

LIST OF SYMBOLS AND ABBREVIATIONS

l_m	:	Length of magnet
L	:	Core length of generator
L_i	:	Iron core length
l_{sy}	:	Stator yoke length
l_{ry}	:	Rotor yoke length
μ_{fe}	:	Rotor yoke length
μ_o	:	$4\pi * 10^{-7}$
H_{pm}	:	Height of magnet
g	:	Airgap length
g_{eff}	:	Effective airgap length
r_s	:	Mean stator radius
r_r	:	Mean rotor radius
θ_p	:	Angular pole pitch
w_s	:	Slot width
t_s	:	Slot pitch
N_{ph}	:	Per phase number of turns
f	:	Frequency
θ_e	:	Electrical angle
β	:	Half of pole arc electrical angle
h	:	Space harmonic
k	:	Time harmonic
P'	:	Pole pair
A_{gi}, A_{go}	:	Area of airgap - inner, outer
A_{pmi}, A_{pmo}	:	Area of permanent magnet - inner, outer
μ_{pm}	:	Permeability of magnet
w_e	:	Electrical angular speed
w_m	:	Mechanical angular speed
R_{sh_nc}	:	Natural Convective thermal resistance of shaft to the Environment
R_{sh}	:	Conductive thermal resistance of shaft

R_{ryu}, R_{ryl}	:	Conductive thermal resistance of upper and lower part of rotoryoke
R_{pmu}, R_{pml}	:	Conductive thermal resistance of upper and lower part of PM
R_{pm_air}	:	Conductive thermal resistance of air between the two magnets
R_{air}	:	Conductive thermal resistance of air
R_{ar_nc}	:	Convective thermal resistance between rotor to air
R_{sw}	:	Conductive thermal resistance between the winding and core
R_{sti}, R_{stu}	:	Conductive thermal resistance of lower and upper part of tooth
R_{syl}, R_{syu}	:	Conductive thermal resistance of lower and upper part of stator yoke
R_{sy_nc}	:	Convective thermal resistance between stator yoke to environment
C_{ry}	:	Thermal capacitance of rotor yoke
C_{pm}	:	Thermal capacitance of permanent magnet
C_{cu}	:	Thermal capacitance of Copper winding
C_{st}	:	Thermal capacitance of stator tooth
C_{sy}	:	Thermal capacitance of stator yoke
P_{cu}	:	Power loss in copper winding
P_{pm}	:	Power loss in permanent magnet
P_{sy}	:	Power loss in stator yoke
P_{st}	:	Power loss in stator tooth
P_{ry}	:	Power loss in rotor yoke
T_a	:	Ambient temperature (30°C)
R_{sh_nc}	:	Natural Convective thermal resistance between shaft to environment
R_{sh}	:	Conductive thermal resistance of shaft
R_{sh_r}	:	Radiation thermal resistance from the shaft to the environment
R_{syiu}, R_{syil}	:	Conductive thermal resistance of the radially upper and lower part of inner stator yoke
R_{syiL}, R_{syiR}	:	Conductive thermal resistance of axially left and right side of the inner stator yoke
R_{syi_nc}	:	Natural Convective thermal resistance between inner stator yoke to the environment
R_{syi_r}	:	Radiation thermal resistance from the inner stator yoke to the environment

R_{stiu}, R_{stil}	:	Conductive thermal resistance of the radially upper and lower part of inner stator tooth
R_{stiL}, R_{stiR}	:	Conductive thermal resistance of the axially left and right side of the inner stator tooth
R_{sti_nc}	:	Natural Convective thermal resistance between inner stator tooth to the environment
R_{sti_r}	:	Radiation thermal resistance from the inner stator tooth to the environment
R_{ag_sti}	:	Conductive thermal resistance between inner air and inner stator tooth
R_{st_wi}	:	Conductive thermal resistance between inner stator tooth and inner stator winding
R_{stpmi_r}	:	Radiation thermal resistance from the inner stator tooth to the environment
R_{stpmi_c}	:	Convective thermal resistance between inner stator tooth and inner permanent magnet
R_{sw_syi}	:	Conductive thermal resistance between inner stator winding and inner stator yoke
R_{ag_swi}	:	Conductive thermal resistance between inner stator winding and inner airgap
R_{sw_ui}, R_{sw_li}	:	Conductive thermal resistance of the radially upper and lower part of inner stator winding
R_{swiL}	:	Conductive thermal resistance of the axially left side of the inner stator winding
R_{sewiL}, R_{sewiR}	:	Conductive thermal resistance of the axially left and right side of the inner stator end winding
R_{sewi_r}	:	Radiation thermal resistance from the inner stator end winding to the environment
R_{sewi_nc}	:	Convective thermal resistance between inner stator end winding to the environment
R_{pmiu}, R_{pmil}	:	Conductive thermal resistance of the radially upper and lower part of inner PM

R_{pmiL}, R_{pmiR}	:	Conductive thermal resistance of the axially left and right side of the inner PM
R_{pmi_r}	:	Radiation thermal resistance from the inner PM to the environment
$R_{pmi_{nc}}$:	Convective thermal resistance between inner PM to the environment
$R_{pm_{agi}}$:	Conductive thermal resistance between inner PM and inner air
R_{ryu}, R_{ryl}	:	Conductive thermal resistance of the radially upper and lower part of rotor yoke
R_{ryL}, R_{ryR}	:	Conductive thermal resistance of the axially left and right side of the rotor yoke
R_{ry_r}	:	Radiation thermal resistance from the rotor yoke to the environment
$R_{ry_{nc}}$:	Convective thermal resistance between of the rotor yoke to the environment
$R_{ry_{agi}}$:	Conductive thermal resistance between rotor yoke and inner air
R_{pmou}, R_{pmol}	:	Conductive thermal resistance of the radially upper and lower part of outer PM
R_{pmoL}, R_{pmoR}	:	Conductive thermal resistance of the axially left and right side of the outer PM
R_{pmo_r}	:	Radiation thermal resistance from the outer PM to the environment
$R_{pmo_{nc}}$:	Convective thermal resistance between outer PM to the environment
$R_{pm_{ago}}$:	Conductive thermal resistance between outer PM and outer air
$R_{ag_{sto}}$:	Conductive thermal resistance between outer air and outer stator tooth
$R_{st_{wo}}$:	Conductive thermal resistance between outer stator tooth and outer stator winding
R_{stpmo_r}	:	Radiation thermal resistance from the outer stator tooth to the outer PM
R_{stpmo_c}	:	Convective thermal resistance between outer stator tooth and outer permanent magnet
$R_{sw_{syo}}$:	Conductive thermal resistance between outer stator winding and outer stator yoke
$R_{ag_{swo}}$:	Conductive thermal resistance between outer stator winding and outer airgap
$R_{sw_{uo}}, R_{sw_{lo}}$:	Conductive thermal resistance of the radially upper and lower part of

		outer stator winding
R_{swoL}	:	Conductive thermal resistance of the axially left side of the outer stator winding
R_{sewoL}, R_{sewoR}	:	Conductive thermal resistance of the axially left and right side of the outer stator end winding
R_{sewo_r}	:	Radiation thermal resistance from the outer stator end winding to the environment
$R_{sewo_{nc}}$:	Convective thermal resistance between outer stator end winding to the environment
R_{stou}, R_{stol}	:	Conductive thermal resistance of the radially upper and lower part of outer stator tooth
R_{stoL}, R_{stoR}	:	Conductive thermal resistance of the axially left and right side of the outer stator tooth
$R_{sto_{nc}}$:	Natural Convective thermal resistance of outer stator tooth to the environment
R_{sto_r}	:	Radiation thermal resistance from the outer stator tooth to the environment
R_{syou}, R_{syol}	:	Conductive thermal resistance of the radially upper and lower part of outer stator yoke
R_{syoL}, R_{syoR}	:	Conductive thermal resistance of the axially left and right side of the outer stator yoke
$R_{syo_{anc}}$:	Natural Convective thermal resistance between outer stator yoke along axial length to the environment
$R_{syo_{ar}}$:	Radiation thermal resistance from the outer stator yoke along axial length to the environment
$R_{syo_{nc}}$:	Natural Convective thermal resistance between outer stator yoke to the environment
R_{syo_r}	:	Radiation thermal resistance from the outer stator yoke to the environment
C_{syi}	:	Thermal capacitance of inner stator yoke
C_{sti}	:	Thermal capacitance of inner stator tooth

C_{sewi}	:	Thermal capacitance of inner stator end winding
C_{cui}	:	Thermal capacitance of inner stator winding
C_{pmi}	:	Thermal capacitance of inner PM
C_{ryi}	:	Thermal capacitance of rotor yoke
C_{pmo}	:	Thermal capacitance of outer PM
C_{sewo}	:	Thermal capacitance of outer stator end winding
C_{cuo}	:	Thermal capacitance of outer stator winding
C_{sto}	:	Thermal capacitance of outer stator tooth
C_{syo}	:	Thermal capacitance of outer stator yoke
P_{syi}	:	Power loss in inner stator yoke
P_{sti}	:	Power loss in inner stator tooth
P_{sewi}	:	Power loss in inner stator end winding
P_{cui}	:	Power loss in inner stator winding
P_{pmi}	:	Power loss in inner PM
P_{ryi}	:	Power loss in rotor yoke
P_{pmo}	:	Power loss in outer PM
P_{sewo}	:	Power loss in outer stator end winding
P_{cuo}	:	Power loss in outer stator winding
P_{sto}	:	Power loss in outer stator tooth
P_{syo}	:	Power loss in outer stator yoke