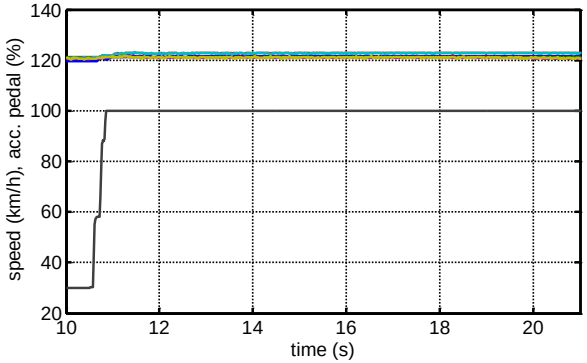
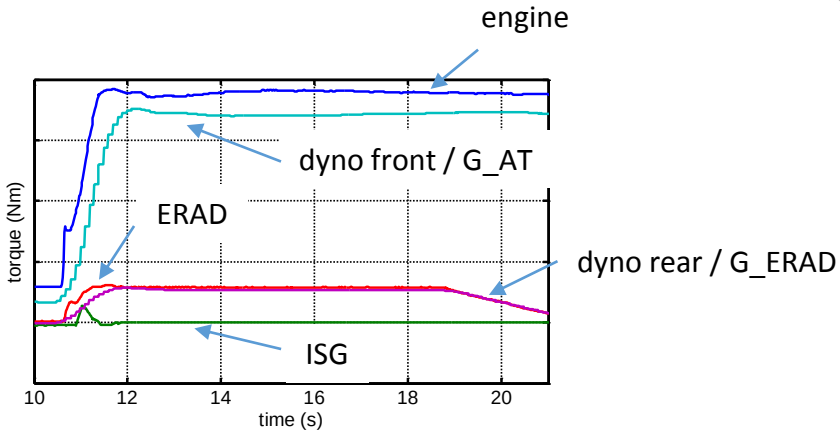
Power determination of hybrid vehicle in line with ISO 20762

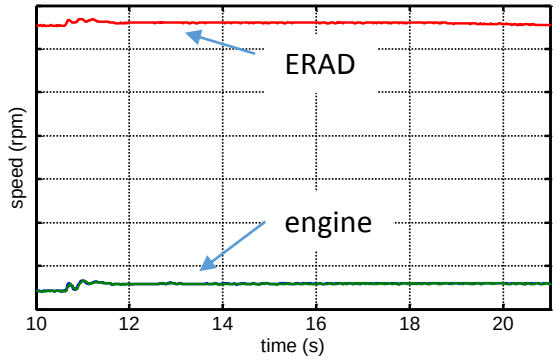
Test performed 2019 week 6 on chassis dyno at Volvo cars.
Test vehicle XC60 T8
Vehicle data logged from on board sensors and models
Dyno traction forces and speed translated to analog signals and logged together with vehicle data.

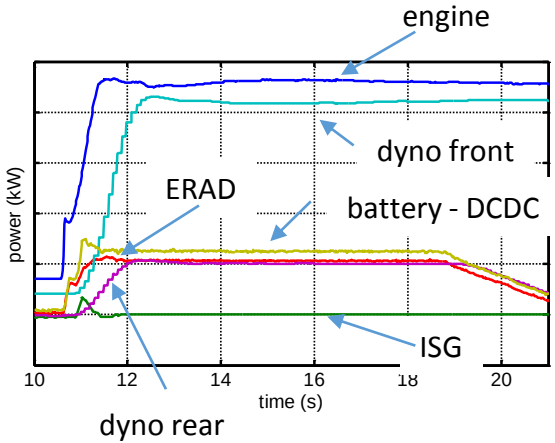
Powertrain configuration:
Turbo charged petrol engine, crank mounted starter generator and 8 speed automatic transmission in front.
Electric motor with fixed gearing in rear.
High voltage battery (plug-in)

Typical 10 s response

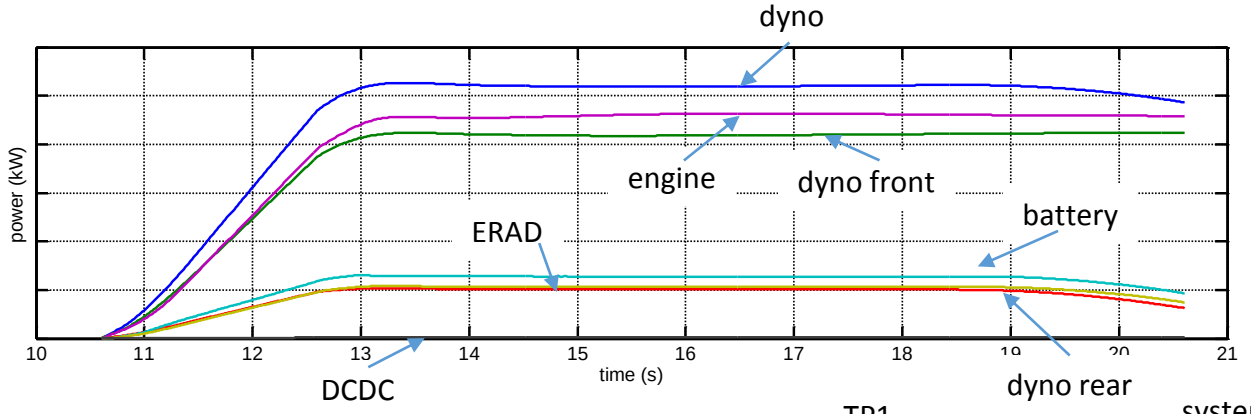


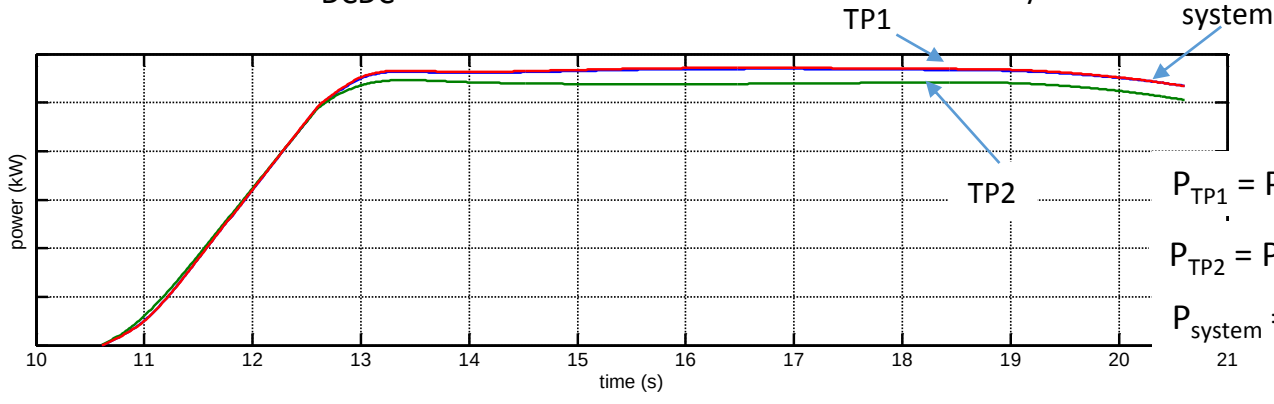






Power with 2 second averaging filter



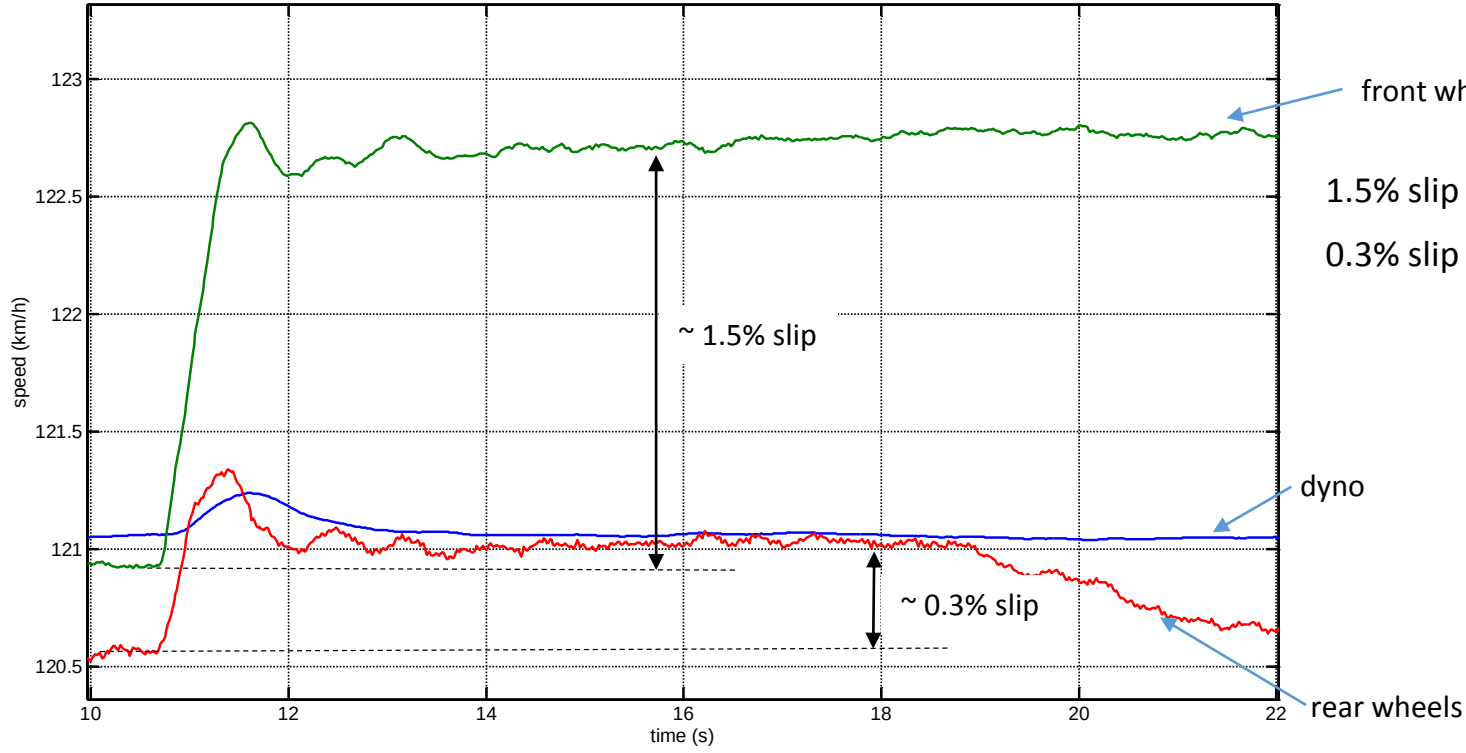


$P_{TP1} = P_{eng} + (P_{bat} - P_{DCDC}) * 0.85$

$P_{TP2} = P_{dyno\_front}/0.96 + P_{dyno\_rear}/0.98$

$P_{system} = P_{eng} + P_{ERAD} + P_{ISG}$

Tire loss estimation



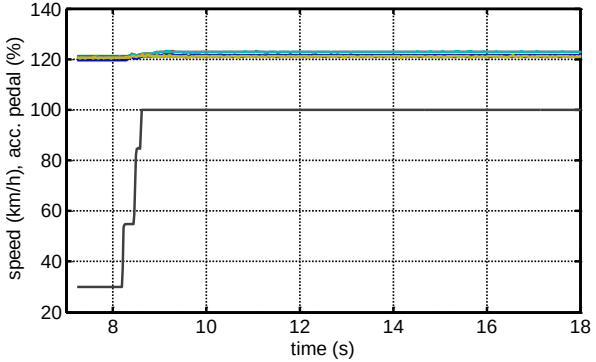
1.5% slip in front ~ 3.2 kW

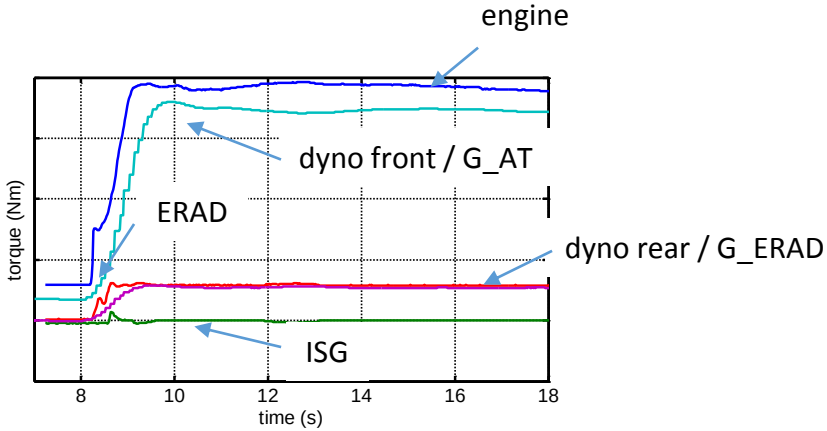
0.3% slip in rear ~ 0.2 kW

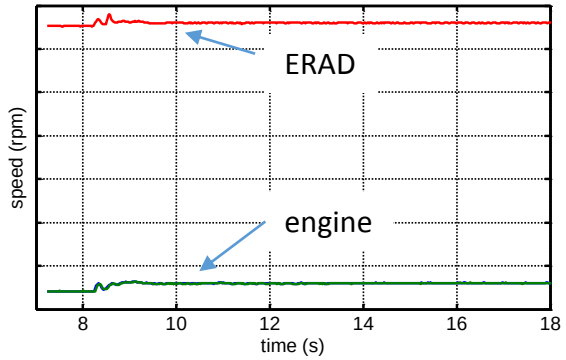
Vehicle weight 2200 kg. Rolling resistance unloaded ~ 7 kW at 120 km/h

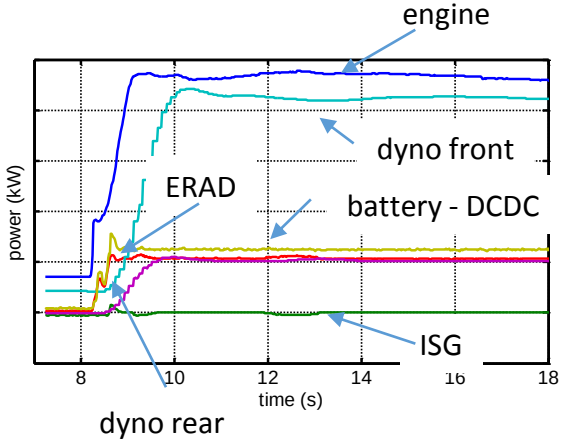
Total tire losses: ~ 10 kW

Typical 10 s response extended engine boost

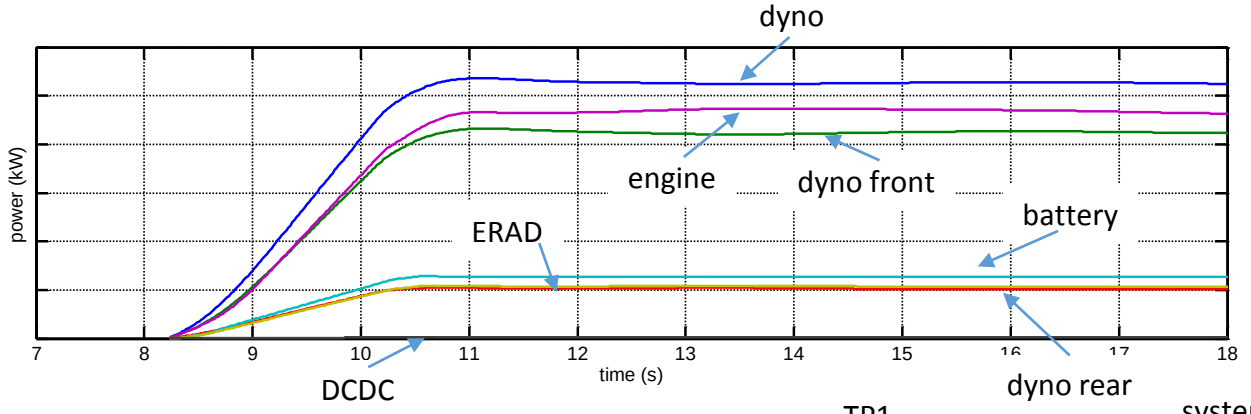


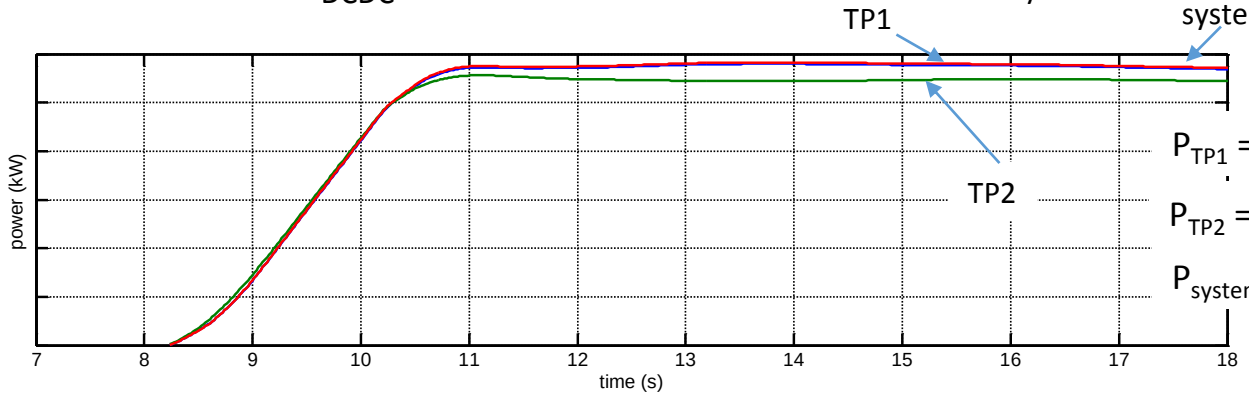






Power with 2 second averaging filter



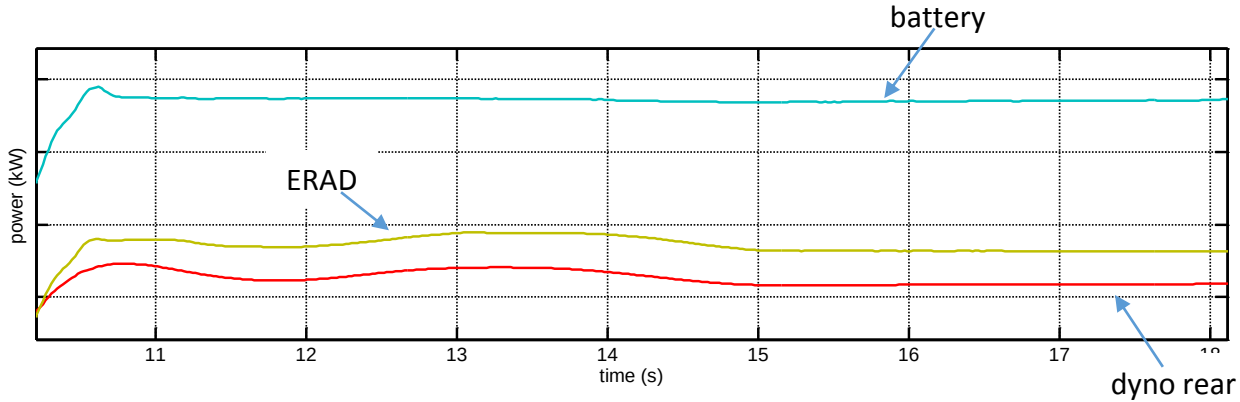


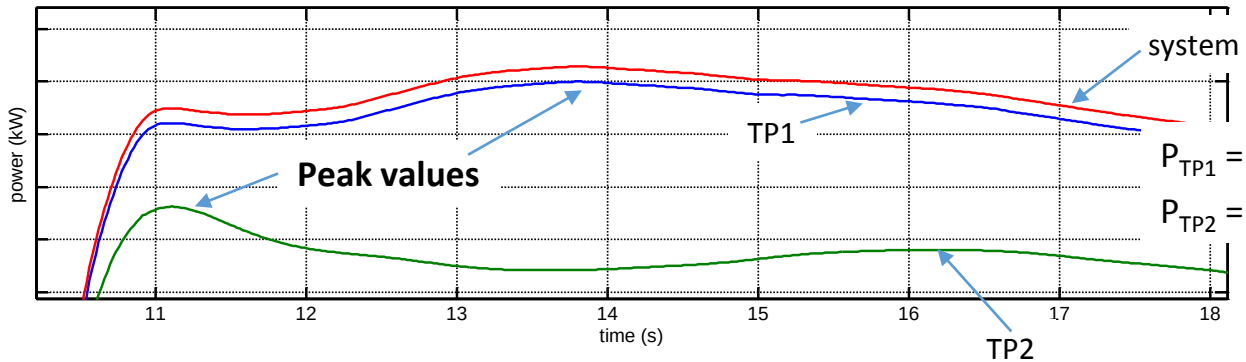
$P_{TP1} = P_{eng} + (P_{bat} - P_{DCDC}) * 0.85$

$P_{TP2} = P_{dyno\_front}/0.96 + P_{dyno\_rear}/0.98$

$P_{system} = P_{eng} + P_{ERAD} + P_{ISG}$

Power with 2 second averaging filter





$P_{TP1} = P_{eng} + (P_{bat} - P_{DCDC}) * 0.85$

$P_{TP2} = P_{dyno\_front}/0.96 + P_{dyno\_rear}/0.98$

Data collected at 121 km/h with extended boost (4 measurements)

		TP1	TP2	TP2 comp.
Peak power				
Average	kW	reference	-11	-1
Min	kW	-1	-14	-4
Max	kW	1	-9	1
Sustained power				
Average	kW	-6	-18	-8
Min	kW	-8	-20	-10
Max	kW	-4	-17	-7

Summary

- No issues running at high power (3:rd gear) on dyno
- Avoiding shifting during test is a concern.
- Power evaluated according to TP1 and TP2 has different dynamic behavior. Risk of inconsistent evaluation of peak power.
- Tire losses estimated to 10 kW.
- TP1 and TP2 similar result with compensation for tire losses (coincidence?)
- Sustained power(10 s) preferred for robustness. Initial transient may give unpredictable result on peak power (e.g. influence of dyno control).
- Method needs to incorporate estimation of tire losses if testing without torque measurements on wheels or drive shafts.
- ISO standard applies general assumptions on system efficiencies. Guidance on how to measure more appropriate efficiencies needed to get result on par with currently used rig measurements of motors.