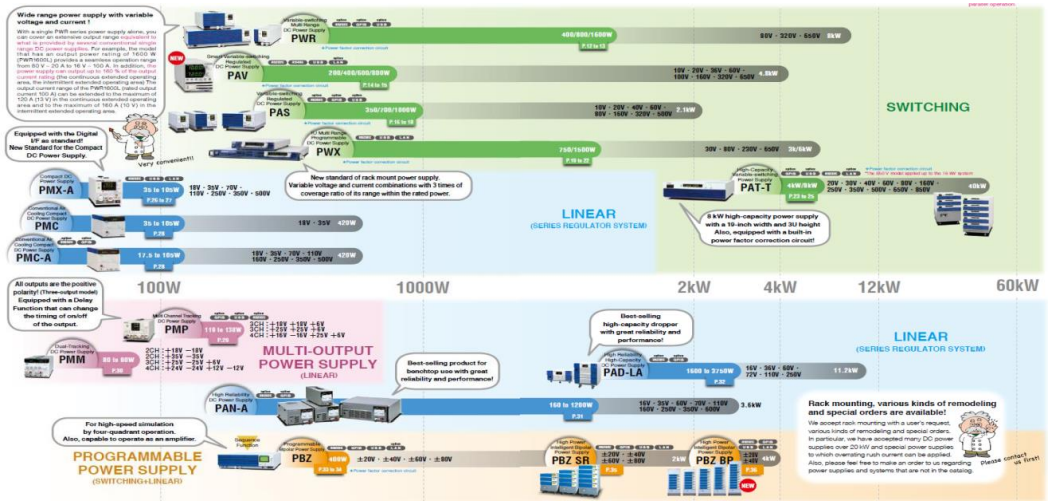
KIKUSUI

KIKUSUI SOLUTIONS

Kikusui is specialized in Electronics Test and Measurement!

- AC/DC regulated power supplies and Electronics loads for testing
- Safety, EMC, Standard test equipment
- Battery/Fuel cell tester

Kikusui DC Power Suply



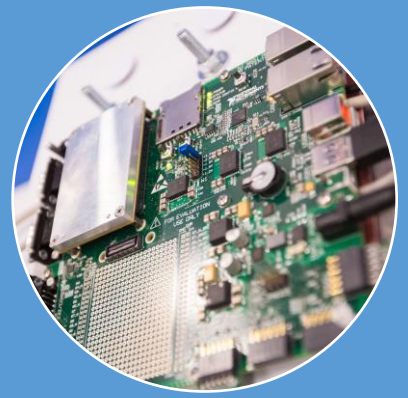
Kikusui AC Power Suply

haliaTECH

Haliatech Customers

Industry Focus

Academic



Electronics

Automotive

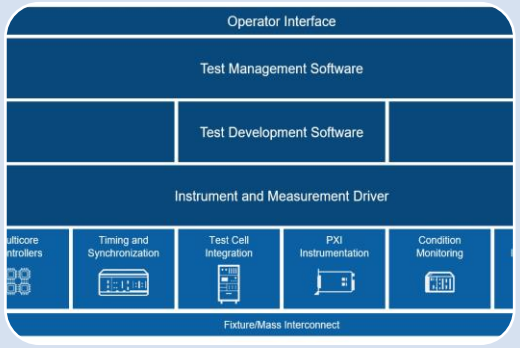
Aero & Defense

Energy

Specific Products and Services Solution

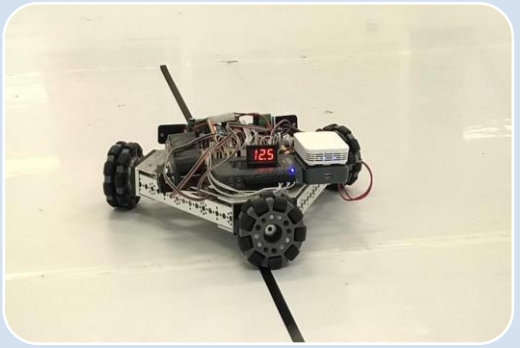
LabVIEW Technical

Consultation & Training



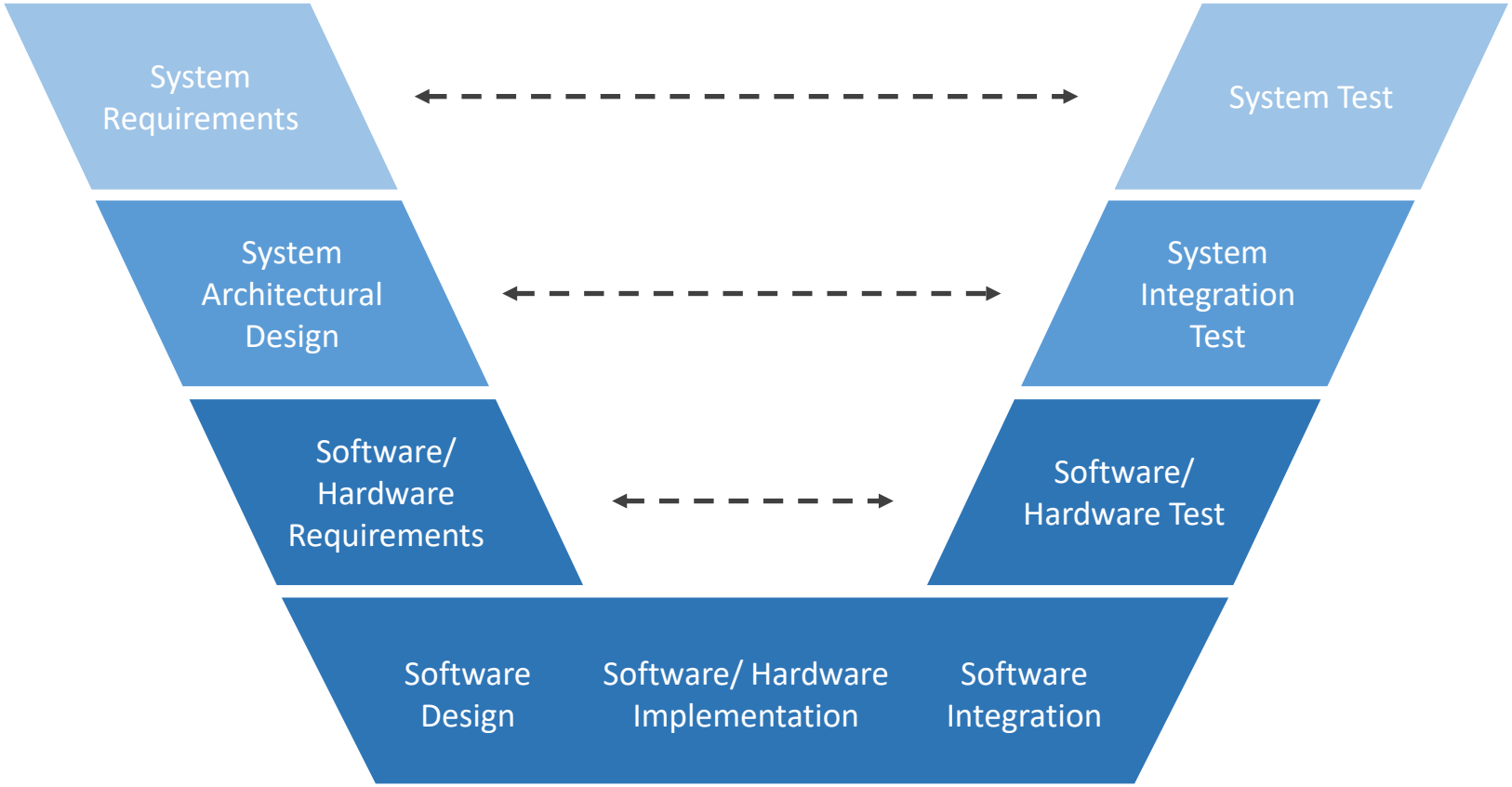
Automated Test System

Smart Factory & IIoT



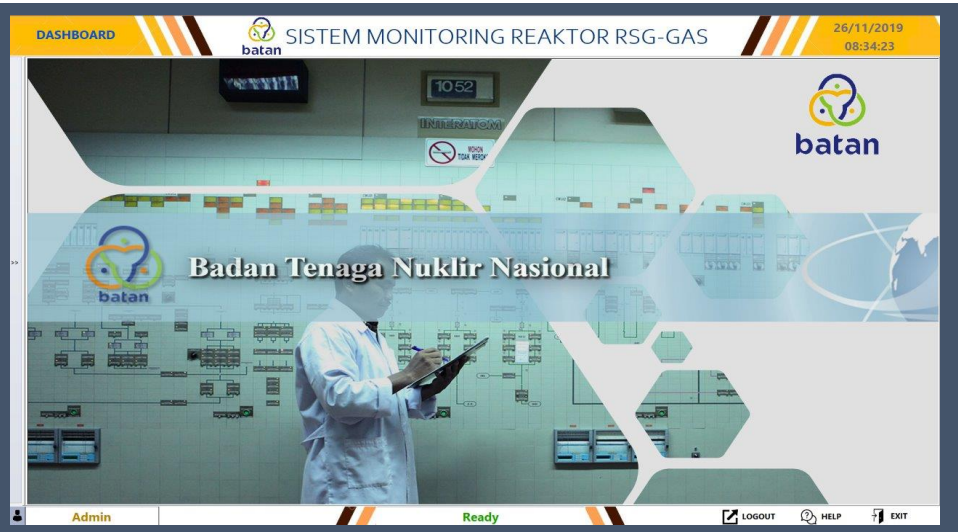
Mobile Robotic

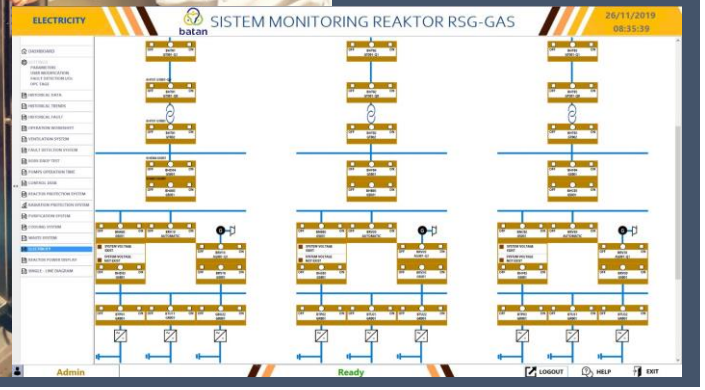
Test, Measurement and Control Coverage



Additional Value and Services

- Technical Consultation
- Technical Support by Phone and Email
- Source Code





Badan Tenaga Nuklir Nasional

Fault and Condition Monitoring for 30 MW Main Reactor (PRSG)

Application

- Monitored more than 1000 Inputs with accuracy of 10uS with GPS Timing Synchronization
- Provide automated report generation and web monitoring for BATAN Customer

Main Factor using LabVIEW

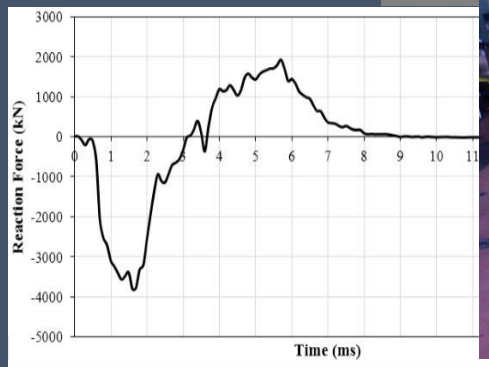
- Synchronization with other system and visualizations to the web

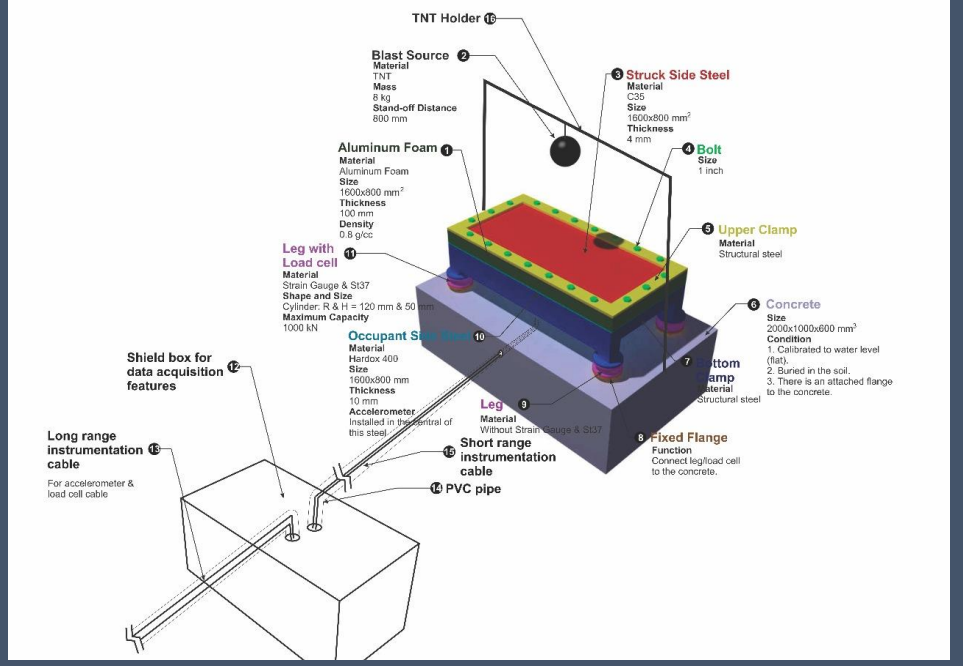
Key Products Used

- LabVIEW, RT and FPGA, CompactRIO

Next Project

- Condition Monitoring for Reactor Cooling System





PINDAD and ITB

Tank Base Plate Blast Test

Application

- Testing of Blast Energy Absorption of the Impact Layer

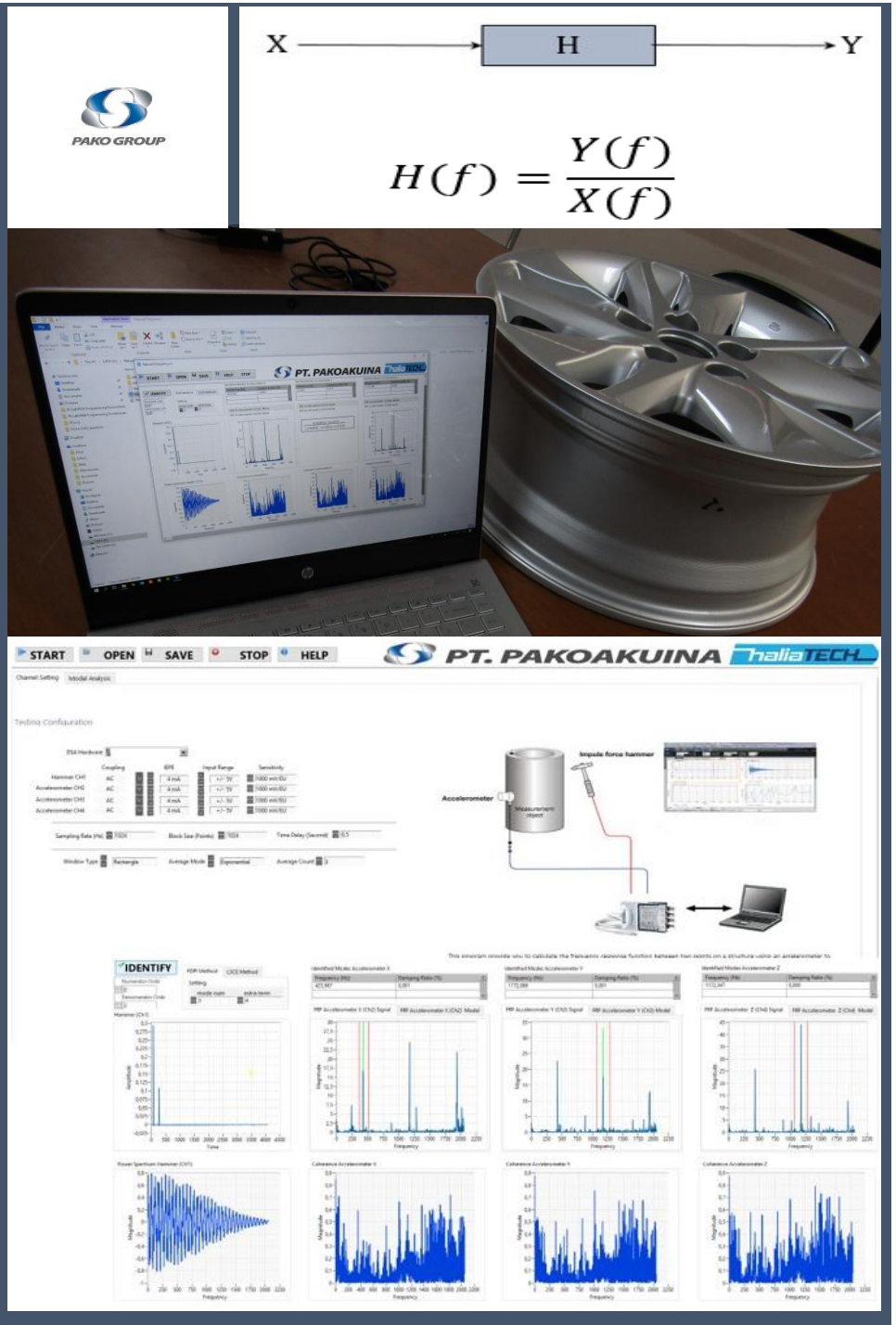
Main Factor using LabVIEW

- Fast measurement and recording of Blast Test

Key Products Used

- LabVIEW, CompactDAQ

Next Project



Pakoakuina

Vibration Test for Production Test

Application

- Natural Frequency Identification in rims production
- Quality of the Rims production is decided by its natural frequency

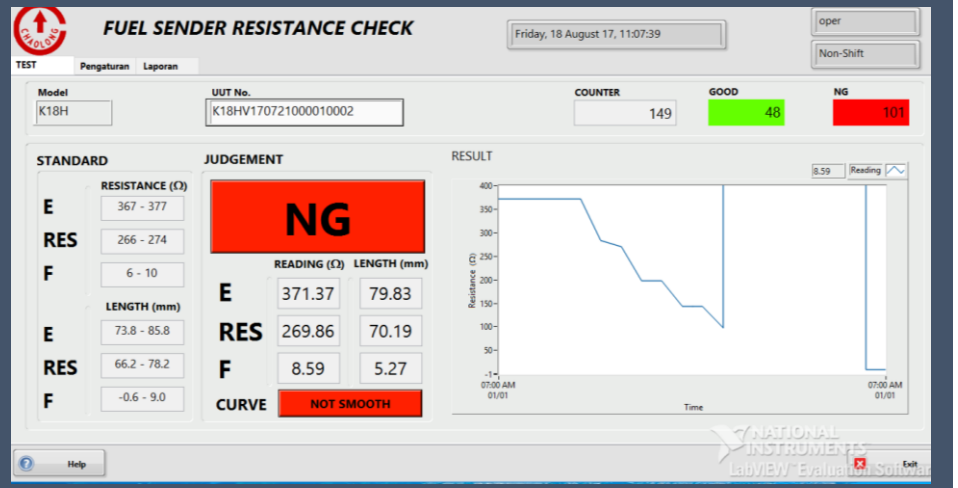
Main Factor

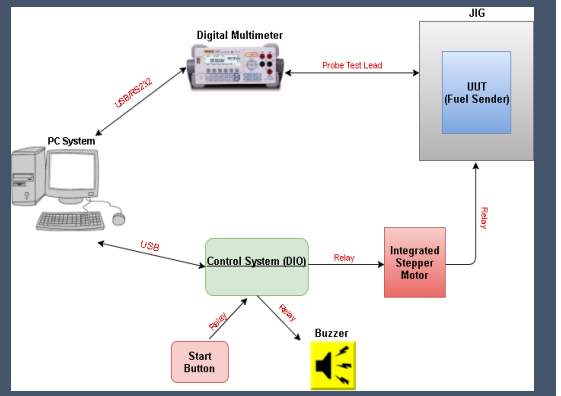
- Minimum effort to add function in the future

Key Products Used

- LabVIEW, Accelerometers, Hammer

Next Project





PT. Chao Long Motor Part Indonesia

Fuel Sender Resistance Check System

Application

- Checked the resistance value sensor using 2 wiring, 4 wiring and smoothness method. Calculated the distance between starting position (home) and peak position in fuel tank.
- Determined the reliability of fuel tank system.

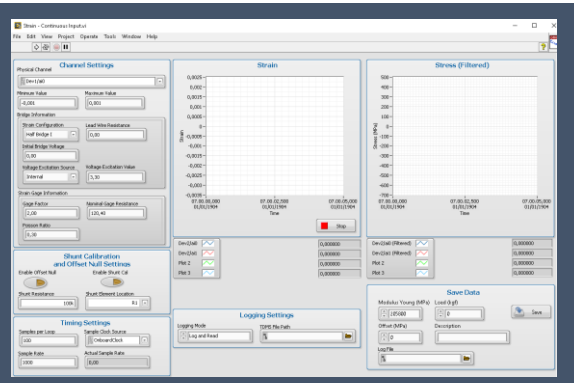
Main Factor using LabVIEW

- Signal processing and synchronization with other system

Key Products Used

- LabVIEW, NI USB, NI Motion, and NI Stepper Motor

Next Project



Indospring

Natural Frequency for Automotive Leaf and Coil Spring

Application

- Measured Strains on leaf and coil spring
- Determine its natural frequency and MTBF

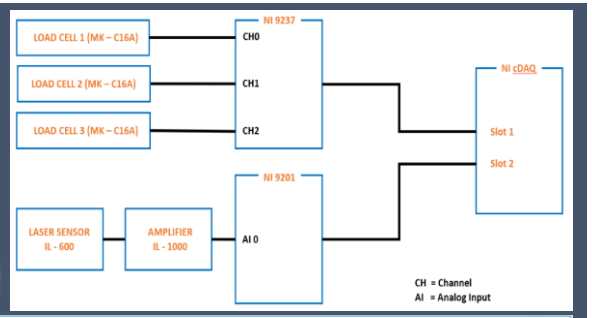
Main Factor

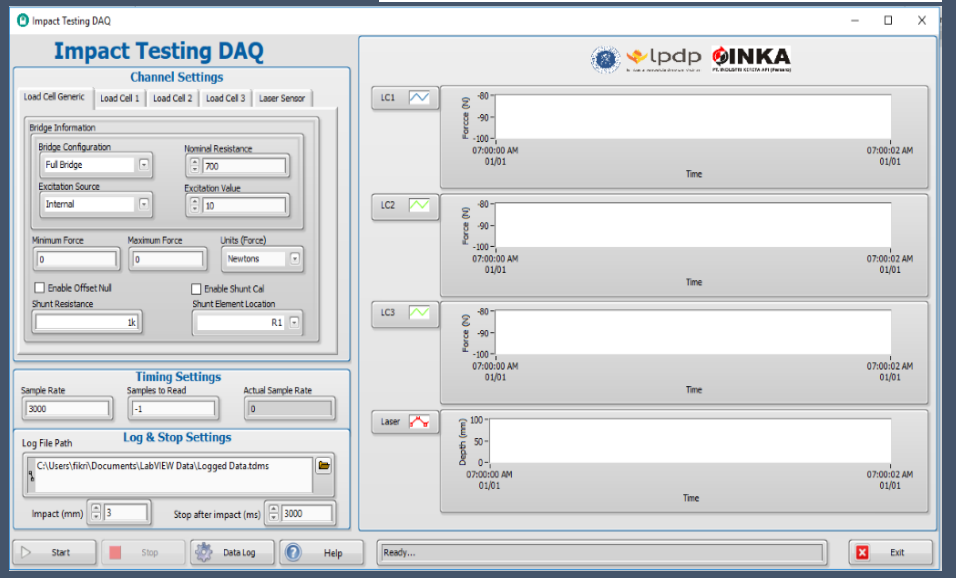
- Intuitive and interactive user interface
- Modular programming for mechanical test

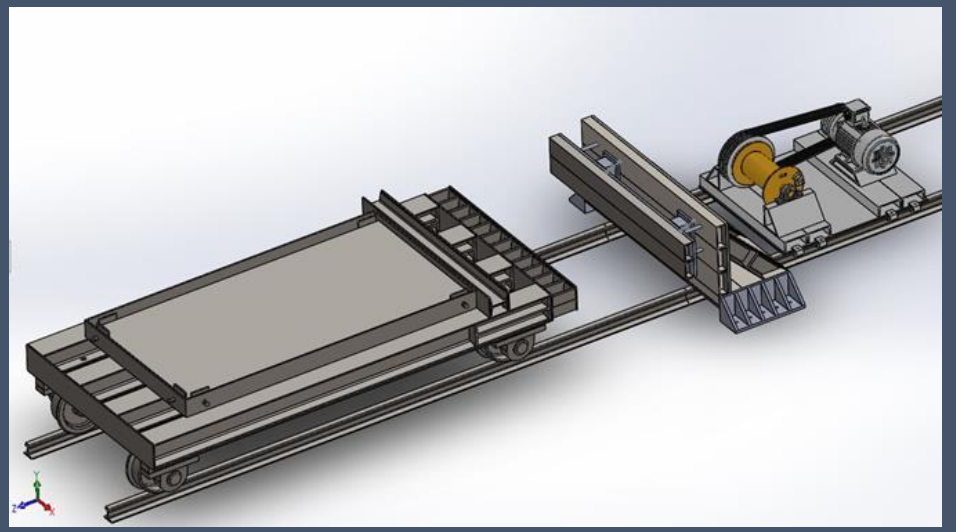
Key Products Used

- LabVIEW, DAQ, Strain Sensor

Next Project







ITB and INKA

Impact Test of Train Carts

Application

- Measured high speed measurement for impact test
- Impact measurement is to validate a designed absorber that can minimize the accident

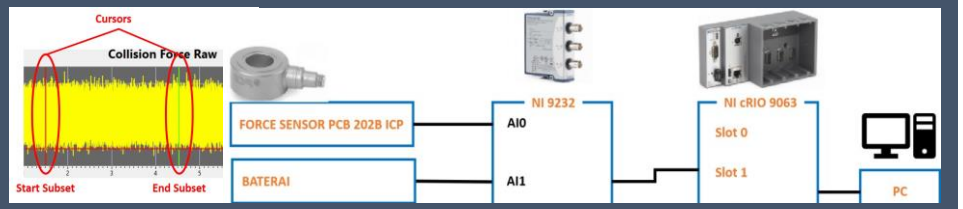
Main Factor

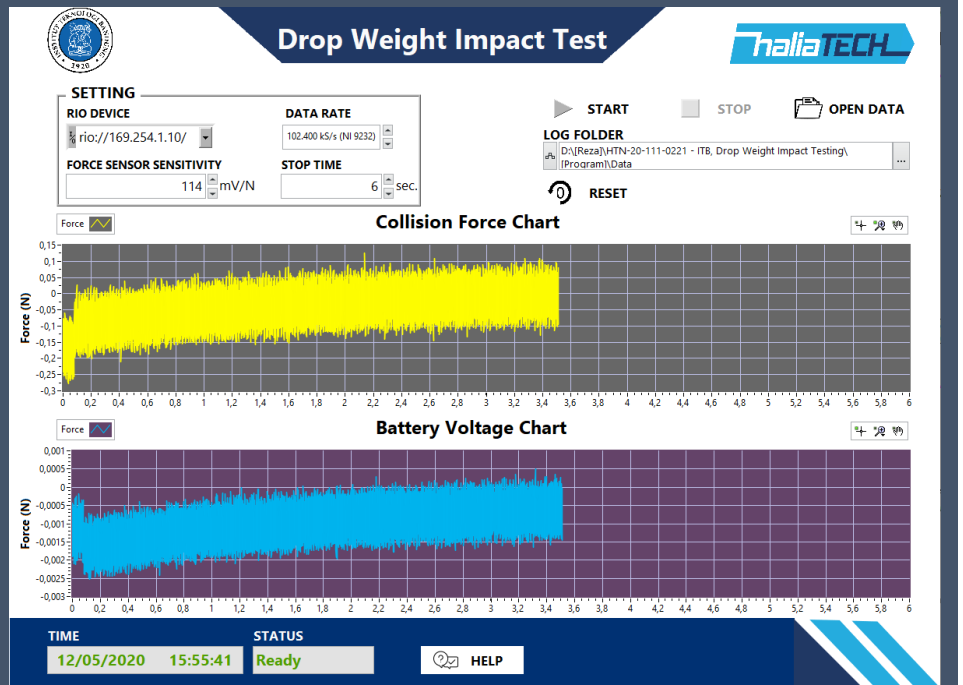
- Fast data recording for impact test
- High speed sampling rate measurement

Key Products Used

- LabVIEW, DAQ, Loadcell

Next Project





Institut Teknologi Bandung (ITB)

Drop Weight Impact Test

Application

- Analyzed and determined materials response to a sudden external force
- Acquired impact sensor and battery voltage at a **sample rate** of up to 102,4 kS/s

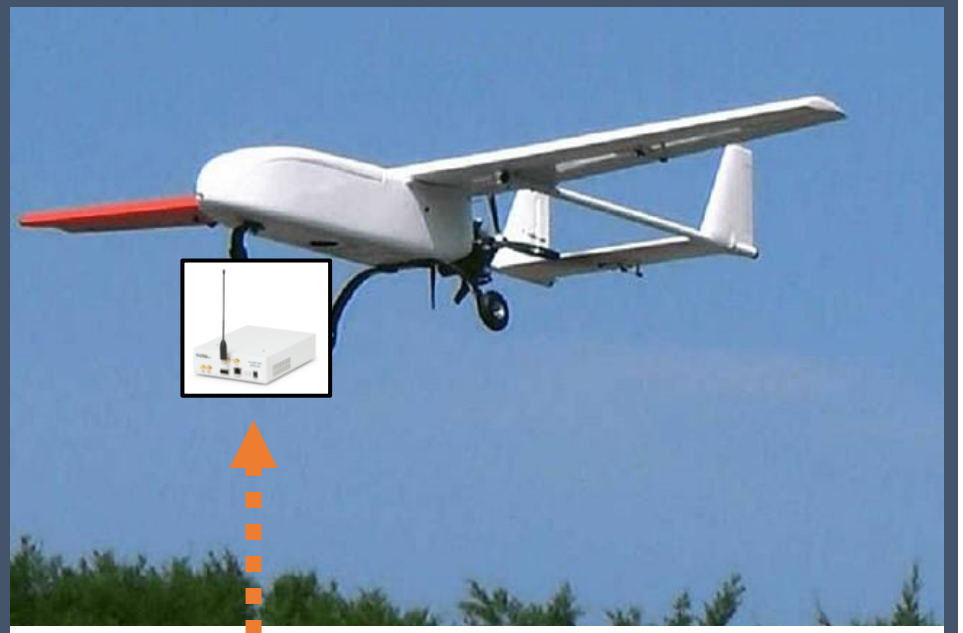
Main Factor using LabVIEW

- High Speed Sampling rate and fast data recording

Key Products Used

- LabVIEW, FPGA, RAD, CompactRIO, NI 9232, and Force Sensor

Next Project



*pictures only for illustration

Pusat Riset Elektronik (PRE) BRIN

Custom Communication System for Aircraft and Ground Station

Application

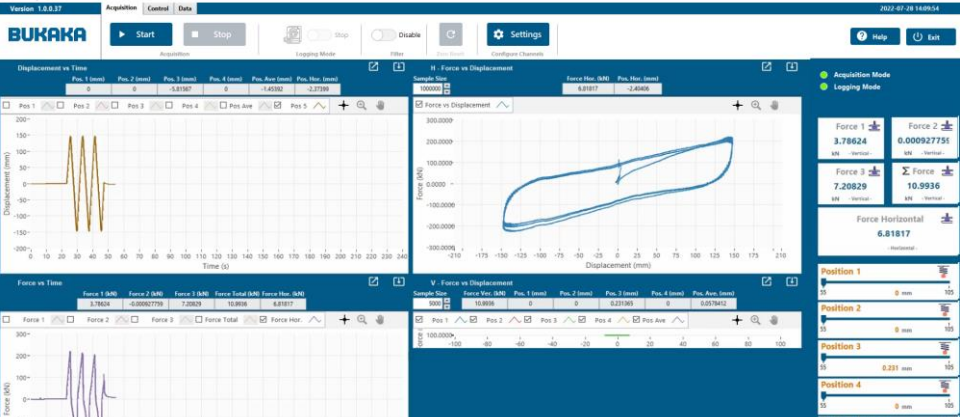
- Provide Communication between Unmanned Aerial Vehicle (UAV) Satellite and Ground Stations.

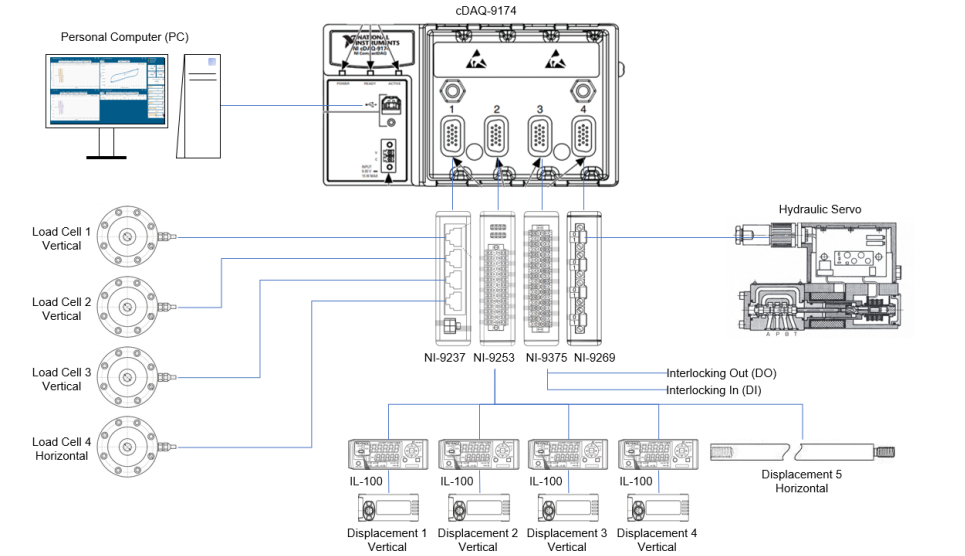
Main Features

- High-speed software defined radio for streaming baseband I and Q signals to a host PC over 1 Gigabit Ethernet
- 20 MHz Bandwidth, 400 MHz to 4.4 GHz Frequency, Included GPS-Disciplined OCXO

Key Products Used

- USRP 2932
- LabVIEW Communication System Design





Bukaka

Static and Dynamic Structural Test Software

Application

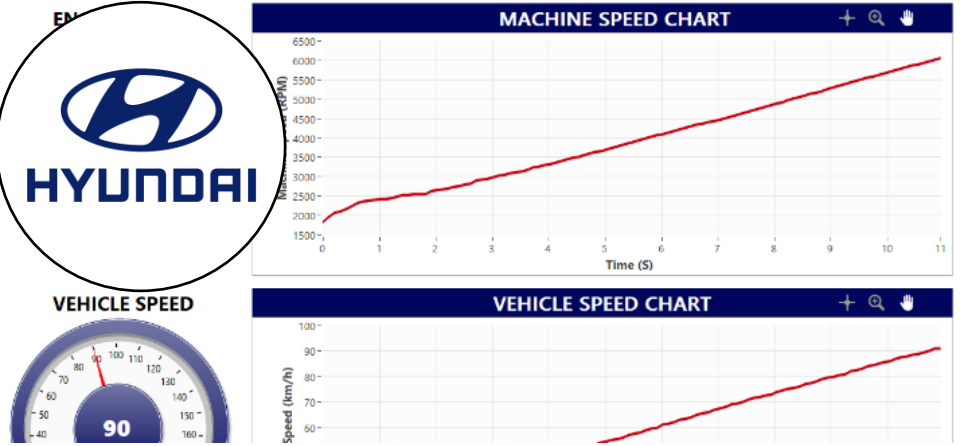
- Static & dynamic structural test software for multiple bearing test system on the bridge structure system.

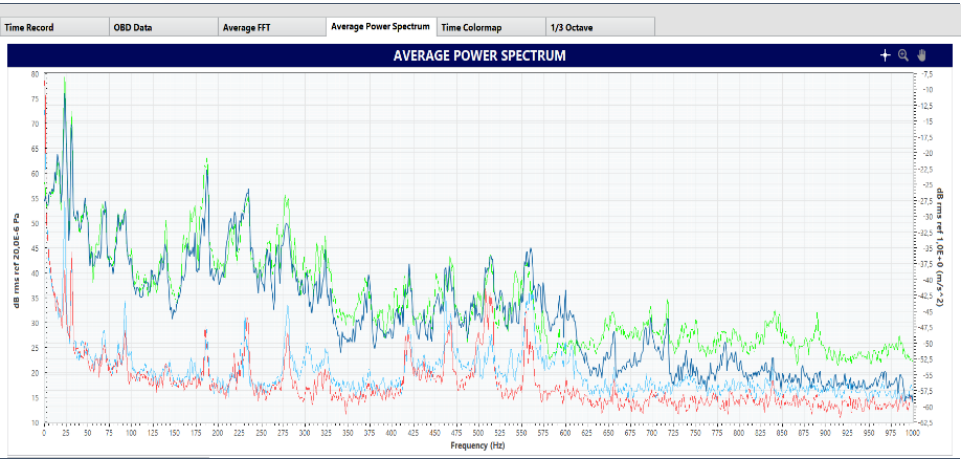
Main Features

- Monitor and Log data with 5kS/s/ch
- Log data to TDMS File
- Display static and dynamic load measurement data into the XY graph
- Interlocking System by Communicating with PLC to control the tester machine.
- Control Servo Movement

Key Products Used

- LabVIEW, cDAQ 9174, NI 9237, NI 9253, Hydraulic Servo, Load Cell & Displacement Transducer.





Hyundai

Sound and Vibration Analysis (SVA) for Car

Application

- Acquire multiple data from car using OBD II CAN Bus & NI cDAQ.
- Analyze data using labview with multiple mathematical function (FFT, STFT, Power Spectrum, 1/3 Octave)

Main Factor using LabVIEW

- Support high speed data acquisition with CAN Bus
- Easy to implement multiple mathematical & statistical analysis from one or many data source.

Key Products Used

- NI-9174, NI 9862, NI 9234, OBDII CAN BUS

EV Validation Test

The Right Approach to Have Control Over Your Test Strategy

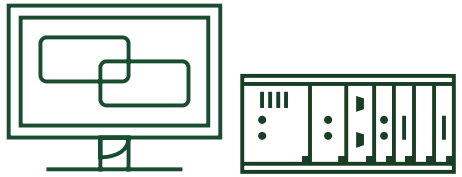
Fully Customized System

"Customer Does Everything"

Costly (Time, Upkeep)

No Ecosystem

Customer Maintains



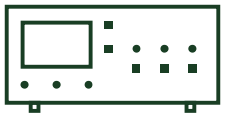
Open Platform-Based System

"Customer Knows Best"

Customizable Solution

Open, Valuable Ecosystem

Customer Designs



Closed Turnkey System

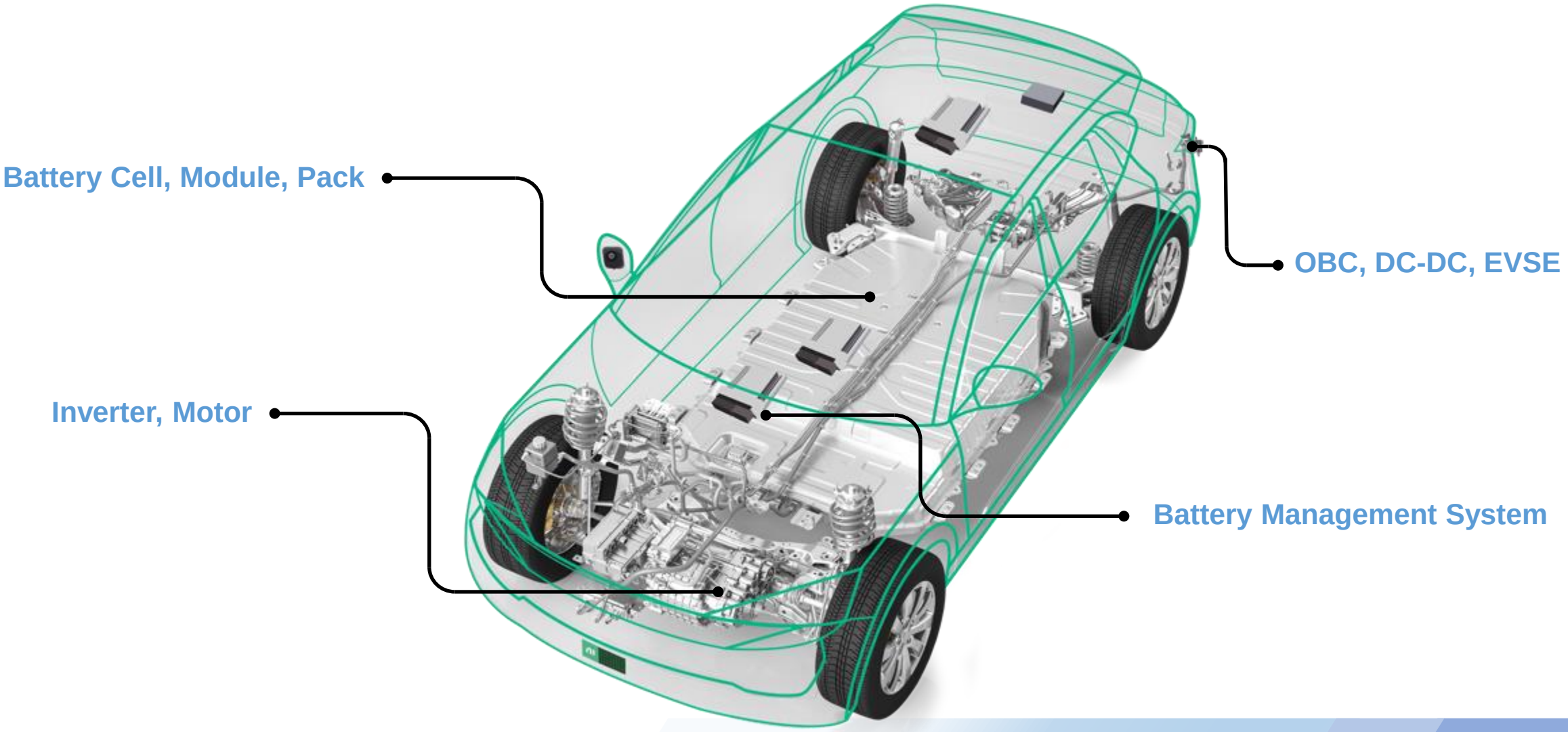
"Vendor Knows Best"

Fixed Functionality

Closed Ecosystem

Customer Pays

Accelerating EV Product Performance



EV Solution

Enterprise Software

DATA ANALYTICS

ELECTRIFICATION

Battery

BATTERY VALIDATION TEST

BATTERY CELL QUALITY
BATTERY FUNCTIONAL TEST
BATTERY EOL TEST

BMS

BMS HIL SIMULATOR

BMS
PRODUCTION TESTER

Inverter

INVERTER TEST SYSTEM
(SIGNAL AND POWER LEVEL HIL)

INVERTER
PRODUCTION TESTER

Motor

E-MOTOR TEST BENCH
E-AXLE TEST BENCH

EOL EDYNO

Charging
(EVSE, OBC, V2G)

AC GRID SIMULATORS

AC SOURCES & LOADS

BATTERY EMULATORS

EV Solution

Enterprise Software

DATA ANALYTICS

ELECTRIFICATION

Battery	BMS	Inverter	Motor	Charging (EVSE, OBC, V2G)

BATTERY VALIDATION TEST

BMS HIL SIMULATOR

INVERTER TEST SYSTEM
(SIGNAL AND POWER LEVEL HIL)

E-MOTOR TEST BENCH
E-AXLE TEST BENCH

AC GRID SIMULATORS

BATTERY CELL QUALITY
BATTERY FUNCTIONAL TEST
BATTERY EOL TEST

BMS
PRODUCTION TESTER

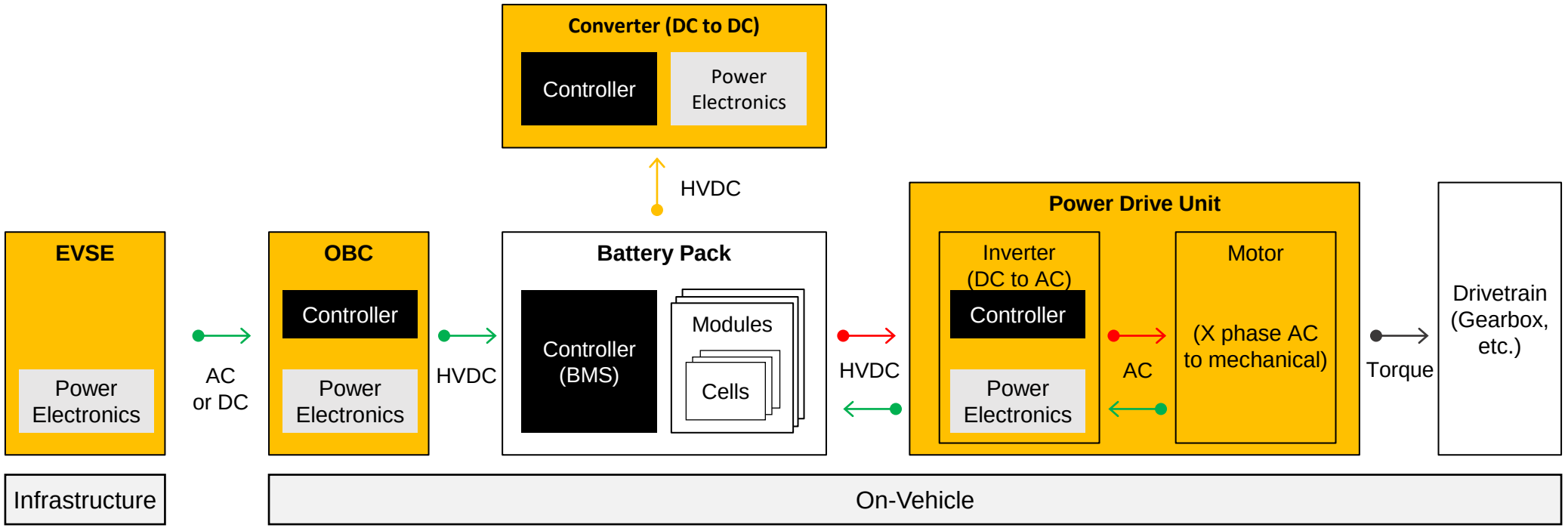
INVERTER
PRODUCTION TESTER

EOL EDYNO

AC SOURCES & LOADS

BATTERY EMULATORS

EV Test Focus Areas



EVSE/OBC

- Standard powerline communication support
- AC and DC charging

Traction Inverter - Signal Level HIL

- System modeling for control system dev/tuning

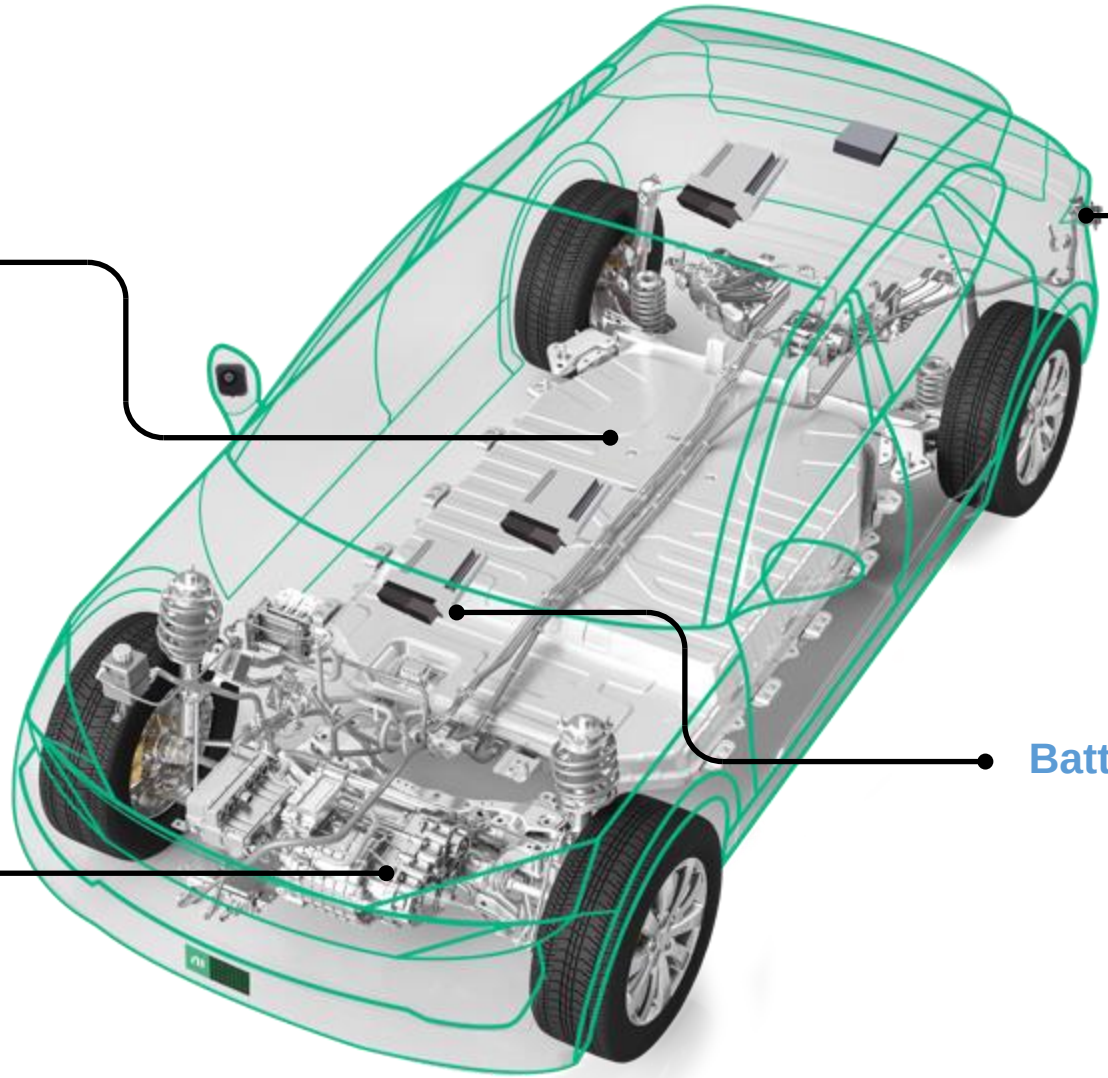
Traction Inverter - Power Level HIL

- Between Signal Level testing and Dyno
- Hi-Fi motor emulation for controls dev/tuning
- Low-Fi active loads for durability/lifetime

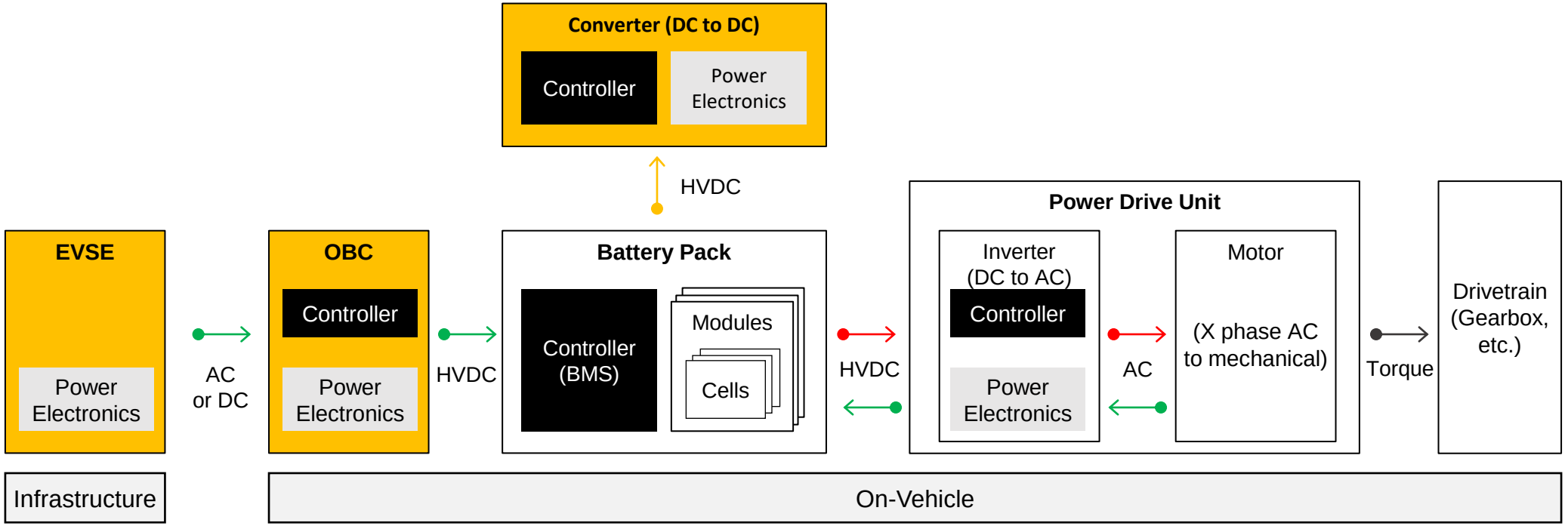
eDyno

- Power level inverter + motor
- Battery pack emulation
- Mechanicals emulation (load motor + models)

Accelerating EV Product Performance



EV Powertrain Test Focus Areas



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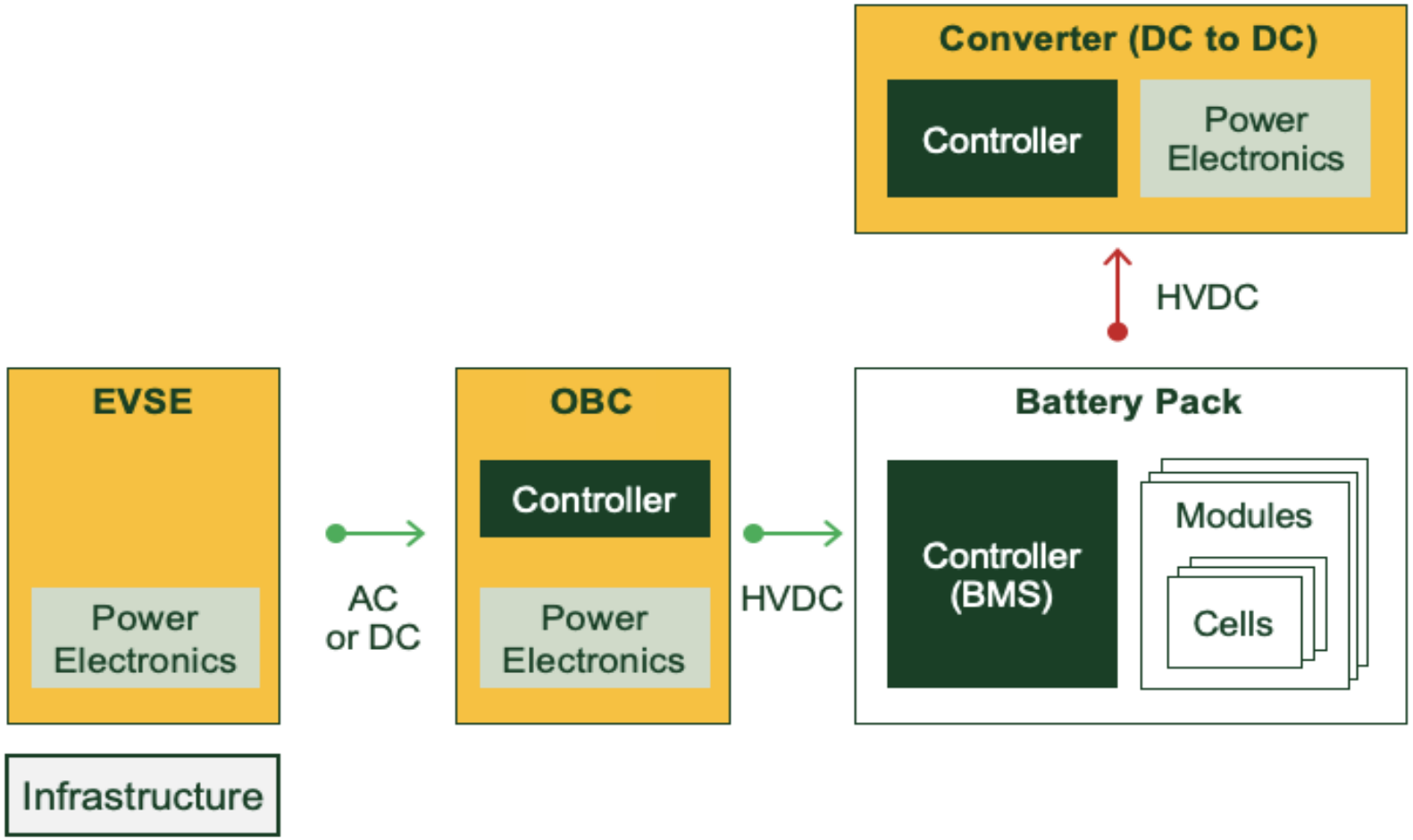
Power Flow in EV



Power Flow in EV

EVSE

Power Electronics

Infrastructure

AC or DC

OBC

Controller

Power Electronics

HVDC

Converter (DC to DC)

Controller

Power Electronics

HVDC

Battery Pack

Controller (BMS)

Modules

Cells

EV Charging Test Solutions

Four Charging Modes

1. **Mode 1** – **AC** Slow Charger
2. **Mode 2** – **AC** Type 2 Charger Cables (at home)
3. **Mode 3** – **AC** Wall Chargers (public city)
4. **Mode 4** – **DC** Fast Chargers (public motorway)

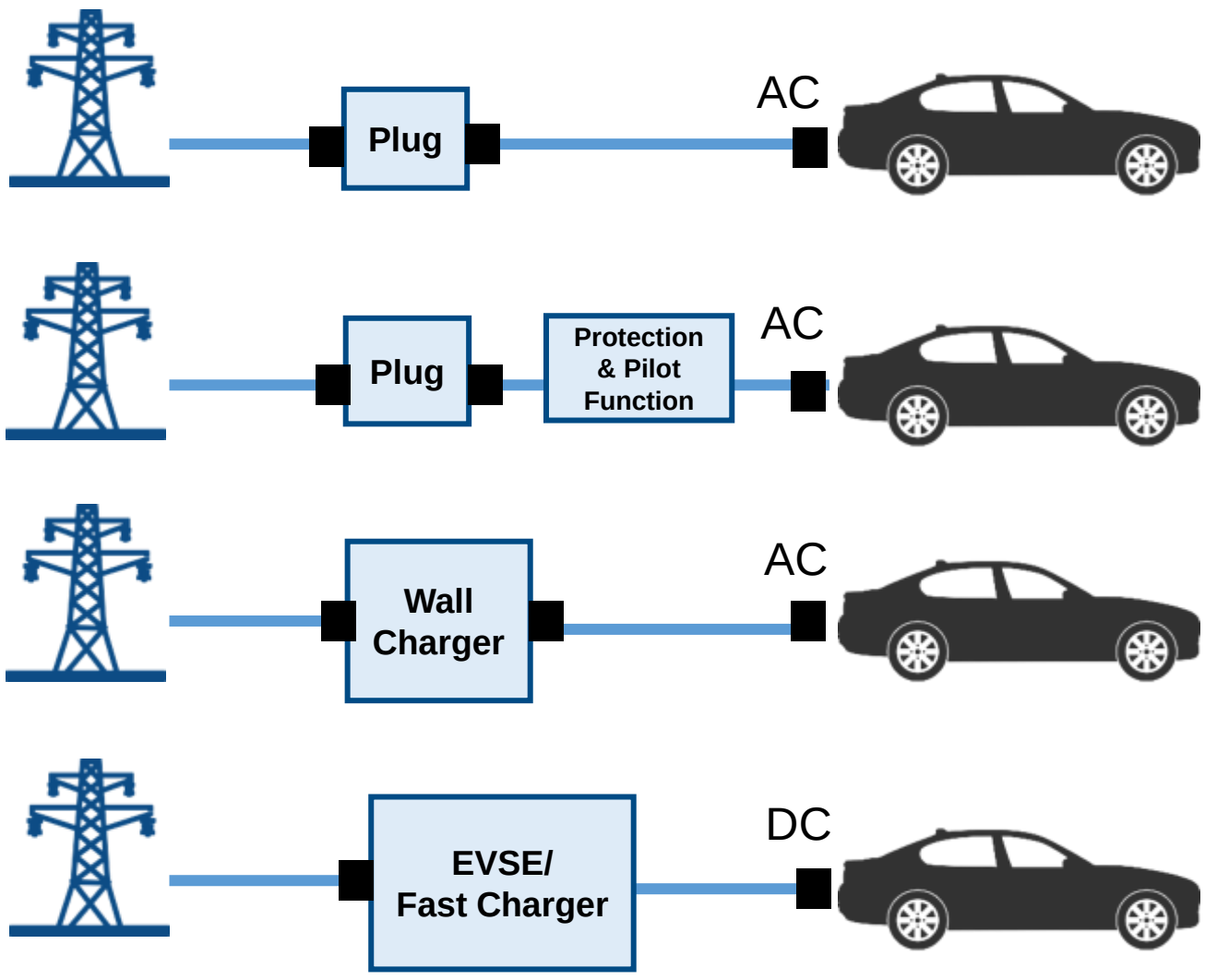
EVSE Modes of Charging

1. **Mode 1 – Slow AC Charger**
   - Slow AC charging
   - Maximum current of 16 A
   - Without communication
   - Standard power connections

2. **Mode 2 – Type 2 Charger Cables**
   - Slow AC charging
   - Maximum current of 32 A
   - Protection and pilot function in the cable

3. **Mode 3 – Wall Chargers**
   - Slow or Semi-quick AC charging
   - Maximum current of 63 A
   - Integrate into the wall charging

4. **Mode 4 – DC Charging**
   - DC Fast Charging
   - Maximum power of 38 kW in low DC and 170 kW in high DC
   - Monitoring, protection and pilot function integrate into the charger



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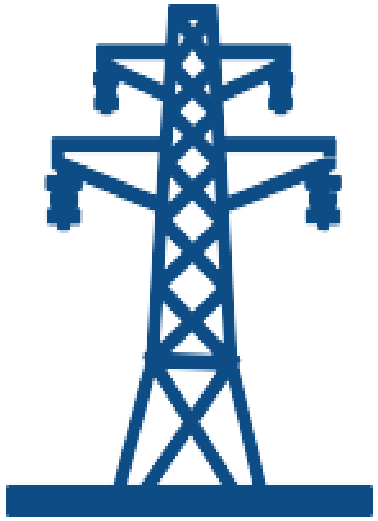
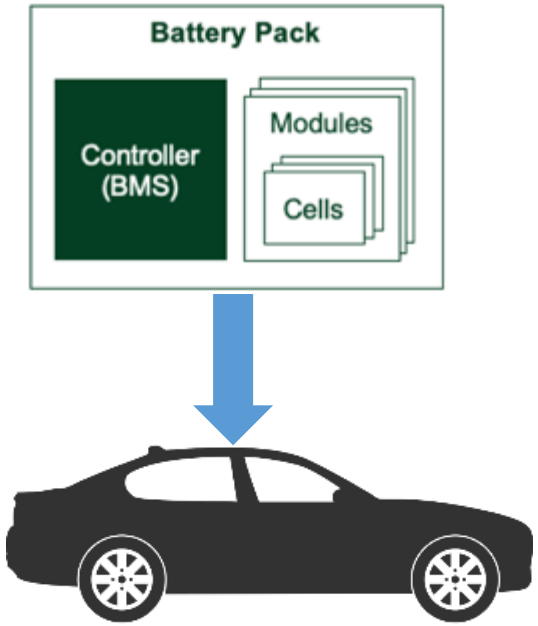
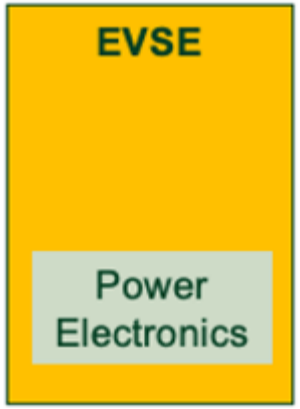
OBC Validation



Input

Output





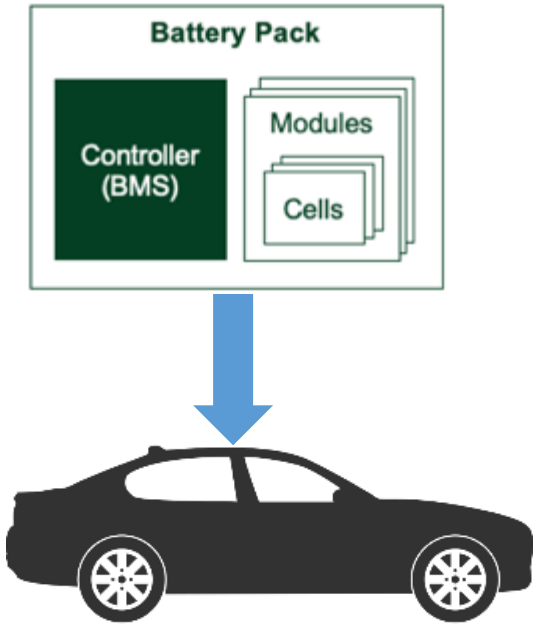
OBC Validation

Regenerative Grid Simulator / AC Source

DC Source

Input

Output



OBC Validation

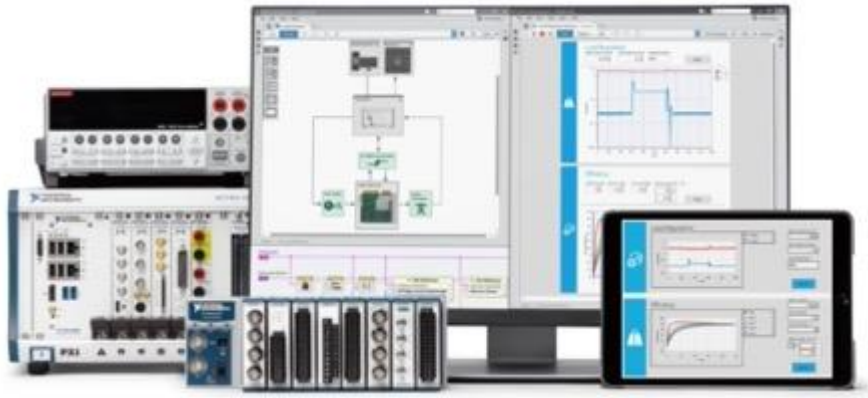
Input

Regenerative Grid Simulator / AC Source

DC Source

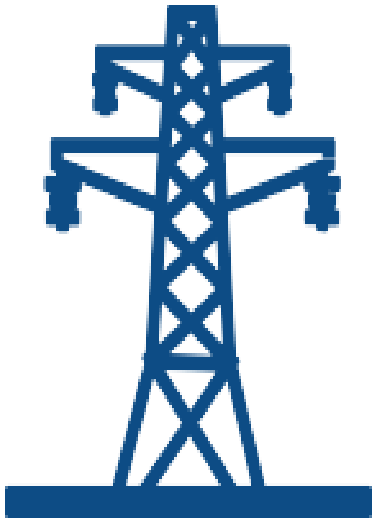
Output

Battery Emulator

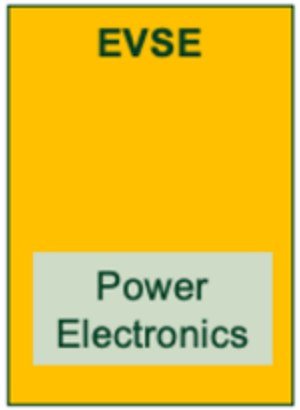


Power Measurement setup

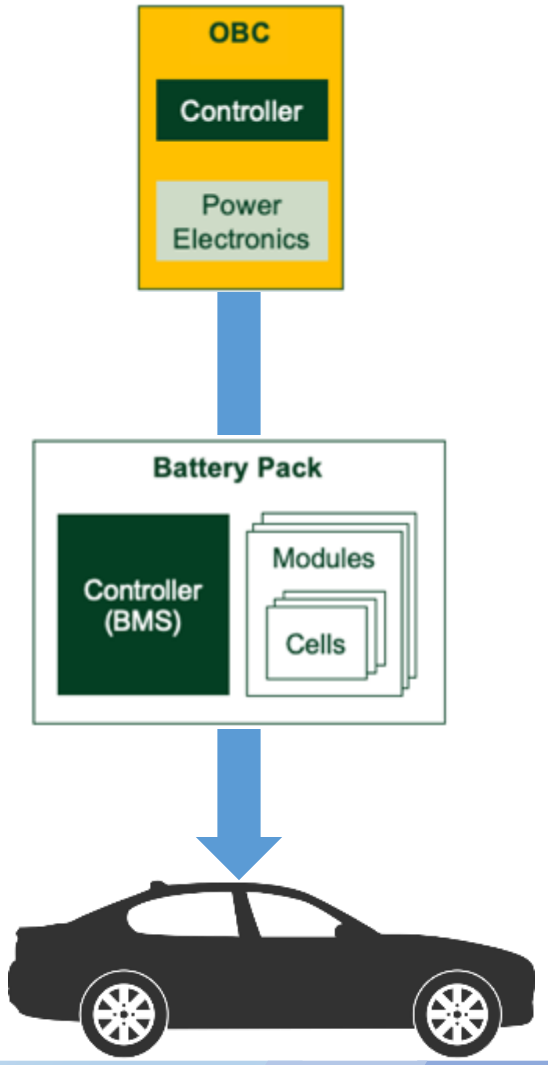
EVSE Validation



Input



Output

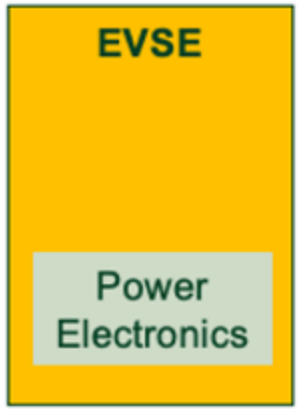


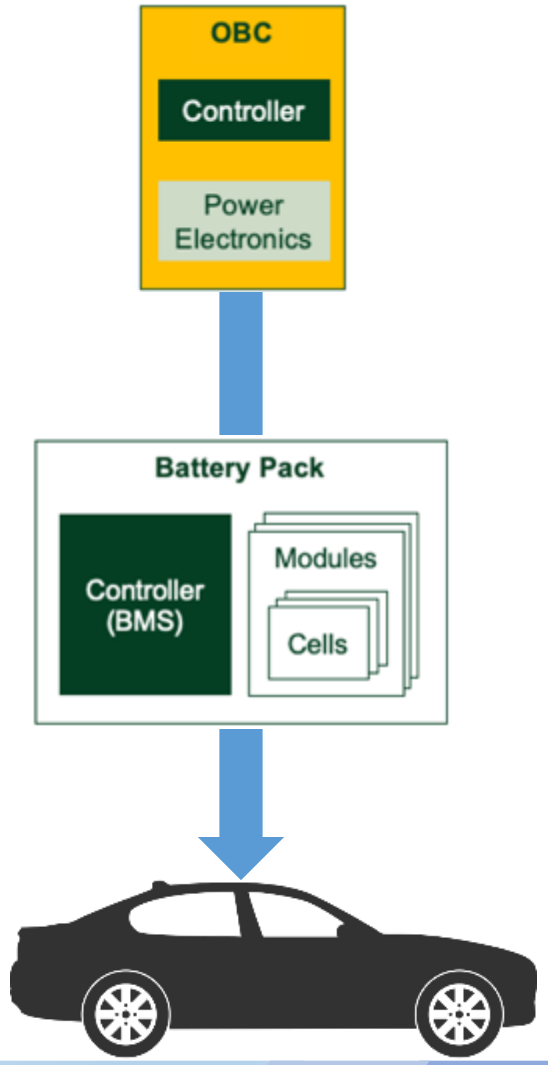
EVSE Validation

Regenerative Grid Simulator / AC Source

Input

Output





EVSE Validation

Input

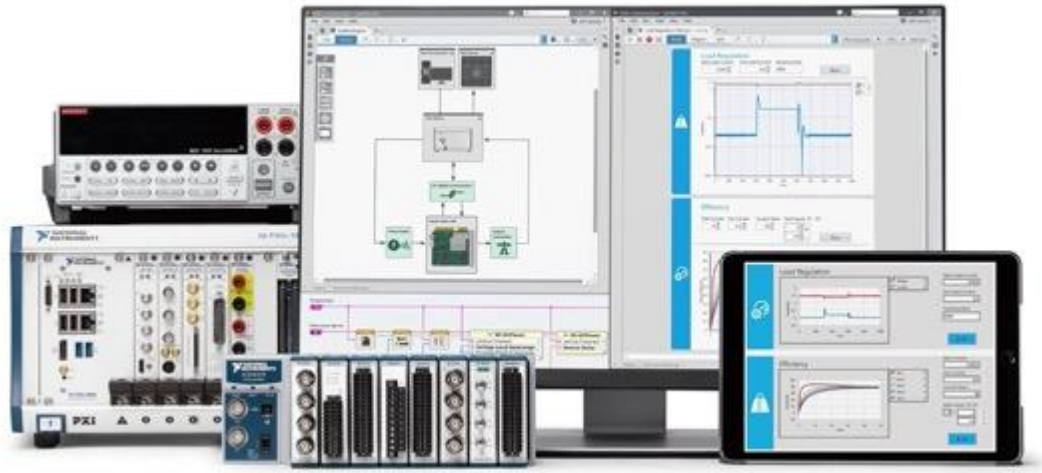
Output

Regenerative Grid Simulator / AC Source

EVSE

Power Electronics

Regenerative AC Load

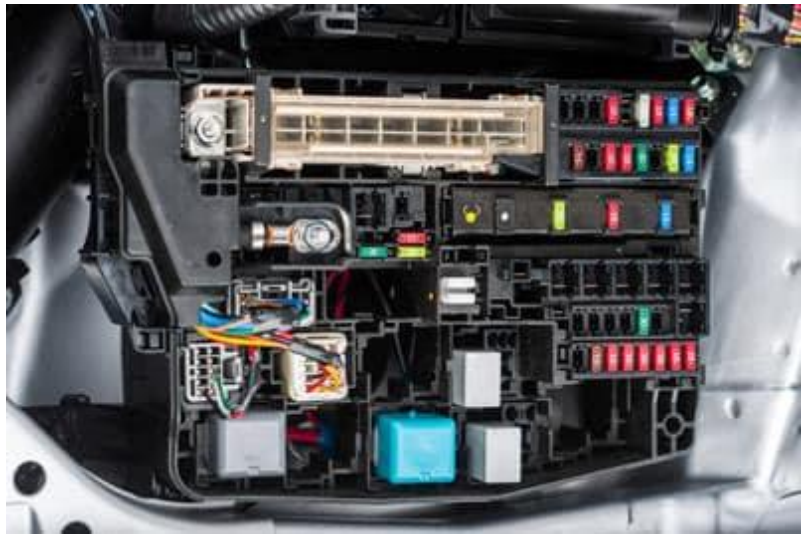


Power Measurement setup

DC – DC Converter Validation

Input

Output



DC – DC Converter Validation

Battery Emulator

Input

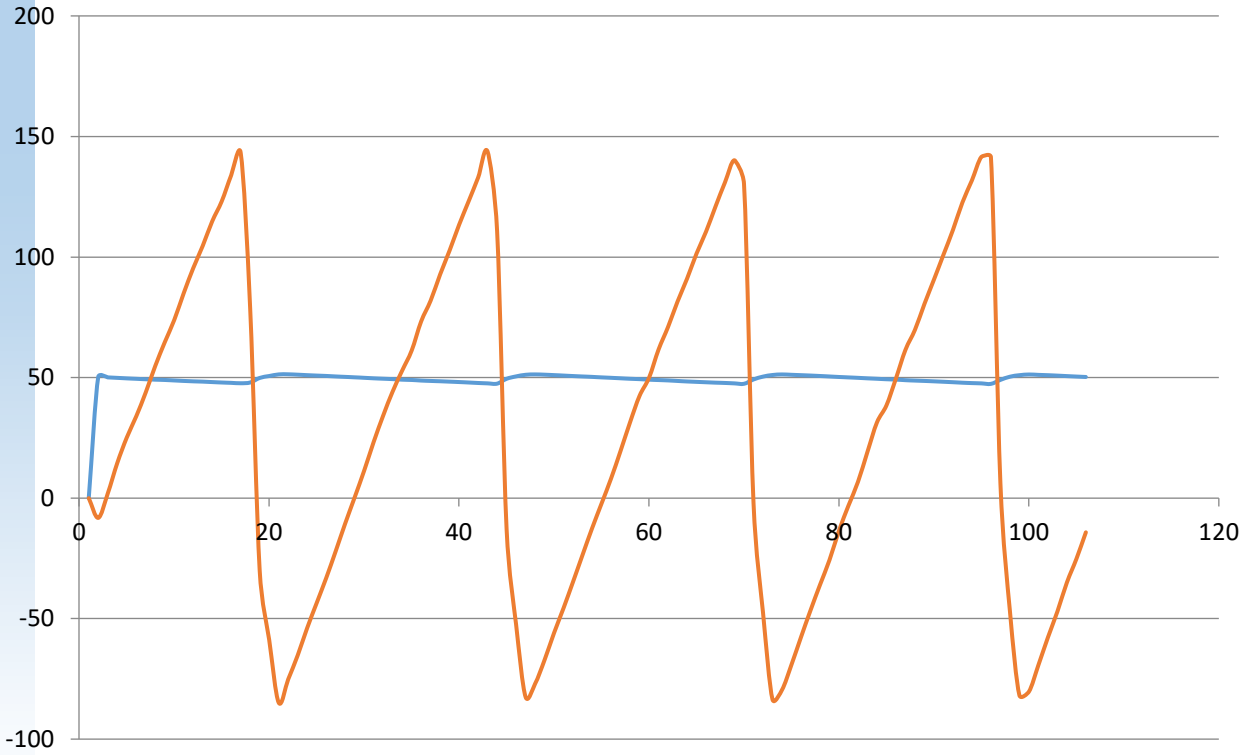
Output

Programmable AC/DC Load

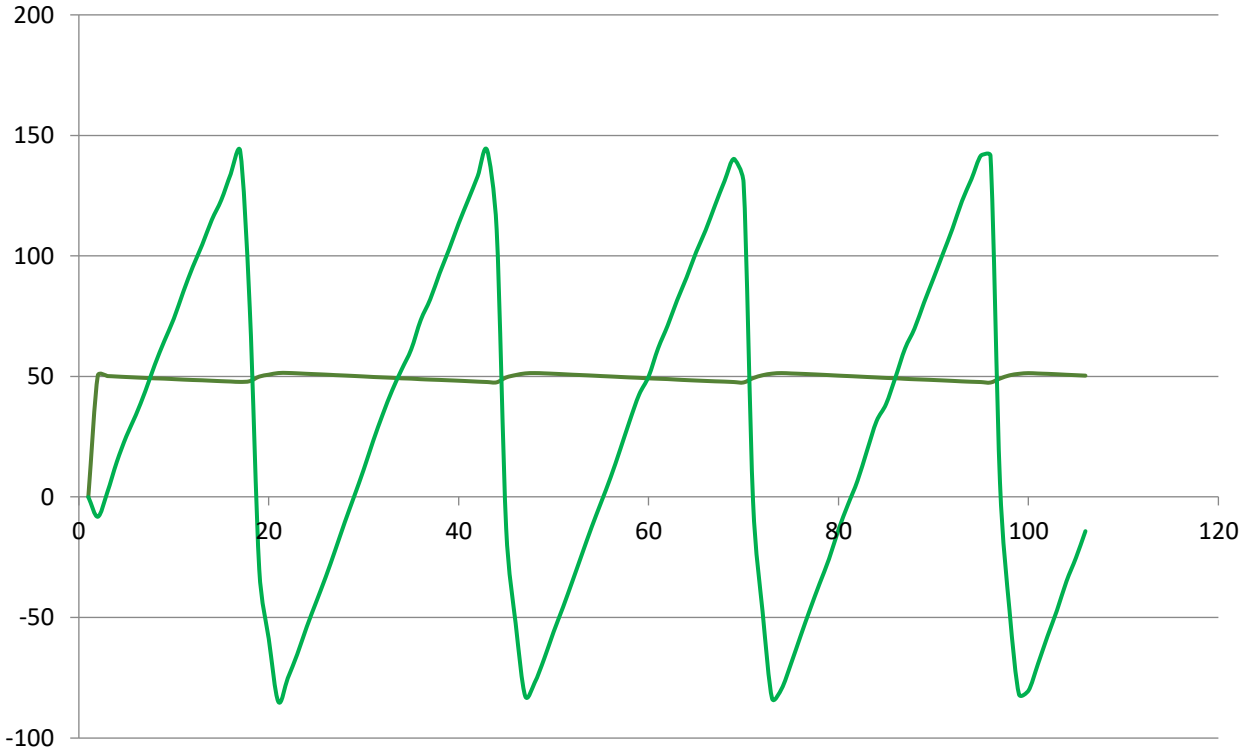
Power Measurement setup

Real World Results

48V Battery



NHR Battery Emulation



Includes Series Resistance

Featured Power Flow Application Test Solutions

9200/9300 Series

- Bi-directional DC Source
- Battery Test System
- Battery Emulation
- Regenerative DC Load

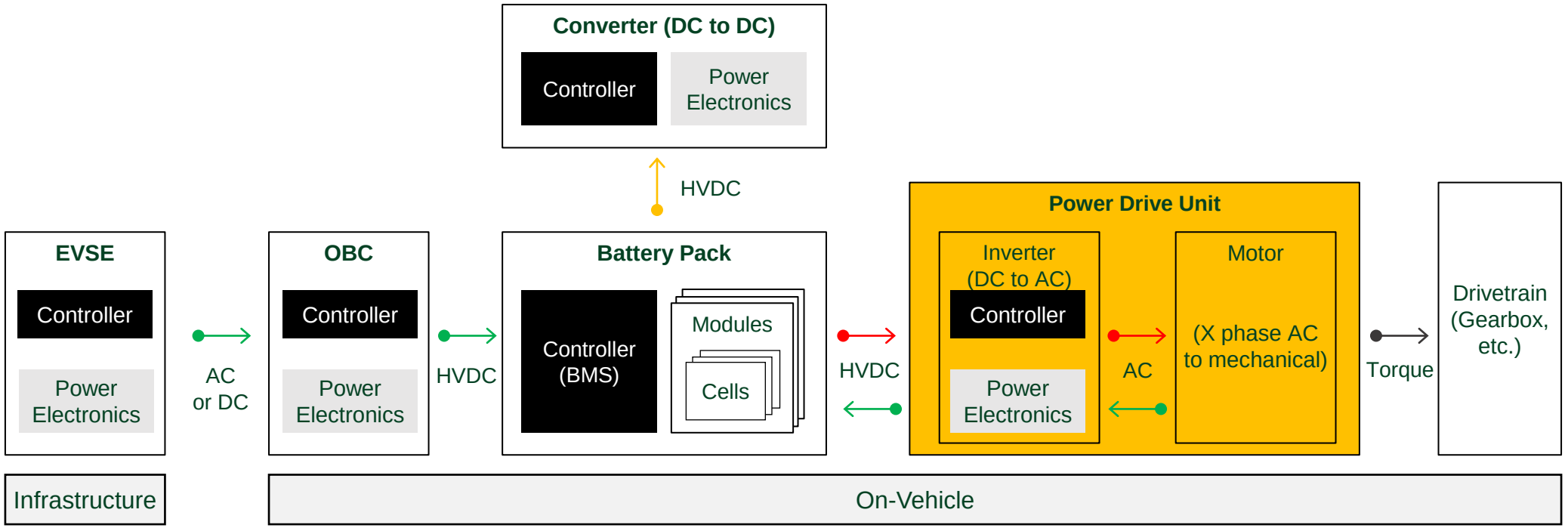
AC-Related

9510 Regenerative Grid Simulator
Simulates the Utility Grid – 50kw up to 1.2MW

9410 Regenerative Grid Simulator
Simulates the Utility Grid – 4kw up to 96kW

9430 Regenerative 4 Quadrant AC Load
Simulates any combination of load profile

NI EV Powertrain Test Focus Areas



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- System modeling for control system dev/tuning

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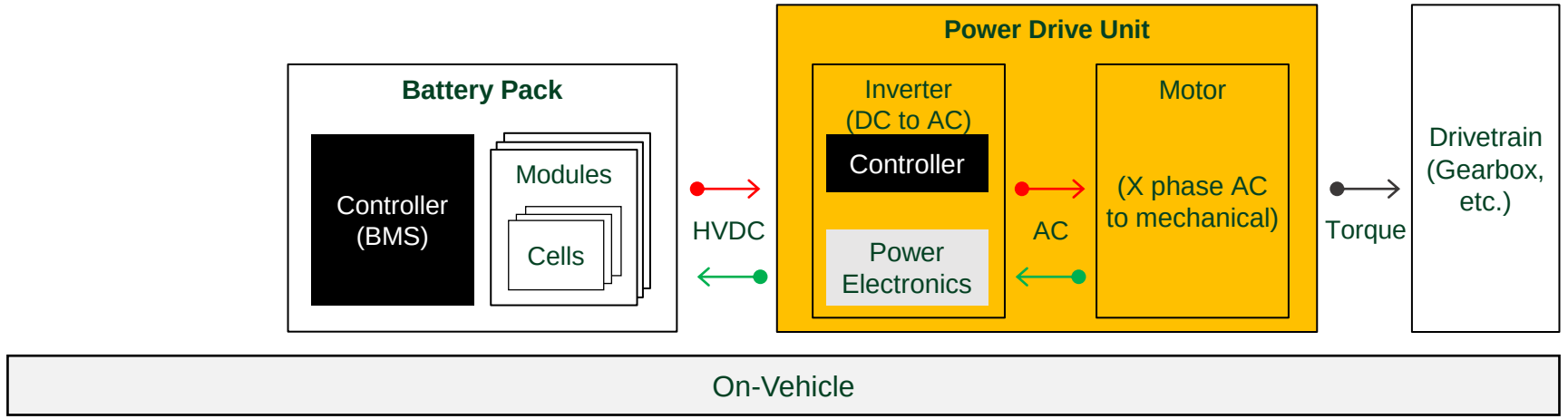
EV Powertrain Validation



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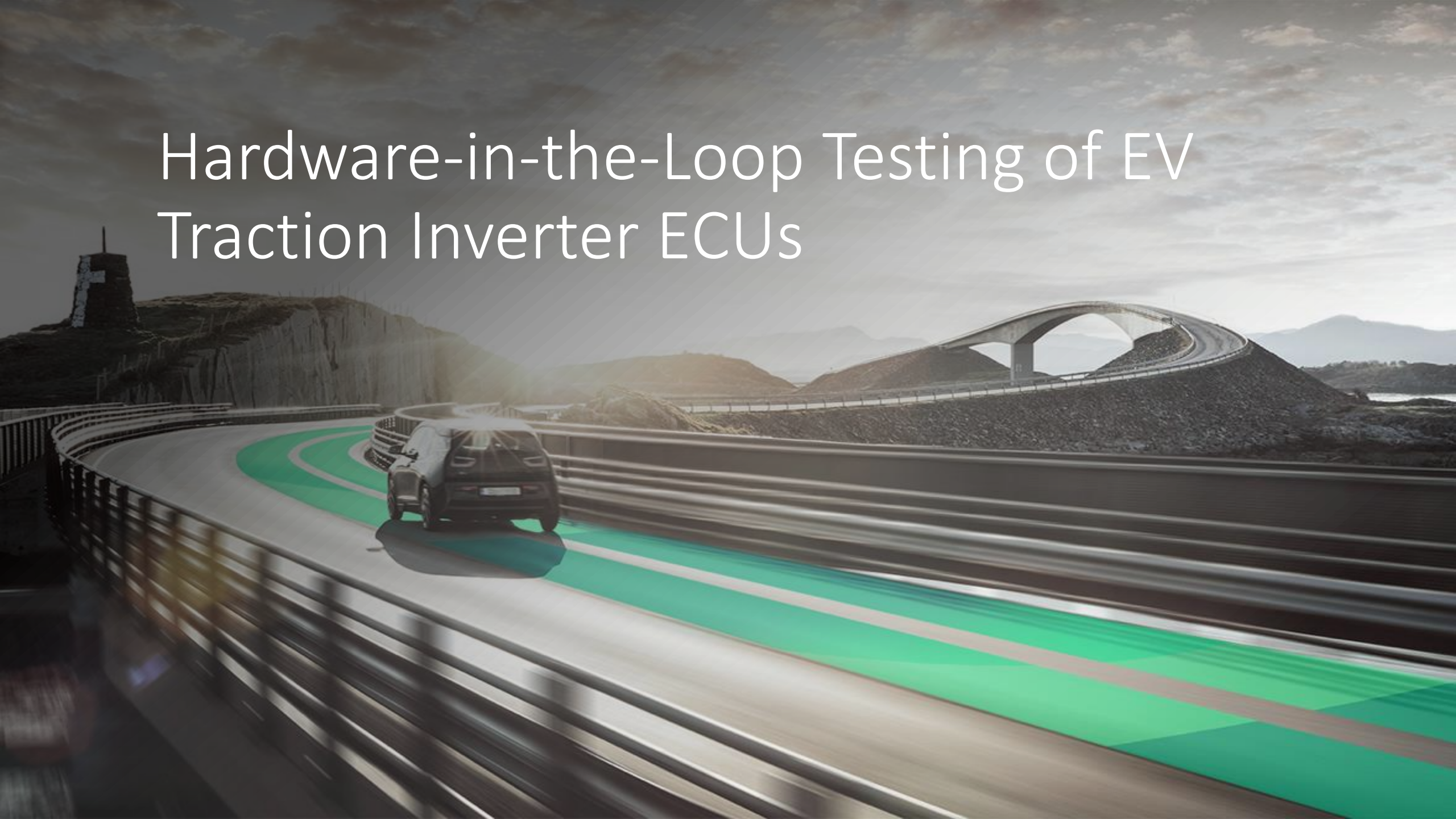
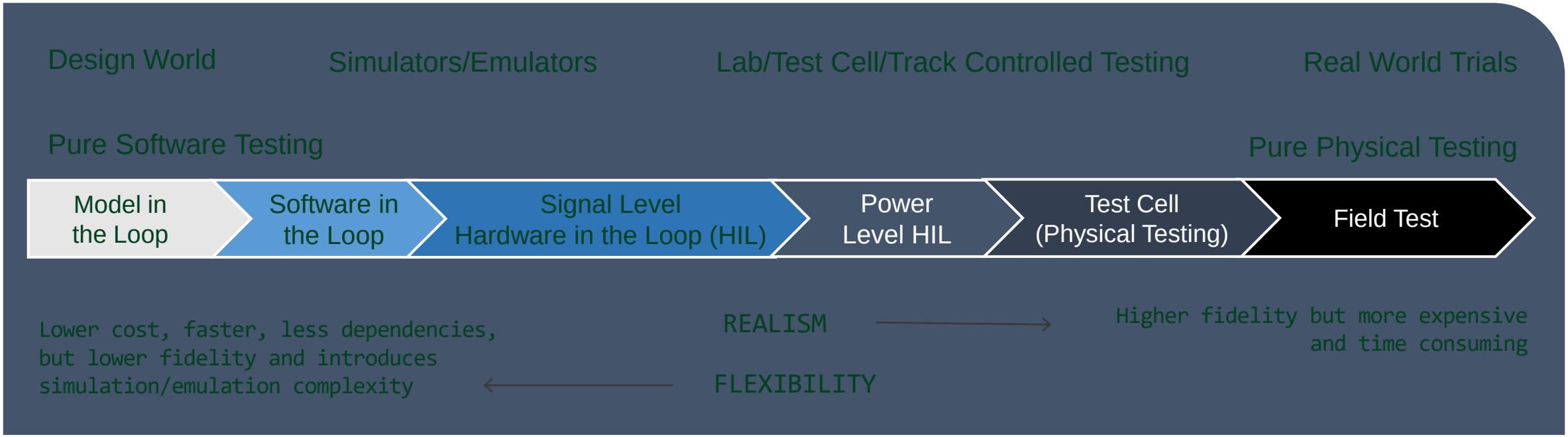
Hardware-in-the-Loop Testing of EV Traction Inverter ECUs



Test Approaches Along the Design Lifecycle



Goal

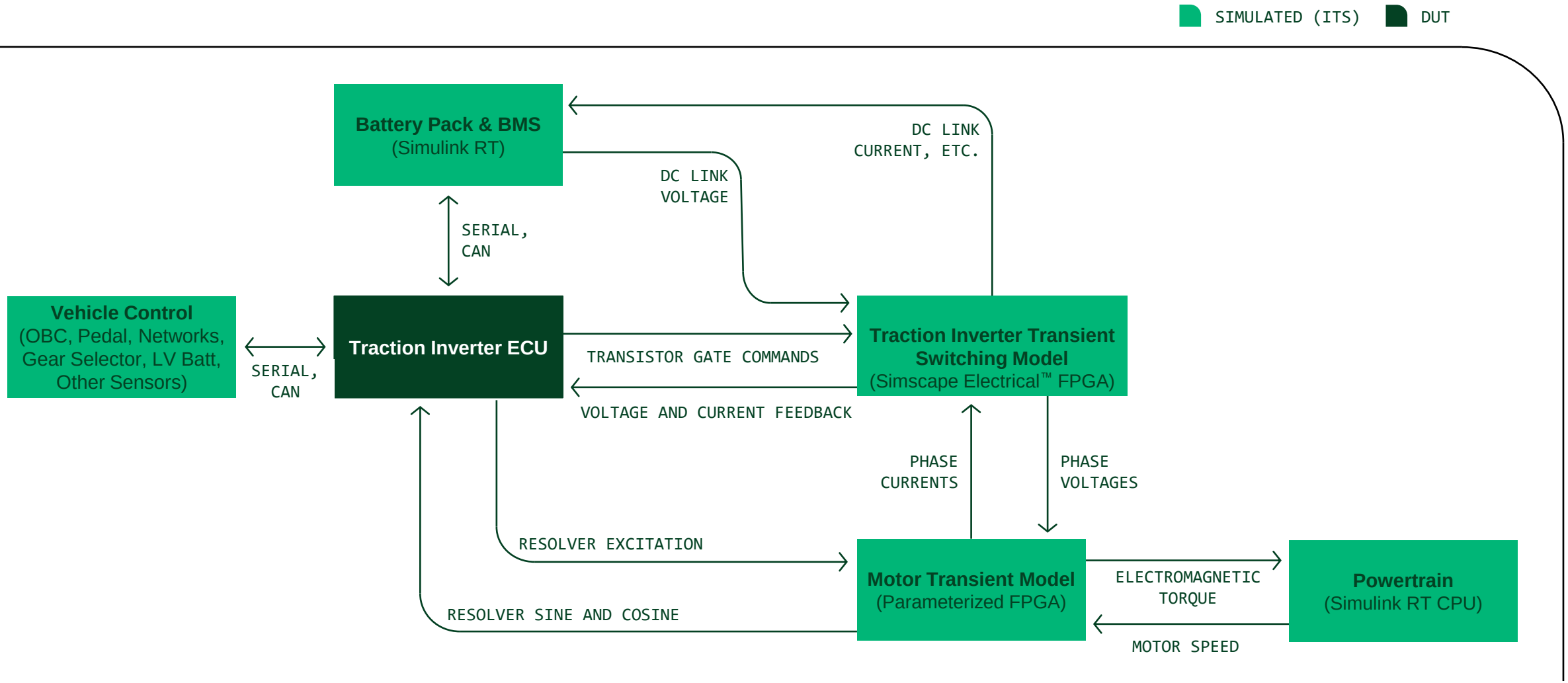
Confidently Test Earlier in the Development Cycle

- Increasing ability to choose scenarios
- Flexibility to test different technology
- Less dependence on real system availability
- Accelerate test (faster than real time)

Increasing Cost, Risk, Time to Fix, and Effort

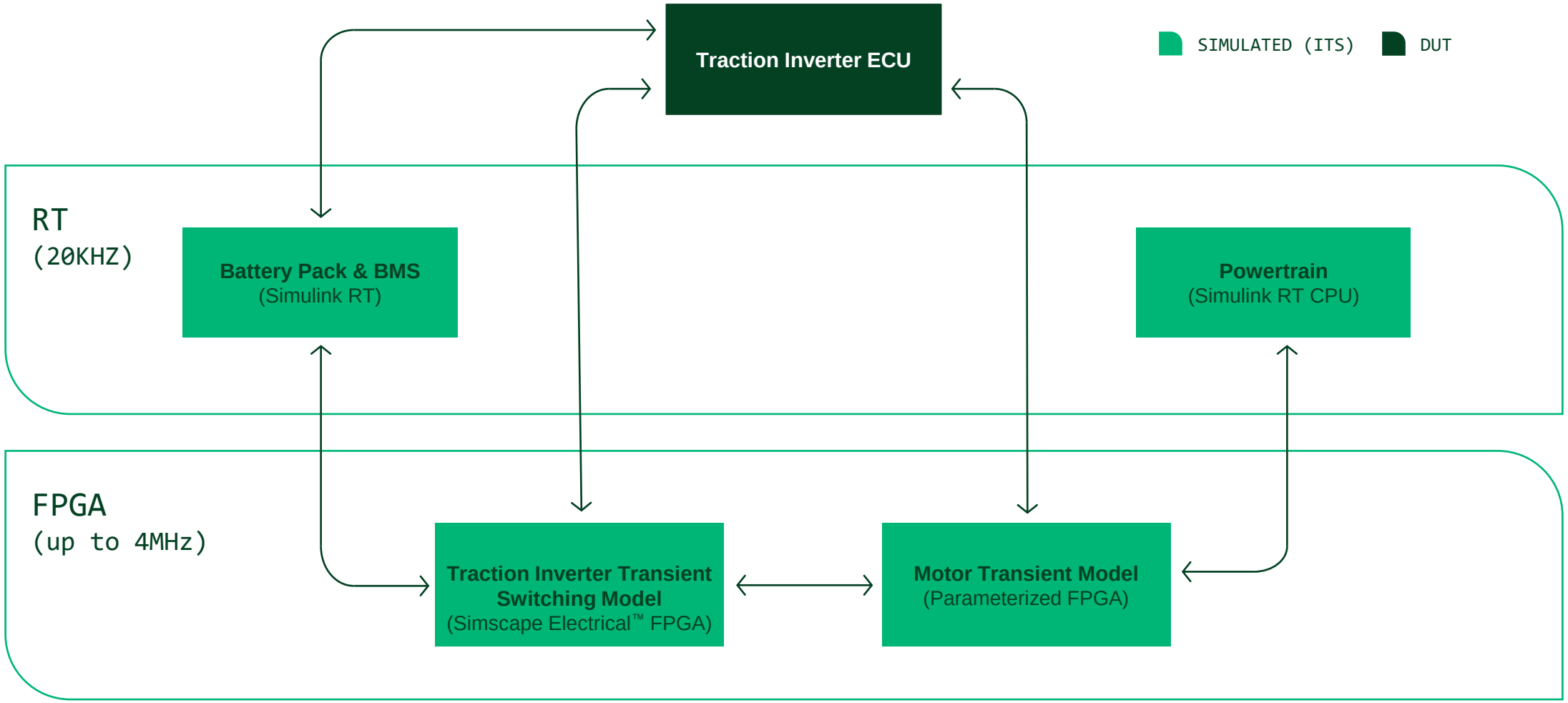
NI ITS Traction Inverter HIL Test

- *Real-Time EV Powertrain Simulation*



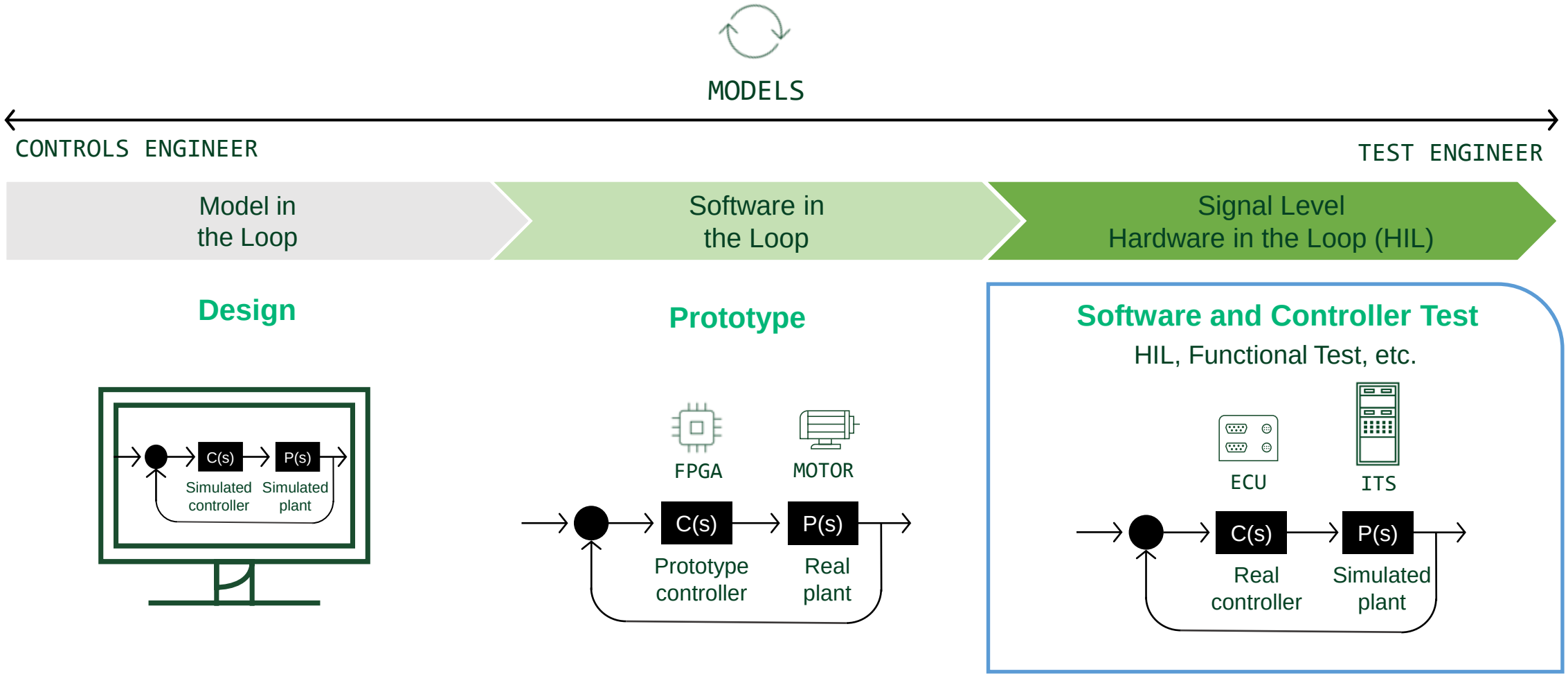
Model Co-Simulation

ITS Architecture & Advantages - Modeling



Model Based Development

ITS Architecture & Advantages - Modeling



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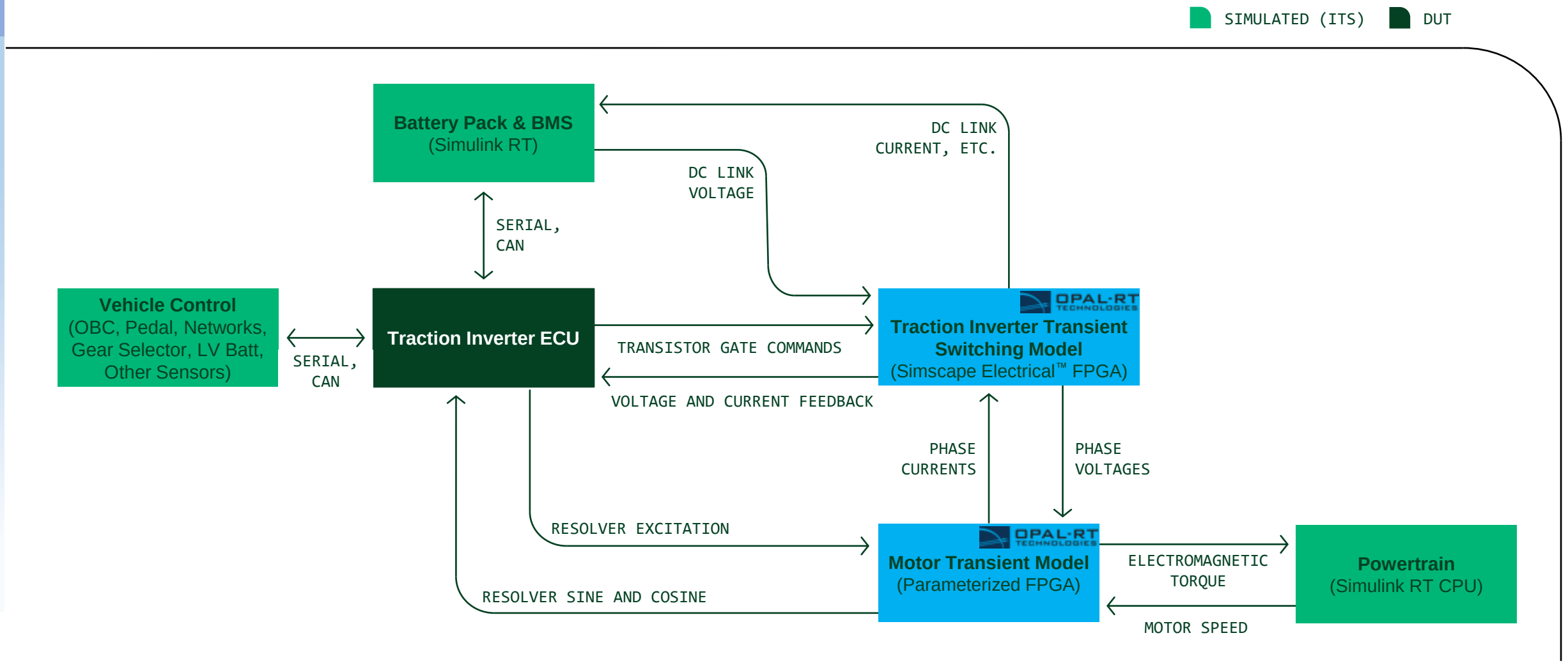
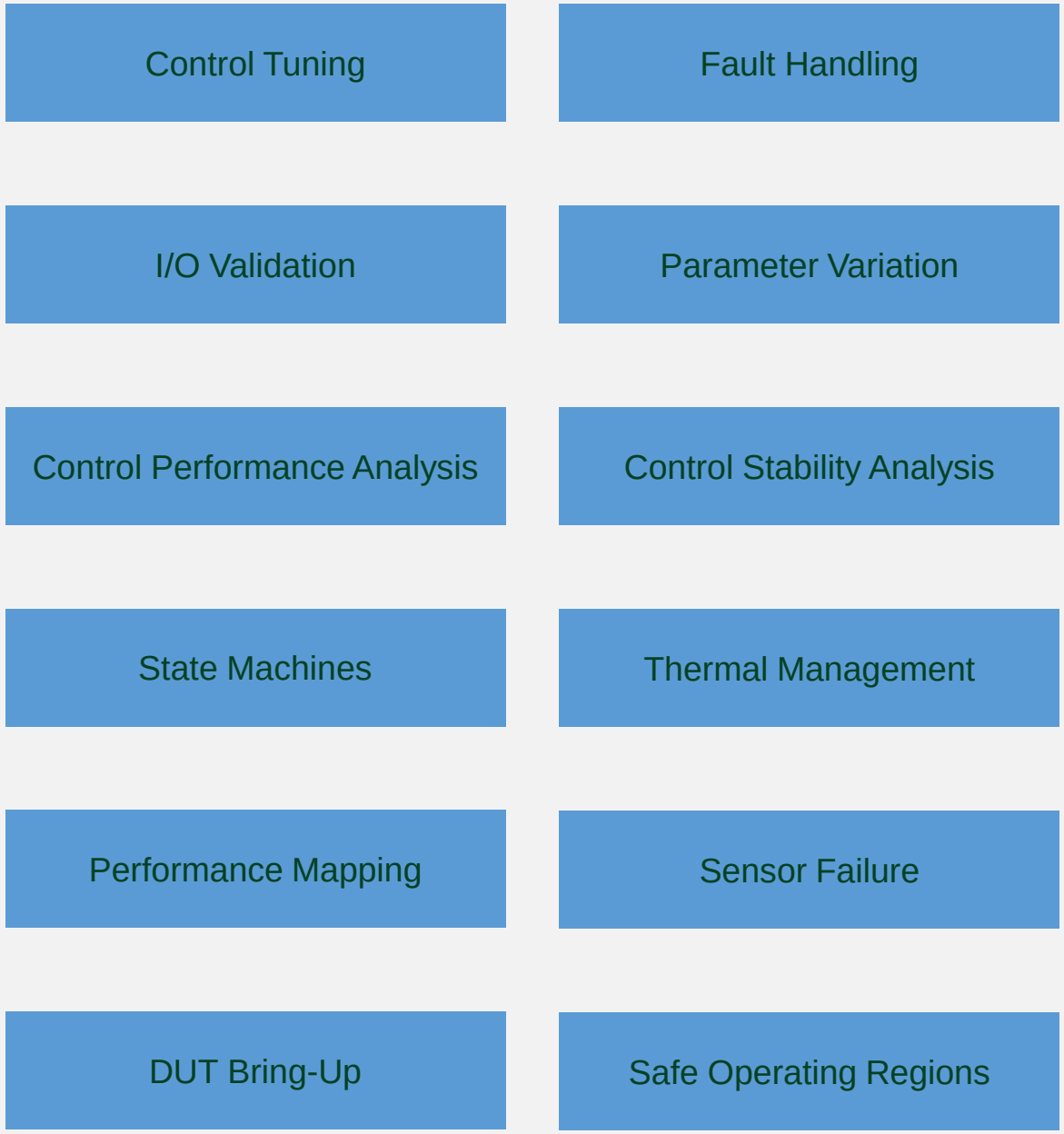
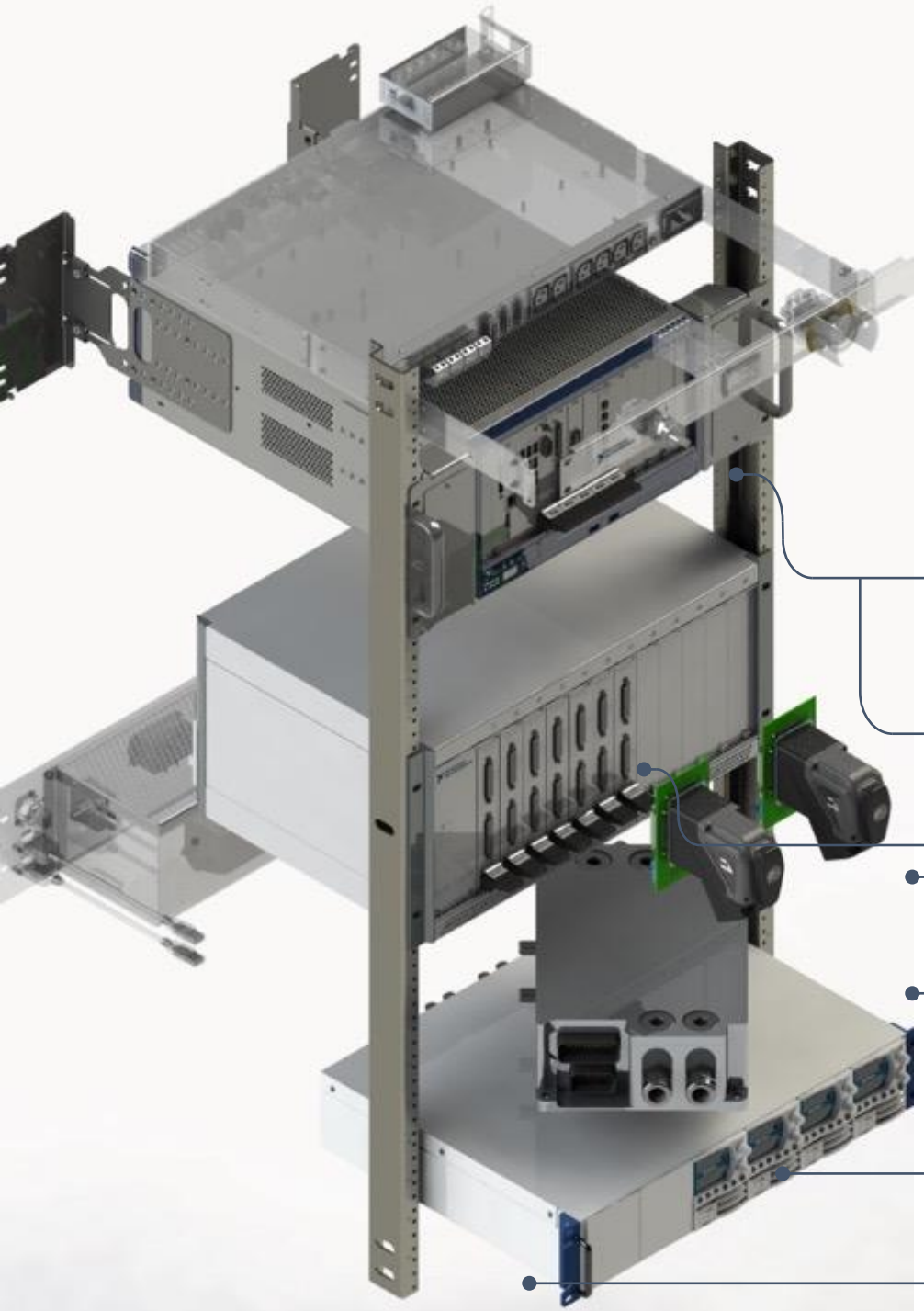


Testing Enabled Through HIL

- Validate ECU performance over a wide range of parameter variations to achieve full test coverage
- Verify ECU functionality in range of conditions, including extreme environments not easily created or replicated in the real world
- Map test cases to requirements to ensure complete test coverage
- Perform regression tests with ease to quickly validate design iterations



- Customer defined
- Flexible and scalable
- High performance
- Open for integration



Software
SystemLink – data and system management
TestStand – test executive
VeriStand – real-time test and model integration
Opal-RT add-on – FPGA based PE modeling
LabVIEW – programming and customization

PXI
Measurements and I/O
Communications
Power Electronics Models in FPGA

SLSC
Switch, Load, Signal Conditioning for fault insertion and routing signal paths. Ease of connection and wiring.

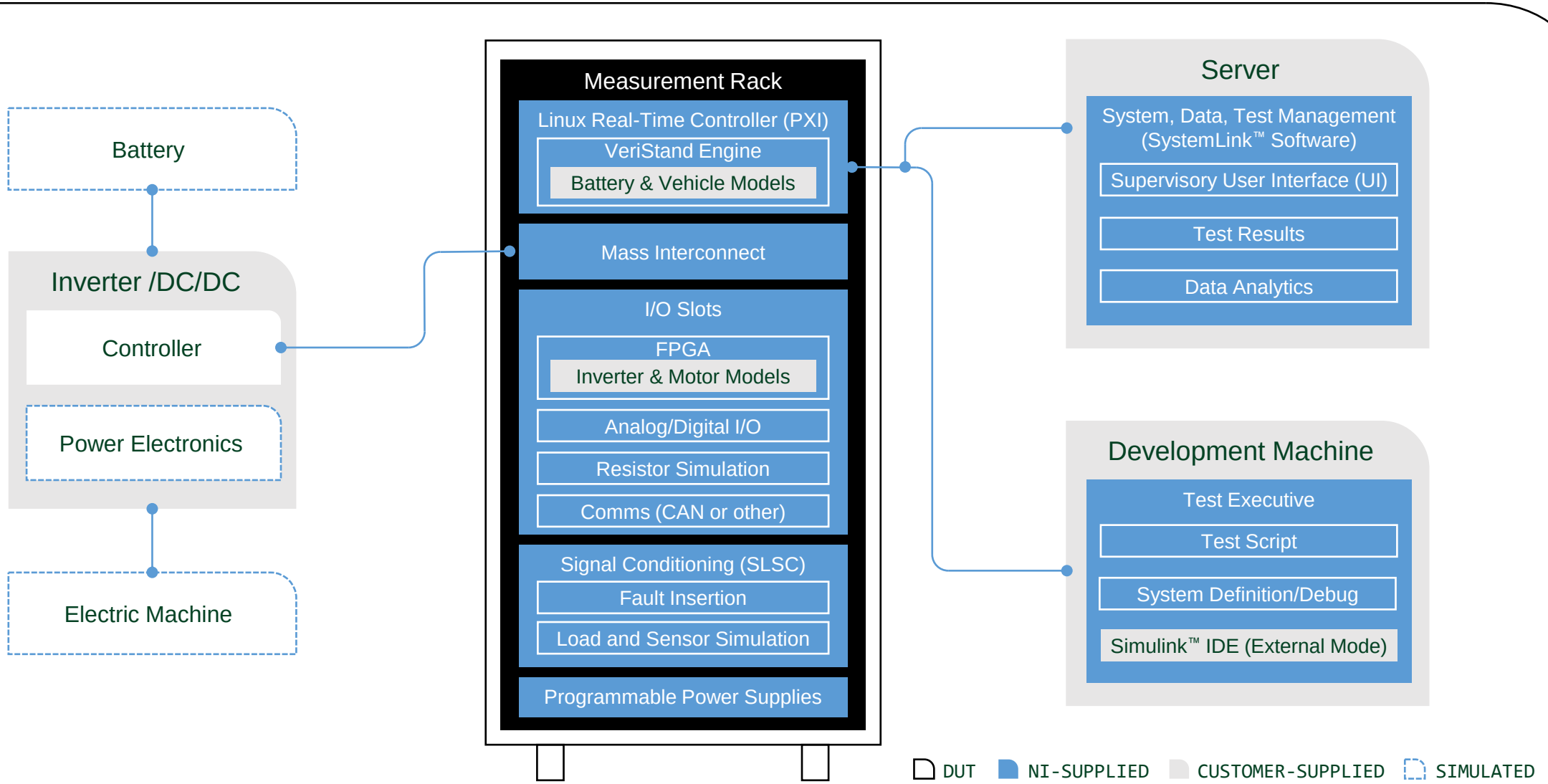
Connectivity
Cabling references for flexible connections to DUTs

DUT
Traction inverter ‘control board’
aka ‘MCU/VCU’
aka ‘cracked inverter’

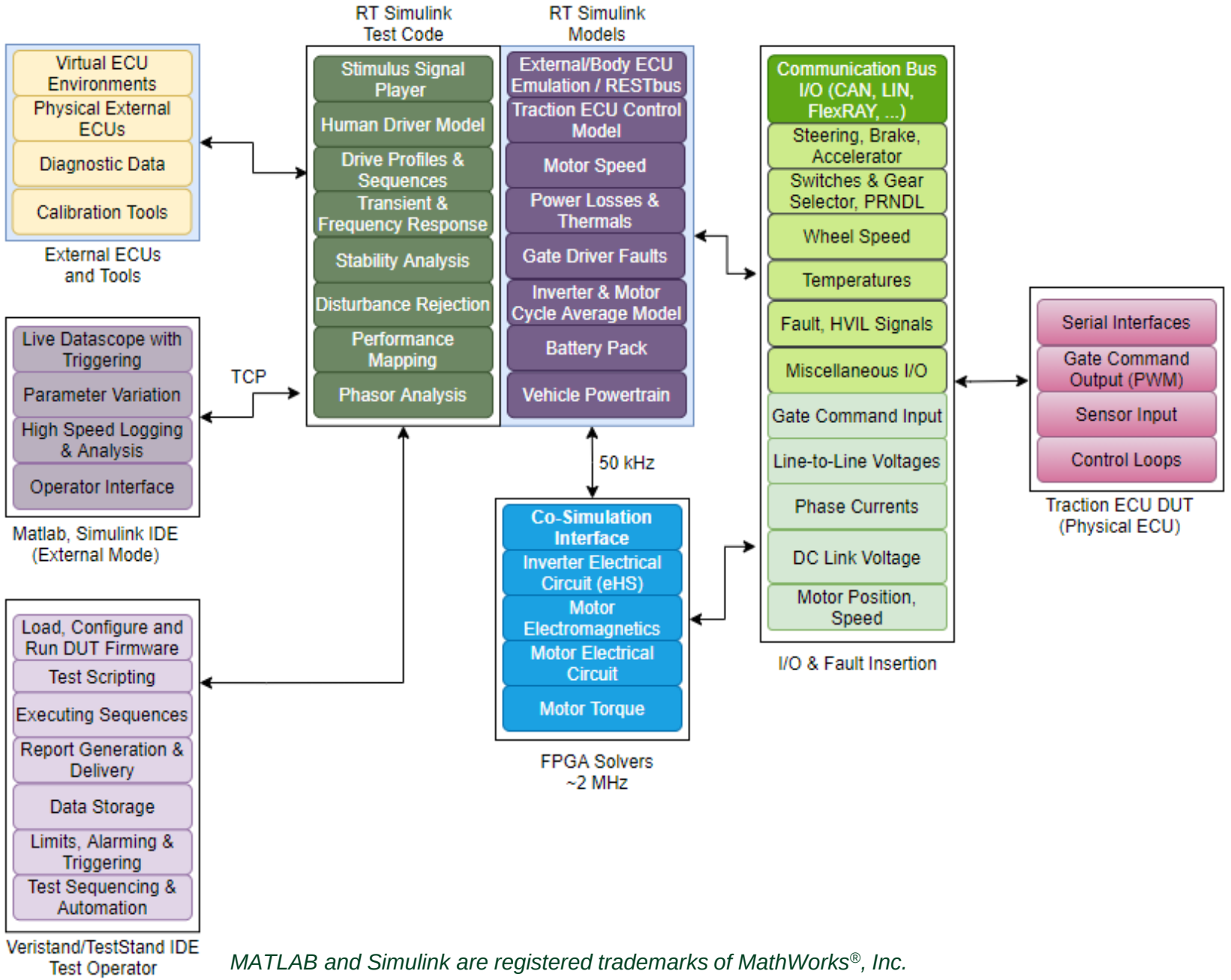
RMX
Programmable loads and DUT power

ATE Core Configurations

Inverter Test System (ITS) Diagram



ITS Components



Why customers choose HIL for EV

1. Ability to use not only Simulink but Simscape reduces inverter model development time
    1. Model creation typical hours (Simulink 10hr, Simscape 0.5hr)
    2. Building it onto the FPGA (Simulink 3-9hr, Simscape 0hr)
2. Ability to use different motor modeling software (JMAG, Maxwell support)
3. Low FPGA latency increases accuracy
    1. NI has 0 latency due to Ultrascale FPGA
    2. Others have 300 to 700 ns latency
4. ITS architecture for fast delivery and consistency in design
5. Global support and delivery

NI Offerings Along the Inverter Design Lifecycle

Reduce Development Time and Improve Engineering Efficiency Through Model Reuse

Powertrain and Vehicle Models

Model-in-the-loop
Software-in-the-loop

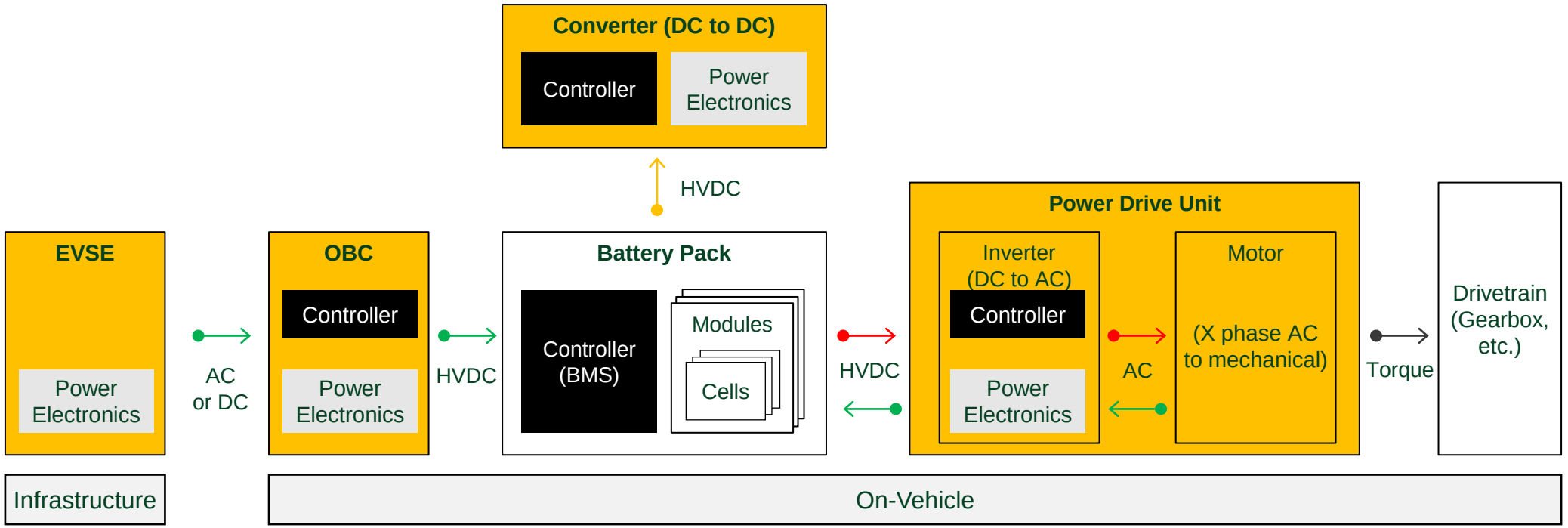
Signal-Level HIL
sHIL

Power-Level HIL
pHIL

Test Cell – eDyno
Physical Testing

Field
Test

NI EV Powertrain Test Focus Areas



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EV Solution

Enterprise Software

DATA ANALYTICS

ELECTRIFICATION

Battery	BMS	Inverter	Motor	Charging (EVSE, OBC, V2G)

BATTERY VALIDATION TEST

BMS HIL SIMULATOR

INVERTER TEST SYSTEM
(SIGNAL AND POWER LEVEL HIL)

E-MOTOR TEST BENCH
E-AXLE TEST BENCH

AC GRID SIMULATORS

BATTERY CELL QUALITY
BATTERY FUNCTIONAL TEST
BATTERY EOL TEST

BMS
PRODUCTION TESTER

INVERTER
PRODUCTION TESTER

EOL EDYNO

AC SOURCES & LOADS

BATTERY EMULATORS

EV Solutions

Enterprise Software

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