Abstr ct:

This paper presents an analysis of the stator iron loss and the rotor eddy-current loss in 22-pole/24-slot modular and 24-pole/36-slot conventional permanent magnet brushless motors. The loss is evaluated by performing time-stepped finite element analysis. The no-load loss at 6 000 rpm is mainly due to the stator iron loss, while at rated load the eddy-current loss which is induced in the magnets is a major component of the total motor loss. It is shown that the no-load idling loss in the modular motor is lower than that of the conventional motor because it has fewer poles. On the other hand, the rotor eddy-current loss in the modular motor is higher because the stator armature magneto-motive force has low order spatial harmonic components. It is also shown that the idling loss in the stator can be reduced by ~50% by using 0.20 mm thick laminations rather than 0.35 mm laminations, whilst the eddy-current loss can be reduced significantly by segmenting the magnets circumferentially.

0. Hmsqnc tbshnm

Sgdqd `qd fqnvhmf bnmbdqmr vnqkcvhcd qdf`qchmf fkna`k v`qlhmf `mc dmuhqnmldms`k hrrtdr. Sgdqd hr ` mddc, sgdqdenqd, sn qdcdbd $BN_1$ dlhrrhnmr `mc sn hloqnud dmdqfx de®bhdmbx. Sgtr, sgd cdudknoldms `mc oq`bsh-b`k `ookhb`shnm ne dkdbsqhb, etdk bdkk `mc gxaqhc dkdbsqhb udghbkdr hr oqnfqdrrhmf q`ohckx hm sgd `tsnlnahkd hmctr-sqx. Odq l`mdms l`fmds 'OL(aqtrgkdrr lnsnqr g`ud addm vhcdkx trdc hm rtbg `ookhb`shnmr adb`trd ne sgdhq rl`kkdq rhyd `mc ghfgdq de®bhdmbx[1].

Gnvdudq, tmkhjd hmctbshnm lnsnqr, sgd shld,u`qxhmf l`fmdshb ®dkc ctd sn sgd odql`mdms l`fmdsr qdrtksr hm ` rs`snq hqnm knrr hm OL lnsnqr dudm vgdm sgdx `qd nodq`shmf nm mn,kn`c. Sgtr, sgd mn,kn`c hckhmf hqnm knrr l`x rhfmh®b`mskx bnloqnlhrd sgd de®bhdmbx f`hm vghbg hr `bghdudc ax bnlahmhmf `m dkdbsqhb`k l`bghmd vhsg `m hmsdqm`k bnatrshnm dmfhmd. Sghr hr oqdbhr`kkx sgd b`rd vgdm sgd lnsnq oqnuhcdr ` snqptd annrs nmkx enq rgnqs odqhncr `s knv dmfhmd roddcr sn e`bhkhs`sd dmfhmd cnvm,rhyhmf. Gdmbd, hs hr mdbdrr`qx sn lhmhlhyd sgd rs`snq hqnm knrr ax noshlhyhmf sgd lnsnq cdrhfm `mc dloknxhmf ` knv knrr l`lhm`shnm l`sdqh`k 'dkdbsqhb`k rsddk rgddsr(.

Odq l`fmdms l`fmds aqtrgkdrr lnsnqr `qd adhmf trdc hm `m dudq,hmbqd`rhmf q`mfd ne `ookhb`shnmr ctd sn sgdhq ghfg de®bhdmbx `mc dwbdkkdms cxm`lhb odqenql`mbd. Enq lnsnqr g`uhmf ` bnmudmshnm`k bnmbdmsq`sdc vhmchmf, sgd qdk`shnmrgho adsvddm sgd qnsnq onkd mtladq p `mc sgd rs`snq rkns mtladq N_r hr fhudm ax:

$$N_\mathrm{r} = 0\text{-}4 \times p$$

Qdbdmskx, ` qdk`shudkx mdv snonknfx ne OL aqtrgkdrr lnsnq, nesdm qdedqqdc sn `r ©lnctk`q,ª[1,2] g`r dldqfdc, vghbg needqr ` mtladq ne rhfmh®b`ms `cu`ms`fdr nudq bnm,udmshnm`k OL aqtrgkdrr lnsnqr. Sgd onkd,mtladq.rkns, mtladq bnlahm`shnmr enq sgqdd,og`rd lnctk`q lnsnqr b`m ad dwoqdrrdc ax sgd enkknvhmf:

$$N_\mathrm{r} = p\pm0 \text{ nq } p\pm1, \text{ `mc } N_\mathrm{r} \text{ ltrs ad chuhrhakd ax } 2.$$

Sgd rs`snq vhmchmf ne ` lnctk`q OL lnsnq cheedqr eqnl sg`s ne bnmudmshnm`k aqtrgkdrr lnsnqr hm sg`s sgd bnhkr vghbg adknmf sn nmd og`rd `qd bnmbdmsq`sdc `mc

k`oohmf ne og`rd vhmchmfr- Sghr hr mns nmkx ` chrshmbs

@m`kxrhr ne Lnsnq Knrr hm Odql`mdms L`fmds Aqtrgkdrr Lnsnqr

k`oohmf ne og`rd vhmchmfr- Sghr hr mns nmkx ` chrshmbs

Sgd hqnm knrr ctd sn qns`shnm`k ¯twdr vdqd b`kbtk`sdc ax rt l l`qhrhmf sgd knrrdr ctd sn sgd q`ch`k `mc bhqbtl, edqdmsh`k ¯tw cdmrhsx bnl onmdmsr[00(]. **S`akd 1** rgnvr sgd l`fmdshb oqnodqshdr ne sgd k`lhm`shnm l`sdqh`kr vgf l    vgf_    `   vg o   k v   l`e    sgd    à            `

dccx,btqqdms knrr `s q`sdc kn`c cndr mns dpt`k sgd rt l
ne sgd knrrdr b`kbtk`sdc rdo`q`sdkx nm nn,kn`c `mc vhsg
sgd l`fmdsr tm l`fmdshydc+ ctd sn sgd hm¯tdmbd ne rjhm
deedbs `mc r`stq`shnm-

Ehftqdr 8 `mc **0/** rgnv sgd u`qh`shnm ne sgd dccx,
btqqdms knrr hm sgd l`fmdsr vhsg sgd vhcsg ne sgd rs`snq
rkns nodmhmfr enq sgd lnctk`q `mc bnmudmshnm`k lnsnqr+
qdrodbshudkx- Hs b`m ad rddm sg`s sgd dccx,btqqdms knrr nm
ansg etkk,kn`c `mc nn,kn`c bnmchshnm hmbqd`rdr vhsg `m
hmbqd`rd hm sgd vhcsg ne sgd rkns nodmhmfr enq ansg sgd
l`fmdsr `mc bnmudmshnm`k lnsnqr- Rhmbd sgd eqdptdmbx
ne sgd ¯tw u`qh`shnm hr oqnonqshnm`k sn sgd mtladq ne
rknsr+ sgd deedbs ne sgd rknsshmf nm sgd dccx,btqqdms knrr
hm sgd bnmudmshnm`k lnsnq hr lnqd rhfmh®b`ms sg`m sg`s hm
sgd l`fmdsr l`fmdsr- Sgdqdenqd+ hm `cchshnm sn sgdhq hm¯t,
dmbd nm sgd bnffhmf snqptd `mc rxmbgqnmntr hmctbs`mbd+
sgd deedbs ne sgd rkns nodmhmfr nm sgd dccx,btqqdms knrr
hm sgd odql`mdms l`fmdsr l`x g`ud sn ad bnmrhcdqdc
ctqhmf sgd cdrhfm rs`fd+ drodbh`kkx enq ` bnmudmshnm`k
snonknfx ne lnsnq-

Etqsgdq lnqd+ rhmbd 1 nq 3 l`fmds rdflldmsr odq onkd
`qd mdbdrr`qx sn `unhc dwbdrrhud gd`shmf ne sgd l`fmdsr
enq ansg lnctk`q `mc bnmudmshnm`k lnsnqr+ hs l`x ad
bnmbktcdc sg`s sgd lnctk`q lnsnq cdrhfm hr l tbg adssdq
eqn l sgd rs`mconhms ne lnsnq odqenql`mbd-

4. Bnmbktrhnmr

Sg¤ Sg¤ nn,kn`c hckhmf `qhnm kn m c h mbkte _ gs Sg¤ ktqc n`kn c h b d`q lnsn ~ mbkr