SPEAKER KRISTOFFER NILSSON

COMPANY ALVIER MECHATRONICS

TOPIC

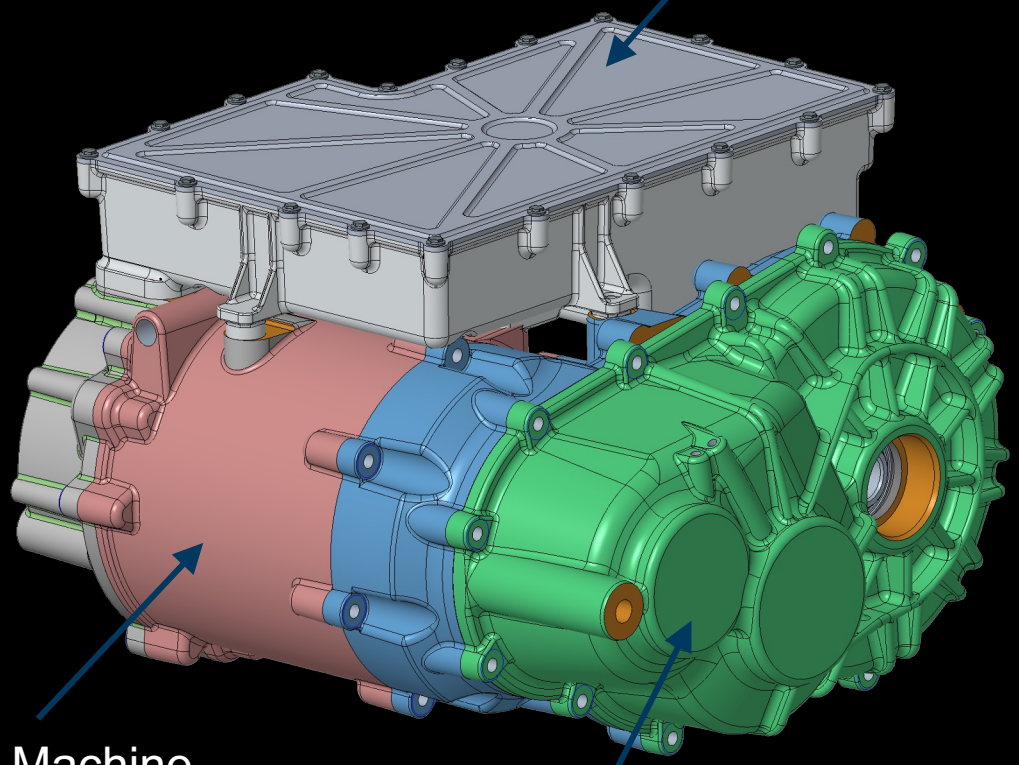
IDS – SUSTAINABLE PROPULSION SYSTEM FOR ELECTRICAL VEHICLES

iDS Specification

iDS – Integrated Drive System

Drive System (3-in-1) for EVs

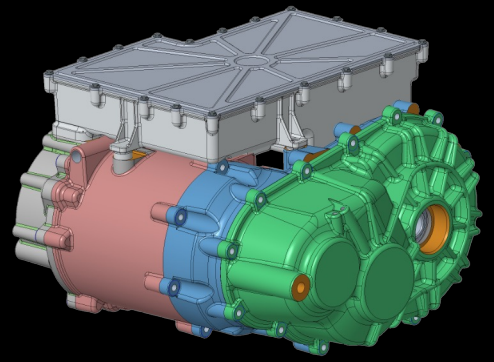
- Voltage: 400V_{DC}
- Peak Power: 150 kW
- Peak Torque: 3000 Nm
- Target Volumes: 100-350 k/a
- Highest Drive Cycle Efficiency
- Weight: <80 kg
- Size
  - Height: 310 mm
  - Length: 480 mm
  - Width: 540 mm



alvier MECHATRONICS

iDS Priorities & Key Metrics

iDS – Integrated Drive System



Major drivers → Potential Major USPs

High customer value, key part of the value proposition. The “more” the better.

- Cost
- System Efficiency
- Sustainability

← Prio 1, Main System Selection Criteria

Minor drivers → Potential Minor USPs

Some customer value in certain applications when exceeding the requirement.

- Durability
- Package Space
- Weight
- Manufacturability
- Scalability

← Prio 2, Secondary System Selection Criteria

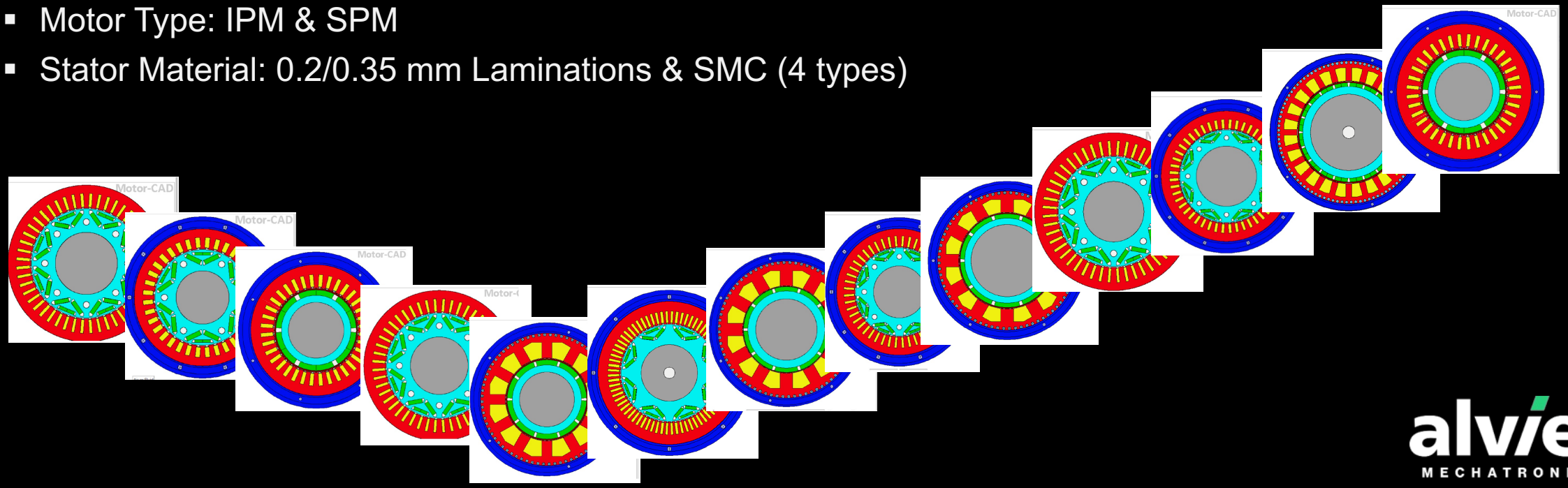
alvier MECHATRONICS

Selected Concept

iDS – Integrated Drive System – Electrical Machines Considered

Key Data Variations

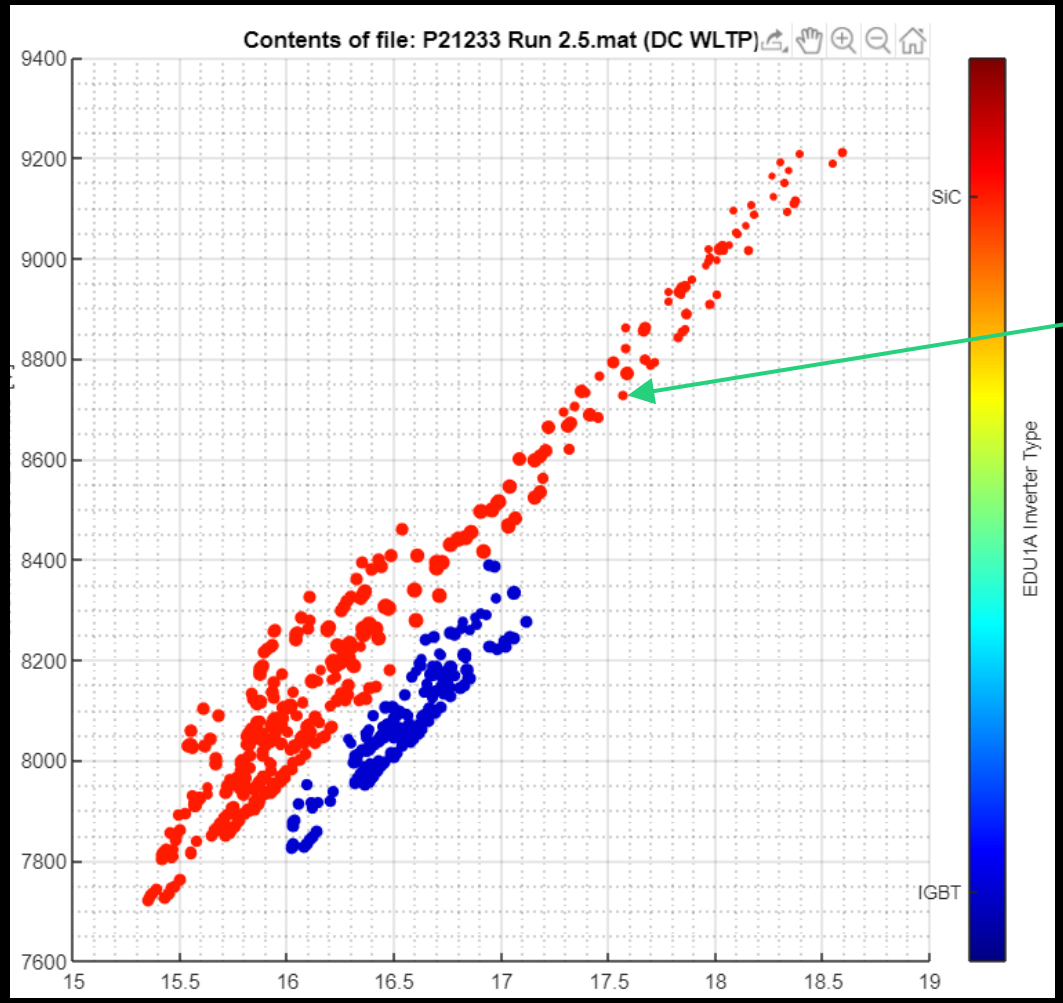
- Windings: Distributed & Concentrated
- Max Speed: 16-35 krpm
- Motor Type: IPM & SPM
- Stator Material: 0.2/0.35 mm Laminations & SMC (4 types)



alvier MECHATRONICS

Inverter Technology

iDS – System Optimization – ePop – Efficiency

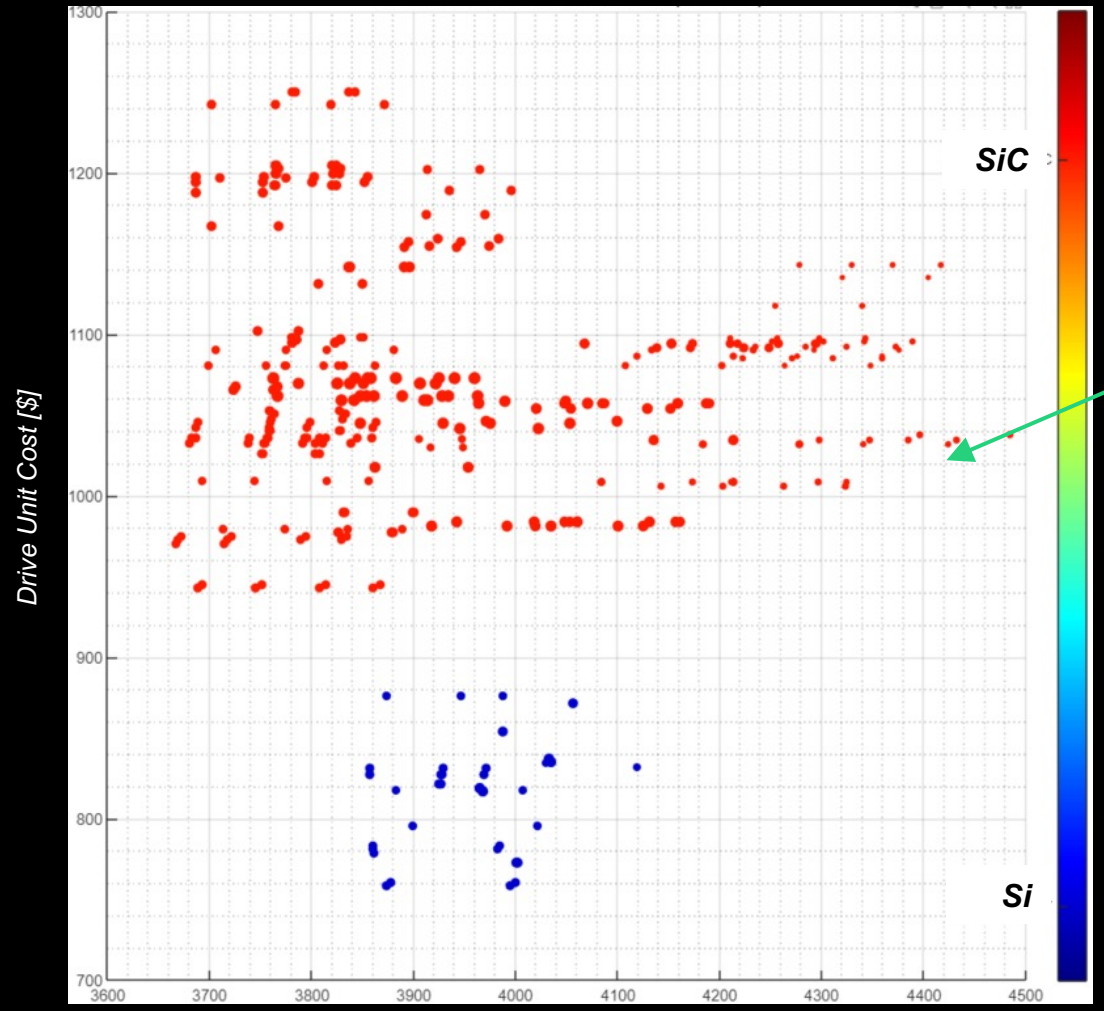


Each dot represents a feasible system combination meeting the system requirements.

Inverter type, Electrical Machine Design, Material, Gear Ratio, etc, are varied to find the optimal system.

Inverter Technology

iDS – Sustainability – CO_2 Footprint

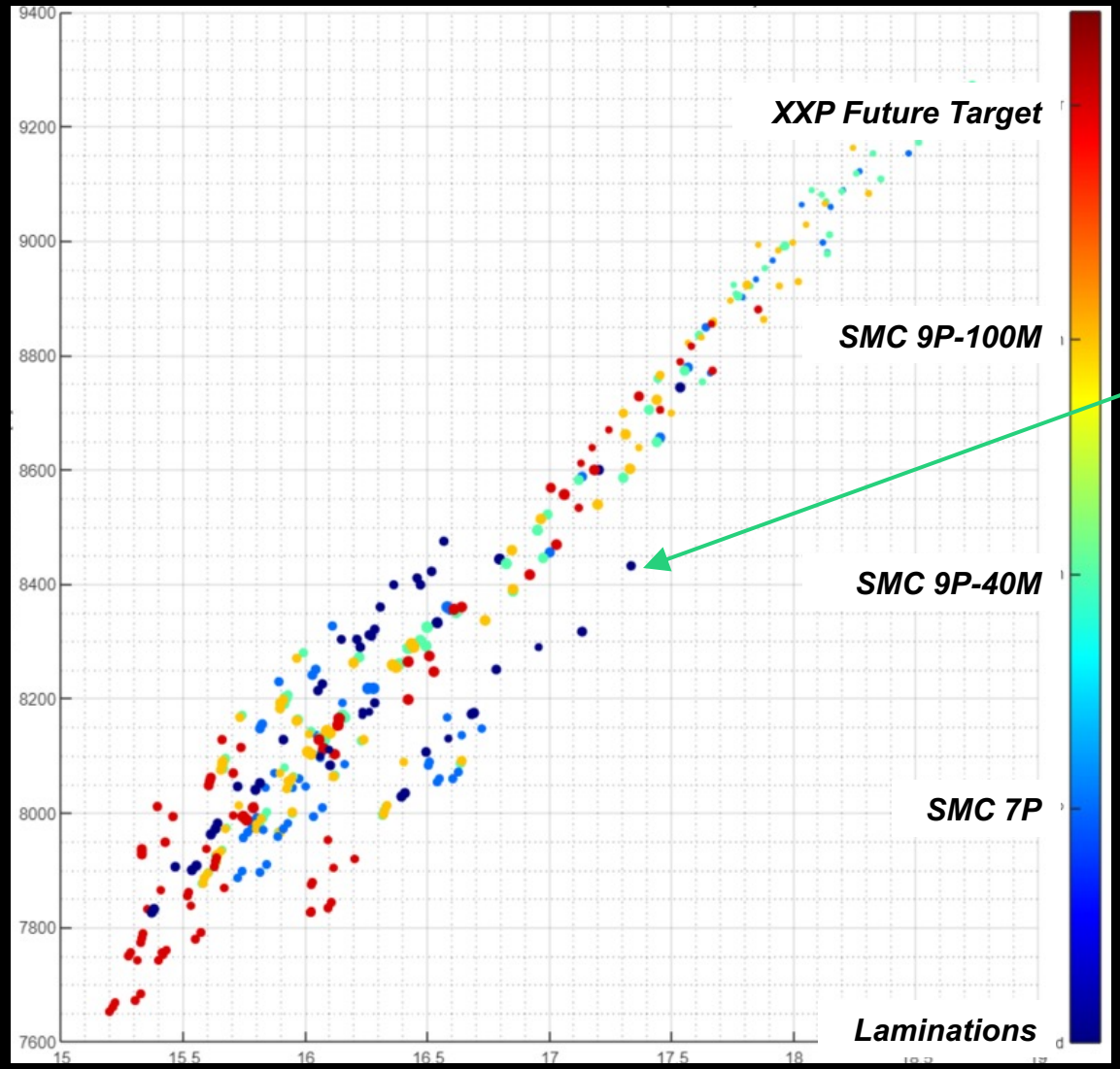


Each dot represents a feasible system combination meeting the system requirements.

Inverter type, Electrical Machine Design, Material, Gear Ratio, etc, are varied to find the optimal system.

Electrical Machine Technology

iDS – Energy Consumption & Total Cost vs Stator Material

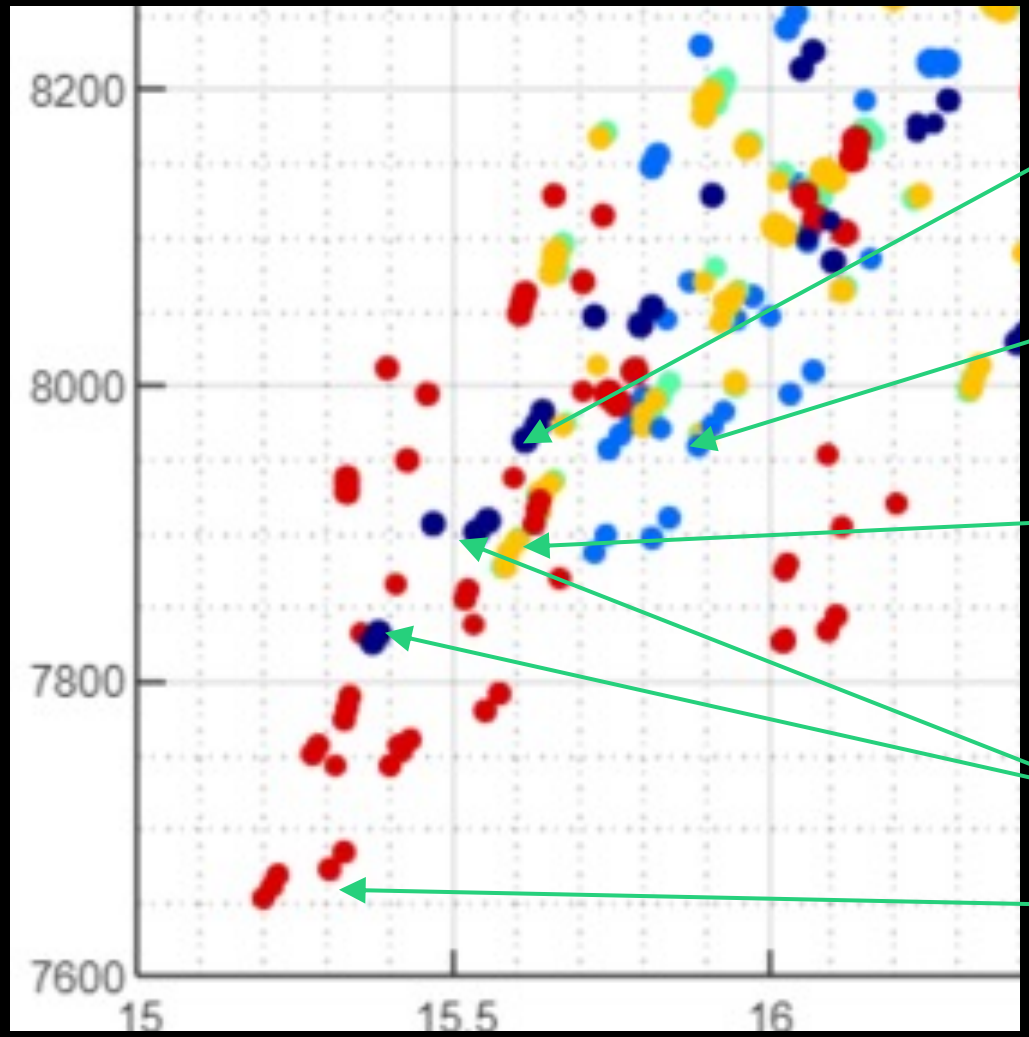


Each dot represents a feasible system combination meeting the system requirements.

Inverter type, Electrical Machine Design, Material, Gear Ratio, etc, are varied to find the optimal system.

Electrical Machine Technology

iDS – Energy Consumption & Total Cost vs Stator Material



Dark Blue dots here are 0,35 mm Laminations

Light Blue dots here are SMC 7P (current material)

Yellow & Green dots here are SMC 9P (currently in development)

Dark Blue dots here are 0,2 mm Laminations

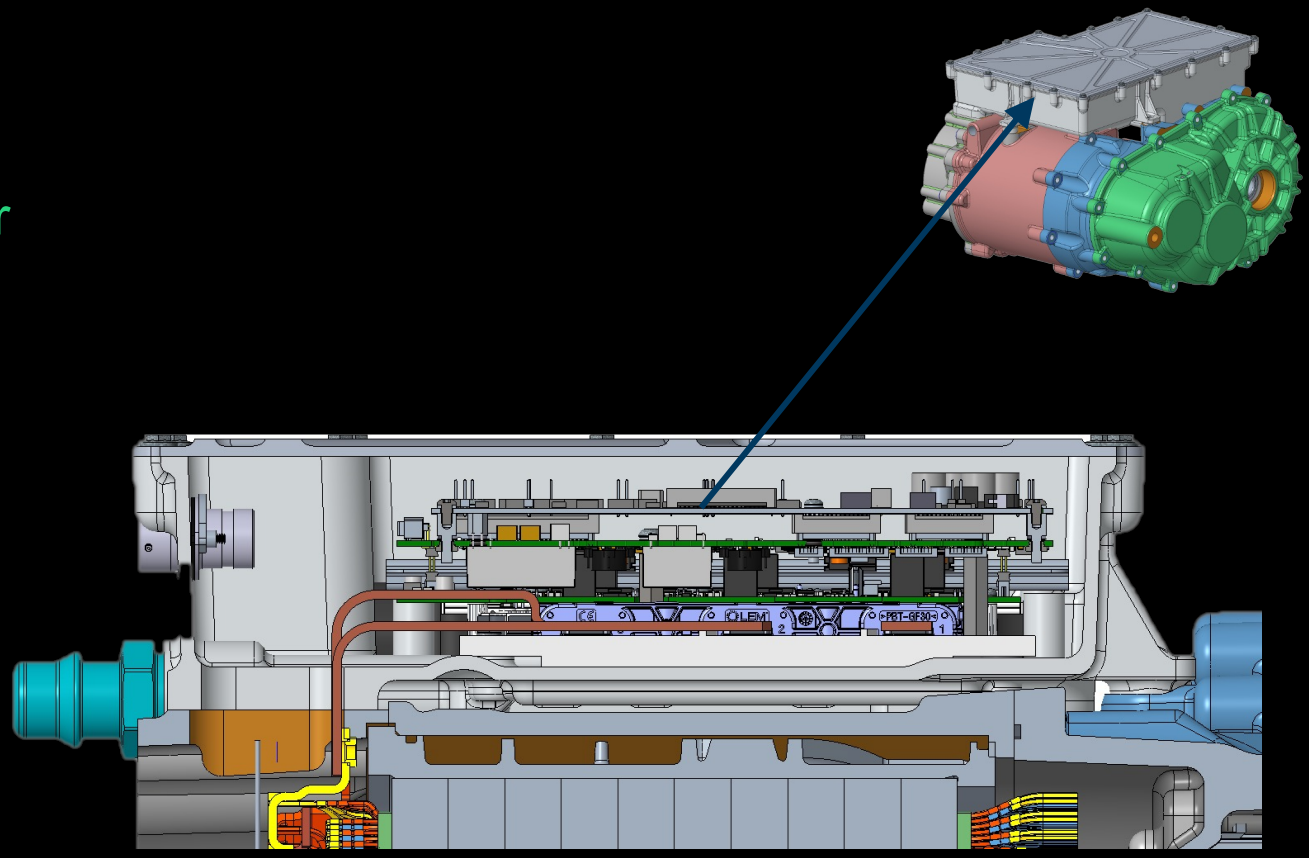
Red dots here are "Future Target XXP"

Selected Concept

iDS – Integrated Drive System – Inverter

Inverter Key Data

- Type: SiC MOSFET
- Phase Current, max: 450 A_{RMS}
- DC Voltage, max 820 V_{DC}
- Microcontroller: Infineon Aurix TC299T
- System Safety Chip: Infineon TLF35584
- Functional Safety: ASIL D Capable
- Control: Space Vector PWM
- Switching Frequency, max 30 kHz
- Communication: 2x CAN-FD



» Inverter

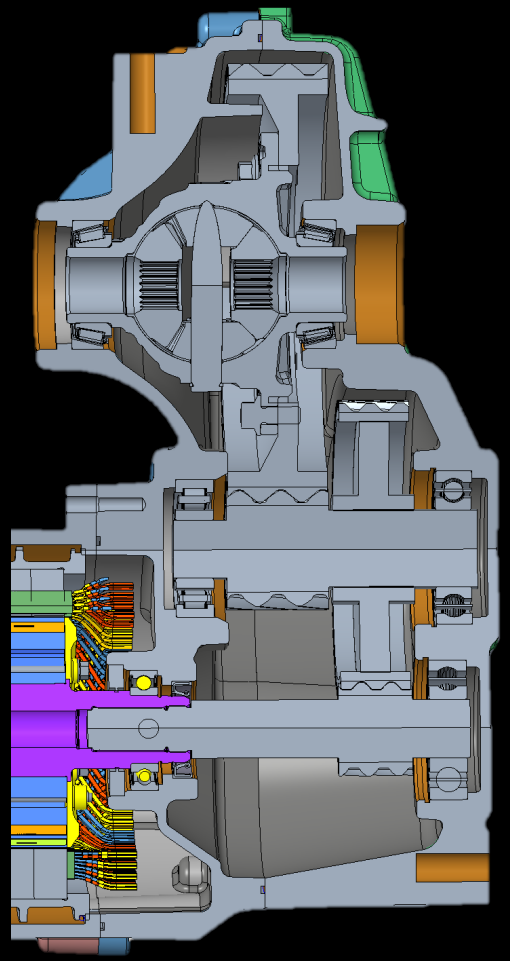
alvier MECHATRONICS

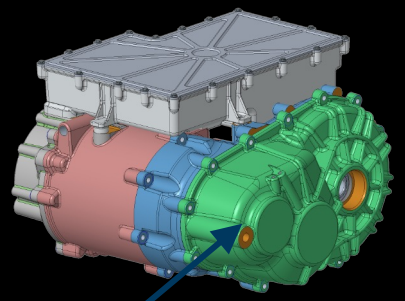
Selected Concept

iDS – Integrated Drive System – Transmission

Transmission Key Data

- Type: Single Speed
- Layout: 2-Stage Reduction
- Gear Ratio: 13,1:1
- Max Input Speed: 16.000 rpm
- Lubrication: Passive





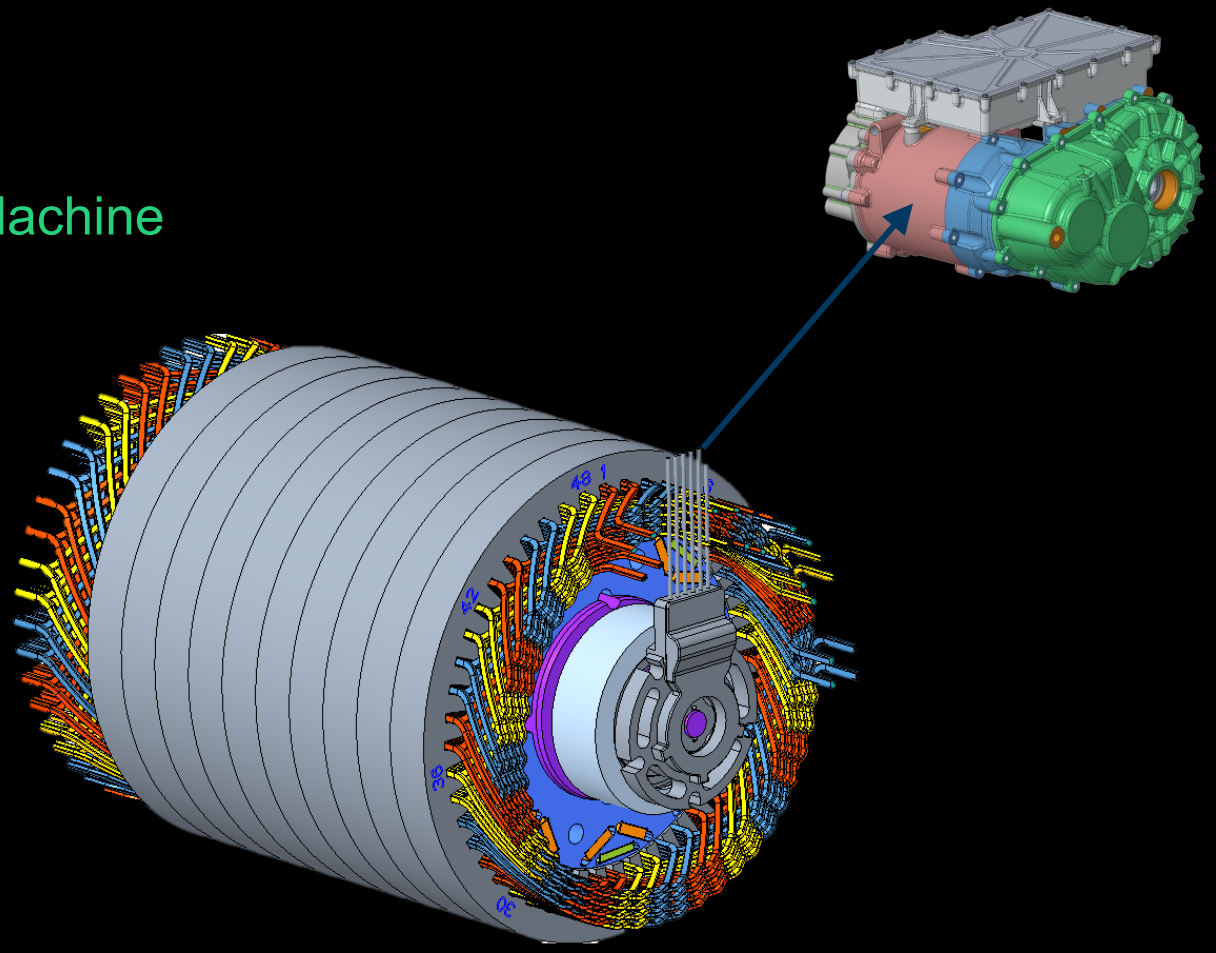
» Transmission

Selected Concept

iDS – Integrated Drive System – Electrical Machine

Electrical Machine Key Data

- Type: PMSM / IPM
- Nominal Voltage: 400V_{DC}
- Peak Power: 150 kW
- Phase Current: 420 A_{RMS}
- Peak Torque: 230 Nm
- Max Speed: 16.000 rpm
- Stator OD: 170 mm
- Cooling: Water Jacket (Direct Oil Optional)
- Stator: SMC Segments, SMC 7P
- Winding: Hairpin, 8 Conductors/slot
- Rotor: Laminated Steel
- Slots/Poles: 48/8



» Electrical Machine

alvier MECHATRONICS

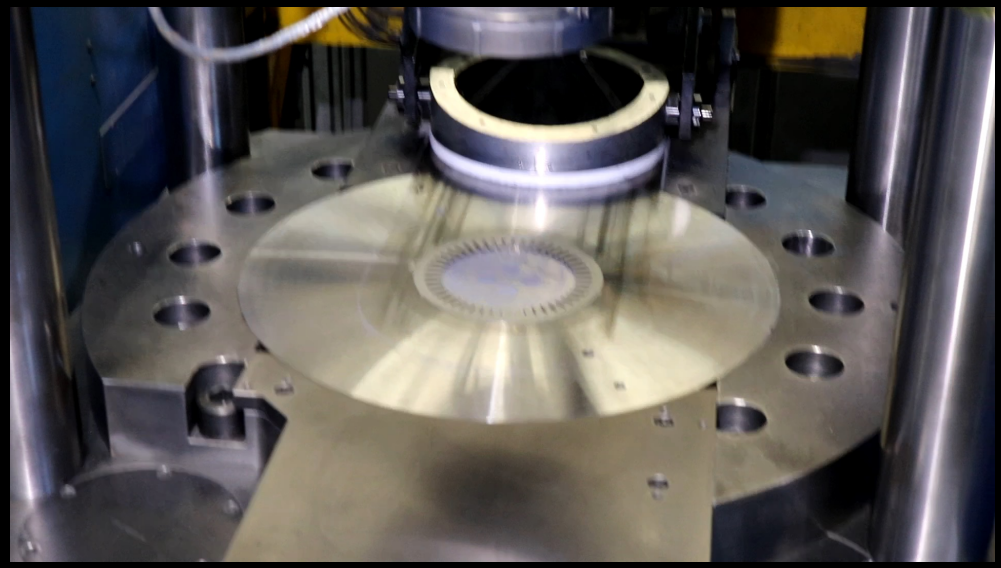
Next Steps

iDS – Integrated Drive System

» iDS

iDS Key Milestones

- Detailed Design Freeze: Q1 2023 ✓
- Prototype Build: Q2 2023
- Full System Testing Completed: Q4 2023

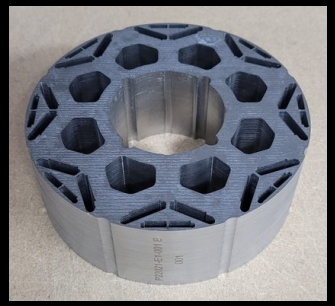


» iDS Stator Segment Manufacturing

alvier MECHATRONICS

Next Steps

iDS – Prototype Build



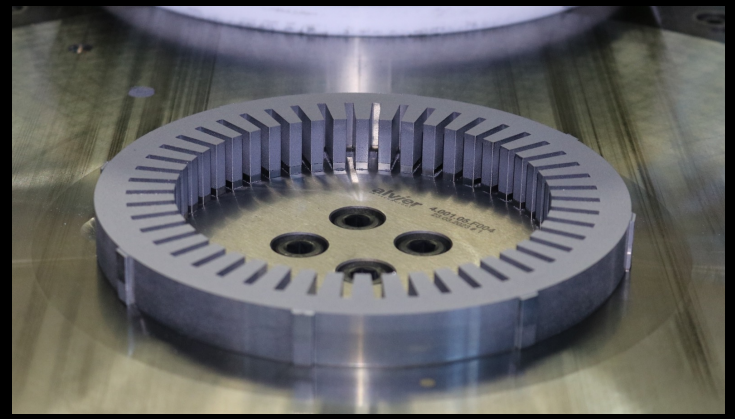
» Rotor

» Electronics

» Casings

» Differential

» Power Module



» Stator Segment

» Stator Sleeve

alvier MECHATRONICS

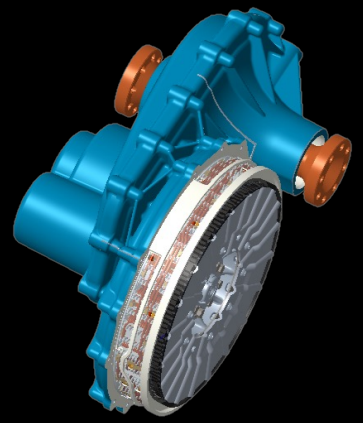
What's next?
iDS – Integrated Drive System

- What's the optimal drive system in terms of cost, sustainability and efficiency?
  - iDS PM RX
  - iDS PM AX
  - iDS EESM RX
  - iDS EESM AX
  - iDS IM RX
  - iDS IM AX
  - iDS Ferrite RX

→ ePop Simulations!

- iDS AX – Axial Flux
  - Concept Design

→



alvier MECHATRONICS

Questions?

Kristoffer Nilsson
Alvier Mechatronics AB

Kristoffer Nilsson
Alvier Mechatronics AB