Preliminary: 148Vdc battery operated asynchronous motor, water cooled. October 14th 2013

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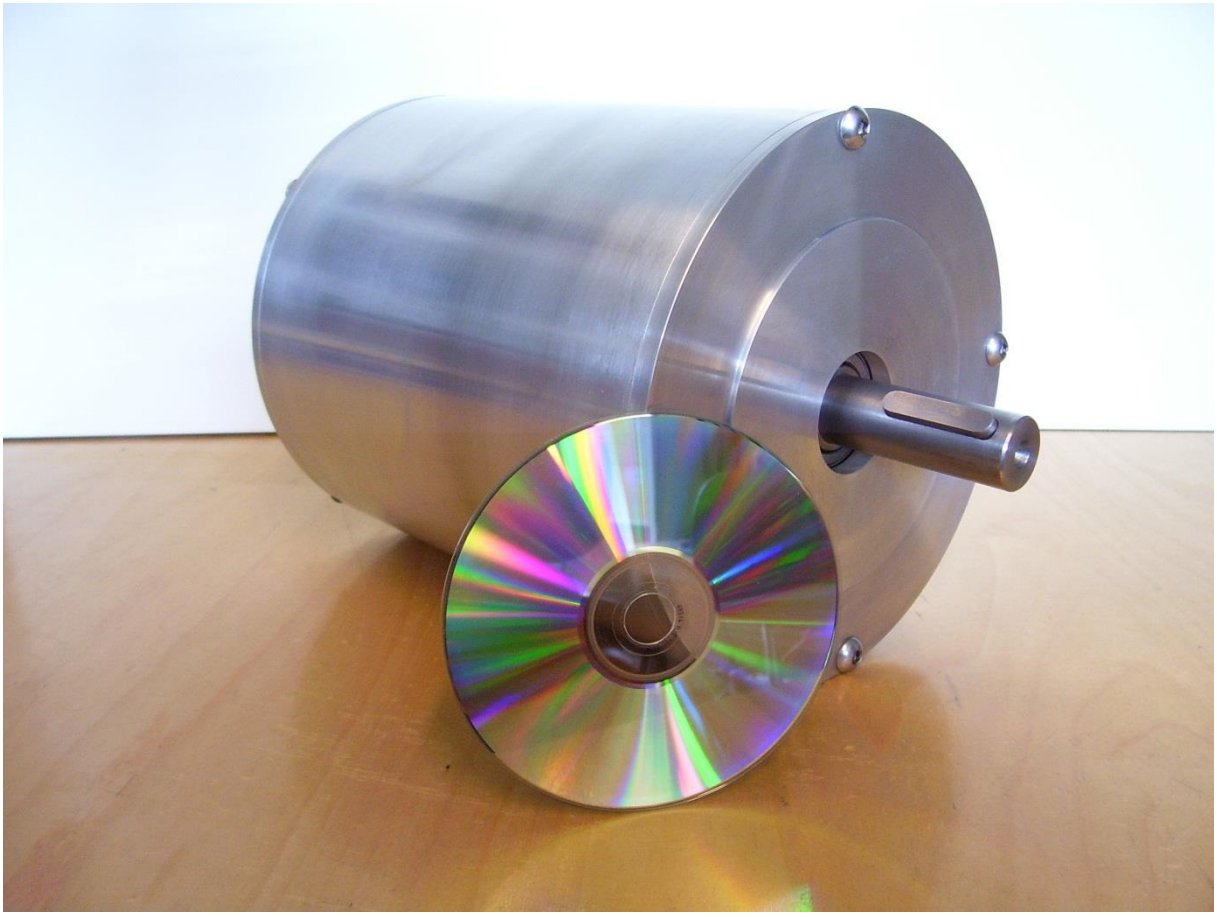
148Vdc battery and commercial forklift motor drive operated asynchronous motor, water cooled



Weight [kg]	31
Overall lenght (incl terminals, ex shaft) [mm]	285
Diameter [mm]	200
Shaft	Customer specific (test rig: 24mm)
Number of poles	4
Rotor construction	Copper, asynchronous
Temperature class motor construction	H
Insulation class	>1000Vdc
Temperature class use, nominal operation	A
Cooling system	water
Speed nominal / max [rpm]	7800 / 15000

On May 5th, 2012 the motor had been put on our test rig. A set up had been made, where two motors were spinning together on one shaft. One motor acts as motor and one as generator / brake. Both motors were fed by a commercial available inverter with following specs:

Max. phase current [A rms]	440
Max. phase voltage [V rms]	98
Switching frequency [kHz]	8.3
Battery voltage applied [Vdc]	140
EMI prevention measurements	PWM with high rise and fall times in pulses
Efficiency in drive mode [%]	Moderate (75-98)
Efficiency in generator mode [%]	Low (<75, due to commercial choice pulse form)

This inverter is a very low cost version and is used in low speed indoor and outdoor vehicles. So the developed efficiency curves are conservative in the given 3D plot. Moreover, the field of operation of the motor will be larger than the currently tested one. The commercial inverter is now the limit in both current and voltage.

This is the reason that the plot is now limited to:

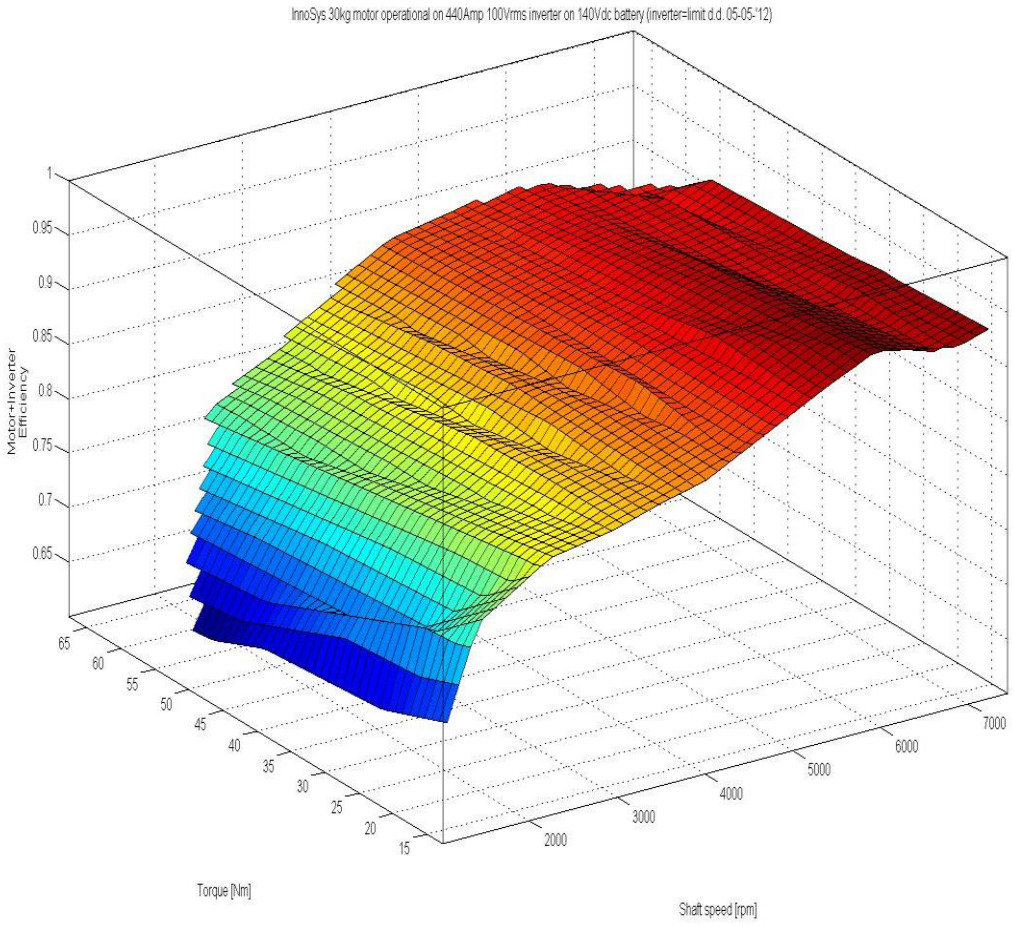
Max torque [Nm]	67
Nominal speed [rpm]	7500
Nominal shaft power [kW]	27
Peak shaft power [kW / HP]	52 / 70
Peak phase voltage [Vrms]	100
Peak phase current [Arms]	440
Battery voltage max [Vdc]	140

The operation on our MosFet inverter will be:

Max torque [Nm]	75
Nominal speed [rpm]	7800
Nominal shaft power [kW]	32
Peak shaft power [kW / HP]	60 / 80
Peak phase voltage [Vrms]	120
Peak phase current [Arms]	500
Battery voltage max [Vdc]	164

The motor has been plotted for drive mode. Generation efficiencies are to be considered similar.

The plot that has been extracted from all the measurement data is given in the figure below:



It can be seen that at nominal rpm (5000-7500rpm) system efficiency is between 91% and 94%, despite the commercial inverter. Due to the switching algorithm in the inverter both motor and especially inverter still produce substantial heat. This can be reduced when the switching algorithm in the new inverter is applied. System efficiencies are expected to be 0,5 to 1% higher in that case.

The low rpm regions lie between 65 and 80% efficiency. Here the motor is of course of more influence in the efficiency. It was noticed that the inverter had difficulties to produce its maximum current in these regions. So measurements in these regions can be considered on the conservative side, with regard to efficiency.