**Forced air cooling (Tbatt):**

T\_{Batt}\ =\ \frac{I^2R}{hA}+T\_A

**Forced air cooling (i):**

I\ =\ \sqrt{\frac{\left(T\_{Batt}-T\_A\right)\cdot h\cdot A}{R}}

**Forced air cooling (h):**

h\ =\ \frac{I^2R}{\left(T\_{Batt}-T\_A\right)\cdot A}

**Battery Pack Energy**

E\_{Batt}=N\_p\cdot N\_s\cdot E\_{Cell}

**Electric Torque – Pg 421**

\ T\_E\ =\ \frac{3}{2}n\_p\left(L\_d-L\_q\right)i\_di\_q+\frac{3}{2}n\_p\lambda \_fi\_q

**Modulation Ratio**

V\_{\text {line }[\mathrm{RMS}]}=220 \mathrm{~V}  
V\_{\text {line [peak] }}=220 \sqrt{2}=311 \mathrm{~V}  
V\_{\text {phase }[\text { peak] }}=311 / \sqrt{3}=180 \mathrm{~V}  
M\_{\mathrm{SPWM}}=\frac{V\_{\text {phase [peak] }}}{V\_{d c} / 2}=\frac{180}{200}=0.9  
M\_{\mathrm{SVM}}=\frac{V\_{\text {line [peak] }}}{V\_{\text {dc }}}=\frac{311}{400}=0.78

**Phase voltage**

\omega\_{\max }=6000 \mathrm{RPM}=6000 / 60 \* 2 \pi \mathrm{rad} / \mathrm{s}=628 \mathrm{rad} / \mathrm{s}

T\_E @ \omega\_{\max }=P @ \omega\_{\max } / \omega\_{\max }=100000 / 628=159 \mathrm{~N} \cdot \mathrm{m}

\lambda\_f=K\_e=0.033 \mathrm{~V} / \mathrm{RPM}=0.033^\* 60 / 2 \pi=0.318 \mathrm{~V} \cdot \mathrm{s} / \mathrm{rad}

T\_E=\frac{3}{2} n\_p \lambda\_f i\_q \Rightarrow i\_q=\frac{2 T\_E}{3 n\_p \lambda\_f}=\frac{2 \* 159}{3^\* 0.318}=333 \mathrm{~A}

i\_{\text {phase [peak] }}=i\_q=333 \mathrm{~A}, i\_{\text {phase }[\mathrm{RMS}]}=333 / \sqrt{2}=235 \mathrm{~A}

v\_d=-\omega\_r L\_q i\_q=-628 \* 100^\* 10^{-6 \*} 333=-20.9 \mathrm{~V}

v\_q=\omega\_r \lambda\_f=628^\* 0.318=200 \mathrm{~V}

v\_{\text {phase [peak] }}=\sqrt{v\_d^2+v\_q^2}=201 \mathrm{~V}

v\_{\text {line }[\mathrm{RMS}]}=\sqrt{3 / 2} v\_{\text {phase [peak] }}=246 \mathrm{~V}

**Vd and Vq**

V\_d=i\_dR\_s-\omega \_{\max }L\_qi\_q

V\_q\ =i\_qR\_s+\omega \_{\max }L\_di\_d+\omega \_{\max }\lambda \_f