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You can read the recommendations in the user guide, the technical guide or the installation guide for MAXTOR QUANTUM FIREBALL LCT20. You'll find the answers to all your questions on the MAXTOR QUANTUM FIREBALL LCT20 in the user manual (information, specifications, safety advice, size, accessories, etc.). Detailed instructions for use are in the User's Guide.

User manual MAXTOR QUANTUM FIREBALL LCT20
User guide MAXTOR QUANTUM FIREBALL LCT20
Operating instructions MAXTOR QUANTUM FIREBALL LCT20
Instructions for use MAXTOR QUANTUM FIREBALL LCT20
Instruction manual MAXTOR QUANTUM FIREBALL LCT20

Quantum

**Quantum Fireball lct20 10.0/20.0/30.0/40.0 GB AT
Product Manual**

October 25, 2000
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&RPPDQG 7DEOH &RQILJXUDWLRQ &RPPDQG)RUPDW 7DEOH &RPPDQG (UURUV 7DEOH 7DEOH 7DEOH 7DEOH 7DEOH YLL 4XDQWXP)LUHEDOO OFW *% \$7 &KDSWHU %\$287 7+,6 0\$18\$/ 7KLV FKDSWHU JLYHV DQ RYHUYLHZ RI WKH FRQWHQWV RI WKLW PDQXDO LQFOXGLQJ WKH LQWHQGHG DXGLHQFH KRZ WKH PDQXDO LV RUJDQLJHG WHUPLQRORA DQG FROYHQWLRQV DQG UHIHUHQFHV \$8' (1 & (7KH 4XDQWXP)LUHEDOO OFW *% \$7 3URGXFW ODQXDO LV LQWHQGHG IRU VHYHUDO DXGLHQFHV 7KHVH DXGLHQFHV LQFOXGH WKH HQG XVHU LQVWDOOHU GHYHORSHU FRQVXPHU HOHFWURQLFV DQG SHUVRQDO FRPSXWHU RULJLQDO HTXLSPHQW PDQXIDFWXUHU & (3 & 2(0 DQG GLVWULEXWUR 7KH PDQXDO SURYLGHV LQIRUPDWLRQ DERXW LQVWDOODWLRQ SULQFLSOHV RI RSHUDWLRQ LQWHUIDFH FRPPDQG LPSOHPHQDWLRQ DQG PDLQHQDQFH 0\$18\$/ 25*\$1, = \$7,21 7KLV PDQXDO LV RUJDQLJHG LQWR WKH IROORZLQJ FKDSWHUV &KDSWHU \$ERXW 7KLV ODQXDO &KDSWHU *HQHUDO 'HVFULSWLRQ &KDSWHU ,QVWDOODWLRQ &KDSWHU 6SHFLILFDWLRQV &KDSWHU %DVLF 3ULQFLSOHV RI 2SHUDWLRQ &KDSWHU \$7\$ %XV ,QWHUIDFH DQG \$7\$ &RPPDQGV 7(50,12/2 * \$1' & 219(17,216 ,Q WKH *ORVVDU DW WKH EDFN RI WKLW PDQXDO VR FDQ ILQG GHILQLWLRQV IRU PDQ\ RI WKH WHUPV XVHG LQ WKLW PDQXDO ,Q DGGLWLRQ WKH IROORZLQJ DEEUHYLDWLRQV DUH XVHG LQ WKLW PDQXDO \$6, & \$7\$ ESL G% G%\$ DSSOLFADWLRQVSHFLILG LQWHJUDWHG FLUFXLW DGYDQFHG WHFKQRORA DWVDFKPHQW ELWV SHU LQFK GHFLEHOV GHFLEHOV \$ ZHLJKWHG 4XDQWXP)LUHEDOO OFW *% \$7 \$ERXW 7KLV ODQXDO '36 636 (& IFL +] .% /6% P\$ 0% 0ELWV 0%V 0+] PV 06% P9 QV WSL V 9 'DWD 3URWHFWLRQ 6VWHP 6KRFN 3URWHFWLRQ 6VWHP HUURU FRUUHFWRUJ FRGH IOX[FKDQJHV SHU LQFK KHUW] NLOREWHV OHDVW VLJQLILFDQW ELW PLOOLDPSHUHV PHJDE\WHV 0% E\WHV ZKHQ UHIHUULQJ WR GLVN VWRUDJH DQG E\WHV LQ DOO RWKHU FDVHV PHJDELWV SHU VHFROG PHJDE\WHV SHU VHFROG PHJDKHUW] PLOOLVHFROGV PRVW VLJQLILFDQW ELW PLOOLYROWV QDQRVHFROGV WUDFNV SHU LQFK PLFURVHFROGV YROWV 7KH WSRJUDSKLFDQ DQG QDPLQJ FRQYHQWLRQV XVHG LQ WKLW PDQXDO DUH OLVWHG EHORZ &RQYHQWLRQV WKDW DUH XQLTXH WR D VSHFLILF WDEOH DSSHDU LQ WKH QRWHV WKDW IROORZ WKDW WDEOH 7SRJUDSKLFDQ &RQYHQWLRQV IDPHV RI %LWV %LW QDPHV DUH SUHVHQWHG LQ LQLWLDO FDSLWDOV PRG HJDPSON LV WKH +RVW 6RIWZDUH 5HVHW ELW &RPPDQGV ,QWHUIDOO VWDQGDUG \$7\$ GDWD WUDQVIHU PRGHV ZLWK 3,2 PRG DQG PXOWLZRUG '0\$ PRGH DQG 80WUD '0\$ PRGH DQG \$GDSWLYH FDFKH VHJPHQWVWDLWLRQ 5HOLDDELWLW KRUVV PHDQ WLPH EHWZHHQ IDLOXUH 07%) LQ WKH ILHOG \$XWRPDWLF UHWU\ RQ UHOG HUURUV ELW LQWHUOHDYHG 5HHG6RORPRQ (UURU &RUHFWRUJ &RGH (& ZLWK FURVV FKHFNLQJ FRUUHFWRUJ XS WR IRXU VHSUDUDWH EXUVVW RI ELWV HDFK WRWDOOLQJ XS WR ELWV LQ OHQJWK 60\$57 6HOIORLWRULQJ \$QDOVLV DQG 5HSRUWLQJ 7HFKQRORA 3DWHQWHG \$LUORFN DXWRPDWLF VKLSSLQJ ORFN PDJQHWF DFWDWRU UHWUDFW DQG GHGLFDWHG ODQGLQJ JRQH 7UDQVSDUHQW PHGLD GHIFW PDSLQJ +LJK SHUIRUPDQFH LQOLQH GHIFWLYH VHFWRU VNLSSLQJ 5HDVVLQPHQW RI GHIFWLYH VHFWRUV GLVFRYHUHG LQ WKH ILHOG ZLWKRXW UHIRUPDWLRQJ 6KRFN 3URWHFWLRQ 6VWHP , WR HQDQFH SURWHFWLRQ DJDLQV ERWK RSHUDWLRQ DQG QRORSHUDWLRQJ VKRFN 'DWD 3URWHFWLRQ 6VWHP WR YHUL GULYH LQWHJULW 4XDQWXP)LUHEDOO OFW *% \$7 *HQHUDO 'HVFULSWLRQ 9HUVWLOLW 3RZHU VDYLQJ PRGHV 'RZORDGDEOH ILUPZDUH &DEOH VHOHFV IHDWXUH \$EOLW WR GDLVFKDLQ WZR GULYHV RQ WKH LQWHUIDFH 5HJXODWRU &RPSOLDQFH 6WDQGDUGV 4XDQWXP &RUSUDWLRQV GLVN GULYH SURGXFWV PHHW DOO GRPHVWLQ DQG LQWHUQDWLRQDO SURGXFW VDIHW UHJXODWRU FRPSOLDQFH UHTXLUHPHQWV 4XDQWXPV GLVN GULYH SURGXFWV FRQIRUP WR WKH IROORZLQJ VSHFLILFDQ\ PDUNHG 3URGXFW 6DIHW 6WDQGDUGV 8QGHUZULWHUV /DERUDWRULHV & 6WDQGDUG 7KLV FHUWLILFDWH LV D FDWHJRU FHUWLILFDWLRQ SHUWDLQLQJ WR DOO LQFK GULYH PRGHOV LQ WKH 86\$ DQG &DQGD 789 5KHLQODQ 6WDQGDUG (1 7KLV FHUWLILFDWH LV D FDWHJRU FHUWLILFDWLRQ SHUWDLQLQJ WR DOO LQFK GULYH PRGHOV 3URGXFW (0,06 4XDOLILFDWLRQV & (0DUN DXWKRULJDWLRQ LV JUDQWHG E 789 5KHLQODQ LQ FRPSOLDQFH ZLWK RXU TXDOLNLQJ XQGHU (1 DQG (1 & 7LFN 0DUN LV DQ \$XVWODOLDQ DXWKRULJDWLRQ PDUNHG QRWHG RQ 4XDQWXPV GLVN GULYH SURGXFWV 7KH PDUN SURYHV FRQIRUPLV WR WKH UHJXODWRU FRPSOLDQFH GRFXPHQW \$61=6 DQG %6 (1 \$SSURYDO IURP 7DLZDQ %60, IXPEHU \$ 4XDQWXPV GLVN GULYHV DUH GHVLJQHG DV D VHSUDUDWH VXEDVVHPE\ WKDW FRQIRUPV WR WKH)& 5XOHV IRU 5DGLDWHG DQG &RQGFHWG HPLVLRQV 3DUW 6XESDUW - &ODV % ZKHQ LQVWDOOHG LQ D JLYHQ FRPSXWHU VVWHP +\$5' \$5(5(48,5(0(176 7KH 4XDQWXP)LUHEDOO OFW KDUG GLVN GULYHV DUH FRPSDWLEOH ZLWK WKH ,%0 3 & \$7 DQG RWKHU FRPSXWHUV WKDW DUH FRPSDWLEOH ZLWK WKH ,%0 3 & \$7 , WRQOHFWV WR WKH 3 & HLWKHU E PHDQV RI D WKLUGSDUW, (FRPSDWLEOH DGDSWHU ERDUG RU E SOXJLQJ D FDEOH IURP WKH GULYH GLUHFWO\ LQWR D 3 & PRWKHUERDUG WKDW VXSSOLHV DQ \$7\$ LQWHUIDFH 4XDQWXP)LUHEDOO OFW *% \$7 *HQHUDO 'HVFULSWLRQ 4XDQWXP)LUHEDOO OFW *% \$7 &KDSWHU ,167\$/\$7,21 7KLV FKDSWHU H[SODLQV KRZ WR XQSDFN FRQILJXUH PRXQW DQG FRQOHFW WKH 4XDQWXP)LUHEDOO OFW *% \$7 KDUG GLVN GULYH SULRU WR RSHUDWLRQ ,W DOVR H[SODLQV KRZ WR VWDUW XS DQG RSHUDWLRQ WKH GULYH 63\$ & (5(48,5(0(176 7KH 4XDQWXP)LUHEDOO OFW KDUG GLVN GULYHV DUH VKLSSHG ZLWKRXW D IDFHSODWH)LJXUH VKRZV WKH H[WHUQDO GLPHQLVLRQV RI WKH 4XDQWXP)LUHEDOO OFW *% \$7 GULYHV)LJXUH 0HFKDQLFDQ 'LPHQLVLRQV RI 4XDQWXP)LUHEDOO OFW +DUG 'LVN 'ULYH 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ 813\$ & .1* ,16758 & 7,216 & \$87,21 7KH PD[LXP OLPLWV IRU SKVLFDQ VKRFN FDQ EH H[FHHGHG LI WKH GULYH LV QRW KDQGOHG SURSHU\ 6SHFLDO FDUH VKRXOG EH WDNHQ QRW WR EXPS RU GURS WKH GULYH ,W LV KLJK\ UHFRRPHQGHG WKDW 4XDQWXP)LUHEDOO OFW GULYHV DUH QRW VWDFNHG RU SODFHG RQ DQ KDUG VXUIDFH DIWHU WKH DUH XQSDFNHG 6XFK KDQGOHQJ FRXOG FDXVH PHGLD GDPDJH 2SHQ WKH VKLSSLQJ FRQWDLQHU DQG UHPRYH WKH SDFNLQJ DVVHPE\ WKDW FRQWDLQV WKH GULYH 5HPRYH WKH GULYH IURP WKH SDFNLQJ DVVHPE\ & \$87,21 'XULQJ VKLSPHQW DQG KDQGOHQJ WKH DQWLVDWLF HOHFWURVWDWLF GLV FKDUJH (6' EDJ SUHYHQWV HOHFWURQLF FRPSRQHQW GDPDJH GXH WR HOHFWURVWDWLF GLVFKDUJH 7R DYRLG DFFLGHQWDO GDP DJH WR WKH GULYH GR QRW XVH D VKDUS LQVWUXPHQW WR RSHQ WKH (6' EDJ DQG GR QRW WRXFK 3 & % FRPSRQHQWV 6DYH WKH SDFNLQJ PDWH ULDOV IRU SRVLEOH IXWXUH XVH :KHQ VR DUH UHOG\ WR LQVWDOO WKH GULYH UHPRYH LW IURP WKH (6' EDJ)LJXUH VKRZV WKH SDFNLQJ DVVHPE\ IRU D VLQJOH 4XDQWXP)LUHEDOO OFW KDUG GLVN GULYH \$ SDFN VKLSSLQJ FRQWDLQHU LV DYDLODEOH IRU PXOWLSOH GULYH VKLSPHQWV)LJXUH 'ULYH 3DFNLQJ \$VVHPE\ 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ)LJXUH 'ULYH 3DFNLQJ \$VVHPE\ RI D 3R\SRUOHQH 3DFN &RQWDLQHU IRWH 7KH SDFN FRQWDLQHU VKRXOG EH VKLSSHG LQ WKH VDPH ZD\ LW ZDV UHFHLYHG IURP 4XDQWXP :KHQ LQGLYLGHG GULYHV DUH VKLSSHG IURP WKH SDFN FRQWDLQHU WKHQ LW VKRXOG EH DSSURSUL DWHO\ SDFNDJHG QRW VXSSOLHG ZLWK WKH SDFN SURYHQW GDP DJH 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ +\$5' \$5(237,216 7KH FRQILJXUDWLRQ RI D 4XDQWXP)LUHEDOO OFW *% \$7 KDUG GLVN GULYH GHSHQGV RQ WKH KRVV VVWHP LQ ZKLFK LW LV WR EH LQVWDOOHG 7KLV VHFWRQ GHVFULEHV WKH KDUGZDUH RSWLRQV WKDW VR PXVW WDNH LQWR DFFRXQW SULRU WR LQVWDOODWLRQ)LJXUH VKRZV WKH SULQWHG FLUFXLW ERDUG 3 & % DVVHPE\ LQGLFDWLRQ WKH MXPSHUV WKDW FRQWURO VRPH RI WKHVH RSWLRQV)LJXUH -XPSHU /RFDWLRQV IRU WKH 4XDQWXP)LUHEDOO OFW +DUG 'LVN 'ULYH)LJXUH -XPSHU /RFDWLRQV RQ WKH ,QWHUIDFH &RQOHFWUR 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ 7KH FRQILJXUDWLRQ RI WKH IROORZLQJ IRXU MXPSHUV FRQWUROV WKH GULYHV PRGHV RI RSHUDWLRQ & 6' DEOH 6HOHFV '6' 'ULYH 6HOHFV 3.



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LUHEDOO OFW *% \$7 ,QVWDOODWLRQ)LJXUH 0RXQWLQJ 6FUHZ &OHDUDQFH IRU WKH 4XDQWXP)LUHEDOO OFW +DUG 'LVN 'ULYHV &\$87,21 7KH 3&% LV YHU FORVH WR WKH PRXQWLQJ KROHV 'R QRW H| FHHG WKH VSHFLILHG OHQJWK IRU WKH PRXQWLQJ VFUHZV 7KH VSHFLILHG VFUHZ OHQJWK DOORZV IXOO XVH RI WKH PRXQWLQJ KROH WKUHDGV ZKLOH DYRLGLQJ GDPDJLQJ RU SODFLQJ XQ ZDQWHG VUWHVV RQ WKH 3&%)LJXUH VSHFLILHV WKH PLQ LPXP FOHDUDQFH EHWZHHQ WKH 3&% DQG WKH VFUHZV LQ WKH PRXQWLQJ KROHV 7R DYRLG VWULSSLQJ WKH PRXQWLQJ KROH WKUHDGV WKH PD|LPXP WRUTXH DSSOLHG WR WKH VFUHZV PXVW QRW H|FHHG LQFKSRXQGV \$ PD|LPXP VFUHZ OHQJWK RI LQFKHV PD\ EH XVHG 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ &OHDUDQFH &OHDUDQFH IURP WKH GULYH WR DQ\ RWKHU VXUIDFH H|FHSW PRXQWLQJ VXUIDFHV PXVW EH D PLQLXP RI PP LQFKHV 9HQWLQDWRQ 7KH 4XDQWXP)LUHEDOO OFW *% \$7 KDUG GLVN GULYHV RSHUDWH ZLWKRXW D FRRQLQ IDQ SURYLGHG WKH DPDLQW DLU WHPSHUDWXUH GRHV QRW H|FHHG) & DW DQ\ SRLQW DORQJ WKH GULYH IRUP IDFWRU HQYHORSH &20%,1\$7,21 &211(&725 -- LV D WKUHLQROH FRPELQDWRQ FRQOHWWRU 7KH GULYH ' & SRZHU FDQ EH DSSOLHG WR VHFWRQ \$ 7KH \$7\$ EXV LQWHUIDFH SLQ XVHV VHFWRQ & 7KH FRQOHWWRU LV PRXQWHG RQ WKH EDFN HGJH RI WKH SULQWHGFLUFXLW ERDUG 3&% DV VKRZQ LQ)LJXUH - ' & 3RZHU DQG \$7\$ %XV &RPELQDWRQ &RQOHWWRU 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ ' & 3RZHU - 6HFWRQ \$ 7KH UHFRPHQGHG PDWLQJ FRQOHWWRU IRU WKH 9' & DQG 9' & LQSW SRZHU DUH OLVWHG LQ 7DEOH 7DEOH J1 Power Connector, Section A 3,1 180%(5 92/7\$*(/9/0\$7,1* &211(&725 7<3(\$1' 3\$57 180%(5 25 (48,9\$(17 - 6HFWRQ \$ 3LQ 9' & *URXQG 5HWXUQ IRU 9' & *URXQG 5HWXUQ IRU 9' & 9' & 1RWH /DEOV LQGLFDWH WKH SLQ QXPEHUV RQ WKH FRQOHWWRU 3LQV DQG RI VHFWRQ \$ DUH WKH DQG YROW UHWXUQV DQG DUH FRQOHWWHG WR JHWKHU RQ WKH GULYH 3LQ &RQOHWWRU \$03 31 /RRVH SLHFH FRQWDFWV \$03 31 96 6WULS FRQWDFWV \$03 31 96 (WHUQDO 'ULYH \$FWLYLW\ /' \$Q H|WHUQDO GULYH DFWLYLW\ /' PD\ EH FRQOHWWHG WR WKH '\$63,2 SLQ RQ -)RU PRUH GHWDLOV VHH WKH SLQ GHVFULSWLRQ LQ 7DEOH \$7\$ %XV ,QWHUIDFH &RQOHWWRU - 6HFWRQ & 2Q WKH 4XDQWXP)LUHEDOO OFW *% \$7 KDUG GLVN GULYHV WKH \$7\$ EXV LQWHUIDFH FDEOH FRQOHWWRU - VHFWRQ & LV D SLQ 8QLYHUVO +HDGHU DV VKRZQ LQ)LJXUH 7R SUHYHVV WKH SRVLEOLW\ RI LQFRUHFWD LQVWDOODWLRQ WKH FRQOHWWRU KDV EHHG E\ UHPRYLQJ 3LQ 7KLV HQVXUHV WKDW D FRQOHWWRU FDQQRW EH LQVWDOOHG XSVLGH GRZQ 6HH &KDSWHU \$7\$ %XV ,QWHUIDFH DQG \$7\$ &RPPDQGV IRU PRUH GHWDLOH LQIRUPDWLRQ DERXW WKH UHTXLUH VLJQDOV SHIHU WR 7DEOH IRU WKH SLQ DVVLJQPHQW RI WKH \$7\$ EXV FRQOHWWRU - VHFWRQ & 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ)25 6<67(06 :,7+ \$ 027+(5%2\$5' \$7\$ \$37(5 <RX FDQ LQVWDOO WKH 4XDQWXP)LUHEDOO OFW *% \$7 KDUG GLVN GULYHV LQ DQ \$7FRPSDWLEOH VVWHP WKDW FRQWDLQV D SLQ \$7\$ EXV FRQOHWWRU RQ WKH PRWKHUERDUG 7R FRQOHWWRU WKH GULYH WR WKH PRWKHUERDUG XVH D FRQGXFWRU ULEERQ FDEOH FRQGXFWRU ULEERQ FDEOH LI XVLQJ 80WUD\$7\$ GULYH LQFKHV LQ OHQJWK RU VKRUWHU (QVXUH WKDW SLQ RI WKH GULYH LV FRQOHWWHG WR SLQ RI WKH PRWKHUERDUG FRQOHWWRU)25 6<67(06 :,7+ \$1 \$7\$ \$37(5 %2\$5' 7R LQVWDOO WKH 4XDQWXP)LUHEDOO OFW *% \$7 KDUG GLVN GULYHV LQ DQ \$7FRPSDWLEOH VVWHP ZLWKRXW D SLQ \$7\$ EXV FRQOHWWRU RQ LWV PRWKHUERDUG RX QHHG D WKLUGSDUW\ ,FRPSDWLEOH DGDSWHU ERDUG \$GDSWHU %RDUG ,QVWDOODWLRQ &DUHIXOO\ UHDG WKH PDQXDO WKDW DFRPSDQLHV RXU DGDSWHU ERDUG EHIRUH LQVWDOOLQJ LW 0DNH VXUH WKDW DOO WKH MXPSHUV DUH VHW SURSHU\ DQG WKDW WKHUH DUH QR DGGUHV RU VLJQDO FRQIOLFV <RX PXVW DOVR LQYHVLJDWH WR VHH LI RXU \$7FRPSDWLEOH VVWHP FRQWDLQV D FRPELQDWRQ IORSS DQG KDUG GLVN FRQWUROOHU ERDUG ,I LW GRHV RX PXVW GLVDEOH WKH KDUG GLVN GULYH FRQWUROOHU IXQFWLRQV RQ WKDW FRQWUROOHU ERDUG EHIRUH SURFHGHQJ 2QFH RX KDYH GLVDEOHG WKH KDUG GLVN GULYH FRQWUROOHU IXQFWLRQV RQ WKH IORSS KDUG GULYH FRQWUROOHU LQVWDOO WKH DGDSWHU ERDUG \$JDLQ PDNH VXUH WKDW RX KDYH VHW DOO MXPSHU VWUDSV RQ WKH DGDSWHU ERDUG WR DYRLG DGGUHVVLQJ DQG VLJQDO FRQIOLFV (RW)RU 6HFWRQV DQG SRZHU VKRXOG EH XWUHQH RII RQ WKH FRPSXWHU EHIRUH LQVWDOOLQJ WKH GULYH 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ &RQOHWWRU WKH \$GDSWHU %RDUG DQG WKH 'ULYH 8VH D SLQ ULEERQ FDEOH WR FRQOHWWRU WKH GULYH WR WKH ERDUG 6HH)LJXUH 7R FRQOHWWRU WKH GULYH WR WKH ERDUG ,QVHUW WKH SLQ FDEOH FRQOHWWRU LQWR WKH PDWLQJ FRQOHWWRU RI WKH DGDSWHU ERDUG 0DNH VXUH WKDW SLQ RI WKH FRQOHWWRU PDWFKHV ZLWK SLQ RQ WKH FDEOH ,QVHUW WKH RWKHU HQG RI WKH FDEOH LQWR WKH KHDGHU RQ WKH GULYH :KHQ LQVHUWLQJ WKLW HQG RI WKH FDEOH PDNH VXUH WKDW SLQ RI WKH FDEOH FRQOHWWRU WR SLQ RI WKH GULYH FRQOHWWRU 6HFUXH WKH GULYH WR WKH VVWHP FKDVVLV E\ XVLQJ WKH PRXQWLQJ VFUHZV DV VKRZQ LQ)LJXUH)LJXUH 'ULYH 3RZHU 6XSSO\ DQG \$7\$ %XV ,QWHUIDFH &DEOHV 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ)LJXUH &RPSOHWLQJ WKH 'ULYH ,QVWDOODWLRQ 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ 7(&+1,48(6 ,1 '5,9(&21) ,*85\$7,21 7KH 0HJDEWHV %DUULHU 20GHU %%,26 WKDW RQO\ VXSSRUW ,Q FRPPDQGV IRU DFFHVVLQJ \$7\$ GULYHV WKURXJK '26 EDVHG RSHUDWLQJ VVWHPV ZLOO EH OLPLWHG WR XVH RQO\ FOLQGHUV 7KLV ZLOO UHGXFH WKH HIIHFWLYH FDSDFLW\ RI WKH GULYH WR 0EWHV :KHQYHU SRVVLEOH WKH 4XDQWXP)LUHEDOO OFW *% \$7 GULYH VKRXOG EH XVHG RQ VVWHPV WKDW VXSSRUW %\$ WUDQVODWLRQ WR HQVXUH WKH XVH RI WKH HQWLUH FDSDFLW\ RI WKH GLVN GULYH ,I WKDW LV QRW SRVVLEOH WKH IROORZLQJ DUH VRPH WHFKQLTXHV WKDW FDQ EH XVHG WR RYHUFRPH WKLW EDUULHU 8VH D WKLUG SDUW\ VRIWZDUH SURJUDP WKDW WUDQVODWHV WKH KDUG GULYH SDUDPHWHUV WR DQ DSSURSULDWH VHXS IRU ERWK 06'26 DQG WKH FRPSXWHU VVWHPV 520%,26 ,QVHUW WKH \$OWHUQDWH &DSDFLW\ MXPSHU RQ WKH GULYH VHH 6HFWRQ 7KH *LJDEWHV %DUULHU 1HZHU %,26V DOORZ XVHUW WR FRQLJXUH GLVN GULYHV WR JR EHRQG WKH 0% EDUULHU E\ XVLQJ VYHUDO %,26 WUDQVODWLRQ VFKHPH +RZHYHU ZKLOH XVLQJ WKHVH WUDQVODWLRQV WKH %,26 XVLQJ ,QVWIDWLRQV DUH OLPLWHG WR ELWV RI DGGUHVVLQJ ZKLFK UHVXOWV LQ DQRWKHU EDUULHU DW WKH % FDSDFLW\ 7R RYHUFRPH WKLW EDUULHU D QHZ VHW RI ,QVWIDWLRQV DUH EHLQJ LPSOHPHQWHG E\ PRV %,26 PDQXIDFWXUHUV 7KH QHZ ,QVWIDWLRQV DOORZV IRU IRXU ZRUGV RI DGGUHVVLQJ VSDFH ELWV UHVXOWLQJ LQ WHUDEWHV RI DFFHVVLEOH VSDFH :KHQYHU SRVVLEOH WKH 4XDQWXP)LUHEDOO OFW *% \$7 GULYH VKRXOG EH XVHG RQ VVWHPV ZLWK %,26 WKDW VXSSRUW ,QVWIDWLRQV ,I WKDW LV QRW SRVVLEOH WKH IROORZLQJ DUH VRPH WHFKQLTXHV WKDW FDQ EH XVHG WR RYHUFRPH WKLW EDUULHU 8VH D WKLUG SDUW\ VRIWZDUH WKDW VXSSOHPHQWV WKH %,26 DQG DGGV ,QVWIDWLRQV VXSSRUW 2EWDLQ D %,26 XSJUDGH IURP WKH VVWHP ERDUG PDQXIDFWXUHUV 0DQ\ VVWHP ERDUG PDQXIDFWXUHUV DOORZ WKHU %,26 WR EH XSJUDGH LQ WKH ILHOG XVLQJ VSHFLDO GRZQORDG XWLOLWLV ,QIRUPDWLRQ RQ %,26 XSJUDGHV FDQ EH REWDLQH RQ WKH 6VWHP %RDUG &XVWRPHU 6HUYLFH UHVSHFWLYH ZHE VLWV RQ WKH ,QWHUQHW ,QVHUW WKH \$OWHUQDWH &DSDFLW\ MXPSHU RQ WKH GULYH VHH 6HFWRQ 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ 2SHUDWLQJ VVWHP OLPLDWLRQV 0RVW SRSXODU RSHUDWLQJ VVWHPV DYDLODEOH WRGD\ KDYH DGGLWLRQDO OLPLDWLRQV ZKLFK DIIHFW WKH XVH RI 0DUJH FDSDFLW\ GULYHV +RZHYHU WKHVH OLPLDWLRQV FDQ QRW EH FRUHFHWHG RQ WKH %,26 DQG LW LV XS WR WKH RSHUDWLQJ VVWHP PDQXIDFWXUHUV WR UHOHDVH LPSURYHG YHUVLRQV WR DGGUHVV WKHVH SUREOHPV 7KH PRV SRSXODU RSHUDWLQJ VVWHPV DYDLODEOH WRGD\ '26 DQG :LQ XVH D)LOH \$OORFDWLRQ 7DEOH)\$7 VLJH RI ELWV ZKLFK

ZLOO RQO\ VXSSRUW SDUWLWLRQV XS WR *% \$ QHZHU UHOHDVH RI :LQ FDOOHG 265 ZLWK D ELW)\$7 KDV EHHQ UHOHDVHG WR VVWHP PDQXIDFWXUH RQ\ 7KL V QHZ)\$7 VLJH WDEOH ZLOO VXSSRUW SDUWLWLRQV RI XS WR WHUDEWHV 6<67(0 67\$5783 '\$1' 23(5\$7,21 2QFH\RX KDYH LQVWDOOHG WKH 4XDQWXP)LUHEDOO OFW *% \$7 KDUG GLVN GULYH DQG DGDSWHU ERDUG LI UHTXLUHG LQ WKH KRUV VVWHP\RX DUH UHDA WR SDUWLWLRQ DQG IRUPDW WKH GULYH IRU RSHUDWLRQ 7R VHV XS WKH GULYH FRUHFVW\IROORZ WKHVH VVWHP 3RZHU RQ WKH VVWHP 5XQ WKH 6(783 SURJUDP 7KL LV JHQHUDOO\ RQ D 'LDJQRVWLFV RU 8WLWLWLV GLVN RU ZLWKLQ WKH VVWHPV %,26 6RPH VVWHP %,26 KDYH DQ DXWR GHWHFWLQJ IHDWXUH PDNLQJ 6(783 XQQHFHVVDU\ (QWHU WKH DSSURSULDWH SDUDPHWHUV 7KH 6(783 SURJUDP DOORZV\RX WR HQWHU WKH WASHV RI RSWLRQDO KDUGZDUH LQVWDOOHGVXFK DV WKH KDUG GLVN GULYH WSH WKH IORS\ GLVN GULYH FDSDFLW DQG WKH GLVSOD\ DGDSWHU WSH 7KH VVWHPV %,26 XVHV WKLW LQIRUPDWLRQ WR LQLWLDOLJH WKH VVWHP ZKHQ WKH SRZHU LV VZLWFKHG RQ)RU LQVWUXFWLRQV RQ KRZ WR XVH WKH 6(783 SURJUDP UHUU WR WKH VVWHP PDQXDO IRU\RXU 3 & 'XULQJ WKH \$7 VVWHP &026 VHWXS\RX PXVW HQWHU WKH GULYH WASH IRU WKH 4XDQWXP)LUHEDOO OFW KDUG GLVN GULYHV 7KH GULYH VXSSRUW WKH WUDQVODWLRQ RI LWV SKVLDO GULYH JHRPHWU SDUDPHWHUV VXFK DV FOLQGHUV KHDG DQG VHFWRUV SHU WUDFN WR D ORJLDO DGGUHVVLQJ PRGH 7KH GULYH FDQ ZRUN ZLWK GLIIHUHQW %,26 GULYH WASH WDEOHV RI WKH YDULRXV KRUV VVWHPV <RX FDQ FKRRVH DQ\ GULYH WSH WKDW GRHV QRW H[FHHG WKH FDSDFLW RI WKH GULYH 7DEOH JLYHV WKH ORJLDO SDUDPHWHUV WKDW SURYLGH WKH PD[LXP FDSDFLW RQ WKH 4XDQWXP)LUHEDOO OFW IDPLO\ RI KDUG GLVN GULYHV 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ 7DEOH /RJLDO \$GGUHVVLQJ)RUPDW 48\$1780),5(%\$// OFW /%\$ &DSDFLW &+6 &DSDFLW /RJLDO &OLQGHUV /RJLDO +HDG /RJLDO 6HFWRUV 7UDFN 7RWDO IXPEHU /RJLDO 6HFWRUV 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 0% 1RWH &DSDFLW\ PD\ EH UHVWULFWHG WR *% RU OHVV GXH WR VVWHP %,26 OLPLDWLRQV &KHFN ZLWK\RXU VVWHP PDQXIDFWXUH WR GH WHUPLQH LI\RXU %,26 VXSSRUW /%\$ ORGH IRU KDUG GULYHV JUHDWHU WKDQ *% 'HDXOW ORJLDO FOLQGHUV LV OLPLWHG WR DV SHU WKH \$7 VSHFLILFDWLRQV 7R PDWFK WKH ORJLDO VSHFLILFDWLRQV RI WKH GULYH WR WKH GULYH WASH RI D SDUWLFXODU %,26 FRQVXOW WKH VVWHPV GULYH WASH WDEOH 7KLW WDEOH VSHFLILHV WKH QXPEHU RI FOLQGHUV KHDG DQG VHFWRUV IRU D SDUWLFXODU GULYH WASH <RX PXVW FKRRVH D GULYH WASH WKDW PHHWV WKH IROORZLQJ UHTXLUHPHQWV)RU WKH *% *% *% *% \$7 /RJLDO &OLQGHUV /RJLDO +HDG /RJLDO 6HFWRUV 7UDFN [%RRW WKH VVWHP XVLQJ WKH RSHUDWLRQ VVWHP LQVWDOODWLRQ GLVNIRU H[DPSOH 06'26WKHQ IROORZ WKH LQVWDOODWLRQ LQVWUXFWLRQV LQ WKH RSHUDWLRQ VVWHP PDQXDO 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ &216,('5\$7,216)25 02817,1* \$1 \$9 '5,9()RU & (DSSOLFDFWLRQV LQ ZKLFK TXLHW RSHUDWLRQ RI WKH GULYH LV YHU FULWLFDO ZH UHFRPPHQG WKDW WKH GULYH EH PRXQWHG RQ VKRFN DQG YLEUDWLRQ LVRODWRUV SHIHU WR WKH VHFWRUV EHORZ ZKHQ PRXQWLQJ DQ \$9 GULYH LQ D & ERJ 7KHU DUH PDQ\ GLIIHUHQW ZDV WR PRXQW WKH KDUG GULYH LQ D VHWWRS ERJ)LXUH VKRZ D GULYH PRXQWHG LQ D VHWWRS ERJ 7KH PHWKRQ WKDW\RX VKRXOG FKRRVH GHSHQGV RQ PDQ\ REMHWLYHV RI WKH GHVLJQH RI WKH VHWWRS ERJ 6RPH RI WKHVH REMHWLYHV DUH 7KH DFRXVWLFDO WROHUDQFH OHYHO RI WKH GHVLJQ)RU H[DPSOH D FRPSDQ\ WKDW LV GHVLJQLQJ D VHWWRS ERJ IRU JDPH LV QRW DV FRQFHUQHG DERXW QRLVH HPLVLRQV DV D FRPSDQ\ WKDW LV GHVLJQLQJ D ERJ IRU YLGR UHFRUGLQJ DQG SODNEDFN LQ WKH KRPH 6KRFN DQG YLEUDWLRQ WROHUDQFH OHYHO 8VHUV RI JDPH ERJ\HV ZRXOG EH H[SHFWHG WR WUHDW WKH HTXLSHQW PRUH KDUVKO\ WKDQ XVHUV IRU RWKHU DSSOLFDFWLRQV &RVW REMHWLYHV 7KH PHWKRQV WKDW DFKLHYH QR VRXQG HPLVLRQV ZLOO FRVW PRUH WKDQ WKRVH WKDW UHGXFH WKH VRXQG HPLVLRQV E\ SHUFHQW DQG VR RQ 3DFNDLQJ FRQWUDLQWV)RU H[DPSOH WKH VLJH RI WKH VHWWRS ERJ DQG WKH FRPSDQHQW WKDW JR LQWR WKH ERJ KDYH VRPH LQIOXHQFH RQ WKH PRXQWLQJ RI WKH KDUG GULYH 7KHUPDO FRQLWLRQV LQ WKH VHWWRS ERJ DQG HOYLWRUPHQWDO DPDLHQW WHPSHUDWXUH UHTXLUHPHQWV 7KH KLJKHU WKH RSHUDWLRQDO WHPSHUDWXUH WKH JUHDWHU WKH SUREOHPV WKDW ZLOO H[LVW IURP D OLIH H[SHFWDQF\ YLHZ RI WKH KDUG GULYH 'HVLJQHUV QHHG WR GHWHUPLQH ZKHWHU WR LQFOXGH D IDQ DQG LI QRW KRZ PXFK YHQWLODWLRQ WR SURYLGH DQG ZKDW HIIHFW YHQWLODWLRQ ZLOO KDYH RQ DFRXVWLFV)RXU GLIIHUHQW VRXUFHV RI DFRXVWLF HPLVLRQV PXVW EH GHDOW ZLWK LQ D KDUG GULYH 6SLQGOH PRWRU DLUERUQH QRLVH 6SLQGOH YLEUDWLRQ LQGXFG DFRXVWLFV +HDGVHNLQJ DLUERUQH QRLVH +HDGVHNLQJ YLEUDWLRQLQGXFG DFRXVWLFV 7KH YLEUDWLRQV IURP WKH VSLQGOH EDODQFH DQG IURP WKH KHDG SRVLWLRQHU VHHNLQJ FDQ EH DPSOLILHG PDQ\ WLPHV E\ DQ LQFRUHFV\ GHVLJQH VHWWRS ERJ DQG GULYH PRXQWLQJ PHWKRQ 7KH GHVLJQH VKRXOG EH DZDUH RI WKH IUHTXHQFLHV RI WKHVH YLEUDWLRQV DQG WU\ WR DYRLG GHVLJQLQJ WKH ERJ ZLWK QHDUE\ UHVRODQFH IUHTXHQFLHV LI SRVLEOH ,Q DGGLWLRQ QRWH WKDW VLJQDO FDEOH URXWLQJ DQG (0, SUREOHPV FDQ EH FUHDWHG LI FDUH LV QRW JLYHQ WR WKH SODFPHQW RI FDEOHV DQG WKH GULYH LQ WKH VHWWRS ERJ 4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ &DXHV IRU IRLVH *HQHUDWHG E\ +DUG 'LVN 'ULYHV IRLVH JHQHUDWHG E\ D KDUG GLVN GULYH FDQ EH FDXVHG E\ WCUHH VRXUFHV +HDG SRVLWLRQHU PRYLQJ IURP WUDFN WR WUDFN GXULQJ WKH VHHNLQJ SURFHVV 6SLQGOH PRWRU VZLWFKLQJ SKDVHV GXULQJ WKH VSLQQLQJ SURFHVV 2XW RI EDODQFH FRQGLWLRQ RI WKH GLVNV DV WKH VSLQ 7KHVH QRLVH SUREOHPV DUH LQ WZR IRUPV OHFKDQLDO YLEUDWLRQV \$LUERUQH DFRXVWLFDO QRLVH &DXWLRQV LQ 5HGXFQJ WKH (IHFV RI ([WHUQDO 6KRFN)RUFHV 7KH QRUPDO VKRFN PRXQW LVRODWRU PHWKRQV WKDW DUH DSSOLHG WR PDFKLQHU\ PXVW EH XVHG ZLWK FDXWLRQ LQ WKH FDUH RI D KDUG GLVN GULYH 7KH SUREOHP ZLWK VKRFN PRXQWLQJ D KDUG GULYH LV WKDW PRWLRQ LV SURGXFWG WR WKH GULYH DV D UHVXOW RI WKH HODVWRPHULF VKRFN PRXQW 7KLW PRWLRQ FDXVHV WKH KHDG SRVLWLRQHU WR PRYH RII WKH GDWD WUDFNV DQG WXXV SURGXFH UHDA HUURU SUREOHPV DQG WLPFRQVXPLQJ UHDA UHWU\ DWVWHPV E\ WKH KDUG GULYH \$V D UHVXOW WKH GDWD EXIIHU FDQ HPSW\ DQG YLGR SUREOHPV FDQ UHVXOW &DXWLRQV LQ 5HGXFQJ WKH (IHFV RI ([WHUQDO 9LEUDWLRQ)RUFHV 7KH QRUPDO YLEUDWLRQ PRXQW LVRODWRU PHWKRQV WKDW DUH DSSOLHG WR PDFKLQHU\ PXVW EH XVHG ZLWK FDXWLRQ LQ WKH FDUH RI D KDUG GLVN GULYH 7KH SUREOHP ZLWK VKRFN PRXQWLQJ D KDUG GULYH LV WKDW PRWLRQ LV SURGXFWG WR WKH GULYH DV D UHVXOW RI WKH HODVWRPHULF YLEUDWLRQ PRXQW 7KLW PRWLRQ FDXVHV WKH KHDG SRVLWLRQHU WR PRYH RII WKH GDWD WUDFNV DQG WXXV SURGXFH UHDA DQG ZULWH HUURU SUREOHPV DQG WLPFRQVXPLQJ UHDA UHWU\ DWVWHPV E\ WKH KDUG GULYH \$V D UHVXOW WKH GDWD EXIIHU FDQ HPSW\ DQG YLGR SUREOHPV FDQ UHVXOW 7KH EHV UHVXOWV IRU WUDQVVIHULQJ GDWD GXULQJ YLEUDWLRQV LV WR GLUHFV\ PRXQW WKH KDUG GULYH WR WKH FKVVLV ZKLFK KRZHYHU ZLOO UHVXOW LQ DQ LQFUHDV LQ QRLVH 7KH OLPLDWLRQ RQ WKH GDWD WUDQVVIHULQJ UHDA GHSHQGV RQ EXIIHU VLJH DQG WKH IUHTXHQF\ EDQG RI WKH YLEUDWLRQ \$FRXVWLFDO 7ROHUDQFH /HYHO 7KH DFRXVWLFDO UHGXFWRQ KDUGZDUH UHTXLUHG IRU D SURGXFW GHSHQGV RQ WKH DFRXVWLFDO WROHUDQFH OHYHO IRU D JLYHQ SURGXFW 7KH FRVW RI WKH KDUGZDUH UHTXLUHG ZLOO DOVR EH D IDFWRU LQ WKH FKRLFH RI KRZ PXFK DFRXVWLFDO UHGXFWRQ LV QHHGHG IRU D JLYHQ GHVLJQ \$OPRVW FRPSOHV VLOHQFH IRU H[DPSOH LQ WKH VHWWRS ERJ DSSOLFDFWLRQ ZLOO EH PXFK PRUH H[SHQVLYH WR DFRPSOLVK WKDQ D SHUFHQW UHGXFWRQ LQ VRXQG OHYHO 7KH FKRLFH RI KDUGZDUH LV D WUDGHRII

EHWZHHQ FRVW RI WKH KDUGZDUH DQG DFRXVWLFDO UHGXFWRQ QHHGHG \$W D PLQLXP D PHWKRQ IRU LVRODWLQJ WKH VSLQ
PRWRU DQG KHDG VHHN YLEUDWLRQ IURP WKH FXVWRPHU FKDVVLV VKRXOG EH FRQVLGHUHG 7ZR ZDV RI DFFRPSOLVKLQJ WKL
JRDO DUH E\ XVLQJ VKHHW RI YLEUDWLRQ LVRODWLRQ IRDP PDWHULDO VXFK DV SDUWV DQG RI)LJXUH 4XDQWXP)LUHEDOO OFW
*% \$7 ,QVWDOODWLRQ 9LEUDWLRQ LVRODWLRQ JURPPHWV DV VKRZQ ZLWK SDUW RI)LJXUH \$W WKH RWKHU HQG RI WKH VFDOH
ZLWK FRPSOHWH DFRXVWLFDO DQG YLEUDWLRQ LVRODWLRQ LV WKH HQFORVHG PHWKRQ VKRZQ ZLWK SDUWV DQG RI)LJXUH
ORXQWLQJ OHWKRGV WR 5HGXFH IRLVH DQG 9LEUDWLRQ LQ 6HW7RS %R| \$VVHPEOLHV 7KH DSSOLFDWLRQ RI WKH IROORZLQJ IRXU
PHWKRGV HOLPLQDWH QRLVH DQG YLEUDWLRQ VRXUFHV SURGXFHG E\ KDUG GLVN GULYHV \$\$SOLFDFWLRQ RI GDPSLQJ
PDWHULDOV RQ WKH PHFKDQLFDO YLEUDWLRQ JHQHUDWRUV \$\$SOLFDFWLRQ RI DFRXVWLFDO VRXQG DEVRUSWLRQ PDWHULDOV
IRU DLUERUQH QRLVH \$\$SOLFDFWLRQ RI SKVLFDO QRLVH EDUULHU FRQWDLQPHQW ,VRODWLRQ RI WKH GULYHV IURP WKH VHWWR
ER| ZLWK VKRFN DEVRUELQJ PDWHULDOV)LJXUH 'ULYH ORXQWHG LQ D 6HW7RS %R| 4XDQWXP)LUHEDOO OFW *% \$7
,QVWDOODWLRQ 6VHHO &RYHU \$FRXVWLFDO 9LEUDWLRQ /DPLQDWH +DUG 'ULYH \$FRXVWLFDO 9LEUDWLRQ /DPLQDWH %DVH
\$GKHVLYH Chq9vr Hvt 7hpxr @yhrvp Br)LJXUH 6HW7RS (QFORVXUH &RQWDLQHU %R| \$VVHPEO\ 4XDQWXP)LUHEDOO OFW *% \$7
,QVWDOODWLRQ)LJXUH ORXQWLQJ DQ \$9 'ULYH 6HW7RS %R| (QFORVXUH 7KH GULYH RU GULYHV VKRXOG EH PRXQWHG LI SRVLEOH
LQ VXFK D ZD\ WKDW WKHUH LV D LQFK DLU JDS PP EHWZHHQ WKH ERWRP RI WKH GULYH DQG WKH WRS RI WKH VXUIDFH
EHQHDWK WKH KDUG GULYH WKH FRQWDLQHU ERWRP RU DFRXVWLFDO IRDP IRU H[DPSOH 7KLV VSDFH ZLOO DOORZ DLU
FLUXODWLRQ WR WKH FRPSRQHQWV RQ WKH KDUG GULYH 3&% \$Q DFRXVWLFDO IRDP OLQH ER| OLQH ERWK RQ WKH WRS DQG
VLGHV RI WKH LQVLGH RI WKH ER| VKRXOG EH GHVLJQHG WR ILW RYHU WKH KDUG GULYHV 7KH IRDP VKRXOG EH DERXW PP WKLFN
FRPSUHVVHG WR DERXW PP DQG KDYH D OD\HU RI YLEUDWLRQ GDPSLQJ PDWHULDO ERQGHG WR LW WKDW LV DERXW PP WKLFN
)RU EHVW UHVXOWV WKLW VDOGZLFK VKRXOG EH ERQGHG WR WKH LQVLGH RI WKH VHHO FRYHU 7KLV W\SH RI PDWHULDO FDQ EH
REWDLQH LQ D RQH SLHFH SUHIDE VDOGZLFK IRUP IURP DFRXVWLFDO PDWHULDOV VXSOLHUV 7KH ER| VKRXOG EH VKHHW
PHWDO VHHO PLQLXP RI PP WKLFN DV VKRZQ LQ)LJXUH 7KH GULYH PRXQWLQJ EDVH VKRXOG EH PRXQWHG LQ VXFK D ZD\ WKDW
WKHUH LV YLEUDWLRQ LVRODWLRQ EHWZHHQ WKH GULYHV DQG WKH VHWWR ER| 7KLV GHVLJQ SUHYHQWV YLEUDWLRQ
WUDQVPLVLRQ WR WKH ZDOOV RI WKH VHWWR ER| 7KLV YLEUDWLRQ LVRODWLRQ FDQ EH DFFRPSOLVKHG ZLWK HODVWRPHULF
YLEUDWLRQ GDPSLQJ PDWHULDOV RU IHOW WASHV RI PDWHULDOV RU ZLWK VWDQGDUG YLEUDWLRQ LVRODWLRQ JURPPHWV
4XDQWXP)LUHEDOO OFW *% \$7 ,QVWDOODWLRQ 5HFRPPHQGHG \$FRXVWLF DQG 9LEUDWLRQ 'DPSLQJ ODWHULDO 7KH PRVW
LQWHQVH DFRXVWLFDO RXWSXW RI WKH GULYH FRPHV ZKLOH WKH KHDG SRVLWLRQHU LV VHHNLQJ DV WKH GULYH LV PRYLQJ WKH
KHDGV IURP RQH WUDFN WR DQRWKHU 7ZR PDMRU IUHTXHQF\ SRLQWV FRQWULEXWH WR WKH DFRXVWLFDO HPLVVLRQV RI WKH
GLVN GULYH GXULQJ WKLW VHHN SURFHVV LQ WKH DXGLEOH UDQJH RI +) WR .



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UHFPPHQGHG \$OZDV NHHS WKH GULYH LQVLGH LWV VSHFLDO DQWLVDWLF EDJ XQWLO UHDA WR LQVWDOO IRWH 7R DYRLG
FDXVLQJ DQ GDPDJH WR WKH GULYH GR QRW WRXFK RU UHPRYH WKH 3ULQWHG &LUFXLW %RDUG 3&% RU DQ RI LWV
FRPSRQHQWV ZKHQ KDQGOLQJ WKH GULYH 'RLQJ VR ZLOO FDXVH (6' GDPDJH WR WKH GULYH 5(/,\$%,/7< 0HDQ 7LPH %HWZHHQ
)DLOXUHV 07%) 7KH SURMHFWHG ILHOG 07%) LV KRUV 7KH 4XDQWXP 07%) QXPEHUV UHSUHVHQW %HOO&RUH 75 ,VXXH 'HFHPEHU
07%) SUHGLFWLRQV DQG UHSUHVHQW WKH PLQLXP 07%) WKDW 4XDQWXP RU D FXVWRPHU ZRXOG H[SHFW IURP WKH GULYH HDU
IRW UHTXLUHG FFOHV # DPELHQW &RPSRQHQW /LIH 3UHYHQWLYH 0DLQWHQDQFH 30 6WDUW6WRS IRWH 'ULYH UHOLDELWLW LV
FORVHO UHODWHG WR WKH WHPHUDWXUH WKH GULYH LV H[SRVHG WR 7KH RSHUDWLRQDO GHVLJQ HQYLURQPHQW LV & DW
XWLOL]DWLRQ RU 32+HDU 4XDQWXP)LUHEDOO OFW *% \$7 6SHFLILFDWLRQV (/ &7520\$*1(7, & 686&(37,%,/7< 9ROWVPHWHU RYHU D
UDQJH RI .



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+] WR *+] 63,1/ (,0%\$/\$1&(JPP PD[LPXP 7KLV LV DSSUR[LPDWHO\ HTXLYDOHQW WR J HPLWWHG YLEUDWLRQV ',6. (55256 7DEOH SURYLGHV WKH HUURU UDWHV IRU WKH 4XDQWXP)LUHEDOO OFW KDUG GLVN GULYHV 7DEOH (UURU 5DWHV (5525 7<3(0\$,;080 180%(5 2) (55256 HYHQW SHU (ELWV UHGD HYHQW SHU # 5HWU\ UHFYRHYUG UHGD HUURUV 8QUHFYRHYUG GDWD HUURUV! 6HHN HUURUV" ELWV UHGD HUURU SHU % VHHNV 5HWU\ UHFYRHYUG UHGD HUURUV DUH HUURUV ZKLFK UHTXLUH UHWULHV IRU GDWD FRUUHFWRQ (UURUV FRUUHFWRQ E (\& RQWKHO\ DUH QRW FRQVLGHUHG UHFYRHYUG UHGD HUURUV 5HDG RQ DUULYDO LV GLVDEOHG WR PHHW WKLV VSHFLILFDWLRQ (UURUV FRUUHFWRQ E WKH WKHUPDO DVSHULW\ FRUUHFWRQ DUH QRW FRQVLGHUHG UHFYRHYUG UHGD HUURUV 8QUHFYRHYUG UHGD HUURUV DUH HUURUV WKDW DUH QRW FRUUHFWRQ XVLQJ (\& RU UHWULHV 7KH GULYH WHUPLQDWHV UHWU\ UHGDV HLWKHU ZKHQ D UHSHDWLQJ HUURU SDWWHUQ RFFXUV RU DIWHU WKH SURJUDPPHG OLPLW IRU XQVXFHHVIXO UHWULHV DQG WKH DSSOLFDFWLRQ RI TXDGUXSOHEXUVV HUURU FRUUHFWRQ 6HHN HUURUV RFFXU ZKHQ WKH DFWDWRU IDLOV WR UHDFK RU UHPDLQ RYHU WKH UHTXHVWHG FOLQGHU DQG WKH GULYH UHTXLUHV WKH H[FXWLRQ RI D IXOO UHFDLEUDWLRQ URXWLQ\ WR ORFDWH WKH UHTXHVWHG FOLQGHU IRWH (UURU UDWHV DUH IRU ZRUVV FDVH WHPSHUDXUH DQG YROWDJH 4XDQWXP)LUHEDOO OFW *% \$7 6SHFLILFDWLRQV 4XDQWXP)LUHEDOO OFW *% \$7 &KDSWHU %\$6,& 35,1&,3/(6 2) 23(5\$7,21 7KLV FKDSWHU GHVFULEHV WKH RSHUDWLRQ RI 4XDQWXP)LUHEDOO OFW \$7 KDUG GLVN GULYHV IXQFWLRQDO VXEVVHPV ,W LV LQWHQGHG DV D JXLGH WR WKH RSHUDWLRQ RI WKH GULYH UDWKHU WKDQ D GHWDLOHG WKHRU\ RI RSHUDWLRQ 48\$1780),5(%\$// OFW '5,9(0(&+\$1,60 7KLV VHFWRQ GHVFULEHV WKH GULYH PHFKDQLVP 6HFWRQ GHVFULEHV WKH GULYH HOHFWURQLFV 7KH 4XDQWXP)LUHEDOO OFW KDUG GLVN GULYHV FRQVLVW RI D PHFKDQLFDO DVVHPEO\ DQG D 3&% DV VQRZQ LQ)LJXUH 7KH KHDGGLVN DVVHPEO\ + \$ FRQWDLQV WKH PHFKDQLFDO VXEDVVHPEOLHV RI WKH GULYH ZKLFK DUH VHDHG XQGHU D PHWDO FRYHU 7KH + \$ FRQVLVW RI WKH IROORZLQJ FRPSRQHQW %DVH FDVWLQJ ' & PRWRU DVVHPEO\ 'LVN VWDFN DVVHPEO\ +HDGVWDFN DVVHPEO\ 5RWDU\ SRVLWLRQHU DVVHPEO\ \$XWRPDWLF DFWDWRU ORFN \$LU ILOWHU 7KH GULYH LV DVVHPEOHG LQ D & ODVV FOHDQ URRP &\$87,21 7R HQVXUH WKDW WKH DLU LQ WKH + \$ UHPDLQV IUHH RI FRQWDPDQLQJ QHYHU UHPRYH RU DGMXVW LWV FRYHU DQG VHDV 7DPSHULQJ ZLWK WKH + \$ ZLOO YRLG\RXU ZDUUDQW 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ)LJXUH 4XDQWXP)LUHEDOO OFW \$7 +DUG 'LVN 'ULYH (SORGHG 9LHZ 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ %DVH & DVWLQJ \$VVHPEO\ \$ VLQJOHSLHFH HFRDWHG DOXPLOXPDOOR\ EDVH FDVWLQJ SURYLGHV D PRXQWLQJ VXUIDFH IRU WKH GULYH PHFKDQLVP DQG 3&% 7KH EDVH FDVWLQJ DOVR DFVV DV WKH IODQJH IRU WKH ' & PRWRU DVVHPEO\ 7R SURYLGH D FRQWDPDQLQJ IUHH HQYLURQPHQW IRU WKH + \$ D JDVNHV SURYLGHV D VHDV EHWZHHQ WKH EDVH FDVWLQJ DQG WKH PHWDO FRYHU WKDW HQFORVHV WKH GULYH PHFKDQLVP ' & ORWRU \$VVHPEO\ ,QWHJUDO ZLWK WKH EDVH FDVWLQJ WKH ' & PRWRU DVVHPEO\ LV D IL[HGVKDIW EUXVKOHVV ' & VSLQGOH PRWRU WKDW GULYHV WKH FRXQWHUFORFNZLVH URWDWLRQ RI WKH GLVNV 'LVN 6WDFN \$VVHPEOLHV 7KH GLVN VWDFN DVVHPEO\ LQ WKH 4XDQWXP)LUHEDOO OFW KDUG GLVN GULYHV FRQVLVW RI GLVNV VHFXYHG E D GLVN FODPS 7KH DOXPLOXPDOOR\ GLVNV KDYH D VXSWWHUHG WKLQILOP PDJQHWF FRDWLQJ \$ FDUERQ RYHURDW OXEULFDWHV WKH GLVN VXUIDFH 7KLV SUHYHQWV KHDG DQG PHGLD ZHDU GXH WR KHDG FRQWDFW ZLWK WKH GLVN VXUIDFH GXULQJ KHDG WDNHRII DQG ODQGLQJ +HDG FRQWDFW ZLWK WKH GLVN VXUIDFH RFFXUV RQ\ LQ WKH ODQGLQJ JRQH RXVWLGH RI WKH GDWD DUHD ZKHQ WKH GLVN LV QRW URWDWLRQ DW IXOO VSHHG 7KH ODQGLQJ JRQH LV ORFDWHG DW WKH LQQHU GLDPWHU RI WKH GLVN EHRQG WKH ODVV FOLQGHU RI WKH GDWD DUHD 7DEOH & FOLQGHU & RQWHQWV & <1,1'5 & 217(176 6VWHP 'DWD =21(180%(5 2) 75\$&.6 6(&7256 3(5 75\$&. '\$7 5\$7(0E6)RU XVHU GDWD JRQH LV WKH LQQHUPRVW JRQH DQG JRQH LV WKH RXWHUPRVW JRQH 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ +HDGVWDFN \$VVHPEO\ 7KH KHDGVWDFN DVVHPEO\ FRQVLVWV RI UHGDZLWH KHDGV KHDG DUPV DQG D FRLO MRLQHG WRJHWKHU E LQVHUWLRQ PROGLQJ WR IRUP D URWRU VXEDVVHPEO\ EHDULQJ DQG D IOHJ FLUFXLW 5HDGZLWH KHDGV PRXQWHG WR VSULQJVWHHO IOHJXUHV DUH VZDJH PRXQWHG RQWR WKH URWDU\ SRVLWLRQHU DVVHPEO\ DUPV 7KH IOHJ FLUFXLW FRQHFVW WKH KHDGVWDFN DVVHPEO\ WR WKH 3&% WKURXJK D FRPSUHVVLRQ FRQHFVWRU 7KH IOHJ FLUFXLW FRQWDLQV D UHGD SUHDSOLILHUZLWH GULYHU , & 5RWDU\ 3RVLWLRQHU \$VVHPEO\ 7KH URWDU\ SRVLWLRQHU RU URWDU\ YRLFHFRLO DFWDWRU LV D 4XDQWXP SURLHWDU\ GHVLQJ WKDW FRQVLVWV RI XSSHU DQG ORZHU SHUPDQHQW PDJQHW SODWHV D URWDU\ VLQJOH SKDVH FRLO PROGHG DURXQG WKH KHDGVWDFN PRXQWLQJ KXE DQG D EHDULQJ VKDIW 7KH VLQJOH ELSRODU PDJQHW FRQVLVWV RI WZR DOWHUQDWLQJ SROHV DQG LV ERQGHG WR WKH PDJQHW SODWH \$ UHVLOLHQW FUDVK VWRV SUHYHQWV WKH KHDGV IURP EHLQJ GULYHU LQWR WKH VSLQGOH RU RII WKH GLVN VXUIDFH & XUHQW IURP WKH SRZHU DPSOLILHU LQGXFWV D PDJQHWF ILHOG LQ WKH YRLFH FRLO)OXFWDWLRQV LQ WKH ILHOG DURXQG WKH SHUPDQHQW PDJQHW FDXVH WKH YRLFH FRLO WR PRYH 7KH PRYHPHQW RI WKH YRLFH FRLO SRVLWLRQV WKH KHDGV RYHU WKH UHTXHVWHG FOLQGHU \$XWRPDWLF \$FWXDWRU /RFN 7R HQVXUH GDWD LQWHJULW\ DQG SUHYHQW GDPDJH GXULQJ VKLSPHQW WKH GULYH XVHV D GHGLFDWHG ODQGLQJ JRQH DQ DFWDWRU PDJQHWF UHWUDFW DQG 4XDQWXP SDWHQWHG \$LUORFN 7KH \$LUORFN KROGV WKH KHDGVWDFN LQ WKH ODQGLQJ JRQH ZKHQHYHU WKH GLVNV DUH QRW URWDWLRQ ,W FRQVLVWV RI DQ DLU YDQH PRXQWHG QHDU WKH SHULPHWHU RI WKH GLVN VWDFN DQG D ORFNLQJ DUP WKDW UHWUDLQV WKH DFWDWRU DUP DVVHPEO\ :KHQ ' & SRZHU LV DSSOLHG WR WKH PRWRU DQG WKH GLVN VWDFN URWDWHV WKH URWDWLRQ JHQHUDWHV DQ DLUIORZ RQ WKH VXUIDFH RI WKH GLVN \$V WKH IORZ RI DLU DFURVV WKH DLU YDQH LQFUHDVHV ZLWK GLVN URWDWLRQ WKH ORFNLQJ DUP SLYRWV DZD\ IURP WKH DFWDWRU DUP HQDEOLQJ WKH KHDGVWDFN WR PRYH RXW RI WKH ODQGLQJ JRQH :KHQ ' & SRZHU LV UHPRYHG IURP WKH PRWRU DQ HOHFWURQLF UHWXUQ PHFKDQLVP DXWRPDWLFDOO\ SXOOV WKH DFWDWRU LQWR WKH ODQGLQJ JRQH ZKHUH WKH PDJQHWF DFWDWRU UHWUDFW IRUFH KROGV LW XQWLO WKH \$LUORFN FORVHV DQG ODWFKHV LW LQ SODFH 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ \$LU)LOWDWLRQ 7KH 4XDQWXP)LUHEDOO OFW \$7 KDUG GLVN GULYHV DUH :LQFKHVWHUW\SH GULYHV 7KH KHDGV IO\ YHU\ FORVH WR WKH PHGLD VXUIDFH 7KHUHIRUH LW LV HVVHQWDO WKDW WKH DLU FLUFXODWLQJ ZLWKLQ WKH GULYH EH NHSW IUHH RI SDUWLFOHV 4XDQWXP DVVHPEOHV WKH GULYH LQ D & ODVV SXULILHG DLU HQYLURQPHQW WKHQ VHDV WKH GULYH ZLWK D PHWDO FRYHU :KHQ WKH GULYH LV LQ XVH WKH URWDWLRQ RI WKH GLVNV IRUFH WKH DLU LQVLGH RI WKH GULYH WKURXJK DQ LQWHUQDO PLFURQ ILOWHU 7KH LQWHUQDO + \$ FDLW\ SUHVXUH HTXDOLJHV WR WKH H[WHUQDO SUHVXUH FKDQJH E SDVLUQJ DLU WKURXJK D PLFURQ FDUERQ LPSUHJQDWHG EUHDWKHU ILOWHU '5,9((/&7521,&6 \$GYDQFHG FLUFXLW 9HU/DUJH 6FDOH ,QWHJUDWLRQ GHVLQJ DQG WKH XVH RI PLQLDWXUH VXUIDFHPRXQWHG GHYLFHV DQG SURLHWDU\ 9/6, FRPSRQHQWV HQDEOH WKH GULYH HOHFWURQLFV LQFOXGLQJ WKH \$7\$ EXV LQWHUIDFH WR UHVLGH RQ D VLQJOH SULQWHG FLUFXLW ERDUG DVVHPEO\ 3&%)LJXUH FRQWDLQV D VLPSOLILHG EORFN GLDJUDP RI WKH 4XDQWXP)LUHEDOO OFW KDUG GLVN GULYH HOHFWURQLFV 7KH RQ\ HOHFWULFDO FRPSRQHQW QRW RQ WKH 3&% \$ LV WKH 3UH\$SOLILHU DQG :ULWH 'ULYHU , & ,W LV RQ WKH IOHJ FLUFXLW LQVLGH RI WKH VHDHG + \$ ORXQWLQJ WKH SUHDSOLILHU DV FORVH DV SRVLEOH WR WKH UHGDZLWH KHDGV LPSURYHV WKH VLQJQDWR QRLVH UDWL 7KH IOHJ FLUFXLW

LQFOXGLQJ WKH 3UH\$PSOLILHU DQG :ULWH 'ULYHU , & SURYLGHV WKH HOHFWULFDO FRQOHWFLRQ EHWZHHQ WKH 3&% WKH URWDU\ SRVLWLRQH DUVRPEO\ DQG UHGDZULWH KHDGV)LJXUH 4XDQWXP)LUHEDOO OFW \$7 +DUG 'LVN 'ULYH %ORFN 'LDJUDP 4XDQWXP)LUHEDOO OFW *% \$7 %DVLV 3ULQFLSOHV RI 2SHUDWLRQ ,QWHJUDWHG 3URFHVVU 'LVN &RQWUROOHU DQG \$7\$,QWHUIDFH (OHFWURQLV 7KH 3URFHVVU 'LVN &RQWUROOHU DQG \$7\$,QWHUIDFH HOHFWURQLV DUH FRQWDLQH G LQ D SURSULHWDU\ \$6, & GHYHORSHG E\ 4XDQWXP DV VKRZQ EHZRZ LQ)LJXUH)LJXUH %ORFN 'LDJUDP 4XDQWXP)LUHEDOO OFW *% \$7 %DVLV 3ULQFLSOHV RI 2SHUDWLRQ 7KH LQWHJUDWHG 3URFHVVU 'LVN &RQWUROOHU DQG \$7\$,QWHUIDFH (OHFWURQLV KDYH QLQH IXQFWLRQDO PRGXOHV GHVFULEHG EHZRZ 3URFHVVU 'LJLWDO 6QFKURQRXV 6SRNH '66 (UURU &RUHFWRQ &RGH (& &RQWURO)RUPDWWHU %XIIHU &RQWUROOHU 6HUYR &RQWUROOHU LQFOXGLQJ 3:0 6HULDO ,QWHUIDFH \$7\$,QWHUIDFH &RQWUROOHU 0RWU &RQWUROOHU 3URFHVVU 7KH 3URFHVVU FRUH SURYLGHV ORFDO SURFHVVU VHUFLVH WR WKH GULYH HOHFWURQLV XQGHU SURJUDP FRQWURO 7KH 3URFHVVU PDQJHV WKH UHVRXUFH RI WKH 'LVN &RQWUROOHU DQG \$7\$,QWHUIDFH LQWHUQDOO\ ,W DOVR PDQJHV WKH 5HDG:ULWH \$6, & \$\$\$OLFDFWRQ 6SHFLILF ,QWHJUDWHG &LUFXLW DQG WKH 6SLQGOH9&0 GULYHU H\WHUQDOO\ 'LJLWDO 6QFKURQRXV 6SRNH 7KH '66 GHFRGHV VHUVR LQIRUPDWLRQ ZULWWHQ RQ WKH GULYH DW WKH IDFWRU\ WR GHWHUPLQH WKH SRVLWLRQ RI WKH UHGDZULWH KHDG ,W LQWHUIDFHV ZLWK WKH UHGDZULWH FKDQQHO SURFHVV WLPLQJ DQG SRVLWLRQ LQIRUPDWLRQ DQG VWRUHV LW LQ UHJLVWHUV WKDW DUH UHGD E\ WKH VHUVR ILUPZDUH (UURU &RUHFWRQ &RGH (& &RQWURO 7KH (UURU &RUHFWRQ &RGH (& &RQWURO EORFN XWLQJHV D 5HHG6RORPRQ HQFRGHU GHFRGHU FLUFXLW WKDW LV XVHG IRU GLVN UHGDZULWH RSHUDWLRQ ,W XVHV D WRWDO RI UHGXQGDQF\ EWHV RUJDQLJHG DV (& (UURU &RUHFWRQ &RGH EWHV ZLWK IRXU LQWHUOHDYHV DQG IRXU FURVFKHFN EWHV 7KH (& XVHV HJJKW ELWV SHU \PERO DQG IRXU LQWHUOHDYHV 7KLV DOORZV TXDGUXSOHEXUVW HUURU FRUHFWRQ RI DW OHDVW DQG DV PDQ\ DV ELWV LQ HUURU)RUPDWWHU 7KH)RUPDWWHU FRQWUROV WKH RSHUDWLRQ RI WKH UHGD DQG ZULWH FKDQQHO SRUWLRQV RI WKH \$6, & 7R LQLWLDWH D GLVN RSHUDWLRQ WKH 3URFHVVU ORDGV D FRPPDQG LQR WKH \$6, & UHJLVWHUV 7KH)RUPDWWHU DOVR GLUHFWO\ GULYHV WKH UHGD DQG ZULWH JDWHV 5*: * DQG &RPPDQG 0RGH ,QWHUIDFH RI WKH 5HDG:ULWH \$6, & DQG WKH 5: 3UHPSOLILHU DV ZHOO DV SDVVLQJ ZULWH GDWD WR WKH 3UHFRPSHQVDWRU FLUFXLW LQ WKH 5HDG:ULWH \$6, & 4XDQWXP)LUHEDOO OFW *% \$7 %DVLV 3ULQFLSOHV RI 2SHUDWLRQ %XIIHU &RQWUROOHU 7KH %XIIHU &RQWUROOHU VXSSRUWV D .



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E\WH EXIIHU ZKLFK LV RUSDQLJHG DV . [ELWV 7KH ELW ZLGWK LPSOHPHQWDWLRQ SURYLGHV D 0%V PD\LPXP EXIIHU EDQGZLGWK 7KLV LQFUHDVHG EDQGZLGWK DOORZV WKH 3URFHVVURU WR KDYH GLUHFV DFFHVV WR WKH EXIIHU HOLPLQDWLRQ WKH QHHG IRU D VHSUDUDWH 3URFHVVURU 5\$0 , & 7KH %XIIHU &RQWUROOHU VXSSRUWV ERWK GULYH DQG KRUV DGGUHVV UROORYHU DQG UHORDGLJ WR DOORZ IRU EXIIHU VHJPHQDWRU 'ULYH DQG KRUV DGGUHVVHV PD\ EH VHSUDUDWHO ORDGHG IRU DXWRPDWHG UHDGZULWH IXQFWLRQV 7KH %XIIHU &RQWUROOHU RSHUDWHV XQGHU WKH GLUHFWRU RI WKH 3URFHVVURU 6HUYR 3URFHVVURU 7KH 6HUYR 3URFHVVURU LQ WKH 5HDG :ULWH &KDQQHO \$6, & SURYLGHV VHUVR GDWD UHFVRYHU DQG EXUVV GHPRGXODWLRQ WR H[WUDFW WKH DFWXDWRU SRVLWLRQ LQIRUPDWLRQ 7KLV LQIRUPDWLRQ LV SURFHVVHG LQ WKH FRQWUROOHU \$6, & PLFURSURFHVVURU DQG D FRQWURO VLJQDO LV RXWSXW WR WKH 9&0 LQ WKH 3RZHU \$6, & 7KLV FRQWUROV WKH FXUUHQW LQ WKH DFWXDWRU FRLO ZKLFK FRQWUROV WKH SRVLWLRQ RI WKH DFWXDWRU 5HDG:ULWH , QWHUIDFH 7KH 5HDG:ULWH LQWHUIDFH DOORZV WKH LQWHJUDWHG SURFHVVURU GLVN FRQWUROOHU WR FRPPXQLFDWH ZLWK WKH 5HDG:ULWH FKLS \$7\$, QWHUIDFH &RQWUROOHU 7KH \$7\$, QWHUIDFH &RQWUROOHU SRUWLRQ RI WKH \$6, & SURYLGHV GDWD KDQGOLQJ EXV FRQWURO DQG WUDQVIHU PDQDJPHQW VHUYLFWV IRU WKH \$7\$ LQWHUIDFH &RQILJXUDWLRQ DQG FRQWURO RI WKH LQWHUIDFH LV DFFRPSOLVKHG E\ WKH &RQWUROOHU DFRUVV WKH 0\$ EXV 'DWD WUDQVIHU RSHUDWLRQV DUH FRQWUROOHG E\ WKH %XIIHU &RQWUROOHU PRGXOH 0RWRU &RQWUROOHU 7KH 0RWRU &RQWUROOHU FRQWUROV WKH VSLQGOH DQG YRLFH FRLO PRWRU 9&0 PHFKDQLVP RQ WKH GULYH 5HDG:ULWH \$6, & 7KH 5HDG:ULWH \$6, & LQWHJUDWHV DQ \$GYDQFHG 3DUWLDO 5HVSQVH 0D\LPXP /LNHOLKRRG 350/ SURFHVVURU D VHOHFWDEOH FRGH UDWH (QFRGHU'HFRGHU (1'(& DQG D 6HUYR 3URFHVVURU ZLWK GDWD UDWHV XS WR 0+] 0EV 3URJUDPPLOJ LV GRQH WKURXJK D IDVV 0+] VHULDO LQWHUIDFH 7KH FRQWUROOHU DQG GDWD LQWHUIDFH WKURXJK DQ ELW ZLGH GDWD LQWHUIDFH 7KH 5HDG:ULWH \$6, & LV D ORZ SRZHU 9ROWV VLQJOH VXSSO\ ZLWK VHOHFWLYH SRZHU GRZQ FDSDELOLWHV 7KH 5HDG:ULWH \$6, & FRPSULVHV PDLQ IXQFWLRQDO PRGXOHV GHVFULEHG EHORZ 3UH&RPSHQVDWRU 9DULDEOH *DLQ \$PSOLILHU 9*\$ %XWWHUZRUK)LOWHU),5)LOWHU)ODVK '\$ & RQYHUWHU 9LWHUEL 'HWHFWRU (1'(& 6HUYR 3URFHVVURU 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ &ORFN 6QWKHVLJHU 3//6HULDO , QWHUIDFH 7\$ 'HWHFWLRQ DQG &RUHFWRU 3UH&RPSHQVDWRU 7KH SUHFRPSHQVDWRU LQWURGXFHV SUHFRPSHQVDWLRQ WR WKH ZULWH GDWD UHFHLYHG IURP WKH VHTXHQFH PRGXOH LQ WKH '&, \$7KH SUHFRPSHQVDWHG GDWD LV WKHQ SDVVHG WR WKH 5: 3UH\$PSOLILHU DQG ZULWWHQ WR WKH GLVN 3UHFRPSHQVDWLRQ UHGXFHV WKH ZULWH LQWHUIHUHQFH IURP DGMDFHQW ZULWH ELW 9DULDEOH *DLQ \$PSOLILHU 9*\$ 'LJLWDO DQG DQDORJ FRQWUROOHG \$* & IXQFWLRQ ZLWK LQXSXW DWWHQXDWRU IRU H[WHQGHG UDQJH %XWWHUZRUK)LOWHU &RQLQXRXV WLPH GDWD ILOWHU ZKLFK FDQ EH SURJUDPPHG IRU HDFK JRQH UDWH),5)LQLWH ,PSXOVH 5HVSQVH)LOWHU 'LJLWDO\ FRQWUROOHG DQG SURJUDPPDEOH ILOWHU IRU SDUWLDO UHVSQVH VLJQDO FRGLWLRQLQJ)ODVK '\$ & RQYHUWHU 3URYLGHV YHU KLJK VSHHG GLJLWLDWLRQ RI WKH SURFHVVHG UHDG VLJQDO 9LWHUEL 'HWHFWRU 'HFRGHV '\$ & UHVXOW LQWR ELQDU\ ELW VVUHD (1'(& 3URYLGHV RU FRGH FRQYHUVRQ WR 15= , QFOXGHV SUHDPEOH DQG V\QF PDUN JHQHUDWLRQ DQG GHWHFWLRQ 6HUYR 3URFHVVURU 6HUYR SURFHVVURU ZLWK VHUVR GDWD UHFVRYHU DQG EXUVV GHPRGXODWLRQ &ORFN 6QWKHVLJHU 3URYLGHV SURJUDPPDEOH IUHTXHQFHV IRU HDFK JRQH GDWD UDWH 3// 3URYLGHV GLJLWDO UHDG FORFN UHFVRYHU 6HULDO , QWHUIDFH +LJK VSHHG LQWHUIDFH IRU GLJLWDO FRQWURO RI DOO LQWHUQDO EORFNV 7\$ 'HWHFWLRQ DQG &RUHFWRU 'HWHFWV WKHUPDO DVSHULWLVH GHIFWLVH VHFWRUV DQG HQDEOHV WKHUPDO DVSHULWLVH UHFVRYHULHV 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ 3UH\$PSOLILHU DQG :ULWH 'ULYHU 7KH 3UH\$PSOLILHU DQG :ULWH 'ULYHU SURYLGHV ZULWH GULYHU DQG UHDG SUHDPSOLILHU IXQFWLRQV DQG 5: KHDG VHOHFWRU 7KH ZULWH GULYHU UHFHLYHV SUHFRPSHQVDWHG ZULWH GDWD IURP WKH 3UH&RPSHQVDWRU PRGXOH LQ WKH 5HDG:ULWH \$6, & 7KH ZULWH GULYHU WKHQ VHQV WKLW GDWD WR WKH KHDGV LQ WKH IURP RI D FRUHVSRQGLQJ DOWHUQDWLRQJ FXUUHQW 7KH UHDG SUHDPSOLILHU DPSOLILHV WKH ORZDPSOLWXGH YROWDJHV JHQHUDWHG E\ WKH 5: KHDGV DQG WUDQVPLVV WKHP WR WKH 9*\$ PRGXOH LQ WKH 5HDG:ULWH \$6, & +HDG VHOHFW LV GHWHUPLQHG E\ WKH FRQWUROOHU 7KH SUHDPS DOVR FRQWDLQV LQWHUQDO FRPSHQVDWLRQ IRU WKHUPDO DVSHULWLVH LQGXFHG DPSOLWXGH YDULDWLRQ),5:\$()(\$785(6 7KLV VHFWRU GHVFULEHV WKH IROORZLQJ ILUPZDUH IHDWXUHV 'LVN FDFKLQJ +HDG DQG FOLQGHU VNHZLQJ (UURU GHWHFWLRQ DQG FRUHFWRU 'HIFW PDQDJPHQW 'LVN & FDFKLQJ 7KH 4XDQWXP)LUHEDOO OFW \$7 KDUG GLVN GULYHV LQFRUSRUDWH 'LV&DFKH D . PLQLXP GLVN FDFKH WR HQKDQFH GULYH SHUIRUPDQFH 7KLV LQWHJUDWHG IHDWXU LV XVHUSURJUDPPDEOH DQG FDQ VLJQLILFDQWO\ LPSURYH VVWPH WKURXJKXSXW 5HDG DQG ZULWH FDFKLQJ FDQ EH HQDEOHG RU GLVDEOHG E\ XVLQJ WKH 6HW & RQILJXUDWLRQ FRPPDQG \$GDSWLVH & FDFKLQJ 7KH FDFKH EXIIHU IRU WKH 4XDQWXP)LUHEDOO OFW GULYHV IHDWXUHV DGDSWLVH VHJPHQDWRU IRU PRUH HIILFLHQW XVH RI WKH EXIIHU 5\$0 :LWK WKLW IHDWXU WKH EXIIHU VSDFH XVHG IRU UHDG DQG ZULWH RSHUDWLRQV LV G\QDPLFDO\ DOORFDWHG 7KH FDFKH FDQ EH IOH[LQ\ GLYLGHG LQWR VHYHUDO VHJPHQWV XQGHU SURJUDP FRQWURO (DFK VHJPHQW FRQWDLQV RQH FDFKH HQWU\ \$ FDFKH HQWU\ FRQVLVWV RI WKH UHTXHVWHG UHDG GDWD SOXV LWV FRUHVSRQGLQJ SUHIHWFK GDWD \$GDSWLVH VHJPHQDWRU DOORZV WKH GULYH WR PDNH RSWLXP XVH RI WKH EXIIHU 7KH DPRXQW RI VWRUHG GDWD FDQ EH LQFUHDVHG 5HDG & FDFKH 'LV&DFKH DQWLFLSDWHV KRVV\VVHP UHTXHVWV IRU GDWD DQG VWRUHV WKDW GDWD IRU IDVWHU DFFHVV :KHQ WKH KRUV UHTXHVWV D SDUWLFXODU VHJPHQW RI GDWD WKH FDFKLQJ IHDWXU XVHV D SUHIHWFK VWUDWHJ\ WR ORRN DKHDG DQG DXWRPDWLFDO\ VWRUH WKH VXEVHTXHQW GDWD IURP WKH GLVN LQWR KLJKVSHHG 5\$0 , I WKH KRUV UHTXHVWV WKLW VXEVHTXHQW GDWD WKH 5\$0 LV DFFHVVHG UDWKHU WKDQ WKH GLVN 6LQFH WSLFDO\ SHUFHQW RU PRUH RI DOO GLVN UHTXHVWV DUH VHTXHQWDO WKHUH LV D KLJK SUREDELOLW\ WKDW VXEVHTXHQW GDWD UHTXHVWHG ZLOO EH LQ WKH FDFKH 7KLV FDFKHGDWD FDQ EH UHWULHYHG LQ PLFURVHFROGV UDWKHU WKDQ PLOOLVHFROGV \$V D UHVXOW 'LV&DFKH FDQ SURYLGH VXEVWDQWLDO WLPH VDYLQJV GXULQJ DW OHDVW KDOI RI DOO GLVN UHTXHVWV , Q WKHV LQVWDQFHV 'LV&DFKH FRXOG VDYH PRVW RI WKH GLVN WUDQVDFWLRQ WLPH E\ HOLPLQDWLRQJ WKH VHHN DQG URWDWLRQDO ODWHQ\ GHODV WKDW GRPLQDWH WKH WSLFDO GLVN WUDQVDFWLRQ)RU H[DPSOH LQ D . GDWD WUDQVIHU WKHVH GHODV PDNH XS WR SHUFHQW RI WKH HODSVHG WLPH 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ 'LV&DFKH ZRUNV E\ FRQWLQXLQJ WR ILOO LWV FDFKH PHPRU\ ZLWK DGMDFHQW GDWD DIWHU WUDQVIHUULQJ GDWD UHTXHVWHG E\ WKH KRUV 8QOLNH D QRQDFKLQJ FRQWUROOHU 4XDQWXP GLVN FRQWUROOHU FRQWLQXHV D UHDG RSHUDWLRQ DIWHU WKH UHTXHVWHG GDWD KDV EHHQ WUDQVIHUHG WR WKH KRUV VVWHP 7KLV UHDG RSHUDWLRQ WHUPLQDWHV DIWHU D SURJUDPPHG DPRXQW RI VXEVHTXHQW GDWD KDV EHHQ UHDG LQWR WKH FDFKH VHJPHQW 7KH FDFKH PHPRU\ FRQVLVWV RI D .



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DSSUR[LPDWHO\ '5\$0 EXIIHU DOORFDWHG WR KROG WKH GDWD ZKLFK FDQ EH GLUHFWO\ DFFHVVHG E\ WKH KRVW E\ PHDQV RI WKH 5(\$ DQG :5,7(FRPPDQGV 7KH PPHRU\ IXQFWLRQV DV D JURXS RI VHJPHQV ZLWK UROORYHU SRLQV DW WKH HQG RI FDFKH PPHRU\ 7KH XQLW RI GDWD VWRUHG LV WKH ORJLDO EORFN WKDW LV D PXOWLSOH RI WKH ERW VHFWRU 7KHUHIRUH DOO DFFHVVHV WR WKH FDFKH PPHRU\ PXVW EH LQ PXOWLSOHV RI WKH VHFWRU VLJH \$OO QRQUHGDZULWH FRPPDQGV IRUFH HPSWLQJ RI WKH FDFKH :ULWH &DFKH :KHQ D ZULWH FRPPDQGV LV H[HFVWHG ZLWK ZULWH FDFKLQJ HQDEOHG WKH GULYH VWRUHV WKH GDWD WR EH ZULWWHQ LQ D '5\$0 FDFKH EXIIHU DQG LPPHGLDWHO\ VHQGV D *22' 67\$786 PHVVDJH WR WKH KRVW EHIRUH WKH GDWD LV DFWXDOO\ ZULWWHQ WR WKH GLVN 7KH KRVW LV WKHQ IUHH WR PRYH RQ WR RWKHU WDVNV VXFK DV SUHSDULQJ GDWD IRU WKH QH[W GDWD WUDQVIHU ZLWKRXW KDYLQJ WR ZDLW IRU WKH GULYH WR VHHN WR WKH DSSURSULDWH WUDFN RU URWDWH WR WKH VSHFLILHG VHFWRU :KLOH WKH KRVW LV SUHSDULQJ GDWD IRU WKH QH[W WUDQVIHU WKH GULYH LPPHGLDWHO\ ZULWHV WKH FDFKH GDWD WR WKH GLVN VXVDOO\ FRPSOHWLQJ WKH RSHUDWLQJ LQ OHVV WKDQ PV DIWHU LVVXLQJ *22' 67\$786 :LWK :ULWH&DFKH D VLQJOHEORFN UDQGRP ZULWH IRU H[DPSOH UHTXLUHV RQO\ DEXXV PV RI KRVW WLPH :ULWH&DFKH WKH VDPH RSHUDWLQJ ZRXOG RFFXS WKH KRVW IRU DEXXV PV :ULWH&DFKH DOORZ GDWD WR EH WUDQVIHUUHG LQ D FRQWLQXRXV IORZ WR WKH GULYH UDWKHU WKDQ DV LQGLYLGXDO EORFNV RI GDWD VHSUDWHG E\ GLVN DFFHVV GHODV 7KLW LV DFKLHYHG E\ WDNLQJ DGYDQWJDJH RI WKH DELOLW\ WR ZULWH EORFNV RI GDWD VHTXHQWDOO\ RQ D GLVN WKDW LV IRUPDWHG ZLWK D LQWHUOHDYH 7KLW PHDQV WKDW DV WKH ODVW E\WH RI GDWD LV WUDQVIHUUHG RXW RI WKH ZULWH FDFKH DQG WKH KHDG SDVVHV RYHU WKH QH[W VHFWRU RI WKH GLVN WKH ILUVW E\WH RI WKH RI WKH QH[W EORFN RI GDWD LV UHDA\ WR EH WUDQVIHUUHG WKXV WKHUH LV QR LQWHUUXSWLQJ RU GHOD\ LQ WKH GDWD WUDQVIHU SURFHVV 7KH :ULWH&DFKH DOJRULWKP ILOOV WKH FDFKH EXIIHU ZLWK QHZ GDWD IURP WKH KRVW ZKLOH VLPXOWDQHRXVO\ WUDQVIHUULQJ GDWD WR WKH GLVN WKDW WKH KRVW SUHYLRXVO\ VWRUHG LQ WKH FDFKH 3HUIRUPDQFH %HQHILWV ,Q D GULYH ZLWKRXW 'LV&DFKH WKHUH LV D GHOD\ GXULQJ VHTXHQWDOO\ UHGDV EHFDXVH RI WKH URWDWLQJDO ODWHQF\ HYHQ LI WKH GLVN DFWXDWRU DOUHDA\ LV SRVLWLRQHG DW WKH GHVLUHG FOLQGHU 'LV&DFKH HOLPLQDWHV WKLW URWDWLQJDO ODWHQF\ WLPH PV RQ DYHUDJH ZKHQ UHTXHVWHG GDWD UHVLGHV LQ WKH FDFKH ORUHRYHU WKH GLVN PXVW RIWHQ VHUULFH UHTXHVWV IURP PXOWLSOH SURFHVVHV LQ D PXOWLWDVNLQJ RU PXOWLXVHU HQYLURQPHQW ,Q WKHVH LQVWDQFHV ZKLOH HDFK SURFHVV PLJKW UHTXHVW GDWD VHTXHQWDOO\ WKH GLVN GULYH PXVW VKDUH WLPH DPRQJ DOO WKHVH SURFHVVHV ,Q PRVW GLVN GULYHV WKH KHDGV PXVW PRYH IURP RQH ORFDWLQJ WR DQRWKHU :LWK 'LV&DFKH HYHQ LI DQRWKHU SURFHVV LQWHUUXSWV WKH GULYH FRQWLQXHV WR DFFHVV WKH GDWD VHTXHQWDOO\ IURP LWV KLJKVSHHG PPHRU\ ,Q KDQGLQJ PXOWLSOH SURFHVVHV 'LV&DFKH DFKLHYHV LWV PRVW LPSUHVVLYH SHUIRUPDQFH JDLOV VDYLOJ ERWK VHHN DQG ODWHQF\ WLPH ZKHQ GHVLUHG GDWD UHVLGHV LQ WKH FDFKH 7KH FDFKH FDQ EH IOH[LEO\ GLYLGHG LQWR VYHUDO VHJPHQV XQGHU SURJUDP FRQWURO (DFK VHJPHQW FRQWDLQV RQH FDFKH HQWU\ \$ FDFKH HQWU\ FRQVLYV RI WKH UHTXHVWHG UHGD GDWD SOXV LWV FRUUVSRQGLQJ SUHIHWFK GDWD 4XDQWXP)LUHEDOO OFW %\$ \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLQJ 7KH UHTXHVWHG UHGD GDWD WDNHV XS D FHUWDLQ DPRXQW RI VSDFH LQ WKH FDFKH VHJPHQW +HQFH WKH FRUUVSRQGLQJ SUHIHWFK GDWD FDQ HVVHQWDOO\ RFFXS WKH UHVW RI WKH VSDFH ZLWKLQ WKH VHJPHQW 7KH RWKHU IDFWRUV GHWHUPLQLQJ SUHIHWFK VLJH DUH WKH PD[LXP DQG PLQLXP SUHIHWFK 7KH GULYHV SUHIHWFK DOJRULWKP GQDPLFDOO\ FRQWUROV WKH DFWXDO SUHIHWFK YDOXH EDVHG RQ WKH FXUUHQW GHPDQGV ZLWK WKH FRQVLGHUDWLQJ RI RYUHKHDG WR VXEHTXHQW FRPPDQGV +HDG DQG &OLQGHU 6NHZLQJ +HDG DQG FOLQGHU VNHZLQJ LQ WKH 4XDQWXP)LUHEDOO OFW \$7 KDUG GLVN GULYHV PLQLPLJH ODWHQF\ WLPH DQG WKXV LQFUHDVHV GDWD WKURXJKSXW +HDG 6NHZLQJ +HDG VNHZLQJ UHGXFHV WKH ODWHQF\ WLPH WKDW UHVXOWV ZKHQ WKH GULYH PXVW VZLWFK UHGDZULWH KHDG WR DFFHVV VHTXHQWDOO\ GDWD \$ KHDG VNHZ LV HPSORHG VXFK WKDW WKH QH[W ORJLDO VHFWRU RI GDWD WR EH DFFHVVHG ZLOO EH XQGHU WKH UHGDZULWH KHDG RQFH WKH KHDG VZLWFK LV PDGH DQG WKH GDWD LV UHDA\ WR EH DFFHVVHG 7KXV ZKHQ VHTXHQWDOO\ GDWD LV RQ WKH VDPH FOLQGHU EXW RQ D GLIIHUHQW GLVN VXUIDFH D KHDG VZLWFK LV QHHGHG EXW QRW D VHHN 6LQFH WKH VHTXHQWDOO\ KHDGVZLWFK WLPH LV ZHOO GHILQH RQ WKH 4XDQWXP)LUHEDOO OFW GULYHV WKH VHFWRU DGGUHVHV FDQ EH RSWLPDOO\ SRVLWLRQHG DFURVV WUDFN ERXQGDULHV WR PLQLPLJH WKH ODWHQF\ WLPH GXULQJ D KHDG VZLWFK 6HH 7DEOH &OLQGHU 6NHZLQJ &OLQGHU VNHZLQJ LV DOVR XVHG WR PLQLPLJH WKH ODWHQF\ WLPH DVVRFLDWHG ZLWK D VLQJOH FOLQGHU VHHN 7KH QH[W ORJLDO VHFWRU RI GDWD WKDW FURVVHV D FOLQGHU ERXQGDULHV LV SRVLWLRQHG RQ WKH GULYH VXFK WKDW DIWHU D VLQJOHFOLQGHU VHHN LV SHUIRUPHG DQG ZKHQ WKH GULYH LV UHDA\ WR FRQWLQXH DFFHVVLQJ GDWD WKH VHFWRU WR EH DFFHVVHG LV SRVLWLRQHG GLUHFWO\ XQGHU WKH UHGDZULWH KHDG 7KHUHIRUH WKH FOLQGHU VNHZ WDNHV SODFH EHWZHHQ WKH ODVW VHFWRU RI GDWD RQ WKH ODVW KHDG RI D FOLQGHU DQG WKH ILUVW VHFWRU RI GDWD RQ WKH ILUVW KHDG RI WKH QH[W FOLQGHU 6LQFH VLQJOHFOLQGHU VHHN V DUH ZHOO GHILQH RQ WKH 4XDQWXP)LUHEDOO OFW GULYHV WKH VHFWRU DGGUHVHV FDQ EH RSWLPDOO\ SRVLWLRQHG DFURVV FOLQGHU ERXQGDULHV WR PLQLPLJH WKH ODWHQF\ WLPH DVVRFLDWHG ZLWK D VLQJOHFOLQGHU VHHN 6HH 7DEOH 6NHZLQJ ZLWK ,OHVV ,Q WKH ,OHVV HQYLURQPHQW WKH GULYHV WUDFN DQG FOLQGHU VNHZLQJ ZLOO EH EDVHG LQ XQLW RI ZHGJHV LQVWHGD RI WKH WUDGLWLRQDO VHFWRUV 7KH LQWHJUDWHG SURFHVVU GLVN FRQWUROOHU DQG \$7\$ LQWHUIDFH FRQWDLQV D :HGJH 6NHZ 5HJLVWHU WR DVVLVW LQ WKH WDNV RI VNHZLQJ ZKHUH WKH VNHZ RIIVHW PXVW QRZ EH FDOFXODWHG ZLWK HYHU UHGDZULWH RSHUDWLQJ 7KH ILUPZDUH ZLOO SURJUDP WKH VNHZ RIIVHW LQWR WKLW UHJLVWHU HYHU WLPH WKH GULYH JRHV WR D QHZ WUDFN 7KH LQWHJUDWHG SURFHVVU GLVN FRQWUROOHU DQG \$7\$ LQWHUIDFH ZLOO WKHQ DGG WKLW YDOXH WR WKH ZHGJH QXPEHU LQ WKH , FDOFXODWRU HIIHFWLYHO\ UHORFDWLQJ WKH ILUVW VHFWRU RI WKH WUDFN DZD\ IURP WKH LQGH[]RU H[DPSOH LI ZLWKRXW VNHZ VHFWRU LV WR EH IRXQG IROORZLQJ ZHGJH WKHQ LI WKH VNHZ UHJLVWHU LV VHW WR VHFWRU ZLOO EH IRXQG IROORZLQJ ZHGJH 6LQFH WKH ZHGJHWZHGJH WLPH LV FRQVWDQW RYHU WKH HQWLUH GLVN D VLQJOH VHW RI KHDG DQG FOLQGHU VNHZ RIIVHW ZLOO IXOILOO WKH UHTXLUPHQW IRU DOO UHFRUGLQJ JRQHV 4XDQWXP)LUHEDOO OFW %\$ \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLQJ 6NHZ 2IIVHWV 7DEOH 6NHZ 2IIVHWV 7<3,&\$ /6: 7&+ 7,0 (+HDG 6NHZ &OLQGHU 6NHZ PV PV :(* (2))6(7 IRWH 7KH VZLWFK WLPH LV FDOFXODWHG RQ WKH EDVLV RI WKH QRUPDO ZHGJH WRZHGJH WLPH ZLWK WKH VSLQGOH VSHHG YDULDWLQJ DFFRXQWHG IRU :HGJH RIIVHWV DUH URXQGHG WR WKH FORVHVW ZKROH QXPEHU 5XQWLPH &DOFXODWLQJ 6LQFH WKH ZHGJHWZHGJH WLPH LV FRQVWDQW RYHU WKH HQWLUH GLVN D VLQJOH VHW RI KHDG DQG FOLQGHU VNHZ RIIVHW ZLOO IXOILOO WKH UHTXLUPHQW IRU DOO UHFRUGLQJ JRQHV 7KH IRUPXOD XVHG WR FRPSXWH WKH ZHGJH VNHZ IRU D JLYHQ FOLQGHU DQG KHDG LV :HGJH VNHZ :KHUH + 76 > & RI KHDG 76 & 6 + 76 @ 2' &OLQGHU QXPEHU +HDG QXPEHU +HDG 6NHZ 2IIVHW & 6 &OLQGHU 6NHZ 2IIVHW ZHGJHWUDFN (UURU 'HWHFWLQJ DQG &RUHFWRQ \$V GLVN GULYH DUHDO GHQVLWLV LQFUHDVH REWDLQLQJ H[WUHPHO\ ORZ HUURU UDWHV UHTXLUHV D QHZ JHQHUDWLQJ RI VRSKLVWLFDWHG HUURU FRUHFWRQ FRGHV 4XDQWXP)LUHEDOO OFW KDUG GLVN GULYH VHULHV LPSOPHQW ELW TXDGUXSOHEXUVV

5HHG6RORPRQ HUURU FRUUFWLRQ WHFKQLTXHV WR UHGXFH WKH XQFRUUFWDEOH UHGD EORFN HUURU UDWH WR OHVV
WKDQ RQH ELW LQ [# ELWV UHGD :KHQ HUURUV RFFXU DQ DXWRPDWLF UHWU\ D GRXEOHEXUVV DQG D PRUH ULJRURXV
TXDGUXSOHEXUVV FRUUFWLRQ DOJRULWKP HQDEOH WKH FRUUFWLRQ RI DQ VHFWRU ZLWK IRXU EXUVV RI IRXU LQFRUUFW
EWHV HDFK RU XS WR VL[WHHQ PXOWLSOH UDQGRP RQHEWH EXUVV HUURUV ,Q DGGLWLRQ WR WKHVH DGYDQFHG HUURU
FRUUFWLRQ FDSDELOLWLHV WKH GULYH XVHV DQ DGGLWLRQDO FURVFKHFNQJ FRGH DQG DOJRULWKP WR GRXEOH FKHFN
WKH PDLQ (& FRUUFWLRQ 7KL JUHDW\ UHGXFHV WKH SUREDELOLW RI D PLVFRUUFWLRQ %DFNJURXQG ,QIRUPDWLRQ RQ
(UURU &RUUFWLRQ &RGH DQG (& 2QWKH)\ \$ VHFWRU RQ WKH 4XDQWXP)LUHEDOO OFW \$7 GULYH LV FRPSULVHG RI EWHV RI
XVHU GDWD IROORZHG E IRXU FURVFKHFNQJ ;& EWHV ELWV IROORZHG E (& FKHFN EWHV ELWV 7KH IRXU FURVFKHFNQJ
EWHV DUH XVHG WR GRXEOH FKHFN WKH PDLQ (& FRUUFWLRQ DQG UHGXFH WKH SUREDELOLW RI PLVFRUUFWLRQ (UURUV RI
XS WR ELWV ZLWKLQ RQH VHFWRU FDQ EH FRUUFHWG RQWKHIO\ LQ UHDO WLPD DV WKH RFFXU DOORZLQJ D KLJK GHJUHH RI
GDWD LQWHUJULW ZLWK QR LPSDFW RQ WKH GULYHV SHUIRUPDQFH 7KH GULYH GRHV QRW QHHG WR UHUHGD D VHFWRU RQ WKH
QHJW GLVN UHYROXWLRQ RU DSSO\ (& IRU WKRWH HUURUV WKDW DUH FRUUFHWG RQWKHIO\ (UURUV FRUUFHWG LQ WKLV
PDQQHU DUH 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ LQYLVLVLEOH WR WKH KRUV VVWHP :KHQ HUURUV
FDQQRW EH FRUUFHWG RQWKHIO\ DQ DXWRPDWLF UHWU\ DQG D PRUH ULJRURXV TXDGUXSOHEXUVV HUURU FRUUFWLRQ
DOJRULWKP HQDEOHV WKH FRUUFWLRQ RI DQ VHFWRU ZLWK IRXU EXUVV RI IRXU LQFRUUFW EWHV HDFK XS WR FRQWLJRXV
EWHV RU XS WR PXOWLSOH UDQGRP RQHEWH EXUVV HUURUV ,Q DGGLWLRQ WR WKLV HUURU FRUUFWLRQ FDSDELOLW WKH
GULYHV LPSOPHQDWLRQ RI DQ DGGLWLRQDO FURVFKHFNQJ FRGH DQG DOJRULWKP GRXEOH FKHFNV WKH PDLQ (&
FRUUFWLRQ DQG JUHDW\ GHFUHDVHV WKH OLNHOLKRRG RI PLVFRUUFWLRQ 7KH (& FKHFN EWHV VKRZQ LQ)LJXUH DUH
XVHG WR GHWHFV DQG FRUUFW HUURUV 7KH FURVFKHFNQJ DQG (& GDWD LV FRPSXWHG DQG DSSHQGHG WR WKH XVHU
GDWD ZKHQ WKH VHFWRU LV ILUVV ZULWWHQ)LJXUH 6HFWRU 'DWD)HOG ZLWK (& &KHFN %\WHV 7R REWDLQ WKH (& FKHFN
EWH YDOXH HDFK EWH LQFOXGLQJ FURVFKHFNQJ DQG (& EWHV ZLWKLQ WKH VHFWRU LV LQWHUOHYHG LQWR RQH RI
IRXU JURXS ZKHUH WKH ILUVV EWH LV LQ LQWHUOHYH WKH VHFWRQ EWH LV LQ LQWHUOHYH WKH WKLUG EWH LV LQ
LQWHUOHYH WKH IRXUWK EWH LV LQ LQWHUOHYH WKH ILIWK EWH LV LQ LQWHUOHYH DQG VR RQ DV VKRZQ LQ)LJXUH
)LJXUH %\WH ,QWHUOHYDQJ IRWH (& LQWHUOHYDQJ LV QRW WKH VDPH DV WKH VHFWRU LQWHUOHYDQJ WKDW LV GRQH RQ
WKH GLVN (DFK RI WKH IRXU LQWHUOHYHV LV HQFRGHG ZLWK (& EWHV UHVXOWLQJ LQ WKH (& EWHV DW WKH HQG RI WKH
VHFWRU 7KH IRXU FURVFKHFNQJ EWHV DUH GHULYHG IURP DOO GDWD EWHV 7KH FRPELQDWLRQ RI WKH LQWHUOHYDQJ DQG
WKH QDWXUH RI WKH (& IRUPXODV HQDEOH WKH GULYH WR NORZ ZKHUH WKH HUURU RFFXUV %HFDXVH WKH (& FKHFN EWHV
IROORZ WKH FURVFKHFNQJ EWHV HUURUV IRXQG ZLWKLQ WKH FURVFKHFNQJ EWHV FDQ EH FRUUFHWG 'XH WR WKH SRZHU
DQG VRSKLVWLFDWLRQ RI WKH FRGH HUURUV IRXQG ZLWKLQ WKH (& FKHFN EWHV FDQ DOVR EH FRUUFHWG (DFK WLPD D
VHFWRU RI GDWD LV UHGD WKH 4XDQWXP)LUHEDOO OFW GULYHV ZLOO JHQHUDWH D QHZ VHW RI (& FKHFN EWHV DQG
FURVFKHFNQJ EWHV IURP WKH XVHU GDWD 7KHVH 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ QHZ
FKHFN EWHV DUH FRPSDUHG WR WKH RQH RULJLQDO\ ZULWWHQ WR WKH GLVN 7KH GLIHHUHQFH EHWZHHQ WKH QHZO\
FRPSXWHG DQG RULJLQDO FKHFN EWHV LV UHIOHFWHG LQ D VHW RI \QOGURPHV DQG WKUHH FURVFKHFNQJ \QOGURPHV ZLFLK
FRUUVSRQG WR WKH QXPEHU RI FKHFN EWHV ,I DOO WKH (& \QOGURPH YDOXH HTXDO)HUR DQG F] \QOGURPH YDOXH HTXDOV
RU)) WKH GDWD ZDV UHGD ZLWK QR HUURUV DQG WKH VHFWRU LV WUDQVIHUHG WR WKH KRUV VVWHP ,I DQ RI WKH
\QOGURPHV GR QRW HTXDO)HUR DQ HUURU KDV RFFXUHG 7KH WSH RI FRUUFWLRQ WKH GULYH DSSOLHV GHSHQGV RQ WKH
QDWXUH DQG WKH HJWHQW RI WKH HUURU +LJ VSHHG RQWKHIO\ HUURU FRUUFWLRQ VDYHV VHYHU PLOOLVFRQGV RQ
HDFK VLQJOH RU GRXEOH EXUVV HUURU EHFDXVH WKHUH LV QR QHHG WR ZDLW IRU D GLVN UHYROXWLRQ WR EULQJ WKH
VHFWRU XQGHU WKH KHDG IRU UHUHGLQJ &RUUFWLRQ RI 6LQJOH RU 'RXEOH%XUVV (UURUV 2QWKH)\ 6LQJOHEXUVV HUURUV
PD\ KDYH XS WR IRXU HUURUHRXV EWHV ELWV ZLWKLQ D VHFWRU SURYLGHG WKDW HDFK RI WKH IRXU EWHV RFFXU LQ D
GLIHHUHQW LQWHUOHYH 7KH 4XDQWXP)LUHEDOO OFW GULYHV KDYH WKH FDSDELOLW WR FRUUFW GRXEOHEXUVV HUURUV
RQWKHIO\ DV ZHO\ 'RXEOHEXUVV HUURUV FDQ EH VLPSO\ YLHZHG DV WZR VSDQV RI HUURUV ZLWKLQ RQH VHFWRU ORUH
VSHFLILFDO\ FRUUFWDEOH GRXEOHEXUVV HUURUV PXV KDYH WZR RU IHZHU HUURUHRXV EWHV SHU LQWHUOHYH 7KH
GULYH 5HHG6RORPRQ (& FRUUFWV GRXEOHEXUVV HUURUV XS WR ELWV ORQJ SURYLGHG WKDW WKH HUURU FRQVLVWV RI WZR
RU IHZHU EWHV UHVLGLQJ LQ HDFK RI WKH LQWHUOHYHV 'RXEOH%XUVV (UURU (DPSOHV ,Q WKH H[DPSOH VKRZQ LQ)LJXUH &
WKH ELW HUURU LV XQFRUUFWDEOH VLQFH LW RFFXSLHV PRUH WKDQ WZR HUURUHRXV EWHV SHU LQWHUOHYH 7KH RWKHU
WZR ELW HUURUV VKRZQ LQ)LJXUH \$ DQG % DUH FRUUFWDEOH EHFDXVH QR PRUH WKDQ WZR HUURU EWHV RI WKH HQWLHU
HUURU UHVLGH LQ DQ RQH RI WKH LQWHUOHYHV IRWH \$Q ELW HUURU EXUVV FDQ EH FRUUFHWG RQWKHIO\ XVLQJ GRXEOH
EXUVV HUURU FRUUFWLRQ EHFDXVH QR PRUH WKDQ WZR EWHV FDQ RF FXS\ HDFK LQWHUOHYH)LJXUH &RUUFWDEOH DQG
8QFRUUFWDEOH 'RXEOH%XUVV (UURUV 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ &RUUFWLRQ RI
4XDGUXSOH%XUVV (UURUV 7KURXJK VRSKLVWLFDWHG DOJRULWKP 4XDQWXP)LUHEDOO OFW \$7 GULYHV KDYH WKH FDSDELOLW
WR FRUUFW TXDGUXSOHEXUVV HUURUV HYHQ WKRXJK WKH SUREDELOLW RI WKHLU RFFXUHQFH LV ORZ 4XDGUXSOHEXUVV
HUURUV FDQ EH VLPSO\ YLHZHG DV IRXU VSDQV RI HUURUV ZLWKLQ RQH VHFWRU ORUH VSHFLILFDO\ FRUUFWDEOH
TXDGUXSOHEXUVV HUURUV PXV KDYH IRXU RU IHZHU HUURUHRXV EWHV SHU LQWHUOHYH DQG ZLOO QRW EH FRUUFHWG
RQWKH IO\ 7KH GULYHV 5HHG6RORPRQ (& FRUUFWV TXDGUXSOHEXUVV HUURUV XS WR ELWV ORQJ SURYLGHG WKDW WKH
HUURU FRQVLVWV RI IRXU RU IHZHU EWHV UHVLGLQJ LQ HDFK RI WKH LQWHUOHYHV ,I WKH TXDGUXSOHEXUVV FRUUFWLRQ LV
VXFHHVIXO WKH GDWD IURP WKH VHFWRU FDQ EH ZULWWHQ WR D VSDUH VHFWRU DQG WKH ORJLFDQ DGGUHVV ZLOO EH
PDSSHG WR WKH QHZ SKVLFDQ ORFDWLRQ 4XDGUXSOH%XUVV (UURU (DPSOHV ,Q WKH H[DPSOH VKRZQ LQ)LJXUH & WKH ELW
HUURU LV XQFRUUFWDEOH VLQFH LW RFFXSLHV PRUH WKDQ IRXU HUURUHRXV EWHV SHU LQWHUOHYH 7KH RWKHU WZR ELW
HUURUV VKRZQ LQ)LJXUH \$ DQG % DUH FRUUFWDEOH EHFDXVH QR PRUH WKDQ IRXU HUURU EWHV RI WKH HQWLHU HUURU
UHVLGH LQ DQ RQH RI WKH LQWHUOHYHV IRWH \$Q ELW HUURU EXUVV FDQ EH FRUUFHWG XVLQJ TXDGUXSOHEXUVV HUURU
FRUUFWLRQ EHFDXVH QR PRUH WKDQ IRXU EWHV FDQ RFFXS\ HDFK LQWHUOHYH CORRECTABLE A Interleave Interleave Interleave
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Interleave 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 Interleave 1 120 bits 1 bit 1 bit)LJXUH &RUUFWDEOH DQG 8QFRUUFWDEOH 4XDGUXSOH%XUVV

(UURUV 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ 0XOWLSOH 5DQGRP %XUVW (UURUV 7KH GULYHV (& FDQ FRUHHFW XS WR ELWV RI PXOWLSOH UDQGRP HUURUV SURYLGHG WKDW WKH LQFRUHHFW E\WHV IROORZ WKH JXLGHOLQHV IRU FRUHHFWDEOH TXDGUXSOHEXUVW HUURUV 8S WR ELWV RI PXOWLSOH UDQGRP HUURUV SURYLGHG WKDW WKH LQFRUHHFW E\WHV IROORZ WKH JXLGHOLQHV IRU FRUHHFWDEOH GRXEOHEXUVW HUURUV 8S WR ELWV RI PXOWLSOH UDQGRP HUURUV FDQ EH FRUHHFWHG RQWKHIO\ LI WZR EWHV SHU LQWHUOHDYH FRQWDLQV DQ HUURU ,I PRUH WKDQ IRXU EWHV LQ DQ RQH LQWHUOHDYH DUH LQ HUURU WKH VHFWRU FDQQRW EH FRUHHFWHG)LXUH VKRZV DQ H[DPSOH RI D FRUHHFWDEOH UDQGRP EXUVW HUURU FRQVLVWLQJ RI E\WHV ELWV 7KLV UDQGRP EXUVW HUURU LV FRUHHFWDEOH EHFDXVH QR PRUH WKDQ IRXU EWHV ZLWKLQ HDFK LQWHUOHDYH DUH LQ HUURU INTERLEAVE 1 INTERLEAVE 2 INTERLEAVE 3 INTERLEAVE 4 1 5 9 2 6 10 3 7 11 4 8 12 85 89 93 86 90 94 87 91 95 88 92 96 505 509 513 XC 506 510 514 XC 507 511 515 XC 508 512 516 XC BYTE CONTAINING AN ERROR)LXUH 7ZHOYH &RUHHFWDEOH 5DQGRP %XUVW (UURUV 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ (& (UURU +DQGLQJ :KHQ D GDWD HUURU RFFXUV WKH 4XDQWXP)LUHEDOO OFW KDUG GLVN GULYHV FKHFN WR VHH LI WKH HUURU LV FRUHHFWDEOH XVLQJ KDUGZDUH RQWKHIO\ (& FRUHHFWLRQ ,I WKH HUURU LV FRUHHFWDEOH XVLQJ KDUGZDUH RQWKHIO\ (& FRUHHFWLRQ WKH HUURU LV FRUHHFWHG YLD KDUGZDUH DQG WKH GDWD LV WUDQVIHUHG WR WKH KRUV \VWHP 7KH KDUGZDUH RQWKHIO\ (& FRUHHFWLRQ SURFHVV LV YHU TXLFN DQG GRHV QRW VWRV WKH GLVN WUDQVIHU ,I WKH GDWD LV QRW FRUHHFWDEOH XVLQJ KDUGZDUH RQWKHIO\ (& FRUHHFWLRQ WKH VHFWRU LV UHUHDG LQ DQ DWVHPSW WR UHDG WKH GDWD FRUHHFW\ ZLWKRXW DSSOLQJ ILUPZDUH WULSOH RU TXDGUXSOHEXUVW (& FRUHHFWLRQ %HIRUH LQYRNLQJ WKH ILUPZDUH WULSOH RU TXDGUXSOHEXUVW (& DOJRULWKP WKH GULYH ZLOO DOZDV WU\ WR UHFYRHU IURP DQ HUURU E\ DWVHPSWLQJ WR UHUHDG WKH GDWD FRUHHFW\ 7KLV VWUDWH\ SUHYHQWV LQYRNLQJ FRUHHFWLRQ RQ QRQUHSHDWDEOH HUURUV (DFK WLPH D VHFWRU LQ HUURU LV UHUHDG D VHW RI (& VQGURPH LV FRPSXWHG ,I DOO RI WKH (& VQGURPH YDOXHV HTXDO JHUR DQG ; & VQGURPH YDOXH HTXDO WR RU)) WKH GDWD ZDV UHDG ZLWK QR HUURU DQG WKH VHFWRU LV WUDQVIHUHG WR WKH KRUV \VWHP ,I DQ RI WKH VQGURPH YDOXH GR QRW HTXDO JHUR DQ HUURU KDV RFFXUHG WKH VQGURPH YDOXH DUH UHWDLQHG DQG DQRWKHU UHUHDG LV LQYRNLQJ ,I WKH UHWU\ DOJRULWKP UHDFKHV WKH ODVW VWHS RI WKH UHWU\ WDEOH RU WKH ODVW SDVV WKURXJK WKH UHWU\ WDEOH DQG WKH VHFWRU VWLOO KDV D GDWD HUURU WKHQ WKH GULYH ZLOO DSSO ILUPZDUH WULSOH RU TXDGUXSOHEXUVW (& FRUHHFWLRQ WR UHFYRHU WKH GDWD IRWH IRQUHSHDWDEOH HUURUV DUH XVDOO\ UHODWHG WR WKH VLQDO WR QRLVH UDWLRI WKH \VWHP 7KH DUH QRW GXH WR PHGLD GHIFWV ,I WKH DXWRPDWLF UHDG UHDOORFDWLRQ IHDWXUH LV HQDEOHG DQG WKH GULYH XVHG ILUPZDUH WULSOH RU TXDGUXSOHEXUVW (& FRUHHFWLRQ WR UHFYRHU WKH GDWD WKHQ WKH GULYH ZLOO SHUIRUP D PHGLD WHVV RQ WKH VHFWRU WR GHWHUPLQH LI WKH HUURU ZDV FDXVHG E\ D JURZQ PHGLD GHIFW 7KH PHGLD WHVV FRQVLVWV RI ZULWLQJ DQG UHGLQJ WKH VHFWRU IRXU WLPHV ,I DQ RQH RI WKH ZULWHV RU UHDGV IDLOV RU LI DQ UHDG UHTXLUHV ILUPZDUH TXDGUXSOH EXUVW (& FRUHHFWLRQ WR UHFYRHU WKH GDWD WKHQ WKH VHFWRU LV DXWRPDWLFDOO\ UHVVWLQJHG IRWH 7KH 4XDQWXP)LUHEDOO OFW \$7 GULYHV DUH VKLSSHG IURP WKH IDFWRU\ ZLWK WKH DXWRPDWLF UHDG UHDOORFDWLRQ IHDWXUH HQDEOHG VR WKDW DQ QHZ GHIFWLYH VHFWRUV FDQ EH HDVLO\ DQG DXWRPDWLFDOO\ UHDOORFDWHG IRU WKH DYHJDJH \$7 HQG XVHU 'HIHFW ODQDJPHQW 7KH 4XDQWXP)LUHEDOO OFW GULYHV XVH WZR WHFKQLTXHV IRU UHSODFLQJ GHIFWLYH VHFWRUV LQOLQH UHSODFPHQW DQG RIOLQH UHSODFPHQW XULQJ PDQXIDFWXULQJ LI D VHFWRU RQ D FOLQGHU LV IRXQG WR EH GHIFWLYH WKH DGGUHV RI WKH VHFWRU LV DGGHG WR WKH GULYH V GHIFW OLWV 7KH GHIFWLYH VHFWRU LV VNLSSHG DQG LV UHSODFHG E\ WKH QHJW LPPHGLDWH VHFWRU ZLWK PDLQWLDQV D VHTXWLDO RUGHULQJ RI ORJLDO EORFNV 7KL V LQOLQH VSDULQJ WHFKQLTXH LV HPSORHG LQ DQ DWVHPSW WR HOLPLQDWH VORZ GDWD WUDQVIHU WKDW ZRQG UHVXOW IURP UHTXLULQJ D VHHN WR DQRWKHU FOLQGHU WR DFFHVV D UHSODFPHQW VHFWRU 7KH 4XDQWXP)LUHEDOO OFW GULYHV DUH GLYLGHG LQWR ORJLDO JRQH IRU SXUSRVH RI GHIFW PDQDJPHQW (DFK JRQH KDV D SRRO RI VSDUH VHFWRUV ZLWK DUH UHVHUYHG IRU RIOLQH UHSODFPHQW 'HIHFW WKDW RFFXU LQ WKH ILHOG DUH NQRZQ DV JURZQ GHIFWV ,I VXFK D GHIFWLYH VHFWRU LV IRXQG LQ WKH ILHOG WKH VHFWRU LV UHDOORFDWHG WR D VSDUH VHFWRU IURP WKH QHDUHVW DYDLODEOH SRRO RI VSDUH 7KH GHIFW OLWV VXSSRUWV D PD[LXP RI JURZQ GHIFWV 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ 6HFWRUV DUH FRQVLGHUHG WR FRQWDLQ JURZQ GHIFWV LI WKH TXDGUXSOHEXUVW (& DOJRULWKP PXV EH DSSOLHG WR UHFYRHU WKH GDWD ,I WKLV DOJRULWKP LV VXFFHVVIXO WKH FRUHHFWHG GDWD LV VWRUHG LQ WKH QHZO\ DOORFDWHG VHFWRU ,I WKH DOJRULWKP LV QRW VXFFHVVIXO D SHQGLQJ GHIFW ZLOO EH DGGHG WR WKH GHIFW OLWV \$Q VXEVHTXHQW UHDG WR WKH RULJLQDO ORJLDO EORFN ZLOO UHWXUQ DQ HUURU LI WKH UHDG LV QRW VXFFHVVIXO \$ KRUV FRPPDQG WR RYHUZULWH WKH ORFDWLRQ ZLOO UHVXOW LQ VHYHUDO ZULWHUHDGYHULILHV RI WKH VXVSHW ORFDWLRQ ,I DQ RI WKHV RSHUDWLRQV IDLO WKH QHZ GDWD ZLOO EH ZULWWHQ WR D VSDUH VHFWRU DQG WKH RULJLQDO ORFDWLRQ ZLOO EH DGGHG WR WKH SHUPDQHQW GHIFW OLWV ,I DOO RI WKH RSHUDWLRQV DUH VXFFHVVIXO GDWD ZLOO EH ZULWWHQ WR WKH ORFDWLRQ DQG WKH SHQGLQJ GHIFW ZLOO EH UHPRYHG IURP WKH OLWV 4XDQWXP)LUHEDOO OFW *% \$7 %DVLF 3ULQFLSOHV RI 2SHUDWLRQ 4XDQWXP)LUHEDOO OFW *% \$7 &KDSWHU \$7 \$%86 ,17(5)\$& (\$1' \$7 \$200\$1'6 7KLV FKDSWHU GHVFULEHV WKH LQWHUIDFH EHWZHHQ 4XDQWXP)LUHEDOO OFW *% \$7 KDUG GLVN GULYHV DQG WKH \$7 EXV 7KH FRPPDQGV WKDW DUH LVVXH IURP WKH KRUV WR FRQWURO WKH GULYH DUH OLWVHG DV ZHOO DV WKH HOHFWLDFO DQG PHFKDQLFO FKDUDFWHULVWLFV RI WKH LQWHUIDFH ,175'8&7.21 4XDQWXP)LUHEDOO OFW *% \$7 KDUG GLVN GULYHV XVH WKH VWDQGDUG ,%0 3& \$7 EXV LQWHUIDFH DQG DUH FRPSDWLEOH ZLWK \VWHPV WKDW SURYLGH DQ \$7 LQWHUIDFH FRQQHFWRU RQ WKH PRWKHUERDUG ,W PD\ DOVR EH XVHG ZLWK D WKLUG SDUW DGDSWHU ERDUG LQ \VWHPV WKDW GR QRW KDYH D EXLOWLQ \$7 DGDSWHU 7KH DGDSWHU ERDUG SOXJV LQWR D VWDQGDUG ELW H[SDQVLRQ VORW LQ DQ \$7FRPSDWLEOH FRPSXWHU \$ FDEOH FRQQHFV WKH GULYH WR WKH DGDSWHU ERDUG 2Q QHZHU \VWHPV D 3& ,ELW FDUG PD\ EH DOORZHG 62)7:\$ (,17(5)\$& (7KH 4XDQWXP)LUHEDOO OFW \$7 GULYHV DUH FRQWUROOHG E\ WKH %DVLF ,QSW2XWSXW 6VWHP % ,26 SURJUDP UHVLGLQJ LQ DQ ,%0 3& \$7 RU ,%0 FRPSDWLEOH 3& 7KH % ,26 FRPPXQLFDWIV GLUHFWO\ ZLWK WKH GULYH EXLOWLQ FRQWUROOHU ,W LVVXH FRPPDQGV WR WKH GULYH DQG UHFHLYHV VDWXV LQIRUPDWLRQ IURP WKH GULYH 0(&+\$,&\$ /6&5,37,21 'ULYH &DEOH DQG &RQQHFWRU 7KH KDUG GLVN GULYH FRQQHFV WR WKH KRUV FRPSXWHU E\ PHDQV RI D FDEOH 7KL FDEOH KDV D SLQ FRQQHFWRU WKDW SOXJV LQWR WKH GULYH DQG D SLQ FRQQHFWRU WKDW SOXJV LQWR WKH KRUV FRPSXWHU \$W WKH KRUV HQG WKH FDEOH SOXJV LQWR HLWKHU DQ DGDSWHU ERDUG UHVLGLQJ LQ D KRUV H[SDQVLRQ VORW RU DQ RQERDUG \$7 DGDSWHU (1&75,\$& /17(5)\$& (\$7 \$%XV ,QWHUIDFH \$ SLQ \$7 LQWHUIDFH FRQQHFWRU RQ WKH PRWKHUERDUG RU DQ DGDSWHU ERDUG SURYLGHV DQ LQWHUIDFH EHWZHHQ WKH GULYH DQG D KRUV WKDW XVH DQ ,%0 3& \$7 EXV 7KH \$7 LQWHUIDFH FRQWDLQV EXV GULYHUV DQG UHFHLYHUV FRPSDWLEOH ZLWK WKH VWDQGDUG \$7 EXV 7KH \$7EXV LQWHUIDFH VLQDOV " ,1754 DQG ,2&6 UHTXLUH

