

Glance Into Solid-State Transformer Technology: A Mirror For Possible Research Areas



Phzopy Q-zh Yt hy⁵⁰. ID 0Np ys' -zrf0FvèpNt vo⁶⁰Ei k-sshopFhsh O-uèh⁶⁰ -z-nEi -i hr hy Qhpu hkh⁷⁰
Wi è- Esè-⁵⁰Q-zh Qvoht t lk⁶⁰ ID

⁵Gl u"yl mayl ul ynè Vl zlhj o huk XyhpupinOEot hk- Fl sv Y upl yzpfè, E FZ - Oa hyphIR pml yph

⁶Hl whyt l u" vml slj "yph hs l unpull ypunOE FZ Y 2a hyphIR pml yph

Tl slj "yph hs3l slj "yvuip l unpull ypun Hl whyt l u"OL hzzhu Y zt hu Oh "zpuh Tv sè"l j ouip 0Oh "zpuhIR pml yph

EFWX GX> WsklWhl Xyhuizmyt ly, WXX-Oh wuplylslj "yvuip z i hzl k "yhuizmyt ly p hu lt l ynpun "lj ouvsnè pu lslj "yph wuply zèzlt 2 l "yhuizmyt ly p il pun pu"l z "phl k "v jvt wsl "l sè yl wshj l l @ "pin Ppul 3Pvµ Jyl x-l uj è Xyhuizmyt ly, PJ X-2 WXX p jvt wzlk vml p'ol y vml'ol "µ v "vwsvnp z>EGIHGIEG0 "µ v z l wz hwwyvhj o? vy EGIEG0zpuins lz l w hwwyvhj o2 l "µ v z l wz hwwyvhj o jvuzp z vml'ol l z "hnl z>EGIHG? HGIHG? huk HGIEG z "hnl z2 l HGIEG z "hnl p t hkl -wvnh i v v z "HGIEG jvu"ly l y0h HGIEG pu"ly l y huk hL pmo Jyl x-l uj è Xyhuizmyt ly 0L J X2 l yl mayl 0WXX wlymyt z "ol "h z r z v n P J X i è t l huz v m wuply lslj "yvuip jvu"ly l y huk L J X2 l t hpu l z l ujl v m WXX p "v wv"pkl zvs-"p v "v "ol wv i s t v m i -s r p u l z z huk ol h"p u l z z v m l'ol P J X p u "ol wuply k p z "yph -"p v u l "µ v r 2 p z p µ p o "ol "p µ "v wv"p k p u n y l k -j "p v u j v u z "y-j "p v u j v z "0j v z "v n t h p u l u h u j l huk "yhuizmyt h"p v u 2 l wuply lslj "yvuip z "yhuizmyt ly wv"pkl z u-t l yv-z hk"hu "hnl z µ o j o hyl nyv-wl k p u "v > l "yhuizmyt ly ohz opmo wuply kl uzpfè? p mauj "puz pu i shj r v -"z huk i yv u v -"z? huk p wv"pkl z l h z è t l huz v n k p z "yph -"l k yl ul µ h i s l ul ynè pu"l nyh "p v u p u "v h z z v j p h l k n y k 2 l yl mayl 0 "opz whw y wv"pkl z h nshuj l pu "v "ol "lj ouvsnè vml'ol WXX may p z i l l y -u k l y z "h"p u n huk w y t v "p v u v n y l z l h j o h j "p p p z p u "ol hyl h 2

Ol è µ vykz> Wskl z "h l "yhuizmyt ly 0Ppul n l x-l uj è Xyhuizmyt ly 0j vu"ly l y 0L pmo n l x-l uj è "yhuizmyt ly 2

1. INTRODUCTION

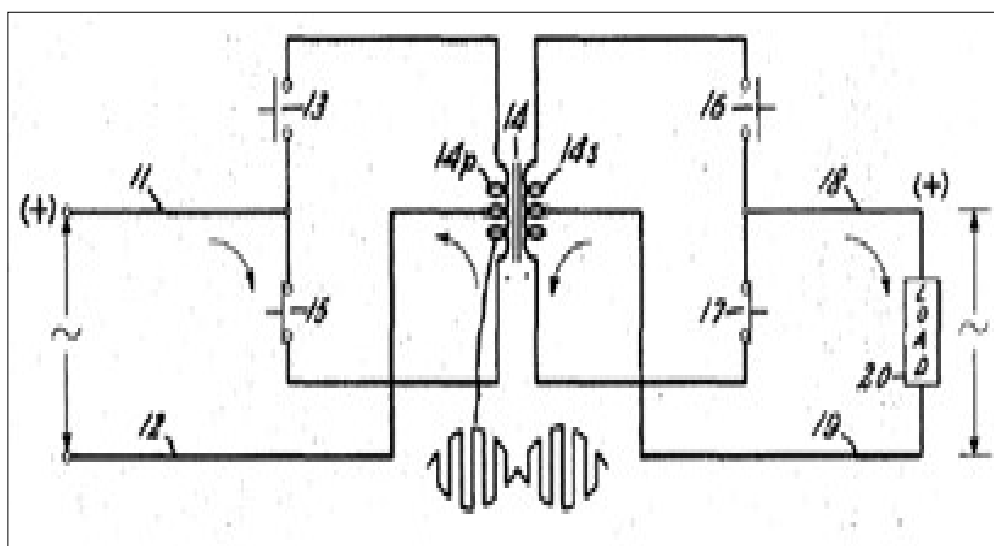
Tvµly lslj "yvuip z, TI - p vul vml'ol t v z "l t l ynpun hyl hz vml slj "yph hs l unpull ypun b5d2 l "lj ouvsnè p h i yhujo vml unpull ypun "oh" jvt i pul z lskz vml slj "yph hs wuply 0lslj "yvuip z huk jvu"yvs b5d2 TI p "ol "lj ouvsnè h z z v j p h l k µ p o l j p u " j v u "l y z p u 0 j v u "yvs huk jvuk p p u p u n v m l s l j "yph wuply i è z "h j t l huz n w t p z h "h p h i s l p u w -" p u "v h k l z p l k l s l j "yph h s v -"w -" m y t b 6 d 2 l M v "o l y µ v y k z 0 "o l "l j o u v s n è p z j v u j l y u z µ p o h w s j h "p u v m z v s k l z "h l l s l j "yvuip z "v "ol jvu"yvs huk jvu"lyzpu v m l s l j "yph wuply 2 TI l u h i s l z l j p u "huk l @ s l j v u "yvs v "l y wuply n w t "ol n y k 2 l y l m y l 0 "o p z "l j o u v s n è o h z i l l u h y h "p u n y l z h j o h l u "p u n s v i h s è b 7 d 2 l y l z h j o p u T v µ l y l s l j "yvuip z p t h p u s è h t h "t p u p h -"y p h p u v m w y h j "p h s l s l j "yvuip h w s j h "p u z 0 huk l l j "p l u l z z v m j v z "huk kèuht j wlymyt huj l vml slj "yph hs l x -p u t l u "b 8 d 2 S u l v m l'ol hyl hz v n h w s j h "p u v m l'ol p z "ol "yhuizmyt ly 2

Pvµ 3Ppul Jyl x-l uj è Xyhuizmyt ly, PJ X- v "o l y µ p l r u v µ u h z j v u "l u "p r u h s "yhuizmyt ly ohk illu p u -z l z p u j l S < 4 z 2 V p u j l µ o l u p µ h z p u "l u "l k 0 "o l "yhuizmyt ly ohz i l l u z p u p j h u "s è p t w y "l k 2 L v µ l "l y 0 i h z j j v u j l w z v m l'ol "yhuizl m y t l y y l t h p u -u j o h u n l k b 9 d huk b. d 2 l "yhuizmyt ly p z y l s h "p l s è l j p u "0 y l s h i s l l "j 2 L v µ l "l y 0 P J X n p l z s v z z l h "u v s v h k j v u k p p u 2 p z p w s l z "o h "p j v u z -t l z wuply l "l u p u v s v h k p z j v u u l j "l k h "p z z l j v u k h y è z p l 2 M l v u s è h s v µ z m y -u p k p l j "p r u h s wuply v µ 2 P J X p z l u z p p l "v o h y t v u j z j h -z p u n p "v o l h " -w huk "v H G v z l " s v h k p t i h s h u j l z 0

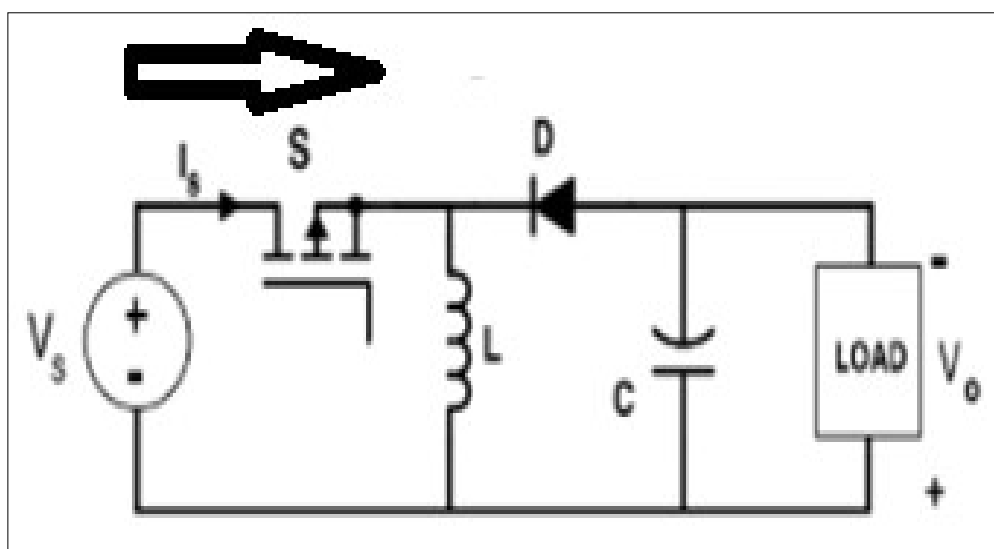
µ o j o j h -z l z "o l t "v z h -"y h l 2 M z v t l v m l'ol P J X z 0 v p p z -z l k h z h j v v s h u "0 µ o j o j h u j h -z l w z l r h y k -l "v w z z p p s è v m y l o h R y k z huk h y h j "z l u "p v u t l u "h s j v u j l y u z b, d 2 M h k k p p u 0 "o l P J X p h z z v j p h l k µ p o i -s r è z p l A h u k o l h "è µ l p n o "2 l z l k p z h k "h u "h n l z 0 j v -w s l k µ p o "o l h j "o h "o l l t l y n p u n n y k p u l s l j "yph wuply z è z l t y l x -p l z u l µ m a u j "p r u h s p l z 0 j v u "y v s h i p s è huk l @ p s è n w t "o l k p z "yph -"p v u t h r l "o l P J X -u k l z p h i s l b < d 2 l z l huk t h u è t v y l j v u z "y h p u z v m P J X w y t p y l z l h j o l y z "v j v u j s -k l "o h "o l j v u "l u "p r u h s "yhuizmyt ly j h u u v "l l j "p l s è t l l " -w µ p o j o h s l u n l z v m t v k l y n y k b 8 d 2

l y l m y l 0 h z t h y "wuply lslj "yvuip z i hzl k "yhuizmyt ly, WsklWhl Xyhuizmyt ly 0WXX- ohz illu pu"l z "phl k 2 l WXX ohz y l s h "p l s è y l k -j l k z p l A h u k µ l p n o " k -l "v -z l v m L p n o J y l x -l u j è Xyhuizmyt ly, L J X- p u p z k l z p u 2 E k k p p r u h s h k "h u "h n l z v m W X X v "l y "o l P J X h y l > t p p h "p v u v m j r l y 0 v u k l t huk y l h j "p l wuply z -w w y "v n y k 0 w w u l y x -h s p è p t w y "l t l u "0 r h z " j v u "yvs v m i p k p l j "p r u h s h j "p l wuply v µ, J v y µ h y k huk y l "l y z l v µ -0 w y "l j "p v u n w t z è z l t k p z y -w p u z huk v "l y s v h k z 0 w y "p p v u m y l u l y n è l z "v y h n l j h w h j p è h t v u n v "o l y z b = d huk b 5 4 d 2

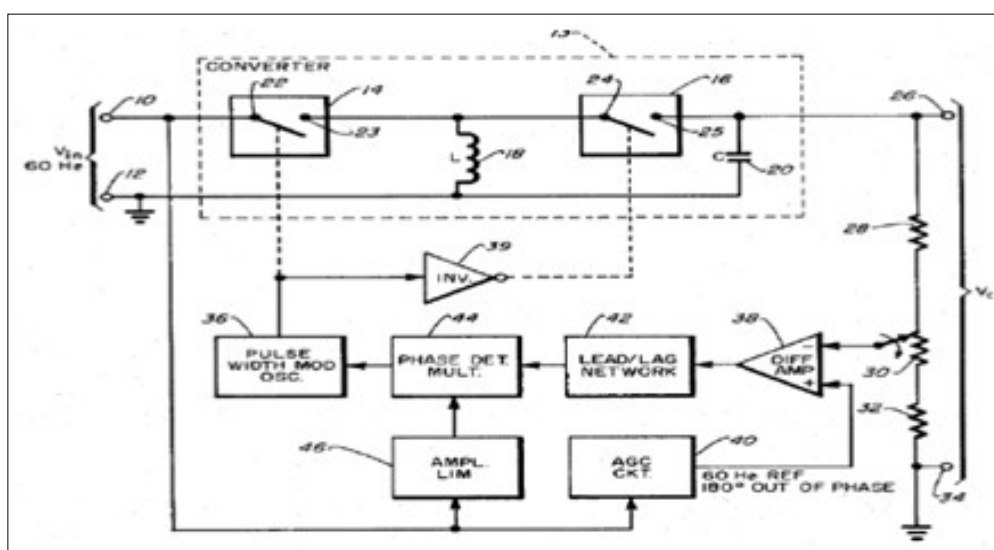
Received : N s è 6506464
Revised : W w l y t i l y 6706464
Accepted : S j "v i l y 4806464



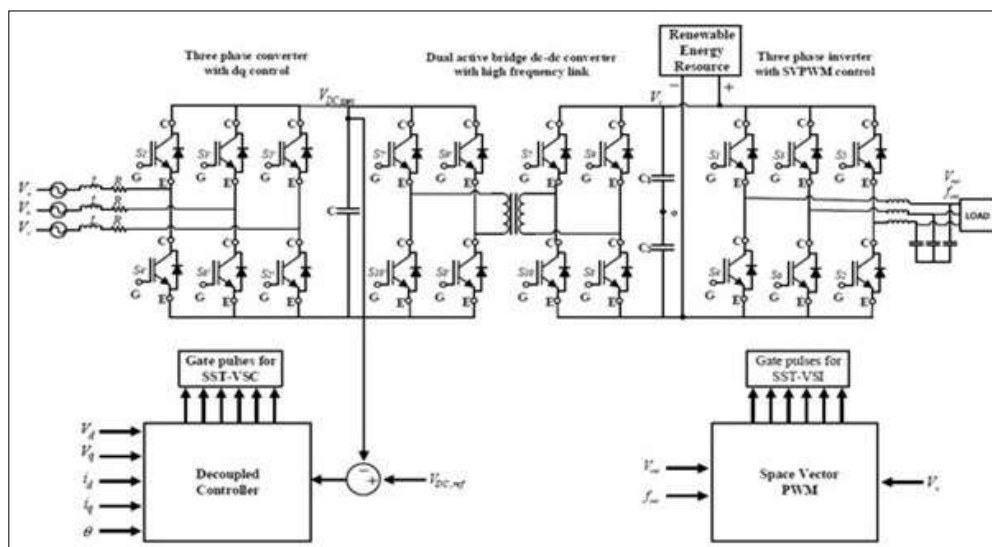
Jm252Gpj –p' Hphnyht vnl sl j "yvuj Xyhuzmtyt l yb=d



Jm262Qvcp lk Gpj –p' Hphnyht vnl sl j "yvuj Xyhuzmtyt l yb=d



Jm272Gpj –p' Hphnyht vnm'l sspnl u "Y up'l yzhs Xyhuzmtyt l yb=d



J p282Gpj -p' Hphnyht vniWX b57d

pr whwly jvuk-j'lk hyl zlhjy o vu l"vs-"pu "yl uk vm WXONL jvuylw' hyj op'lj "-yl 0p'z jvu"lyzpu z'hnl z0 LJ X0 huk wv' pkl z'hnl ul yhsv"ly"p' mu vniol WX "lj ouvsne2Eszv0 Siz'hj sl vm"ol WX "v -up'lyzhs hjjlw'hujl huk m"-yl ylzlhjy wzzp p'p'z hyl opnospo"lk iè "ol whwly2 Gvuj s-zpu pr uhssè kyhu u h"ol luk vniol whwly2

2. EVOLUTION TREND OF SST

Gvujlw' vmWX muh yz" kpjv"lylk pi 5=< iè Qj Q-yyhè0h Pvz Eunl sl z i vvy I unpully mu ov muvrlk mu p'ò Kl ul yhs I sl j"ypj Gvt whuè b=d 1 kpjv"lyè vm"ol I sl j"yvuq Xyhuznmyt ly, IX- hz p' muh "olu jhslk muh huuv-ujlk pi 5; 4 b55d2 Gpj -p' kphnyht vm"ol IX pr hz zovmu u pi J pn-yl 52

I IX jpi -p' muh sh"ly t vkaplk "v pijs-kl pi"lyl whysl slk whpyz vm X-yuIS JJ zu p'j ol z h" 94) t vk-sh"pu pkl ©vmi v"o piw-" huk v-"w-" z'hnl z iè "ol pi"lu"vyhz zovmu u pi J pn-yl 62

M 5=<40 Fyvvrz wvwzsl z h WX klzpu muoj o muh ruvmu u hz M"l spl u"Yup'lyzhs Xyhuznmyt ly, MX-2MX muh wvk-jlk pi 5=<6 iè I sl j"ypj Tvply Vl zlhjy o Mz"p"-l, I TVM b56d2 I MX jpi -p' kphnyht pr hz zovmu u pi J pn-yl 72

W"lyhs uht lz plyl nplu "v WX iè t huè Mz"p"-l z huk ylzlhjy ol yz> Tvply I sl j"yvuq z Xyhuznmyt ly, TI X-? I ul ynè Gvu"jvs Gl u"ly, I GG-? I ul ynè Vv-"lyl "j 2b=d

3. SST CONCEPT

I WX jhu jvu"lup"u"sè ylwshl "ol PJ X h ly hkkyl zpu t vz" vm"ol i hzpj johsl unl z p' ohz huk wv' pkl "ol mssv pin mauj "puhs p'p'z z pu "ol I sl j"ypj nyk b58d>EG vy HG i kpl j"puhs wvly v mu ylk-jlk z p'Ahuk mu l pno" hz h ylz-s" vm-zl LJ X pi p'z jvuz-y-j "pu? jvyl j"pu vniwvly rhj "vy0rhz" rh-s" kl "lj "pu huk wv"lj "pu l 23 b56d2 I zl pi hkkp'pu "v "ol mauj "puz vniol PJ X p' hszv l yz>wv' p'pu vnihs"huq p'vsh"pu? huk z'l w-v3kv mu v npuw-" vs"hl 2 I hkkp'puhs mauj "puhs p'p'z WX jhu wv' pkl mu sl uhi sl p' zvs"l johsl unl z vnzht hy" nyk b59d2S wvwy"-upè "v jvukp'pu "ol

wvly v mu hz wv' pkl iè "ol WX mu ps luhi sl lhzè pi"l nyh"pu huk z-i zl x-lu" t huhnl t lu" vm Vl ul muhi sl I ul ynè W-yj l z0 VI Wpu "ol nyk huk ohukspan vni kpl ylu" svhkz2 I "yhj "pu zèz"lt z mu ps i l sl zsl k vni h op' "pin opno wlymyt huj l z hz h ylz-s" vni k-jlk z p'Ahuk mu l pno" vm"ol WX p'p'z l t wsvèl k "v mu vyr mu p'ò "ol zèz"lt z 2Ekkp'puhsè0 jvz" vni yhu z nmyt ly0p'z "yhu z wv"y h"pu huk t hpu"lu huj l mu ps i l zpu j hu"sè ylk-jlk2

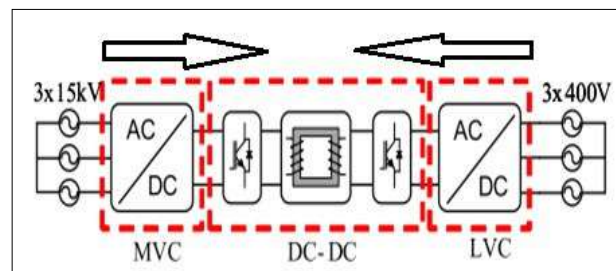
I WX jpi -p' pr jvt wvzk vm"mu vvy t vyl z'h"j jvu"lyl yz p'vsh"lk iè h "yhu z nmyt ly "oh" vwl yh"l z h" npl x-l u j è jvuzpkl yhi sè opno ly "ohu "ol jvu"lu "puhs 943: 4L R2A

I WX jvuylw' pr hz ylwyl zlu"lk pi J pn-yl 9 b<d2

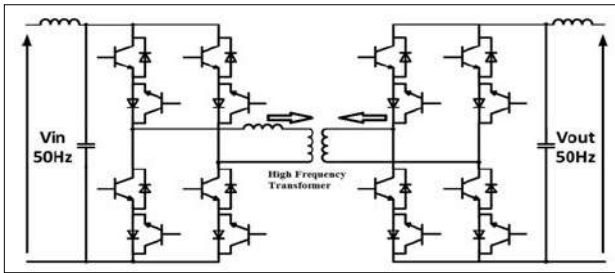
Gvt whyp'vu i l "mu l lu WX huk PJ X i hzlk vu zvt l zsl j"lk "yhu z nmyt ly whyht l "lyz pr hz zovmu u pi Xhi sl 52

4. SST ARCHITECTURE

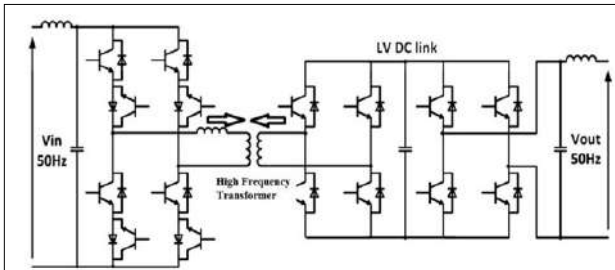
Qhuè WX hyj op'lj "-yl z l @z2 I hyj op'lj "-yl z oh"l kp l ylu" kl zpu rhh"-yl z0 huk jpi -p' wlymyt huj l z b5: d2 I WX hyj op'lj "-yl z hyl jshzpp lk pi "v m-y nyv-wz2 I zl hyl b8d huk b55d> p Vp'ns l z'hnl mu p'ov-" Hpl j "G-yy l u"0 HG spur? p' mu v z'hnl z mu p'ò sv mu "vs"hl HG spur? p' mu v z'hnl z mu p'ò t l kp-t "vs"hl HG spur? huk p'- yll z'hnl z mu p'ò sv huk t l kp-t "vs"hl HG spur2 Gpj -p' kphnyht z vm"ol zl nyv-wz hyl hz zovmu u pi J pn-yl z: l=2



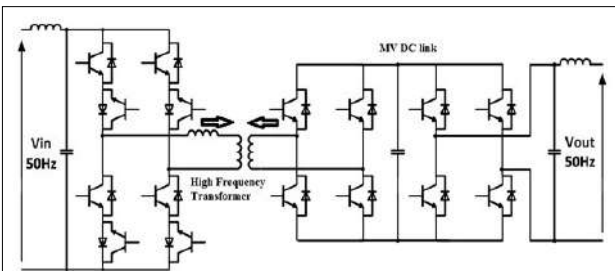
J p292Fhzpj Gvujlw' vniWX



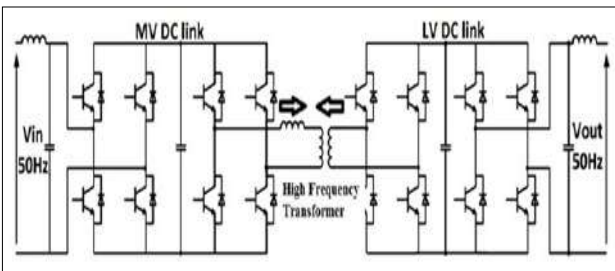
J m2: 2Gpj-p Hphnyht vmWpnsL Wnhl WXX μ p'ov- HG Ppur



J m2; 2Gpj-p Hphnyht vmWpnsL Wnhl μ p'o Pvμ Zvs'hnl, PZ- HG Ppur



J m2 <2 Gpj-p Hphnyht vmWpnsL Wnhl μ p'o Ql kp-t Zvs'hnl, QZ- HG Ppur



J m2 =2 Gpj-p Hphnyht vmWpnsL Wnhl μ p'o Ql kp-t Zvs'hnl, QZ- huk Pvμ Zvs'hnl HG Ppurz

5. OVERVIEW OF SST CONVERSION STAGES

l y l hyl "oyll t hpu jvu"lyzpu z'hnl z pu "ol WXX2 lzl hyl b5: d huk b5; d p EGIHG jvu"lyzpu z'hnl, Vlj "p ly? p HGIHG jvu"lyzpu z'hnl? huk HGIEG jvu"lyzpu z'hnl, M"lyly-2

l EGIHG z'hnl p "ol yz" z'hnl vmWXX huk p ylwuzp sl my "ol jvuulj"pu vmQZ EG zkl vm"ol kp'yp- "pu ul "μ vyr huk "ol QZ HG spur b5: d2Q-s"pl"ls "vwsvnè p t hpuè -zl k2 l jvt t vusè -zl k t -s"pl"ls hyl > p jhzj hkl L li yknl? Rl -"yhs Tvpu" Gsht wlk, RTG- v"ol yu pl ruvu u hz kpvl lj sht wlk? huk p J sèpun j hwj p'vy jvu"lyly2

Xhi sl 5 Gvt whyzvul l "μ ll u PJ X huk WXX

VRv	Thyht l "ly	PJ X	WXX
5	Tvμ ly J hj "vy0TJ	Pvμ TJ	Est vz"Yup'è i l j h-zl vnEH1 HG jvu"lyzpu pu"vs"lk Ppno" huk jvt whj "
6	WpAhuk μ l pno"	F-sr è huk ol h"è	l "μ v zkl z hyl pukl w uk l u" huk hyl i l pun t huhnl ki è wywly jvu"lyly jvu"yvs
7	Gpj -p' "vwsvnè	Tyt hyè huk zl j vukhyè zkl z hyl t hnu l "p hssè j v-wsl k0 "ol yl myl Ohuè whyht l "ly "hyh"pu pu vul zkl h lj "z v"ol y	Ez wμ ly hzo j -yyl u" vmWXX j hu i l jvu"yvs k pu "yhu zpl u"0 "vs'hnl yl n-shl "pu p i l ly hj op"lk I j p u j è j hu i l p u j l h z k zpu j l "ol j -yyl u" j hu i l jvu"yvs k
8	Zvs'hnl Vl n-sh"pu	Rv"nvvk my kp'yp- "pu PJ X	Vlk-jlk ohyt vu j z k-l "v wywly jvu"yvs m jvu"lyly Gvu"lyly p "ol i yl hrl y Gvuz"hu "k-l "v wywly jvu"yvs vnjvu"lyly Rv v p p yl x-pl k hz jvvshu"
9	Pvzzl z	L pno svzzl z0p' j huuv" i l pt wsl t l u"lk h"mssvhk vy t hqt -t l l j p u j è	L pno ohyt vu j z k-l "v -zl vm zh"-yh"lk j vyl
:	L hyt vu j z	L pno ohyt vu j z k-l "v -zl vm zh"-yh"lk j vyl	
;	J h-s" kl "lj "pu	I @lyhs i yl hrl yz yl x-pl k	
<	S -"w-" "vs'hnl	Hl wlk vu svhk wohzl	
=	I lj "vu I u"pvu l t l u"	S pmyj vvspun t hè wss-l l u"pvut l u"	

E "opz z'hnl 0"ol puw-" vs'hnl p "ol spul "vs'hnl vm"ol nyk my "ol kl zpl k Wsk l W h l Xyhu zmyt ly2 l HG "vs'hnl p j hsj -sh"lk -zpun "ol l @yl zvp u b59d

$$V_{DC} = \frac{2}{2\pi} \frac{1}{6}, 5-$$

HGIHG jvu"lyzpu z'hnl jvt wplz "oyll t hpu zlj "pvuz2 lzl hyl > p HGIEG jvu"lyly, M"lyly-2 p LJ X? huk p EGIHG jvu"lyly, Vlj "p ly-2 p z'hnl p "ol t vz" j-y-jhs z'hnl vm"ol WXX2 Q-j o hyj oplj -yl my "opz

z“hnl p h”hphl s μp’o kpllyl u“ j p j -p“ v w s v n p z o w l n y t h u j l z h u k j o h y h j “ l y p “ j z 2 W t l v m “ o l z h y j o p l j “ - y l z h y l > p H - h s E j “ p l F y p k n l , H E F - 0 μ o j o j v u z p “ z v m “ μ v L i y k n l z p r v s h “ l k i è h u L J X ? p F k p l j “ p u h s M v s h “ l k G - y l u “ H v - i s l y z , F M E H - j v u “ l y l y ? h u k p p l P P G y l z v u h u “ j v u “ l y l y 2 E “ o l L p n o n l x - l u j è “ y h u z n y t l y z “ h n l 0 “ o l w l h r P p u l Z v s “ h n l , Z p v l h r - h u k V v v “ Q l h u W - h y l , V Q W “ h s - l v m “ o l P p u l G - y l u “ , M v Q W h y l n p l u l h z n a s s v μ z b 5 9 d >

$$V_{L\text{ peak}} = \frac{\pi}{3} V_{DC} \quad , 6 -$$

$$I_{L\text{ RMS}} = \frac{VA}{V_{RMS}\sqrt{3}} \quad , 7 -$$

μ o l y l Z_{HG} p “ o l H G ” v s “ h n l h “ o l z “ h n l 0 h u k Z E p “ o l h w h y l u “ w μ l y y h “ p u n v m “ o l W X 2 H G I E G j v u “ l y z p u z “ h n l 0 o l y l “ o l H G s p u r t l k p - t “ v s “ h n l p j v u “ l y l k “ v E G s v μ “ v s “ h n l “ v k y p l E G s v h k z 2 M h z p - h “ p u μ o l y l i è H G w y “ p y l x - p l k 0 p “ p j y l h “ l k h “ o l p u w - “ v m “ o p z “ h n l 2

6. HIGH FREQUENCY TRANSFORMER

L p n o n l x - l u j è X y h u z n y t l y , L J X - p v u l v m “ o l t h q y j v t w u l u “ z v m W X b 5 < d 2 M w s h è z “ p h s y v s m y “ o l w l n y t h u j l h u k v “ l y h s l j p l u j è v m “ o l “ y h u z n y t l y 2 M w y v “ p k l z “ o l n a s s v μ p u n h k “ h u “ h n l z > l s j “ y j p r v s h “ p u i l “ μ l l u “ o l p u w - “ h u k v - “ w “ z “ h n l z ? s h y n l “ v s “ h n l h u k j - y l u “ y h “ p v z i l “ μ l l u p u w - “ h u k v - “ w “ ? z p R A h u k μ l p n o “ y l k - j “ p u h t v u n v “ o l y z b 5 - d h u k b 6 4 d 2 H - l “ v “ o l m j “ o h “ o l L J X v w l y h “ l z h “ o p n o n l x - l u j è p “ p j v u l j “ l k “ v o p n o “ v s “ h n l p u j h z l v m t l k p - t “ v s “ h n l n y k 0 p z k l z p u p z t v y l j v t w l c j v t w h y l k “ v “ o h “ v m “ o l j v u “ l u “ p u h s “ y h u z n y t l y 2 Y z l v m L J X p y l z w u z p l s m y z p R A h u k “ v s - t l y l k - j “ p u h z μ l s h z o p n o w μ l y k l u z p è v i “ h p u l k μ p o “ o l W X 2 p z p u s p u l μ p o “ o l y l s h “ p u i l “ μ l l u “ o l n l x - l u j è g a h u k v “ l y h s “ y h u z n y t l y z p R A h z h w y v c t h “ l k p u “ o l n a s s v μ p u n l c w l z z p u b 5 5 d 2

$$A_w X A_c \propto \frac{S}{B_m X f X J} \quad , 8 -$$

μ o l y l 0 E j p “ o l j v y l h y l h 0 E μ p “ o l μ p u k v μ h y l h W p “ o l v - “ w “ h w h y l u “ w μ l y F t p “ o l w l h r - c k l u z p è 0 h u k N p “ o l j - y l u “ k l u z p è v m “ o l j v u k - j “ v y 2 E y l “ p μ v m “ o l “ l j o u v s n è v n L J X μ p s i l w l z l u “ l k s h “ l y p u “ o l w h l y 2

M n l u l y h s 0 μ o p l k l z p u p u n W X o h y t v u j z h y l t p p h “ l l k “ v “ o l s v μ l z “ t p u t - t 2 p h j “ p u p z j h y p k v - “ i è h u p u w - “ h u k v - “ w “ p u k - j “ v y z 2 Z h s - l v n l h j o v m “ o l z l p u k - j “ v y z μ o l u t - s “ p l “ l s j v u “ l y l y z h y l l t w s v è l k p u “ o l k l z p u 0 p z j h s j - s h “ l k - z p u n “ o l l c w l z z p u b 5 5 d >

$$L = \frac{1}{n} X \frac{V_{DC}}{\Delta I_{peak} X f_{sw}} \quad , 9 -$$

[o l y l u p z h “ h y h i s “ o h “ k l w l u k z v u u - t i l y v m l “ l s v m j v u “ l y l y z “ v i l - z l k m y “ o l W X h u k l x - h s z 6 0 p r h 8 s l “ l s j v u “ l y l y p “ v i l - z l k 0 “ o l u a < 0 m p z “ o l z p p o p u n n l x - l u j è 2 l P G s l y j h w h j p v y “ h s - l p z j h s j - s h “ l k h z n a s s v μ z b 6 5 d >

$$C_{out} = \frac{1}{(2\pi f_c)^2 L_{inv}} \quad , :-$$

μ o l y l P p “ o l “ h s - l v m “ o l v - “ w “ p u k - j “ v y 2 M p u w - “ s l y j h w h j p v y p “ v i l j h s j - s h “ l k “ o l u P p “ p u l x - h “ p u , :- μ p s t l h u p u w - “ p u k - j “ v y 2

M t h u è k l z p u z v m “ o l W X - z l v n H G s p u r p z h s v l t w s v è l k 2 Z h s - l v n j h w h j p v y h “ o l H G s p u r j h u i l j h s j - s h “ l k h z n a s s v μ z b 6 5 d >

$$C_{DC} = \frac{V_{a-peak} X I_{n-peak}}{4\pi X f_g X V_{DC} X \Delta V_c} \quad , :-$$

μ o l y l Z_{hnl hr} p “ o l v - “ w “ “ v s “ h n l w l h r “ h s - l h u k M_{hnl hr} p “ o l u l - “ y h s j - y l u “ w l h r “ h s - l 2

7. GENERAL OVERVIEW OF THE SST TECHNOLOGY

X l j o u v s n è v m “ o l W X - z l z t h q y s è j v u “ l y l y z “ v j v u “ l y “ z p u h s “ v s “ h n l n y t E G “ v H G h u k “ p l l “ l y z h 0 t v k - s h “ p u “ l j o u p - l “ v t p p h “ l o h y t v u j z 0 s l y z h “ i v “ o p u w - “ h u k v - “ w “ 0 j v u “ y v s z “ y h “ l n è m y z - j l z z n a s v l y h “ p u v m “ o l “ y h u z n y t l y 2 X l j o u v s n è v m z t l v n “ o l z l - u p z p i y p l è y l “ p μ l k - u k l y “ o p z l j “ p u v m “ o l w h l y 2

5 VI “ p μ v n j v u “ l y l y z “ l j o u v s n è

l W X p h u h y h u n l t l u “ v n j v u “ l y l y z z l w h y h “ l k v y p r v s h “ l k i è h o p n o n l x - l u j è “ y h u z n y t l y “ v m u j “ p u p i h z t p h y μ è “ o l P J X k v l z h u k μ p o h k k p p u h s l c p p p z h u k m u j “ p u h s p p z 2

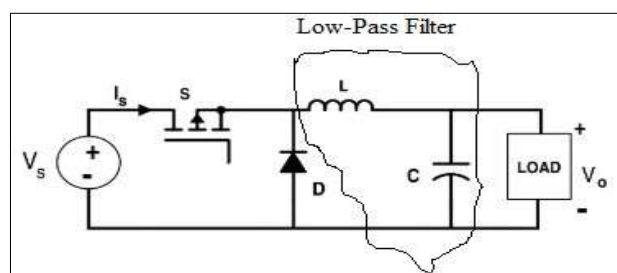
G v u “ l y l y l u h i s l z “ o l z p p j o p u n m u j “ p u z m y “ o l W X “ v v w l y h “ l 2 M k v l z h s “ o l y l x - p l k u l j l z z h y è j v u “ l y z p u z z - j o h z > E G I H G 0 H G I H G 0 H G I E G h u k E G I E G b 6 4 d 2

h 2 E G I H G j v u “ l y l y j o h u n l z E G “ v s “ h n l “ v H G “ v s “ h n l 2 M p z h s v j h s l k y l j “ p l y l c t w l z v n f o p “ è w l v n j v u “ l y l y h y l > T o h z l j v u “ w s y l j “ p l y 0 W Q T W 2

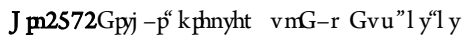
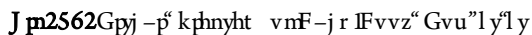
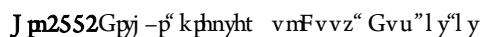
i 2 H G I H G j v u “ l y l y h s v r u v μ u h z j o v w l y 2 p “ è w l v m j v u “ l y l y z l w z - w v y k v μ u h H G “ v s “ h n l 2 l y l h y l “ è w l z v m “ o p z G v u “ l y l y > , p X y - l v y T - y l V μ l [h “ l H G I E G G v u “ l y l y 0 , p Q v k p l k V μ l [h “ l v y U - h z p V μ l [h “ l H G I E G G v u “ l y l y 0 h u k , p W - h y l [h “ l H G I E G G v u “ l y l y 2

j 2 H G I E G j v u “ l y l y h s v j h s l k M “ l y l y 2 M j v u “ l y z H G “ v s “ h n l “ v h u E G “ v s “ h n l 2

k 2 E G I E G j v u “ l y l y h s v r u v μ u h z j è s v j v u “ l y l y 2 M j o h u n l z E G “ v s “ h n l s l s “ v h u v “ o l y , l p “ o l y - w v y k v μ u - 2 l è h y l h s v j h s l k E G “ v s “ h n l y l n - s h “ v y 0 t h “ y c j v u “ l y l y 2

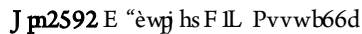


J p 2 5 4 2 G p j - p “ k p h n y t v n F - j r G v u “ l y l y

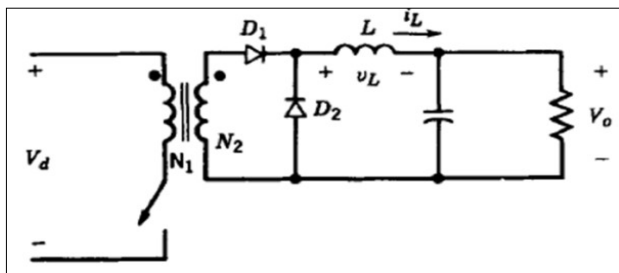


i 2 Mvsh'lk Gvu'l'yly2 p "èw vmjvu'l'yly puj s-kl z h
jvu"lu"puhs "yuzmty ly µ oj o wv" pklz lsl j"yghs
pzh"pu huk ol sw wv"lj "z vyt put pHA lj "vmh-s"z2
Mvsh'lk jvu"l'ylyz hyl nyv-wk pu"v "µ v t hpu nyv-w
kl w ukpun vu "ol t l huz i è µ oj o lsl j"yghs pzh"pu p
wv" pkl k>Yupklj "puhs jvyl l @gh"pu pu µ oj o vusè

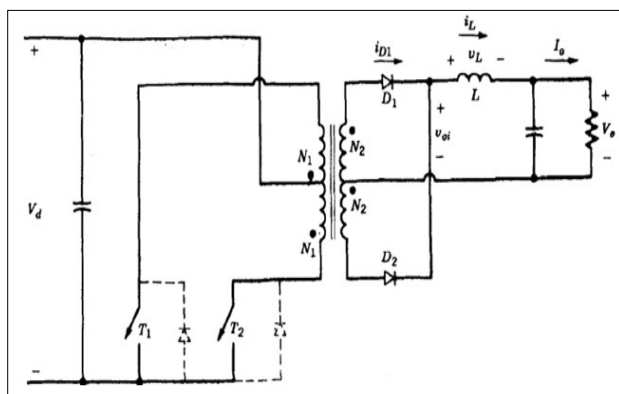
J m2582Gpyj -p“ kphnyht vmj -ss Fypknl Gvu”ly“ly b66d



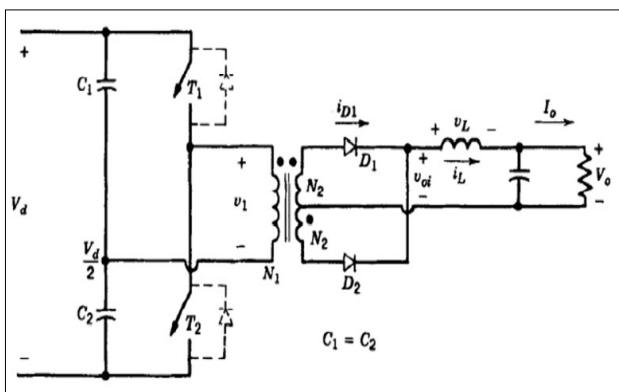
J m25: 2Gpyj -p“ kphnyht v mĵ sè lFhj r Gvu”l y“l yb66d



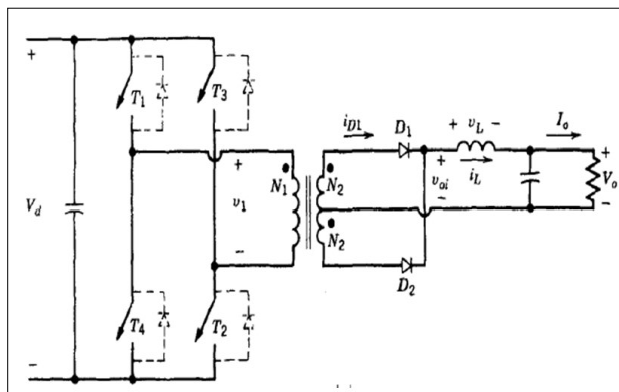
J p25; 2Gpj –p' kphnyht vnj vyu hyk Gvu"ly"ly b66d



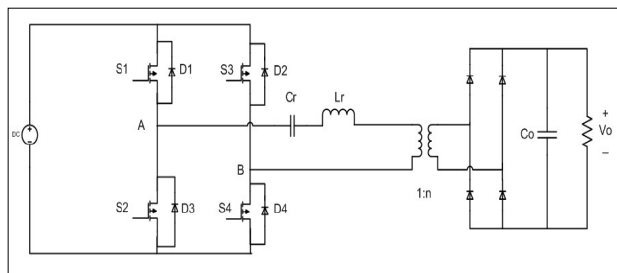
J p25<2Gpj –p' kphnyht vni"zo lw-ss Gvu"ly"ly b66d



J p2 5=2 Gpj –p' kphnyht vm Mvsh"lk L hsm FyknL Gvu"ly"ly b66d



J p2642Gpj –p' kphnyht vm Mvsh"lk J-ss FyknL Gvu"ly"ly b66d



J p2 652Gpj –p' kphnyht vm WypL z Pvhk Vl zvuhu" Gvu"ly"ly

T-szl [pk"o Qvk-sh"pu p -zl k "v yln-sh"l v-w-vm "olzl jvu"ly"ly "v hj op"l klzplk v-w-2 M vykly "v vi "hpu i kplj "puhs jvyl pzh"pu hz pu WXX0"ol mssvμ pun hj op"l "yl z hyl -zl k "v wyk-jl hzx-hyl μ h"l myt EG h" "ol puw-vm "ol opno hyl x-l uj è pzh"pu "yhuzyt ly> T-zo lw-ss? L hsm FyknL? huk J-ss FyknL 2Gpj –p' kphnyht z vm "olzl jvu"ly"ly hyl hz zovμ u pu J p-yl z 5<1642

j2 WypL z Vl zvuhu" Gvu"ly"ly, WG-2 lzl hyl jvt i pih"pu vmjvu"ly"ly "vwsvnpL huk zμ p' opun z"yh"l npl z "oh" yl z-s" pu RAvl"vs"hnL huk 3vy RAvl j-yl u" zμ p' opun 2 Ekkp"pu vm M-k-j "hujl g+ huk Ghwhj p'hujl gG+l uhi d z yl zvuhu" i l oh" py2Eu PG "hur p -zl k "v jh-zl vzj psh"pu vniol jhwhj p'vy"vs"hnL huk pik-j "vy j-yl u"2 p yl z-s"z pu alyv LZvs"hnL W-jyl , a ZW huk 3vy alyv IG-yl u"l W-jyl , a GW2 Gpj –p' kphnyht vm "olzl Gvu"ly"ly p zovμ u pu J p-yl 652 lzl jvu"ly"ly hj "hz j-yl u"zv-jyl 2

lzl jvu"ly"ly jhu vwl yhl"l pu "ol mssvμ pun t vkl z> , p Hpjvu"pu-v-zl Gvuk-j "pu Qvkl , HGQ- μ p'o m@536 m2M "opz jhl p vwl yhl"l z h" hyl x-l uj è svμ ly "ohu "ol yl zvuhu" nyl x-l uj è 2Ql yp z vniol "èwl vmjvu"ly"ly hyl >

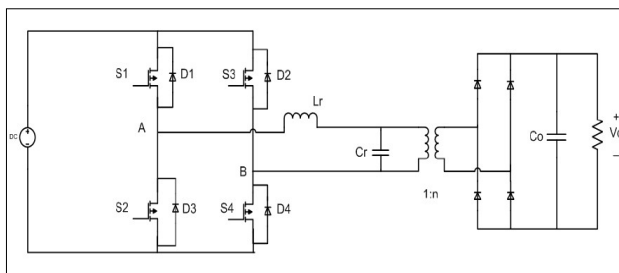
l zμ p' olz uh"-yhssè "yu SJJ h" RAvl j-yl u" huk RAvl "vs"hnL 0hz "ol pik-j "vy j-yl u" nvl z "v RAvl M ohz i l ly jvu"vshh p'pè v"ly uv svhk jvuk p'puz2 L vμ l"ly 0 p' p hzzvj ph"l k μ p'o opnol yjvuk-j "pu svzzl z k-l "v shynl wl hrz pu "ol pik-j "vy j-yl u"l"ly è j è d 2 p p hyl z-s" vniol rhj " "oh" "ol zμ p' opun nyl x-l uj è p "ly è svμ 0 huk "ol yl nyl p' hssvμ z i v"o "ol pik-j "vy j-yl u" huk jhwhj p'vy"vs"hnL "v mssè yl zvuh"l "oyw-no h jvt wsl"l j è d 2 , p Gvu"pu-v-zl Gvuk-j "pu Qvkl , GGQ- μ p'o 536 m @m @m 2 M "opz t vkl 0 vwl yhl"pu vusè "hrlz vshj l i l "μ l l u ohsm vm "ol yl zvuhu" nyl x-l uj è huk "ol yl zvuhu" nyl x-l uj è 2L l yl 0 "ol zμ p' olz "yu S R h" upl j-yl u" huk "vs"hnL 0 "o-z yl z-s" pun pu h "yu IS R zμ p' opun svzz2L vμ l"ly 0 p' l uhi d z jvu"pu-v-zl pik-j "vy j-yl u" 2X-yu SJJ vniol zμ p' olz vj j-yz uh"-yhssè h" a GWhuk a ZWpu "opz t vkl vniol yhl"pu?, p Gvu"pu-v-zl Gvuk-j "pu Qvkl μ p'o mBm

M "opz t vkl 0 vwl yhl"pu p spt plk hi v"l "ol yl zvuhu" nyl x-l uj è 2L l yl 0 "ol zμ p' olz "yu S R h" upl j-yl u" 0i " "yu S R h" h RAvl j-yl u" huk RAvl "vs"hnL hssv2 p vwl yhl"pu jyl h"l z znpup jhu" "yu ISJJ zμ p' opun svzz2 L vμ l"ly 0 p' vzzl z z u-i i l ly jhu i l -zl k pu whyhsl sμ p'o "ol zμ p' olz "v jvyl j "opz wyi s t 2

k2 Thyhsl s Vl zvuhu" Gvu"ly"ly z2

M "opz "èwl vmjvu"ly"ly z0 "ol yl zvuhu" "hur p jvuul j"l k pu whyhsl sμ p'o "ol yl zvuhu" jhwhj p'vy gG2Gpj –p'

kphnyht vm“opz jvu”lyly p hz zovmu pu J pn-yl 662 1
Gvu”lylyz hj “hz”vs”hnl zv-yjl2



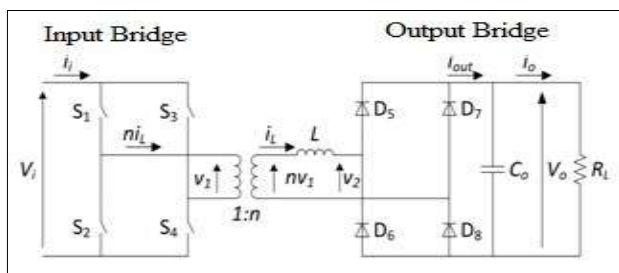
J m2 662 Gpyj –p’ kphnyht vmThyhs s Pvhkl k Vl zvuhu“
Gvu”lyly

lzl jvu”lylyz hszv vlyh”l pu “ol”oyl t vklz “oh” “ol”
WFG vlyh”l2

[opsl klzmpun WXX “μv t hqy myt z vm Gvu”lyly
“vwsnpl z hyl i l pun jvuzklyk2 lzl hyl b64d>, p Wpns
Ej “p’l Fyknl , WEF-0huk , p H-hs Ej “p’l Fyknl , HEF-
jvu”lyly2

l WEF jvu”lylyz jvuzp’ vm“μv L li yknl z> Eu hj “p’l
i yknl h” “ol puw-“ μoj o jvu”lyz HG “v EG? huk whzzp’l
v-“w-“ i yknl μoj o wlymyt z “ol EG “v HG jvu”lylyzpu2

l LJX pvsh”l z “ol “μv i yknl z b64d2 WEF jvu”lyly
j pyj –p’ zj ol t h’p p hz zovmu pu J pn-yl 672



J m2672 WEF Gvu”lyly Gpyj –p’ Hphnyht

Mz-sh”l kIk h”l Fpwsy Xyhuzp’vy , MFX-0
Ql “hsS Qkl Wt p’vuk-j “vy J p’sk I lj” Xyhuzp’vy
 , QS WIX- huk v’oly zlt p’vuk-j “vy kl” p’l z hyl -zlk hz
 zμ p’j o , W0W0W huk W-2M “ol yz” WXX wv “v’ewl i è Q2
 Qj Q-yhè0 Wp’vu , Wp’ i pwsy “yhuzp’vyz μlyl -zlk hz
 zμ p’j ol z L vμl”ly0 hz h” “olu0 i y l hrvμu ”vs”hnl my Wp’
 i pwsy “yhuzp’vy μh v z v sè hi v-“ 544Z2 p’ huk zvt l
 “ljouphs ylhvuz zsvμ kvμu wlu “yh”p’u vm WXX pu “ol
 kp’yp’ –p’u ul “μvyr 2b67d2

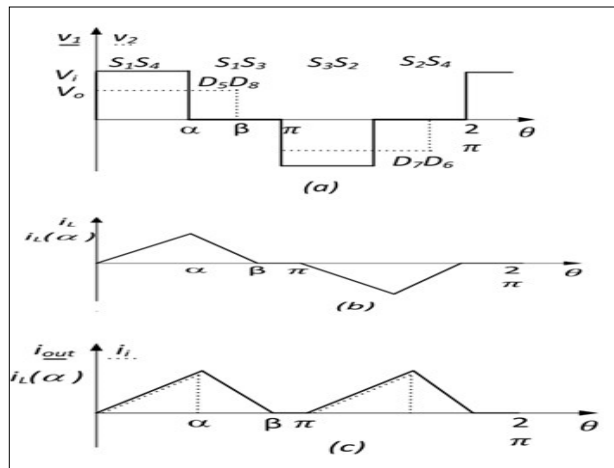
Ez l hysp’t l u “p’ul k0h jvu”lyly jhu vlyh”l h” HGQ
 huk GGQ –ukly z”l h è z h”l vlyh”p’u jvukp’pu2 [olu
 WEF p z-i d j “lk “v vlyh”l h” HGQ0 wsv “vmj –yyl u”z huk
 ”vs”hnl z hyl hz zovmu pu J pn-yl 682 M p’ vi zly”lk pu “ol
 J pn-yl 680 “oh” j –yyl u”z huk ”vs”hnl z oh”l ohsh”l h”l
 zèt t l “yè2

l svhk j –yyl u” gMOS – “w-“ Zvs”hnl gZ4+huk Ej “p’l
 wμly T4 h” “opz vlyh”p’u vm “ol WEF hyl n’p’lu pu “ol
 msvμ pun l @yl zpvuz jvuzklypun J pn-yl 68 yl zwlj “p’l sè
 b64d2

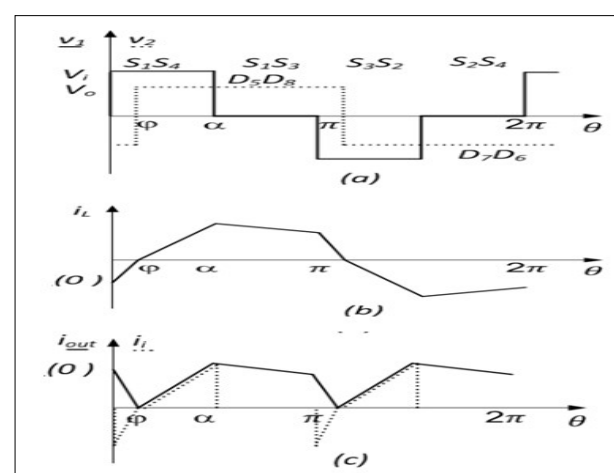
$$I_{o,DCM} = \frac{V_i \pi \alpha^2}{2 \omega L \pi^2} \left(\frac{V_1}{V_0} - 1 \right) , <$$

$$V_{0,DCM} = V_i \frac{R_L \alpha^2}{4 \pi \omega L} \left[-1 + \sqrt{1 + \frac{8 \pi \omega L}{R_L \alpha^2}} \right] , =$$

$$P_{0,DCM} = \frac{V_i V_0 \pi \alpha^2}{2 \pi^2 \omega L} \left(\frac{V_i}{V_0} - 1 \right) , 54-$$



J m2682 WEF Gvu”lyly G –yyl u” huk Zvs”hnl [h”l myt z
 –ukly HGQ b64d



J m2692 WEF Gvu”lyly G –yyl u” huk Zvs”hnl [h”l myt z
 –ukly GGQ b64d

S u “ol v’ol y ohuk0 –ukly GGQ0 “ol WEF φ” vs”hnl z huk
 j –yyl u”z hyl zovmu pu J pn-yl 692

Yukly “opz jvukp’pu0 “ol j –yyl u” zop huns p’j hsj –sh”l k hz
 zovmu pu “ol msvμ punl @yl zpvuz2

$$\varphi = \frac{\pi}{2} \left(\frac{\alpha}{\pi} - \frac{V_0}{V_1} \right) , 55-$$

l Pvhk j –yyl u” gM –v-“w-“ vs”hnl gZ4+huk hj “p’l wμly
 gT4kl s’lylk –ukly “ol GGQ jvukp’pu hyl n’p’lu i è “ol
 msvμ punl @yl zpvuz b64d2

$$I_{0,CCM} = \frac{\pi V_1}{2 \omega L} \left[\frac{\alpha}{\pi} - \frac{1}{2} \left(\frac{\alpha}{\pi} \right)^2 - \frac{1}{2} \left(\frac{V_0}{V_1} \right)^2 \right] , 56-$$

$$V_{0,CCM} = V_1 \frac{2\omega l}{\pi R_L} \left[-1 + \sqrt{1 + \left(\frac{2\alpha}{\pi} - \frac{\alpha^2}{\pi^2} \right)^2 \left(\frac{\pi R_L}{2\omega l} \right)^2} \right], \quad 57-$$

$$P_{0,CCM} = \frac{\pi V_i V_0}{2\omega l} \left[\frac{\alpha}{\pi} - \frac{1}{2} \left(\frac{\alpha}{\pi} \right)^2 - \frac{1}{2} \left(\frac{V_0}{V_i} \right)^2 \right], \quad 58-$$

; 26 VI p'p' v m o p n o x-l u j è "y h u z m y t l y" l j o u v s v n è

M μ h z l h y s p y t l u "p u l k " o h " o l W X j v u z p ' l k v m j v u " l y l y z h " i v " o p u w " h u k v - " w " i l p u n z l w h y h " l k i è " o l L J X 2 l - z l v m L J X " v w y v " p k l n h s " h u j p z v s h " p u p u " o l k l " l s v w t l u " v m " o l W X p z y l z w u z p i s l m y " o l h j o p " l t l u " v m " o l s v μ p z p h A h u k s p n o " μ l p n o " v m " o l W X 2 p z μ h z l @ y l z z l k p u l x - h " p u , 8-2

X v h j o p " l L J X z v t l p t w y " h u " w p u " z h y l " v i l w - " p u " v j v u z p k l y h " p u z 2 l z l p u j s - k l b 6 8 d > , p w y v w l y t h n u l " p t h " l y p h s z l s j " p u " v h j o p " l " o l y l x - p l k o p n o w μ l y k l u z p è h u k s v μ s v z z l z ? , p p l y t h s i l o h " p r y " v h " v p k i y l h r k v μ u l z w l j p h s s è m y o p n o l " v s " h n l h u k o p n o l w μ l y k l z p u z ? , p p p " o l μ p u k p u n j v u n - y h " p u v m " o l L J X j h u z p u p j h u " s è h l j " p z l j p u j è h " o p n o x-l u j è ? , p - M z - s h " p u y l x - p l t l u " h " o p n o l " v s " h n l v w l y h " p u z o v - s k i l j v u z p k l y l k 2

W t l t h n u l " p t h " l y p h s z z - p h i s l m y o p n o w μ l y z h u k " o l p y t l y p z h u k k l t l y p z h y l " h i - s h " l k p u X h i s l 5 b 6 4 d 2

X h i s l 6 Q h n u l " p t h " l y p h s z j v t w h y z v u

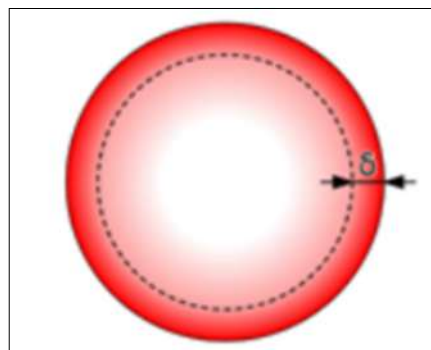
VRv	Qh'l yphs	Ql y p'	Hl t l y p'
5	Wp'z'l s	, p L p n o zh"-yh"p'u -© kl uzp'è , p L p n o w l y t l h i p p'è	, p L p n o s v z z l z h" o p n o v w l y h " l p u n x-l u j è
6	J l y p f l	, p Q v k l y h " l s v z z l z , p P v μ j v z "	, p P v μ zh"-yh"l k -© kl uzp'è
7	J l l Et vywov-z h s v è	, p Q v k l y h " l zh"-yh"p'u -© , p Q v k l y h " l s v z z l z	
8	G v l ht vywov-z h s v è	, p P v μ s v z z l z	, p P p t p l k zh"-yh"p'u -© kl uzp'è
9	R h u v j y è z " h s p u l h s v è	, p L p n o zh"-yh"p'u -© , p P v μ s v z z l z	, p L p n o j v z " , p P p t p l k z l s j " p u v m h " h p h i s l z o h w l z

W r h y O J l l h t v y w o v - z p z j v u z p k l y l k i è z v t l W X k l z p n u l y z h z " o l i l z " 2 p z p i l j h - z l p u h k k p p u " v v " o l y t l y p z 0 p z z h "- y h " p u - © k l u z p è y l h j o l z 5 9 : X 2 X y h u z m y t l y z " y - j " - y l o h z p u - l u j l v u w μ l y k l u z p è h u k l j p u j è 2 l y l m y l 0 " o l z " y - j " - y l j o v p l p z " l y è p t w y " h u " h z w j " v m " o l W X k l z p n u 2 S m " o l " μ v " y h u z m y t l y z " y - j " - y l z , z v s l u v p k h s h u k j v h @ h s 0 z v s l u v p k h s p z " o l t v z " - z l k i l j h - z l v m p z n a s s v μ p u n h k " h u " h n l z b 6 4 d 2

, p I h z p l y " v k l z p u
, p p I h z p l y " v t h u - r h j " - y l
, p p P v μ l y j v z " z

X μ v l l j " z 0 z r p u h u k w y v @ t p è l l j " z t - z " i l w - " p u " v j v u z p k l y h " p u μ o p l k l z p u p u n h u L J X 2 W p u l l j " p z " o l " l u k l u j è v m h u h s " l y u h " p u n l s j " y p j - y l u " " v k p z " y p i - " l μ p o p u h j v u k - j " v y z - j o " o h " o l j - y l u " k l u z p è p z s h y n l z " u l h y " o l z - y h j l v n f o l j v u k - j " v y 0 h u k k l j y l h z l z μ p o n y l h " l y k l w o z p u " o l j v u k - j " v y 2

p l l j " p k l t v u z " y h " l k p u J p n - y l 6 9 2



J p n 2 6 : 2 W p u k l w " o p u h z l j " p u v n h j v u k - j " v y b 6 4 d

E " o p n o x-l u j p z 0 " o l z r p u k l w " o p z z t h s l y h u k " o l y l m y l 0 " o l z r p u l l j " j h - z l z p u j y l h z l p u " o l l l j " p l y l z p " h u j l v m " o l j v u k - j " v y 0 " o - z 0 l k - j p u n " o l l l j " p l j y v z z z l j " p u h s h y l h v m " o l j v u k - j " v y 2 W p u k l w " o p z " o l k l w " o i l s v μ " o l z - y h j l v m " o l j v u k - j " v y h " μ o p o " o l j - y l u " k l u z p è o h z h s l u " v M l , h i v - " 7 ;) v m N l j - y l u " k l u z p è g h u k z r p u k l w " o g + h y l y l z w l j " p l s è n p l u h z n a s s v μ z b 6 4 d >

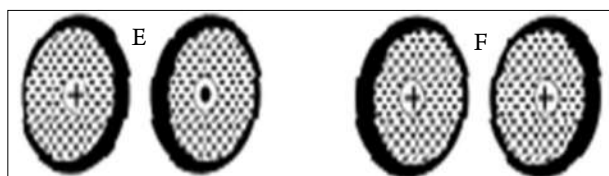
$$J = J_s e^{-d/\delta}, \quad 59-$$

$$\delta = \sqrt{\frac{2\rho}{\omega\mu}}, \quad 5:-$$

[o l y l N p z " o l j - y l u " k l u z p è v u " o l z - y h j l 0 k p z " o l k p z " h u j l n p t z - y h j l h u k g + p z " o l z r p u k l w " o p z " o l y l z p " p p è v m " o l j v u k - j " v y h u k

A 4 y p z " o l w l y t l h i p p'è 2 T y v @ t p è l l j " v j j - y z μ o l u t v l j v u k - j " v y z j h y è p u n h s " l y u h " p u n j - y l u " h y l u l h y i è 2 l k p z " y p i - " p u v m j - y l u " μ p o p u h j v u k - j " v y μ p s i l j v u z y h p u l k " v z t h s l y l n p r u z p n j - y l u " p z v μ p u n " o y v - n o v u l v y t v l v " o l y u l h y i è j v u k - j " v y z 2 l y l z - s " p u n j - y l u " j y v μ k p u n p u j y l h z l z l l j " p l y l z p " h u j l v m " o l j p j - p h u k p p u j y l h z l z μ p o " o l p u j y l h z l p u x-l u j è b 6 4 d 2

T y v @ t p è l l j " p z p s - z " y h " l k p u J p n - y l 6 : 2



J p n 2 6 : 2 T y v @ t p è l l j " μ p o v w w z p l , h - h u k z h t l , i - j - y l u " k p l j " p u z

Xv h lu-hl "ol zrp huk wv@t pèl lj "z-zl vmpPRA
 µpl p uvyt hssè lt wsvèlk i è "ol klzpnulyz vmlJ X2PpRA
 µpl jvuzp"z vmt huè "opu µpl z"yhukz0 pikp"pk-hssè
 puz-sh"lk huk "µp"lk vy µv"lu "vnl"oly0v lu pu zl "lyhs
 sl"lsz2J m-yl 6; zovµzhul @t wsl vmpPRApl 2



J m26<2l @t wsl vmpPRApl

l LJX p "ol t hpu jvt wulu" ilpun -zl k pu "ol
 klzpu vm"ol WXX "v hjo p"l ylk-j "pu pu zpRA"vs-t l huk
 l"lu jvz"2Qhuè h lt w"z oh"l illu t hkl "v vw"t RA"ol
 LJX klzpu myhwwsj h"pu pu "ol WXX z-j o pu b69I74d2

; 27 Gvu"yvt ljohupt

WXX -zlz wµlyjvu"lylyz pu p"z pt wsl t lu"hpv2 p
 z-i zlj "pu µps kpj-zz i ypl è hi v-" wµly jvu"lylyz
 jvu"yvs t ljohupt z "oh" hyl -z-hssè lt wsvèlk µopl
 klzpnupin WXX2S ul vm"ol jvu"yvt ljohupt z my WXX p h
 jsvzklsvvw jvu"yvsly2 p jvu"yvsly pu -z-hssè -zl k pu
 klzpnupin hu WXX "v yln-sh"l "ol jvu"lylyv-"w-" "vs"hn
 huk jvt wuzh"l zv-yjl vsvhk kpz-"yi hujlz2M "opz "èw vm
 jvu"yvsly0 "ol lyyvy il"µllu v-"w-" "vs"hn huk p"z
 ylyhlyl p t p"t pRA vylst pih"lk2 l lyyvy p "ol pu
 hjj-yhj è il"µllu hj "-hsv-"w-" huk "ol pu"lyhlyl 2
 Xv klzpu h klzpl k wµly jvu"lyly jvu"yvsly0 "ol
 mssvµpnt l "ovkvsnpz hyl hkhw"lk2

- , p kl"lsvwt hsszpuhst vklshyv-uk "ol vlyh"pun
 wpu"vnhz"lhkèz"hl
- , p nl"µoly "ol jvu"yvs"v lv-"w-" "yhuzhymuj "pu
 "hrlzwhjl pu "ol jvu"lyly
- , p zwlj pà "ol svvwnhpu l @lj "lk kl wukpun vu "ol
 klzpu zwlj p jh"puz
- , p- Hl zpu jvu"yvsly "yhuzhymuj "pu "v t h"o "ol
 klzpl k svvwnhpu

Tyvwy"puhslM"lyhs , TM jvu"yvsly p "ol t vz"
 jvt t vusè -zl k jvu"yvsly my wµly jvu"lylyz2 Plhk
 Gvt wuzh"vy, PG- p hu hsl yuh"p"l "v jvu"yvsly my wµly
 jvu"lyly b75d2 l jvt wuzh"vy pujyl hzl z "ol svvwnhpu
 wohzl lt hymp2Hphk"hu"hn vm"ol "µv jvu"yvslyz , TMhuk
 PG- µoj o hyl t hpusè klzpnul k myh zpnsl vlyh"pun wpu"p
 "oh"0"ol è hjo p"l vusè pu upl nhpu h" HG2 lyl myl 0p p
 kp j-s "v ylhjo RAv zlhkèz"hl lyyvy µolu "ol
 kpz-"yi hujl vyl ylyhlyl p hu EG zpuhs h" svµ nxl x-luj è
 b76d2 KhpuVolk-sun Gvu"yvs , KWG- p hu pt wv"lk
 jvu"yvs "ljoupx-l jvt whyl k "v TMhuk PG2Eslyuh"p"l "v
 KWG p Ekhw"p"l Gvu"yvs , EkG-2 l EkG hkq-z"z jvu"yvs
 whyht l"lyz2Xv hjo p"l i l ylywmyt hujl pu KWG0vulspul
 whyht l"ly p lt wsvèlk2 Yz-hssè0 hkhw"p"l jvu"yvs p

lt wsvèlk vu hzèz"lt µolu p"z z"y-j "-yl p ruvµu µopl p"z
 whyht l"lyz hyl -uruvµu vy "hyèpun b76d 2S "olyvuvul hy
 t l "ovkz vmwµly jvu"lyly jvu"yvslyt wsl t lu"hpv hyl
 b77d > p Fhjr lz"l wµpini hzl k vu Pèhw-uv" muj "pu huk p
 J-RAvnpj 2

; 28 Qvk-sh"pu Xljoupx-l

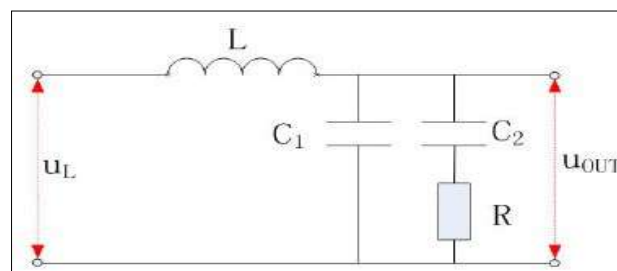
Qvk-sh"pu "ljoupx-lz my wµly jvu"lylyz hyl
 kl"lsvwk pu "ol mssvµpnt b78I7: d2

- , p Zvs"hn Pl"ls Fhzk Esnyv"ot z , ZPFE- p
 t l "ovk vlyh"l z pu "pt l kvt hpu2 T-sz [pk"o
 Qvk-sh"pu , T[Q- p "ol t vz- -zl k "vs"hn sl"ls
 i hzl k t vk-sh"pu "ljoupx-l? "opz p iljh-zl vmpz
 opno wlymyt hujl0 zpt wsj pè0 @k zµ p"j opun
 nxl x-luj è huk lhzè kpphs huk huhsn
 pt wsl t lu"hpv2
- , p Whjl Zlj "vy Fhzk Esnyv"ot z , WZFE- M "opz
 t vk-sh"pu "ljoupx-l0"ol ylyhlyl "vs"hn p ylw
 ylzul k i è h ylyhlyl "lj"vy2Yuspl pu "ol "pt l
 kvt hpu µoly h wohzl ylyhlyl p -zl k0ol ylyhlyl
 lujl "lj"vyz -zl k "v jvt w-"l "ol zµ p"j opun "pt lz
 huk z"hl z2M WZFE0u-t il yvmyl k-ukhu"zµ p"j opun
 z"hl z huk jvt wsl @è vmzsl j "pun z"hl z pujyl hzl
 µp"o pujyl hzl pu u-t il yvml"lsz2

Es"ov-no "oly hyl zl"lyhs zwjl "lj"vy i hzl k
 hsnv"ot z0jhypl y i hzl k T[Q p h kvt pihu" t vk-sh"pu
 "ljoupx-l pu jvu"lylyz vlyh"puz2 p p iljh-zl0 p
 ylx-pl z h ylyhlyl zpuhs0 jhypl zpuhs0 huk h zpt wsl
 jvt whyt"vy my "ol nh"pun zpuhsz2S u "ol v"oly ohuk0Whjl
 "lj"vy i hzl k hsnv"ot z ylx-pl h"sl hz "oyl z"hn z>h z"hn
 "v zl sl j "ol "lj"vyz myt vk-sh"pu0h z"hn "v jvt w-"l "ol
 k-"è jèsl huk h z"hn µoly "ol zlx-lujl my "ol "lj"vyz p
 nl ul yh"lk2 p t lhuz "oh" "ol zwjl "lj"vy hsnv"ot z oh"l
 opno lyohyµ hyl ylx-pl t lu"z "ohu "ol T[Q "ljoupx-l z2

; 29 Jp"ly

Jp"lyz hyl -zl k h" puw-" vy v-"w-" z"hn vmWXX "v
 h lu-hl wvwhnh"pu vnohyt vupj z b7; d2E "èwjs puw-" vy
 v-"w-" sl"ypz zovµu pu J m-yl 6; 2
 E sl"y my WXX jhu l p"ol y il jvt wzl k vmPG , Mk-j "vy0
 Ghwhj p"vy vy PGV , Mk-j "vy0Ghwhj p"vy huk Vlpz"vy-2M
 J m-yl 6; 0hu PGG "oyl vykly sl"y "vwsvne jvt wzl k vm
 PGV p zovµu2 l PGV jhwhi p"è v-"lu l pnoz "oh" vm"ol
 PG2 p p iljh-zl0 "ol PGV jhu il ly ylyz"yhu" opno
 nxl x-luj è pu"lyhlyl huk jhu ylk-jl nhpu pu ylvuhyl
 vl hr wpu" b7; d2



J m26=2 E z"y-j "-yl "èwjs h Jp"ly my WXX b7; d

S wl u svvw "yhuzyhmuj" pru vñol sly pu J pñ-yl 6; pñpl u hz mssvµ z b7; d>

$$G(s) = \frac{u_{OUT}(s)}{u_L(s)}, S; -$$

$$= \frac{sRC_2 + 1}{S^3 RC_1 C_2 L + S^2 (C_1 + C_2) L + SRC_2 + 1}$$

Yz-hssè G₆ lx-hsz 537 vy 536G₅ 2Ezz-t pin0G₅ A G₆ A G₀ "ol yl mly 0 lxu2, 65- j hu i l zpt wsp l k hz mssvµ z b7; d>

$$G(s) = \frac{u_{OUT}(s)}{u_L(s)}$$

$$= \frac{sRC_2 + 1}{S^3 RC^2 L + 2S^2 CL + SRC + 1}$$

Rh-yhs vzj psh"pru mly x-luj è huk kht wpu yh"pru j hu i l l @wyl zkl k hz mssvµ z j vuzpkl ypu J pñ-yl 6; yl zwj j "pñl sè b7; d2

$$\omega_n = \frac{1}{\sqrt{LC}}, S=-$$

$$\xi = \frac{1}{R} \sqrt{\frac{L}{C}}, 64-$$

µ ol yl 0 0 V0 hyl kht wpu yh"pru huk kht wpu yl zpv vy yl zwj j "pñl 2

M j hu i l k l k-j l k mxt l xu2, 64- "oh"0 kht wpu yh"pru pñ "l yz pñ wvwvy"pruhs "v kht wpu yl zpv vy zv sun P huk G hyl r l w" j vuz"hu"2 Tyvwy j ovj l vñol kht wpu yl zpv vy pñ "l yè pñ wvy"hu" pñ "ol kl zpu vñol sly2 pñ pñ i l j h-zl "ol yl zpv vy hz pñ j vt z-t wz wµ l y0 pñ h l j "z l j pñ u j è vñol WXX2

8. OBSTACLE OF OST TO UNIVERSAL ACCEPTANCE

M pñ nvvk "v yl l l t wohz pñA"oh" j y pñ hs u l l k "v pu j yl hz l ul ynè l j pñ u j è huk zhrh"è pu "ol l s j "y pñ hs pñ k-z"yè pñ v ul vñol t hqy wyvi s t z i l puñ rhj l k i è l s j "y pñ hs wµ l y pñ k-z"yè "oh" ul j l zzh"l z h j o m y z v s "pñ u 2 S "ol y wyvi s t z hyl > M ol yl u "uh"-yl v m y l ul µ h i s l ul ynè 0 pñ "y h k pñ pñ u h s t v u pñ v y pñ u j o l t l z, l h 2 WGEHE- t h è u v "wvy"pñ l l u v-no k l s pñ è "v h k l x-h"l s è t v u pñ v y n l ul y h "pñ u 2

M "pñ µ vñol m y l n pñ u j w y i s t z 0 WXX pñ w y v w z l k "v yl wshj l P J X k-l "v zvt l v m pñ z h k"hu"hn l z h z l u-t l y h"l k l h y s pñ y 2 L v µ l "l y 0 WXX k v l z u v "w l ul "y h"l "ol l s j "y pñ ul "µ v y r n s i h s s 2 pñ pñ k-l "v "ol m s s v µ pñ u b 7 < d>

, p V l s h i pñ è > P J X o h z i l l u z l u "v i l o pñ s è y l s h i s l 2 M v w l y h"l z pñ o h y z o l u "pñ v u t l u "2 S u "ol y v "ol y o h u k 0 WXX k-l "v -z l v m l t pñ v u k-j "v y t h è u v "i l h z y l s h i s l h z "ol P J X 2 pñ j o h u n l j h u i l z pñ u pñ j h u "s è y l k-j l k 2

, pñ G v z " > G v z " pñ h r h j "v y "oh" pñ w- pñ u t v y l j v u k l u j l pñ "ol t pñ k z vñol -z l y z v m l s j "y pñ pñ è huk "ol -"pñ è h z y l n h y k -z l v m P J X h z h n h pñ z "ol WXX 2 Y z l v m z l t pñ v u k-j "v y z huk v "ol y k l "pñ l z o

yl x-pñ l z o-nl t h pñ "l u h j l j v z "2 L v µ l "l y 0 yl z l h j o l y z t h è pñ w y v "l v u "o pñ h y l h 2

, pñ I j pñ u j è > l R h "pñ u h s l s j "y pñ h s Q h u -r h j "-yl y z E z z v j pñ "pñ u -z j s h z z S l j pñ u j è y h "pñ u pñ k j h"l z "oh"0 h 7 4 r Z E P J X t -z "oh"l h u l j pñ u j è v m y l h"l y "ohu =; 2) 2 E j v t w h y i s l W X X "v "o pñ P J X t h è o h"l h u l j pñ u j è v m r h y s l z z "ohu "o pñ "h s-l 2 W X X pñ "v s"l z t h u è j v u "yl z pñ u z "h n l z µ o j o z v t l "pñ l z y l k-j l z pñ z v "l y h s l j pñ u j è 2 L v µ l "l y 0 "o pñ j v -s k i l h "o pñ u vñol r h z "pñ h u l h y m "-yl 2

9. FUTURE RESEARCH

l m s s v µ pñ u h y l z v t l v m "ol h y l h z y l x-pñ y pñ v y -z y l z l h j o "v l u h i s l "ol W X X j v t w s l "l s è y l w s j l "ol P J X pñ "ol l s j "y pñ ul "µ v y r 2

, p W X X y l s h i pñ è pñ t w y v "l t l u "

, pñ M w y v "l t t l u "v m W X X w y v "l j "pñ u

, pñ Y z l v m pñ u "v s "h n l k l "pñ l z "v pñ w y v "l l j pñ u j è

, pñ M j h h z l v m -z l Q -s "pñ l "l s j v u "l y l y z pñ "ol k l z pñ u v m "ol W X X 0 v w "pñ t -t u -t i l y v m s l "l s z o v -s k i l pñ l u "pñ l k 2

, "- T v z z pñ pñ è v m l u h i s pñ u s v µ s v z z o pñ o j -y l u " Q J pñ "l y j v u u l j "pñ u z v w w y "-u pñ è

, p W s l j "pñ u v m w y v w y pñ z -s h "pñ u t h "l y h s z -u k l y Q J "v s "h n l W y l z z 2

10. CONCLUSION

l w h w l y n s h u j l k pñ "ol W X X "l j o u v s n è µ pñ o "ol "pñ µ "v pñ l u "pñ u pñ u o l y l pñ z "l j o u v s n è z "h y l k 0 µ o l y l pñ pñ C E u k o v µ j h u pñ i l pñ t w y v "l k pñ "ol m "-yl 2 M pñ l "pñ l u "oh" µ pñ o "ol h y l h z v m j y l z h n h pñ z "W X X i l pñ u h y pñ k i è y l z l h j o l y z y l z v s "l k 0 "ol "y h u z m y t l y j h u y l w s h j l "ol P J X pñ "ol l s j "y pñ ul "µ v y r 2

AUTHOR INFORMATION

G v y l z w u k pñ u E -"o v y

. T o v u l > / 6 7 8 < 4 9 9 9 9 5 4 6 4

I t h p s > t h t i p s h 6 4 4 4 D è h o v v 3 v t

S V G M I 

F h z o pñ Q -z h Y t h y > 4 4 4 4 1 4 4 4 6 I 4; < = k 9 6 9

Q -z h Q v o h t t l k > 4 4 4 4 1 4 4 4 7 I 7 8; 7 l k 6 4 <

ACKNOWLEDGEMENTS

[l h j r u v µ s k n l k j v u "y pñ -"pñ u v m W X X h k h pñ pñ u -u k h "pñ u 0 R pñ l y h m y z -w w y "pñ u "ol µ v y r µ pñ o h n y h u "2

REFERENCES

- b5d R2 O2 Vñoh huk Q2 Q2 K-wñh0 Mñvk-j "pñ u "v Qñj v j v u "v s l y z 2 6 4 4 5 2
- b6d V2 Wñññ j r p huk K2 Fl u è z l r 0 T v µ l y l s j "y pñ z pñ z t h y "l s j "y pñ h s l u l y n è u l "µ v y r z 0 T v µ l y l y z "2" v s 2 7 8 0 6 4 4 < 0 k v p > 5 4 5 4 4; 3 =; < 1 5 < 8 < 4 4 I 7 5 < l; 2
- b7d N V 2 P h p 0 [2 L 2 P h p 0 V 2 Q v v u 0 P 2 a o h u n 0 h u k E 2 Q h p 1 y h 0 E 5 9 I r Z j s h z z pñ "l s pñ l u " -u pñ l y z h s "y h u z m y t l y m y -"pñ è h w s j h "pñ u z 0 pñ G v u t h y l u j l T y v j l l k pñ u z 1 M I I E w s pñ k T v µ l y l s j "y pñ z G v u t h y l u j l h u k I @ w z pñ pñ u 1 E T I G 0 6 4 5; 0 " v s 2 6 4 5; 1 Q h è 0 w s 2 5 =; 8 5 = < 5 0 k v p > 5 4 5 4 = 3 E T I G 2 6 4 5; 2 8; < 5 7 = 2

- b8d W2 Fo-zr-“10 Q2 Z2 W2 Thuyhy0 huk Q2 H2 W2 Th”p0
Qvkl spun huk Wt -sh“pru vni Wsk IWh”l Xyhuznmyt ly0
M“2NI un2Wj2Vl z2Xl jouvsn0”v290uv270ww2995
99<0645: 0kvp>54Z54=53NIuvkv2<68<2
b9d T2 O2 Tyl“oh huk T2 W2 Gohukyht vohuhu Rhp0
Qvkl p k p“yp -“pru “yhuzynt ly may luohujpun
wuly x-hspè pu kp“yp -“pru zèz”lt z0 M“2N Tvuly
Isj jyvuz2 Hjp”l Wèz”0”v2; 0 uv2 80 ww2 57<: 57=60
645: 0kvp>54Z54=53NIuvkv2<68<2
b: d Z2 a 2 Qhu-zv”0 Q2 O2 R hRav”0 huk H2 Q2 Mhuv”0
Euhèz lz vm Isj“yp hs Thyht l”lyz vm Tvuly
Xyhuznmyt lyz p p0 W-wlyjvuk-j“pun [pukpunz0 pu
M“lyuh”pruhs Gvuthylujl vm”v-un Wlj jphz”z vu
Qp yw3R huv”l jouvsvnl z huk Isj jvu Hl”p l z0l HQ0
645=0”v2 645=INul0 ww2 98; 9950 kvp> 54Z54=3
I HQ 245=2<674=52
b; d V2G2Q hsh0V2Xypwh”0è0V2Xhkl whsp0huk H2V2Vl kkè0
Tlymyt hujl huhsèz pz vm“oyl1 wohzl zvsk z”h”l
“yhuzynt lyz0 6456 M“2Gvun2Hl”p l z0Gpj -p”z Wèz”2
MGGHW 64560 ww2 8<; 8=40 64560 kvp> 54Z54=3
MGGHWèz”24562 5<; : 62
b<d X2Khq p r 0G2Wv v0W2Wèuzr p0huk Q2Qhspv p r p0
Tvyz”lh-s”v wlyh”pru vmoèi yk HGIHG jvu”ly”ly may
Wsk IWh”l Xyhuznmyt ly0 pu Tyvj l l kpinz MIGS R 645;
1 87yk Euv-hs Gvuthylujl vm“ol MII M k-z”yphs
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97; =0kvp>54Z54=3MIGS R 245; 2<65: =752
b=d NI 2L -i ly huk N[2Ovshy0 Wsk IWh”l Xyhuznmyt lyz>
S u“ol S ynpuz huk I”vs-“pru vmOl è Gvuj l w”z0 MII
Mk2I Isj jyvuz2Q hnd”v2540uv270ww25= 6<0645: 0kvp>
54Z54=3QNI 245: 29<<; <2
b54d J 2Zlj hly yi huv0Q2W2Es”hly RIA”s”hyk v0E2E2Vl j hskl 0
huk J 2 Qvuj hèv IVl h0 Wsk IWh”l Xyhuznmyt ly may
I ul ynè I j p u j è I uohuj l t lu”0 pu Vl z h y j o Xylukz
huk Gohs unl z pu W hy”Kyk20M”l j o S w l u064642
b55d E2 Ei -IVhkh0 N F-kp p0 huk E2 Ei kv-0 Wsk Wh”l
Xyhuznmyt lyz Xvwsvnl z0 Gvu”jvsl yz0 huk
Ewswj h”pruz> Wh”l lvn”ol IEy” Pp”l yh”-yl V l”p l u 0
Isj jyvuz20”v2; 0uv26=<0ww25 5<0Rv”2645<0kvp>
5427=43l sj jyvuz2; 5546=<2
b56d W2Fpk huk W2Hvz0 M”l spn u” -up”lyzhs “yhuzynt ly
kl zpun huk hwsj h”pruz0 pu 64 “o M”lyuh”pruhs
Gvuthylujl vu Isj jyp p è H p z y p -“pru Thwly 54760
644=0uv254760ww2< 552
b57d Y2 Xhopy I “hs0 Hl zpnu vm“oyl1 wohzl zvsk z”h”l
“yhuzynt ly kl wvèl k p p0pu t -s”p z”hnl wuly
z p p j opun jvu”ly”lyz0 Ewms2Wj p0”v2=0uv25; 0645=0
kvp>5427=43hww=5; 79892
b58d J 2W6l huk E2L -hun0 Wsk z”h”l “yhuzynt ly pu “ol
m”-yl zt hy”l sj jhszèz”lt 0 64572
b59d E2 Vlot hu huk Q2 Ezoyh0 Hl zpnu huk Euhèz pz vm
T[Q M”ly”ly may 544OZE Wsk Wh”l Xyhuznmyt ly pu
h H p z y p -“pru Wèz”lt 0 MII Ejj l z0”v2; 0ww2584596
5845: <0645=0kvp>54Z54=3hjj l z245=2<868662
b5: d J 2 Fpu-jvsv0 Q2 Fly”vs-RA0 huk G2 Jvu”huh0
Ewswj h”pruz vm”ol zvsk z”h”l “yhuzynt ly jvuj l w”p
“ol Isj jyp hs wuly zèz”lt 0 pu 6459 EIM
M”lyuh”pruhs Euv-hs Gvuthylujl 0 EIM 64590 64590
uv2J li y-hyè 645; 0kvp>54Z54=3EIM 24592 8596792
b5; d R2 Zlyt h0 R2 Wuno0 huk W2 “hkh”0 Wsk z”h”l

Xyhuzm̄yt l̄yz m̄y W̄sk̄lW̄h̄l̄ Xyhuzm̄yt l̄y
Ew̄s̄j̄h̄p̄vuz0 p̄i <“o Tv̄m̄lyI s̄j̄ “yv̄uj̄z0Hyp̄l̄ W̄z̄l̄t̄ z
* Xl̄j̄ouv̄sv̄n̄p̄z, TI H̄W̄K̄Ḡ 645; -0645; 0ww258 5: 2
b75d E2 V2 Esvuzv0 N̄ Wī lz̄“hu0 H2 K2 Pht̄ hy0 Q2 Q2
L̄lyhukv0huk E2Zh̄R̄Āl̄ R̄ĀEu v̄”l̄yhs̄z̄–k̄è vnh̄H–hs̄
Ej̄“p̄l̄ Fȳp̄k̄nl̄ m̄y īp̄k̄p̄l̄j̄“p̄v̄uhs̄ HG3HḠ j̄vu”l̄yzp̄vu0
6454 M̄ĪĪ Īul̄yn̄è Ḡvu”l̄yz2Ḡv̄uny2Ī @w2Ī ḠGĪ 6454
Ī Tyvj̄D̄ ww2 556= 55790 64540 kv̄p̄ 54554=3
Ī ḠGĪ 5454D̄: 5; <8; 2
b76d L̄2a ov–0E2Q2Ooht̄ ī h̄kr̄vul̄0huk̄]̄ 2Ov̄un0 Th̄z̄p̄p̄f̄è
lī h̄zl̄k̄ j̄vu“ȳvs̄m̄ȳhu p̄i“l̄ys̄l̄h̄”l̄k̄ j̄–ȳyl̄u“l̄rh̄k̄ m̄ss̄lī ȳp̄k̄nl̄
j̄vu”l̄ȳl̄ȳ μ̄p̄ō h̄ μ̄p̄kl̄ v̄w̄lȳh̄“p̄un̄ ȳhun̄l̄ –z̄p̄un̄ “ol̄
Fȳh̄è“vūl̄Q̄v̄z̄lȳ m̄yt̄ 0 M̄ĪĪ X̄yh̄uz̄2 Tv̄m̄lȳ Īs̄j̄ “yv̄ūD̄
”vs̄2 680 uv2 =0 ww2 648; 649: 0 644=0 kv̄p̄ 54554=3
XTĪ P̄544=54658652
b77d G2 Gl̄j̄h̄“p̄J̄ 2 Ḡh̄uj̄l̄ h̄0 huk̄ T2 V̄h̄uv̄0 Ē t̄ –s̄“p̄l̄”l̄s̄
p̄i“l̄ȳl̄ȳ m̄y wov̄“v”vs̄“h̄j̄ z̄èz̄“l̄t̄ z̄ μ̄p̄ō m̄R̄Ā sv̄n̄j̄
j̄vu“ȳvs̄0 M̄ĪĪ X̄yh̄uz̄2M̄k̄2Ī s̄j̄ “yv̄ūD̄”vs̄29; 0uv̄2560ww2
8559 8569064540kv̄p̄54554=3X̄N̄Ī5454548855=2
b78d P2K2J̄ ȳh̄ux–l̄sv̄0N̄M̄P̄l̄ vu0huk̄ Ī 2H̄vt̄ p̄un̄–l̄ R̄ĀV̄l̄j̄l̄u“
h̄k̄”h̄uj̄l̄ z̄ p̄i op̄ōl̄w̄μ̄lȳ p̄uk̄–z̄“ȳh̄s̄ h̄w̄s̄j̄h̄p̄vuz0 M̄ĪĪ
M̄2 W̄t̄ w2 M̄k̄2 Īs̄j̄ “yv̄ūD̄ ww2 9 540 64540 kv̄p̄
54554=3M̄W̄Ī5454D̄: 7; : 9: 2

b79d Z2L̄ 2Tȳt̄zh̄k̄0H2F̄vȳv̄èl̄”j̄j̄ o0huk̄ V2a ohun0 Euh̄s̄èz̄p̄
huk̄ j̄vt̄ wh̄yp̄zv̄u v̄m̄z̄wh̄j̄l̄ ”l̄j̄“vȳ t̄ vk̄–s̄h̄“p̄v̄u z̄j̄olt̄ l̄z̄
m̄ȳ h̄ m̄–ȳk̄l̄ n̄”vs̄“h̄nl̄ z̄v̄–ȳj̄l̄ p̄i“l̄ȳl̄ȳ0 p̄i Ḡv̄ūth̄yl̄uj̄l̄
Tȳvj̄l̄l̄k̄p̄un̄z̄ Ī M̄ĪĪ Ew̄s̄j̄d̄k̄ Tv̄m̄lȳ Īs̄j̄ “yv̄uj̄z̄
Ḡv̄ūth̄yl̄uj̄l̄ huk̄ Ī @w̄z̄p̄p̄v̄ū Ī ĒT̄Ī ḠŌ5=; 0”vs̄260ww2
<: 8 <; 50kv̄p̄54554=3h̄w̄l̄j̄ 5=; 9; 9; 8; 2
b7: d Q2V̄ht̄ h̄w̄ȳzh̄k̄ V̄l̄k̄k̄è0X2F̄ȳhot̄ h̄uh̄uk̄h̄ V̄l̄k̄k̄è0huk̄ F2
F̄ȳhot̄ h̄ph̄o0 H̄p̄j̄yl̄“l̄ z̄wh̄j̄l̄ ”l̄j̄“vȳ t̄ vk̄–s̄h̄“p̄v̄u
h̄sn̄v̄ȳp̄ot̄ ī h̄zl̄k̄ ”l̄j̄“vȳ j̄vu“ȳvs̄l̄k̄ p̄uk̄–j̄“p̄v̄u t̄ v̄“vȳ
k̄ȳp̄l̄0 M̄ĪĪ s̄j̄ “ȳ2Ī un̄D̄”vs̄2580uv̄260ww27; 5 7; ; 064582
b7; d]̄ 2P̄”0” 2]̄ –0]̄ 2a ohun0huk̄ X2a ov–0 W̄–k̄è vū h̄ul̄ μ̄
“v̄w̄sv̄n̄è v̄m̄w̄μ̄lȳl̄s̄j̄ “yv̄uj̄ “ȳh̄uz̄m̄yt̄ l̄ȳ0 p̄i 645; 6uk̄
M̄2ȳuh̄“p̄v̄uhs̄ Ḡv̄ūth̄yl̄uj̄l̄ vū Tv̄m̄lȳ huk̄ V̄l̄ul̄μ̄h̄īs̄
Īul̄yn̄è0M̄ĒT̄V̄Ī 645; 0645<0”vs̄2540uv̄2550ww26<5
6<90kv̄p̄54554=3M̄ĒT̄V̄Ī 545; 5; 7=49872
b7<d O2 W̄2 Kh̄k̄np̄0 W̄S̄ P̄N̄H̄ĪW̄K̄EX̄Ī X̄ R̄W̄S̄ V̄Q̄Ī V̄W̄0
uv2: 0ww2764 7680645: 2



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