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Using alternative, non-fossil diesel fuel (HVO) in a race car

Dipl.-Ing. Thomas Hanisch, November 16th 2011

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Content:

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- **Technology platform Audi A4 quattro**
- **References**
- **Using HVO in a race car**
- **Summary**

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Members of Tuning Akademie are:

- Engineers and technicians of technical development department of Audi AG and ika (RWTH Aachen)

Improvement of Brake and suspension items for special requirements	Development and verification of chassis control systems	Alternative fuel and efficiency concepts

Development	Races	Exhibitions/Publications
Integration and adaption of innovative concepts into the technology plattform Gathering measurement data under reproducable conditions Information transfer of alalysing resultes to project partners	Testing of innovative technologies under racing conditions Representation of new technologies and project partners in public view	Support in communication of new technologies and analysing results from scientific point of view Scientific publications of these technologies during scientific conferences and exhibitions

Technology platform Audi A4 3.0 TDI quattro

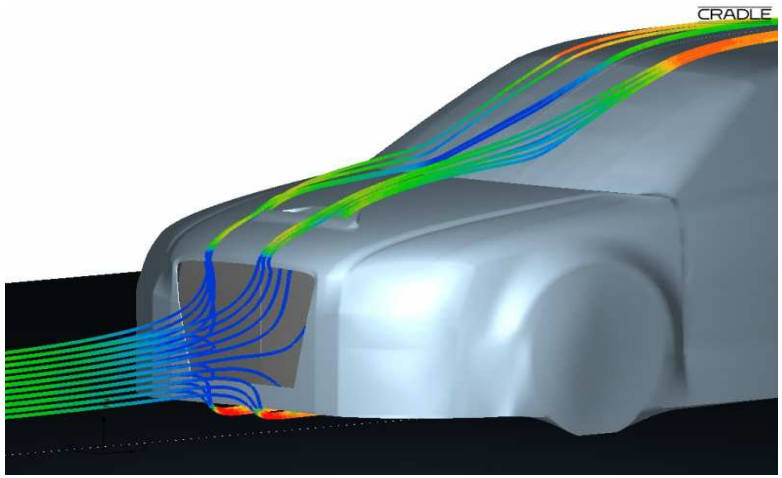
Technical data

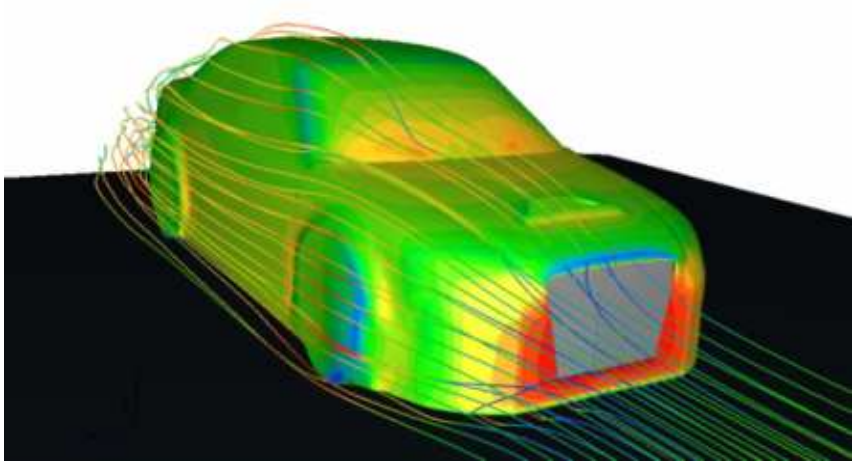
- body: Audi RS4 (B7)
- engine: V6 TDI (Generation 1)
- capacity: 2967ccm
- power: 230 kW
- torque: 600 Nm
- tires: Dunlop 265/660 R 18 DTM
- brakes: B7 RS4 original (steel)
- ABS / ESP: Bosch ESP8 optimized

- Permanent recording of CAN bus during testing and races
- Up to 32 analog signals (e.g. temperature) can be recorded

References of succeeded development topics:

- **Optimisation of engine compartment streaming and cooling** ✓
- **Aerodynamic (details on: www.tuning-akademie.de\downloads)** ✓
- **Application of ABS controller depending on accurate race tire dat** ✓
- **Optimisation of brake balance between front and rear axle for optimized temperature distribution.** ✓





ABS Performance before modification

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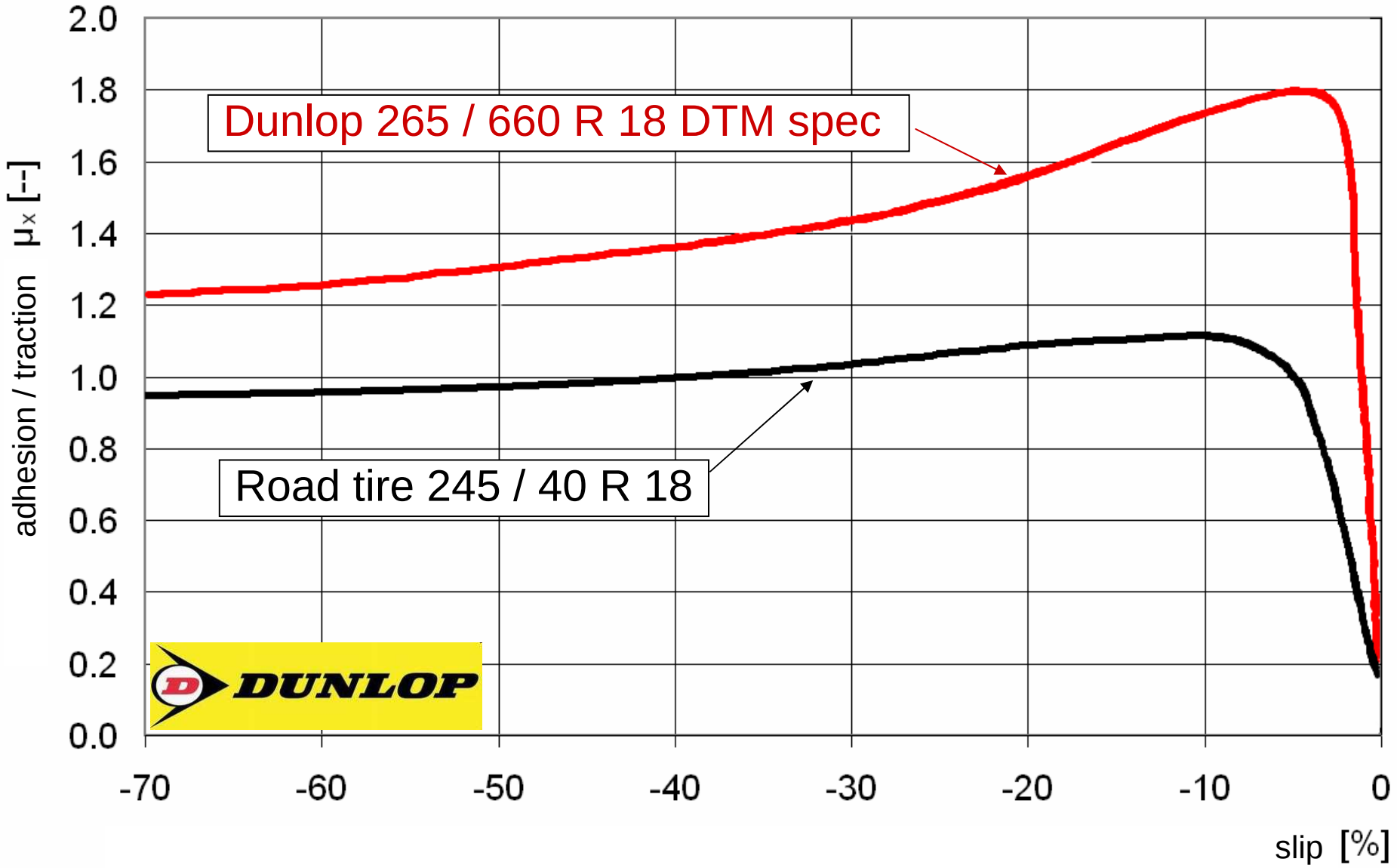
Comparison of µ-slip characteristics on drum (d=2,547m)



ABS Performance after modification

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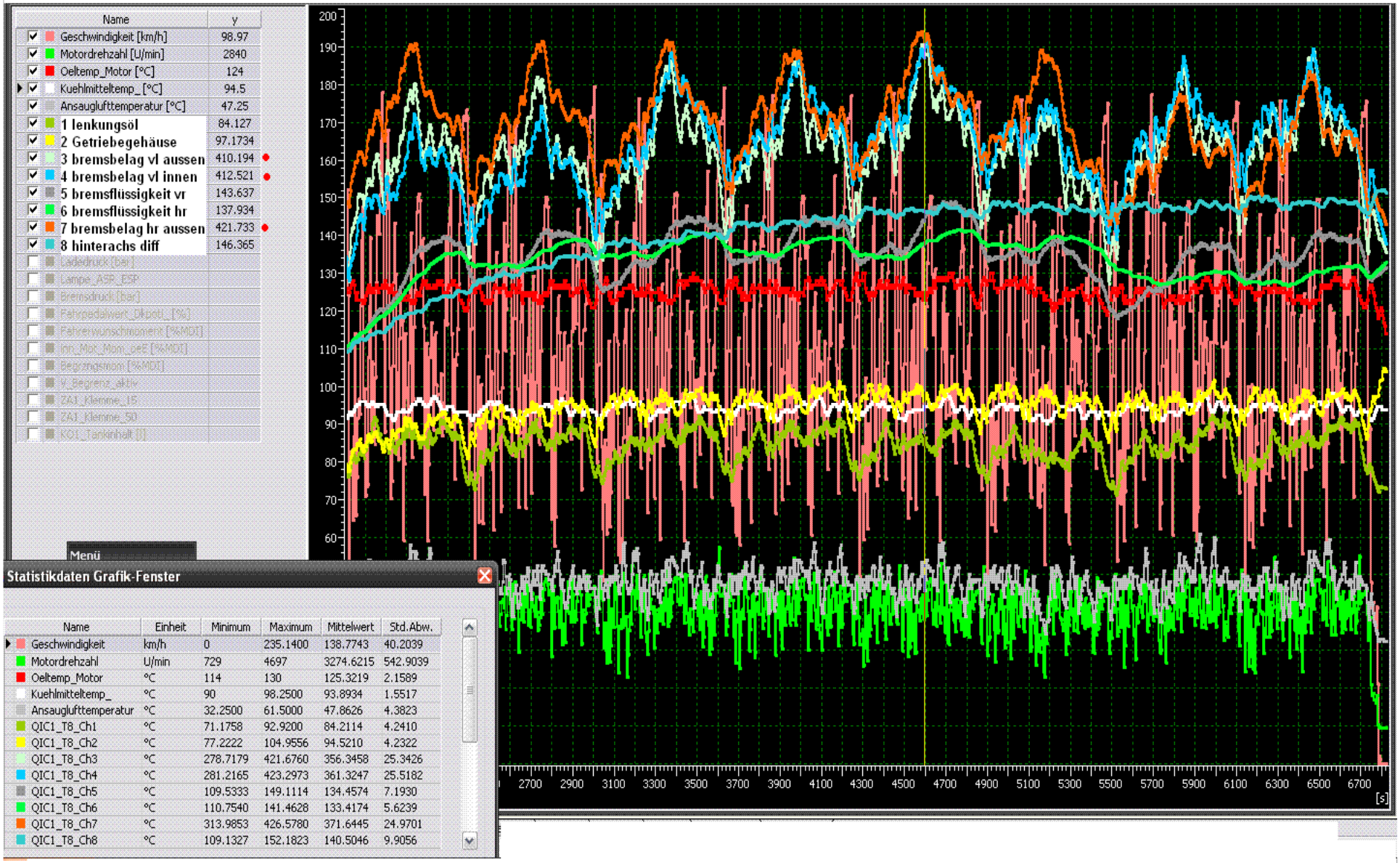
Temperature- and brake balance after modification of abs controller setting



Results of ABS and brake distribution modification:

- Brake balance between front and rear axle is adapted
- Temperature distribution between front and rear axle has been optimized
- Hydraulik pressure hysteresis during abs oparation has been limited (main important for durability)
- Due to the changes of abs parameter setting in addition with modified brake pads from PAGID we reached the durability target of > 3000Km under racing condition
- During 24h race 2011 at Nürburgring no change of brake components has been neccessary

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Using non fossil diesel fuel (HVO) in a race car

Verification of NexBTL (HVO) under reproducable racing conditions

Measurements of the emission behaviour of non fossil fuel compared with currently available diesel fuel

Further development of NExBTL based on gathered data of races

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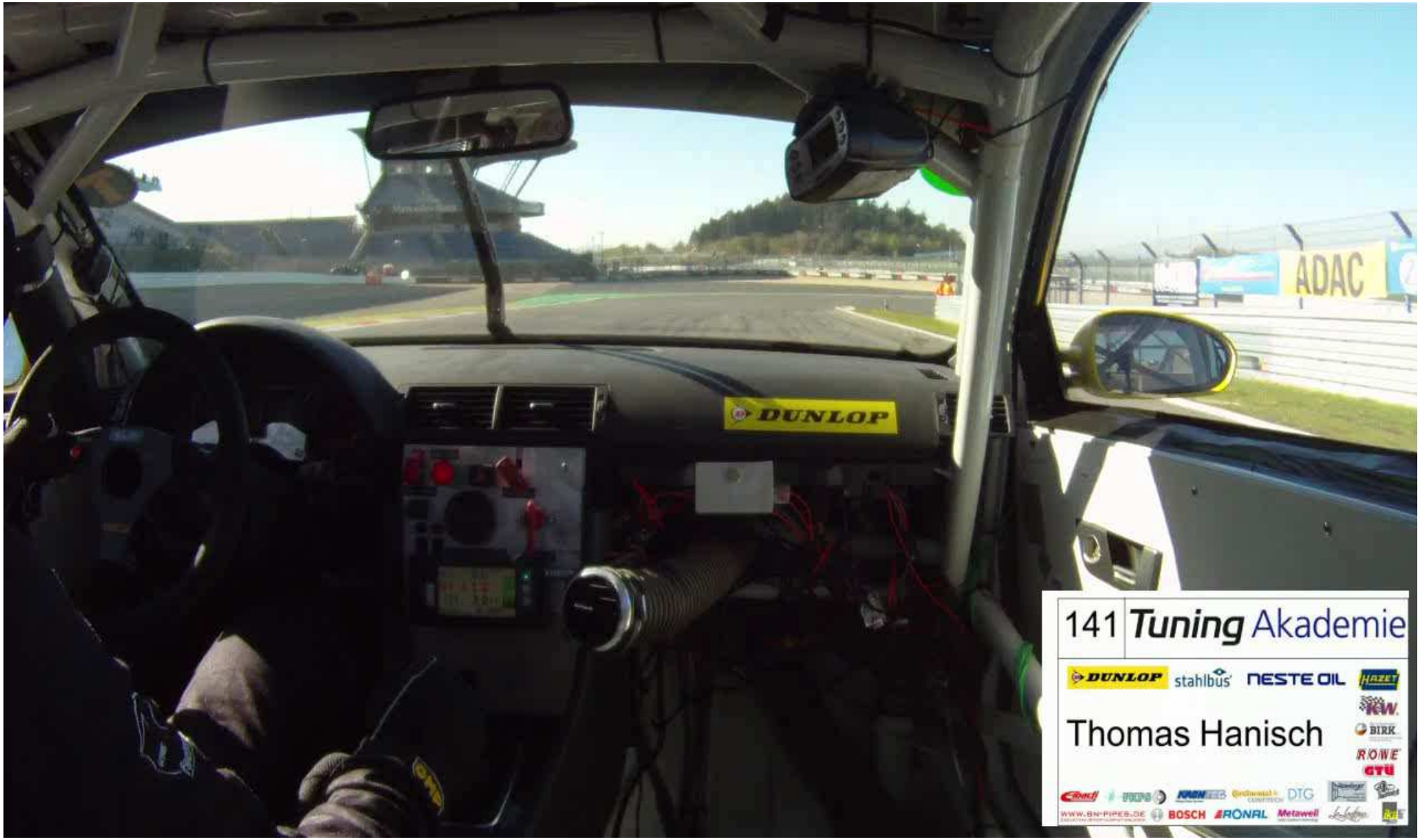
Inboard Video Mercedes-Arena



CANoe Data of Mercedes-Arena

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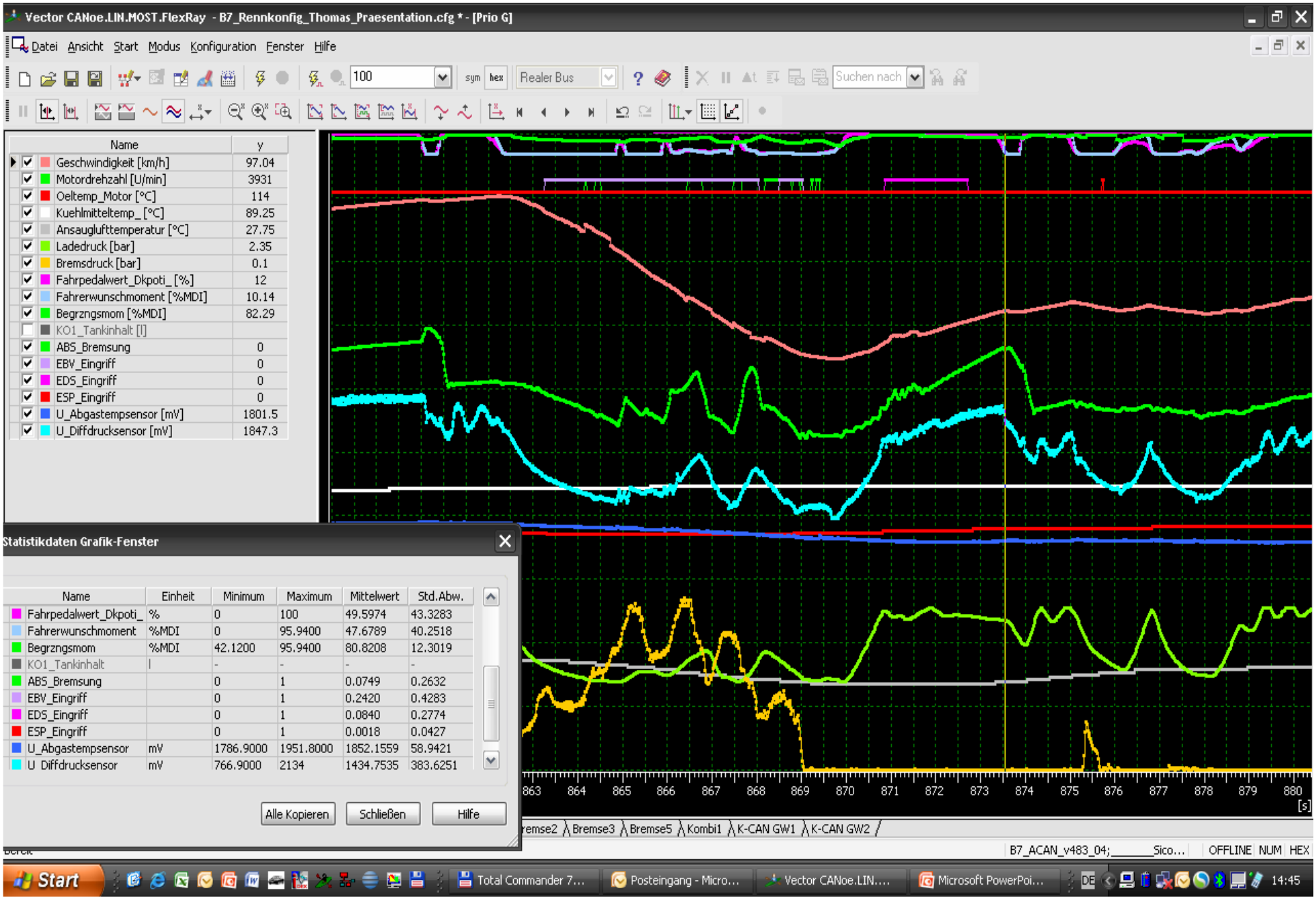

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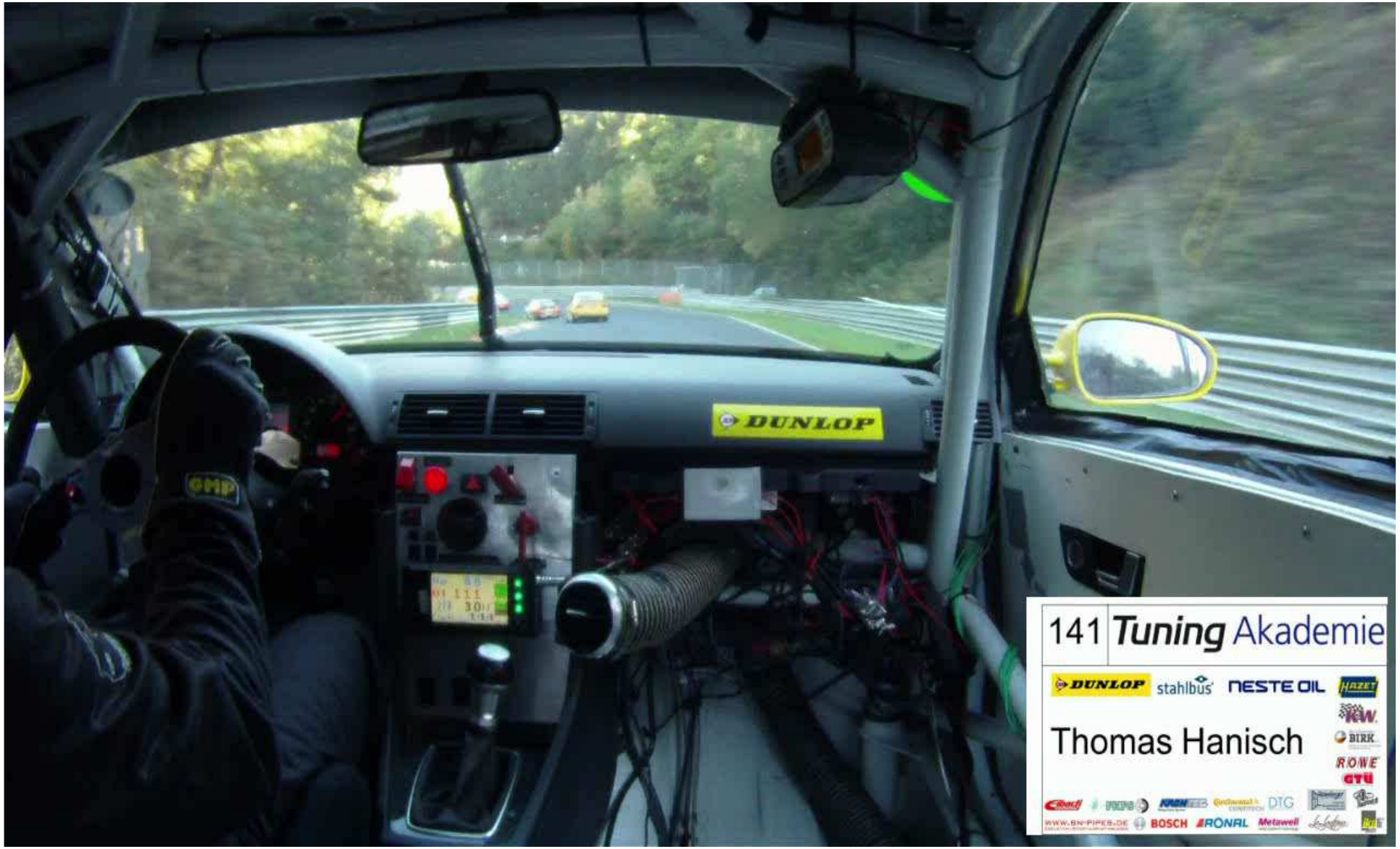
Inboard Video Wehrseifen



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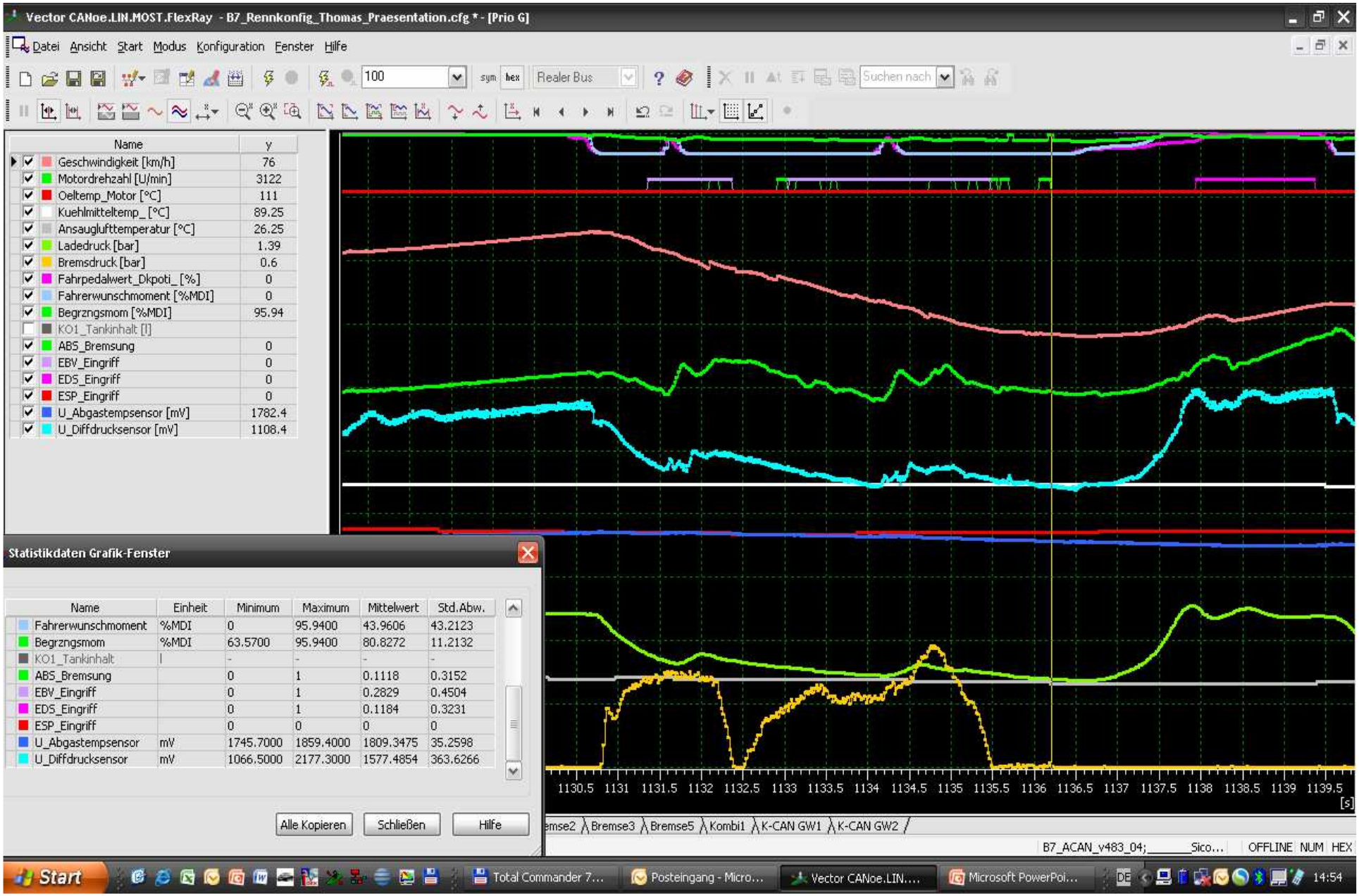
CANoe Data Wehrseifen



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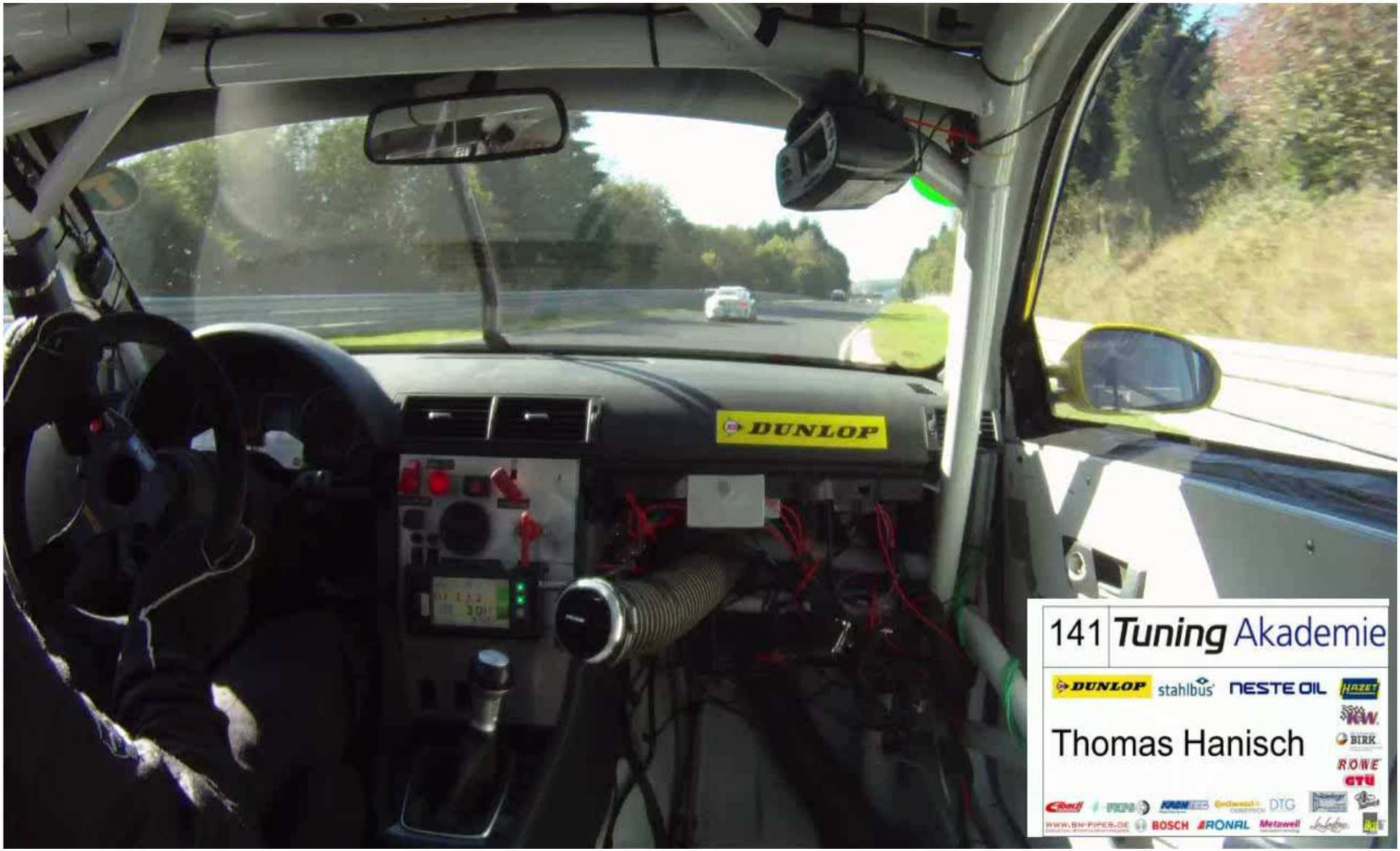
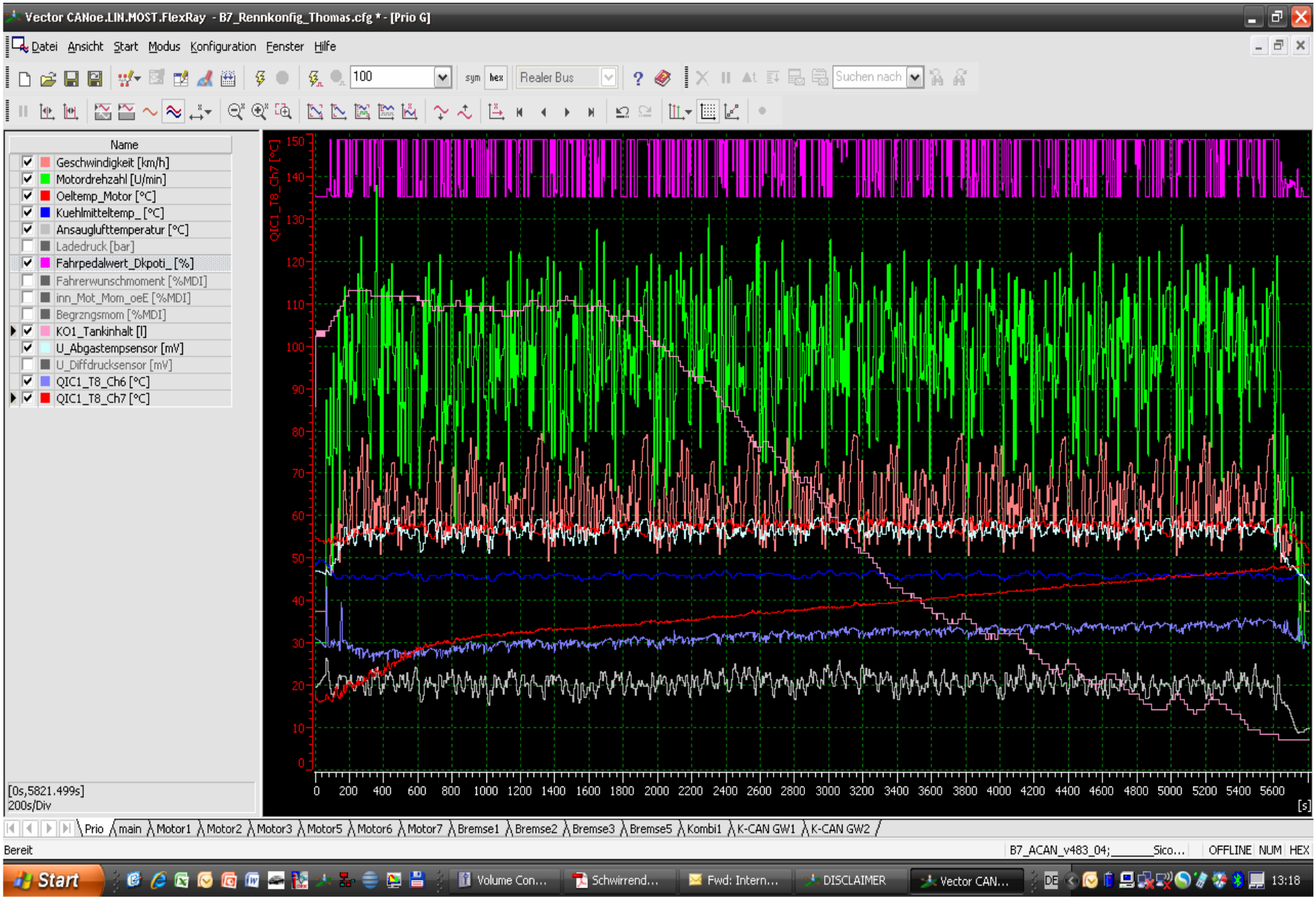
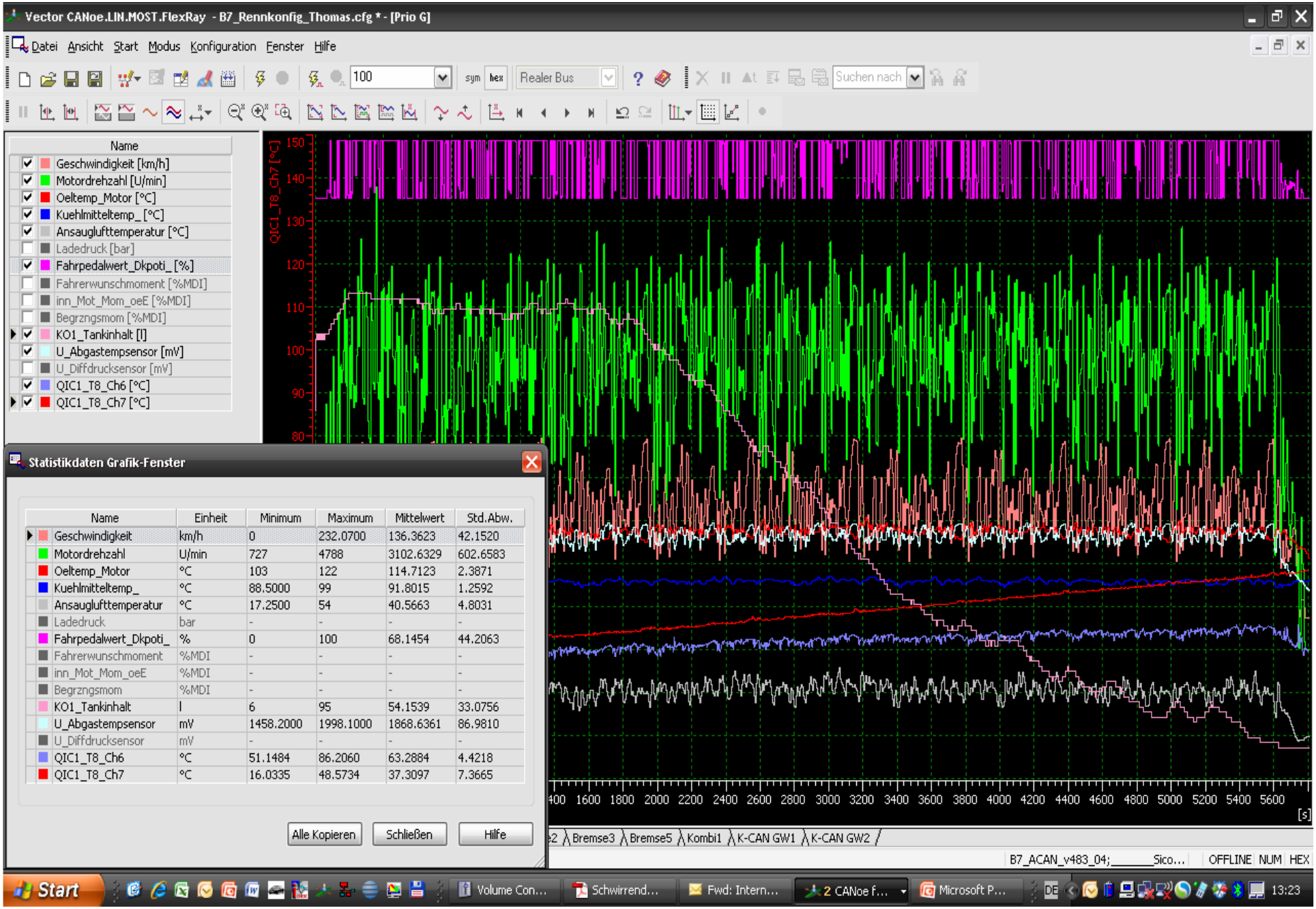
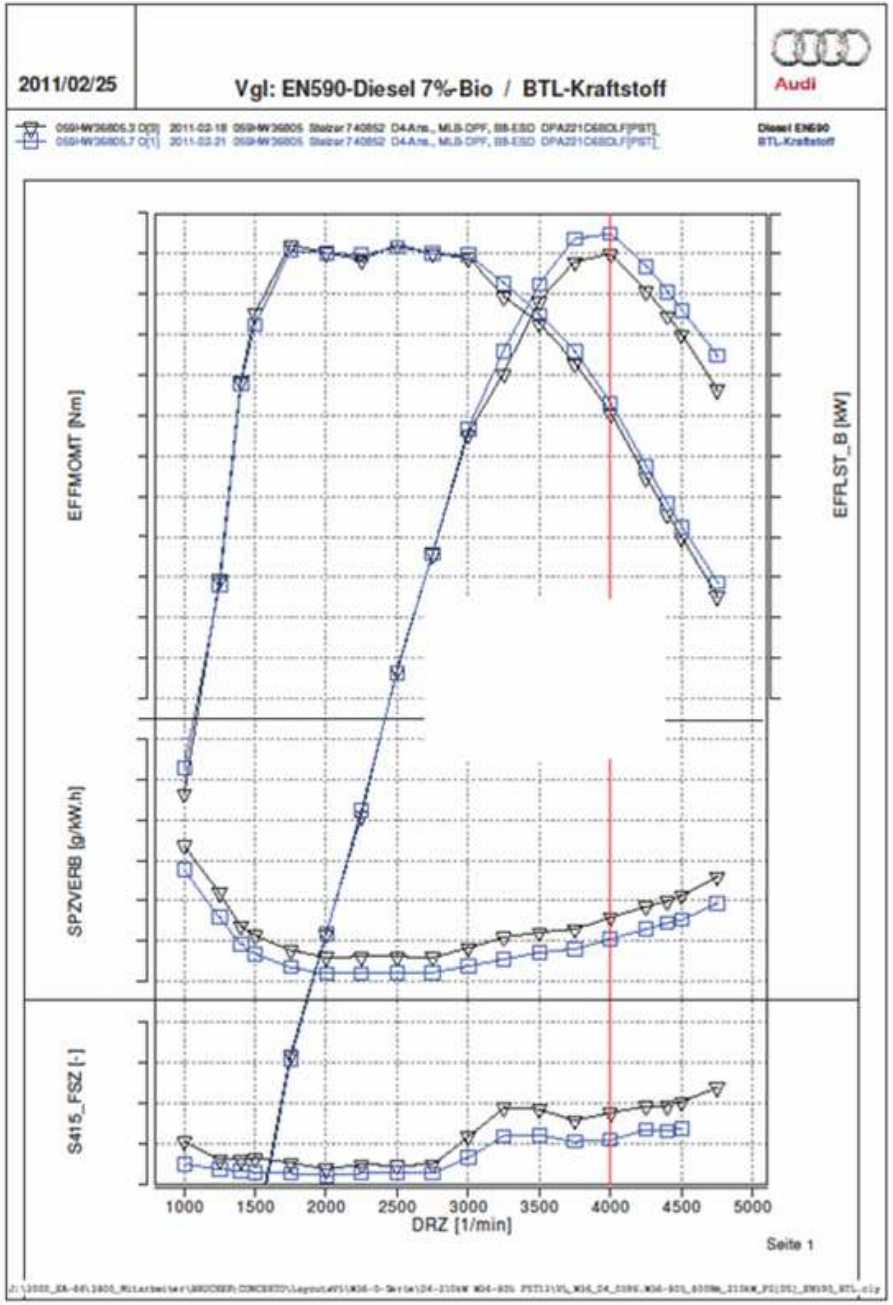
Inboard Video Döttinger Höhe



CANoe Data Döttinger Höhe


Vector CANoe.LIN.MOST.FlexRay - B7_Rennkonfig_Thomas.cfg * - [Prio G]
Datei Ansicht Start Modus Konfiguration Fenster Hilfe
Realer Bus
Suchen nach
Name
Geschwindigkeit [km/h]
Motordrehzahl [U/min]
Oeltemp_Motor [°C]
Kuehlmitteltemp_ [°C]
Ansaugluftemperatur [°C]
Ladedruck [bar]
Fahrpedalwert_Dkpoti_ [%]
Fahrerwunschmoment [%MDI]
inn_Mot_Mom_oeE [%MDI]
Begrzngsmom [%MDI]
KO1_Tankinhalt [l]
U_Abgastempsensor [mV]
U_Diffdrucksensor [mV]
QIC1_T8_Ch6 [°C]
QIC1_T8_Ch7 [°C]
QIC1_T8_Ch7 [°C]
[0s,5821.499s]
200s/Div
[s]
Prio main Motor1 Motor2 Motor3 Motor5 Motor6 Motor7 Bremse1 Bremse2 Bremse3 Bremse5 Kombi1 K-CAN GW1 K-CAN GW2
Bereit
B7_ACAN_v483_04;_____Sico...
OFFLINE NUM HEX
Start
Volume Con...
Schwirrend...
Fwd: Intern...
DISCLAIMER
Vector CAN...
13:18


Vector CANoe.LIN.MOST.FlexRay - B7_Rennkonfig_Thomas.cfg * - [Prio G]
Datei Ansicht Start Modus Konfiguration Fenster Hilfe
Name
Geschwindigkeit [km/h]
Motordrehzahl [U/min]
Oeltemp_Motor [°C]
Kuehlmitteltemp_ [°C]
Ansauglufttemperatur [°C]
Ladedruck [bar]
Fahrpedalwert_Dkpoti_ [%]
Fahrerwunschmoment [%MDI]
inn_Mot_Mom_oeE [%MDI]
Begrzngsmom [%MDI]
KO1_Tankinhalt [l]
U_Abgastempsensor [mV]
U_Diffdrucksensor [mV]
QIC1_T8_Ch6 [°C]
QIC1_T8_Ch7 [°C]
Statistikdaten Grafik-Fenster
Name | Einheit | Minimum | Maximum | Mittelwert | Std.Abw.
Geschwindigkeit | km/h | 0 | 232.0700 | 136.3623 | 42.1520
Motordrehzahl | U/min | 727 | 4788 | 3102.6329 | 602.6583
Oeltemp_Motor | °C | 103 | 122 | 114.7123 | 2.3871
Kuehlmitteltemp_ | °C | 88.5000 | 99 | 91.8015 | 1.2592
Ansauglufttemperatur | °C | 17.2500 | 54 | 40.5663 | 4.8031
Ladedruck | bar | - | - | - | -
Fahrpedalwert_Dkpoti_ | % | 0 | 100 | 68.1454 | 44.2063
Fahrerwunschmoment | %MDI | - | - | - | -
inn_Mot_Mom_oeE | %MDI | - | - | - | -
Begrzngsmom | %MDI | - | - | - | -
KO1_Tankinhalt | l | 6 | 95 | 54.1539 | 33.0756
U_Abgastempsensor | mV | 1458.2000 | 1998.1000 | 1868.6361 | 86.9810
U_Diffdrucksensor | mV | - | - | - | -
QIC1_T8_Ch6 | °C | 51.1484 | 86.2060 | 63.2884 | 4.4218
QIC1_T8_Ch7 | °C | 16.0335 | 48.5734 | 37.3097 | 7.3665
Alle Kopieren
Schließen
Hilfe
Bremse3 Bremse5 Kombi1 K-CAN GW1 K-CAN GW2
OFFLINE NUM HEX
Start
13:23



Analysing results of AUDI test bench:

+ 1,2% increase of torque

+ 1,0% more power

- 1,04% less spezific fuel consumption

- 38% less soot

- all relevant engine and exhaust temperatures are almost on the same level compared to diesel fuel

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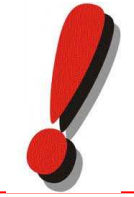
Experiences with HVO after 7000 km under racing conditions:

- **Engine power and torque is slightly higher compared to fossil diesel**
- **No modification of engine ECU is necessary**
- **No problems with decomposing of tubes, pipes and seals have been recognized**
- **Fuel consumption is almost the same**
- **Standard oxykat in addition with HJS diesel particulate filter and HJS additive can be used**
- **The only negative point of using HVO is the entrance fee to use the fuel place for alternative fuels at the Nürburgring.**
  To continue the development and to join the races in 2012 will result in extra costs of 1800 € for each VLN race!



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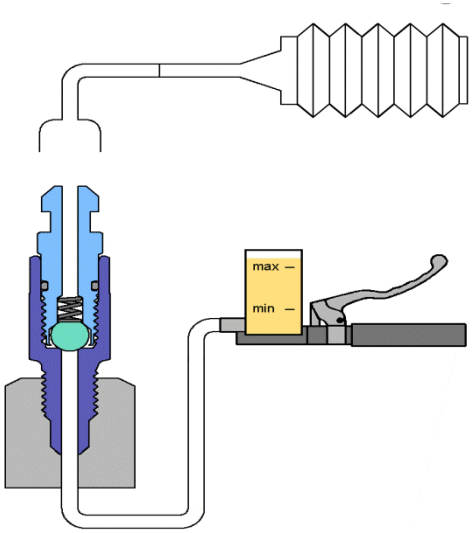
Project Cooperation with stahlbus ROWE maturo

positioning equipment for EMC and wireless testing

Detailed analysis of effects on the passenger car's ABS braking performance due to aged brake fluid

Development of a brake fluid filling system for OEM's and workshops in order to get an completely air evacuated hydraulic brake system



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Thank you very much for your attention

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DUNLOP

ROWE

Kfz-Lackierungen BIRK GmbH
Effekt- und Design-Lackierungen
Unfallinstandsetzung

KW

DTG
Development & Technology

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HAZET

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FKFS

Metawell
metal sandwich technology

BOSCH