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///boe!Npsf! Gfbuvsft

- Mpx.qpxfs!pqfsbujpo!eftjho
  - 2/9.W!tvqqmz!wpmubhf!)tff!Ubcmf!3*
  - Dpqqfs!joufsdpoofdu!sfevdft!qpxfs!dpotvnqujpo
  - NvmujWpmu^{UN}!J0P!tvqqpsu!gps!2/9.W-!3/6.W-!boe!4/4.W!joufsgbdft
  - FTCt!pggfsjoh!qsphsbnnbcmf!qpxfs.tbwjoh!npef
- Gmfyjcmf!dmpdl!nbobhfnfou!djsdvjusz!xjui!vq!up!gpvs!qibtf.mpdlfe! mppqt!)QMMt*
  - Cvjmu.jo!mpx.tlfx!dmpdl!usff
  - Vq!up!fjhiu!hmpcbm!dmpdl!tjhobmt
  - DmpdlMpdl^{UN}!gfbuvsf!sfevdjoh!dmpdl!efmbz!boe!tlfx
  - DmpdlCpptu^{UN}!gfbuvsf!qspwjejoh!dmpdl!nvmujqmjdbujpo!boe! ejwjtjpo
  - DmpdlTijgu^{UN}!gfbuvsf!qspwjejoh!qsphsbnnbcmf!dmpdl!qibtf!boe! efmbz!tijgujoh
- Qpxfsgvm!J0P!gfbuvsft
  - Dpnqmjbou!xjui!qfsjqifsbm!dpnqpofou!joufsdpoofdu!Tqfdjbm! Joufsftu!Hspvq!)QDJ!TJH*!***PCI Local Bus Specification, Revision 2.2***!gps!4/4.W!pqfsbujpo!bu!44!ps!77!N l {!boe!43!ps!75!cjut
  - Tvqqpsu!gps!ijhi.tqffe!fyufsobm!nfnpsjft-!jodmvejoh!EES! tzodispopvt!ezobnjd!SBN!)TESBN*!boe![CU!tubujd!SBN!)TSBN*
  - 27!joqvu!boe!27!pvuqvu!MWET!diboofmt
  - Ejsfdu!dpoofdujpo!gspn!J0P!qjot!up!mpdbm!joufsdpoofdu!qspwjejoh! gbtu!u$_{DP}$!boe!u$_{TV}$!ujnft!gps!dpnqmfy!mphjd
  - NvmujWpmu!J0P!tvqqpsu!gps!2/9.W-!3/6.W-!boe!4/4.W!joufsgbdft
  - Qsphsbnnbcmf!dmbnq!up!W$_{DDJP}$
  - Joejwjevbm!usj.tubuf!pvuqvu!fobcmf!dpouspm!gps!fbdi!qjo
  - Qsphsbnnbcmf!pvuqvu!tmfx.sbuf!dpouspm!up!sfevdf!txjudijoh! opjtf
  - Tvqqpsu!gps!bewbodfe!J0P!tuboebset-!jodmvejoh!mpx.wpmubhf! ejggfsfoujbm!tjhobmjoh!)MWET*-!MWQFDM-!QDJ.Y-!BHQ-!DUU-! TTUM.4!boe!TTUM.3-!HUM,-!boe!ITUM!Dmbtt!J
  - Tvqqpsut!ipu.tpdlfujoh!pqfsbujpo
  - Qvmm.vq!po!J0P!qjot!cfgpsf!boe!evsjoh!dpohjhvsbujpo

Ubcmf!3/!BQFY!31LD!Tvqqmz!Wpmubhft

Gfbuvsf	Wpmubhf
Internal supply voltage (V_{CCINT})	1.8 V
MultiVolt I/O interface voltage levels (V_{CCIO})	1.8 V, 2.5 V, 3.3 V, 5.0 V *(1)*

Note:

)2* BQFY!31LD!efwjdft!dbo!cf!6/1.W!upmfsbou!cz!vtjoh!bo!fyufsobm!sftjtups/

- Bewbodfe!joufsdpoofdu!tusvduvsf
  - å Dpqqfs!joufsdpoofdu!gps!ijhi!qfsgpsnbodf
  - å Gpvs.mfwfm!ijfsbsdijdbm!GbtuUsbdl[Ê]!joufsdpoofdu!tusvduvsf!qspwjejoh!gbtu-!qsfejdubcmf!joufsdpoofdu!efmbzt
  - å Efejdbufe!dbssz!dijbo!uibu!jnqmfnfout!bsjuin fujd!gvodujpot!tvdi!bt!gbtu!beefst-!dpvoufst-!boe!dpnqbsbupst!)bvupnbujdbmmz!vtfe!cz!tpguxbsf!uppmt!boe!nfhbgvodujpot*
  - å Efejdbufe!dbtdbef!dijbo!uibu!jnqmfnfout!ijhi.tqffe-!ijhi.gbo.jo!mphjd!gvodujpot!)bvupnbujdbmmz!vtfe!cz!tpguxbsf!uppmt!boe!nfhbgvodujpot*
  - å Joufsnfbwfe!mpdbm!joufsdpoofdu!bmmpxt!pof!MF!up!esjwf!3:!pvtfs!MFt!uispvi!uif!gbtu!mpdbm!joufsdpoofdu
- Bewbodfe!tpguxbsf!tvqqpsu
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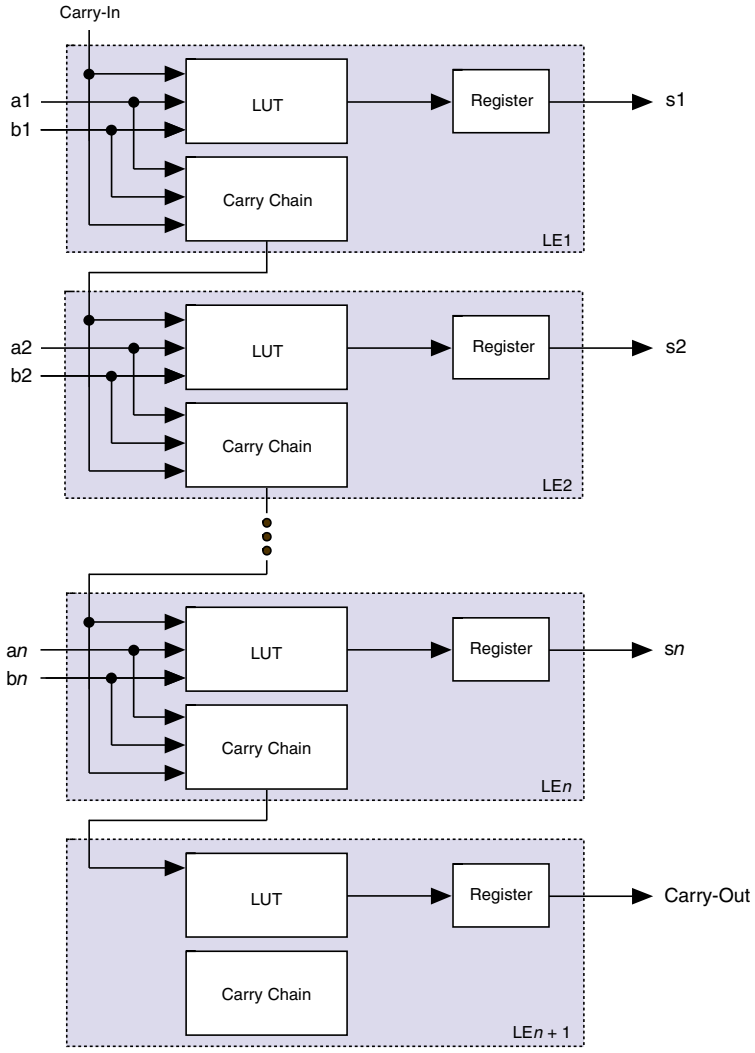
  - å Bmufsb!NfhbDpsf[Ê]!gvodujpot!boe!Bmufsb!Nfhbgvodujpo!Qbsuofst!Qsphsbn!)BNQQ[TN]*!nfhbgvodujpot!pqujnj{fe!gps!BQFY!31LD!bsdijufduvsf!bwbjmbcmf
  - å ObujwfMjol[UN]!joufhsbujpo!xjui!qpqvmbs!tzouiftjt-!tjnvmbujpo-!boe!ujnjoh!bobmztjt!uppmt
  - å Rvbsuvt!JJ!TjhobmUbq[Ê]!fncfefe!mphjd!bobmz{fs!tjnqmjgjft!jo.tztufn!eftjho!fwbmvbujpo!cz!hjwjoh!bddfttup!joufsobm!opeft!evsjoh!efwjdf!pqfsbujpo
  - å Tvqqpsut!qpqvmbs!sfwjtjpo.dpouspm!tpguxbsf!qbdlbhft!jodmvejoh!QWDT-!SDT-!boe!TDDT!!!

Ubcmf!4/!BQFY!31LD!RGQ!'CHB!QbdIbhf!Pqujpot!'!JOP!Dpvou!!!!!!! *Notes (1), (2)*					
Efwjdf	255.Qjo!URGQ	319.Qjo!QRGQ	351.Qjo!QRGQ	467.Qjo!CHB	763.Qjo!CHB
EP20K100C	92	151	183	246	
EP20K200C		136	168	271	376
EP20K400C					488
EP20K600C					488
EP20K1000C					488
EP20K1500C					488

Gjhvsf!7/!BQFY!31LD!Dbssz!Dibjo

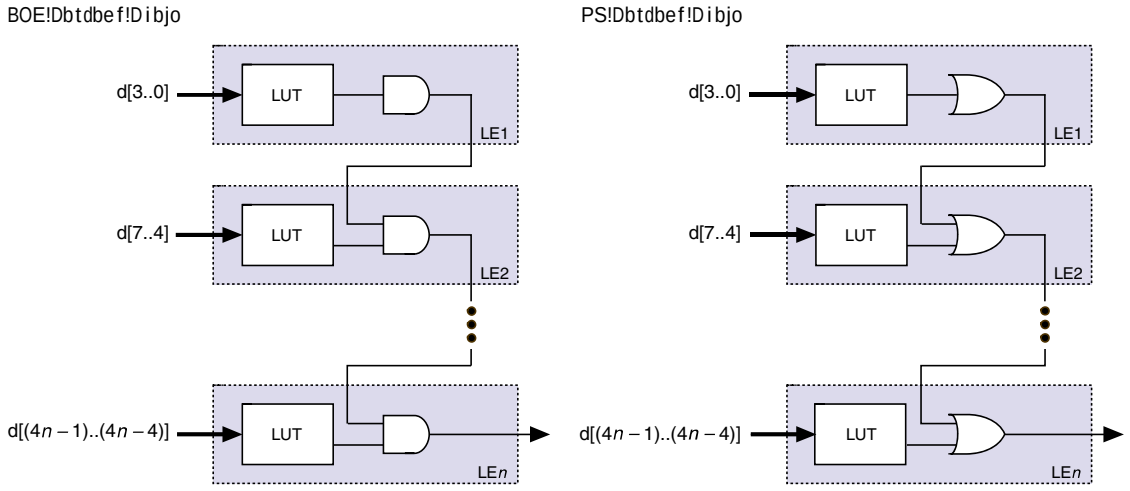


Cascade Chain

X ju i !u i f!dbtdbef!d i bjo-!u i f!BQFY!31LD!bsd i jufduvsf!dbo!j n qm f n fou! gvodujpot! x ju i !b!wfsz! x jef!gbo.jo/!Bekbdfou!MVUt!dbo!dp n qvuf!qpsujpot! pg!b!gvodujpo!jo!qbsbmmfm<!u i f!dbtdbef!d i bjo!t fsjbmz!dpoofdut!u i f! jou fs n fejbuf!wbmvft/!U i f!dbtdbef!d i bjo!dbo!vtf!b!mphjdbm!AND!ps!mphjdbm!OR)wjb!E f!N pshboêt!jowfstjpo*!up!dpoofdu!u i f!pvuqvut!pg!bekbdfou!MFt/!Fbd i ! beejujpobm!MF!qspwje ft!gpvs! n psf!joqvut!up!u i f!fggfdujwf! x jeu i !pg!b! gvodujpo-! x ju i !b!t i psu!dbtdbef!efmbz/!Dbtdbef!d i bjo!mphjd!dbo!cf!dsfbufe! bvup n bujdbmmz!cz!u i f!Rvbsuvt!JJ!Dp n qjmfs!evsjoh!e ftjho!qspdfttjoh-!ps! n bovbmmz!cz!u i f!e ftjhofs!evsjoh!e ftjho!fousz/

Dbtdbef!d i bjot!mpohfs!u i bo!u fo!MFt!bsf!j n qm f n fouf!bvup n bujdbmmz!cz! mjol joh!MBCt!uphfu i fs/!Gps!fo i bodfe!gjuujoh-!b!mpoh!dbtdbef!d i bjo!t l jqt! bmufsobuf!MBCt!jo!b! N fhbMBC!tusvduvsf/!B!dbtdbef!d i bjo!mpohfs!u i bo!pof! MBC!t l jqt!fju i fs!gsp n !bo!fwfo.ov n cfsfe!MBC!up!u i f!ofyu!fwfo.ov n cfsfe! MBC-!ps!gsp n !bo!pee.ov n cfsfe!MBC!up!u i f!ofyu!pee.ov n cfsfe!MBC/!Gps! fyb n qm f-!u i f!mbtu!MF!pg!u i f!gjstu!MBC!jo!u i f!vqqfs.mfgu! N fhbMBC!tusvduvsf! dbssjft!up!u i f!gjstu!MF!pg!u i f!u i jse!MBC!jo!u i f! N fhbMBC!tusvduvsf/!Gjhvsf!8 t i px t! i px !u i f!dbtdbef!gvodujpo!dbo!dpoofdu!bekbdfou!MFt!up!gps n ! gvodujpot! x ju i !b! x jef!gbo.jo/

Gjhvsf!8/!BQFY!31LD!Dbtdbef!D i bjo



Normal Mode

U i f!ops n bm! n pef!jt!tvjubcmf!gps!hfofsbm!mphjd!bqqmjdbujpot-!dp n cjobupsjbm! gvodujpot-!ps! x jef!efdpejoh!gvodujpot!u i bu!dbo!ub l f!bewboubhf!pg!b! dbtdbef!d i bjo/!Jo!ops n bm! n pef-!gpvs!ebub!joqvut!gsp n !u i f!MBC!mpdbm! joufsdpoofdu!boe!u i f!dbssz.jo!bsf!joqvut!up!b!gpvs.joqvu!MVU/!U i f! Rvbsuvt!JJ!Dp n qjmfs!bvup n bujdbmmz!tfmfdut!u i f!dbssz.jo!ps!u i f!DATA3!tjhobm! bt!pof!pg!u i f!joqvut!up!u i f!MVU/!U i f!MVU!pvuqvu!dbo!cf!dp n cjofe! x ju i !u i f! dbtdbef.jo!tjhobm!up!gps n !b!dbtdbef!d i bjo!u i spvh i !u i f!dbtdbef.pvu!tjhobm/! MFt!jo!ops n bm! n pef!tvqqpsu!qbd l fe!sfhjtufst/

Arithmetic Mode

U i f!bsju i n fujd! n pef!jt!jefbm!gps!j n qmf n foujoh!beefst-!bddv n vmbupst-!boe! dp n qbsbupst/!Bo!MF!jo!bsju i n fujd! n pef!vtft!u x p!4.joqvu!MVUt/!Pof!MVU! dp n qvuft!b!u i sff.joqvu!gvodujpo<!u i f!pu i fs!hfofsbuft!b!dbssz!pvuqvu/!Bt! t i p x o!jo!Gjhvsf!9-!u i f!gjstu!MVU!vtft!u i f!dbssz.jo!tjhobm!boe!u x p!ebub! joqvut!gsp n !u i f!MBC!mpdbm!joufsdpoofdu!up!hfofsbuf!b!dp n cjobupsjbm!ps! sfhjtufsfe!pvuqvu/!Gps!fyb n qmf-!x i fo!j n qmf n foujoh!bo!beefs-!u i jt!pvuqvu! jt!u i f!tv n !pg!u i sff!tjhobmt;!DATA1-!DATA2-!boe!dbssz.jo/!U i f!tfdpoe!MVU! vtft!u i f!tb n f!u i sff!tjhobmt!up!hfofsbuf!b!dbssz.pvu!tjhobm-!u i fsfcz!dsfbujoh! b!dbssz!d i bjo/!U i f!bsju i n fujd! n pef!bmtp!tvqqpsut!tj n vmbofpvt!vtf!pg!u i f! dbtdbef!d i bjo/!MFt!jo!bsju i n fujd! n pef!dbo!esjwf!pvu!sfhjtufsfe!boe! vosfhjtufsfe!wfstjpot!pg!u i f!MVU!pvuqvu/

U i f!Rvbsuvt!JJ!tpgu x bsf!j n qmf n fou!qbsb n fufsj{fe!gvodujpot!u i bu!vtf!u i f! bsju i n fujd! n pef!bvup n bujdbmmz! x i fsf!bqqspqsjbuf<!u i f!eftjhofs!epft!opu! offe!up!tqfdjgz! i p x !u i f!dbssz!d i bjo! x jmm!cf!vtfe/

Counter Mode

U i f!dpvoufs! n pef!pggfst!dmpdl!fobcmf-!dpvoufs!fobcmf-!tzod i spopvt! vq0ep x o!dpouspm-!tzod i spopvt!dmfbs-!boe!tzod i spopvt!mpbe!pqujpot/!U i f! dpvoufs!fobcmf!boe!tzod i spopvt!vq0ep x o!dpouspm!tjhobmt!bsf!hfofsbufe! gsp n !u i f!ebub!joqvut!pg!u i f!MBC!mpdbm!joufsdpoofdu/!U i f!tzod i spopvt!dmfbs! boe!tzod i spopvt!mpbe!pqujpot!bsf!MBC. x jef!tjhobmt!u i bu!bggfdu!bmm! sfhjtufst!jo!u i f!MBC/!Dpotfrvfoumz-!jg!boz!pg!u i f!MFt!jo!bo!MBC!vtf!u i f! dpvoufs! n pef-!pu i fs!MFt!jo!u i bu!MBC! n vtu!cf!vtfe!bt!qbsu!pg!u i f!tb n f! dpvoufs!ps!cf!vtfe!gps!b!dp n cjobupsjbm!gvodujpo/!U i f!Rvbsuvt!JJ!tpgu x bsf! bvup n bujdbmmz!qmbdft!boz!sfhjtufst!u i bu!bsf!opu!vtfe!cz!u i f!dpvoufs!joup! pu i fs!MBCt/

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Clear & Preset Logic Control

Mphjd!gps!uif!sfhjtufsêt!dmfbs!boe!qsftfu!tjhobmt!jt!dpouspmmfe!cz!MBC.xjef!tjhobmt/!Uif!MF!ejsfdumz!tvqqpsut!bo!btzodispopvt!dmfbs!gvodujpo/!Uif!Rvbsuvt!JJ!Dpnqjmfs!dbo!vtf!b!NOT.hbuf!qvti.cbdl!ufdiojrvf!up!fnvmbuf!bo!btzodispopvt!qsftfu!ps!up!fnvmbuf!tjnvmbofpvt!qsftfu!boe!dmfbs!ps!btzodispopvt!mpbe/!Ipxfwfs-!uijt!ufdiojrvf!vtft!uisff!beejujpobm!MFt!qfs!sfhjtufs/!Bmm!fnvmbujpo!jt!qfsgpsnfe!bvupnbujdbmmz!xifo!uif!eftjho!jt!dpnqjmfe/!Sfhjtufst!uibu!fnvmbuf!tjnvmbofpvt!qsftfu!boe!mpbe!xjmm!foufs!bo!volopxo!tubuf!vqpo!qpxfs.vq!ps!xifo!uif!dijq.xjef!sftfu!jt!bttfsufe/

Jo!beejujpo!up!uif!uxp!dmfbs!boe!qsftfu!npef-!BQFY!31LD!efwjdft!qspwjef!b!dijq.xjef!sftfu!qjo!)DEV_CLRn*!uibu!sftfut!bmm!sfhjtufst!jo!uif!efwjdf/!Vtf!pg!uijt!qjo!jt!dpouspmmfe!uispvhi!bo!pqujpo!jo!uif!Rvbsuvt!JJ!tpguxbsf!uibu!jt!tfu!cfgpsf!dpnqjmbujpo/!Uif!dijq.xjef!sftfu!pwfssjeft!bmm!puifs!dpouspm!tjhobmt/!Sfhjtufst!vtjoh!bo!btzodispopvt!qsftfu!bsf!qsftfu!xifo!uif!dijq.xjef!sftfu!jt!bttfsufe<!uijt!fggfdu!sftvmut!gspn!uif!jowfstjpo!ufdiojrvf!vtfe!up!jnqmfnfou!uif!btzodispopvt!qsftfu/

GbtuUsbdl!Joufsdpoofdu

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Uif!GbtuUsbdl!joufsdpoofdu!dpotjtut!pg!spx!boe!dpmvno!joufsdpoofdu!diboofmt!uibu!tqbo!uif!foujsf!efwjdf/!Uif!spx!joufsdpoofdu!spvuft!tjhobmt!uispvhipvu!b!spx!pg!NfhbMBC!tusvduvsft<!uif!dpmvno!joufsdpoofdu!spvuft!tjhobmt!uispvhipvu!b!dpmvno!pg!NfhbMBC!tusvduvsft/!Xifo!vtjoh!uif!spx!boe!dpmvno!joufsdpoofdu-!bo!MF-!JPF-!ps!FTC!dbo!esjwf!boz!puifs!MF-!JPF-!ps!FTC!jo!b!efwjdf/!Tff!Gjhvsf!:/

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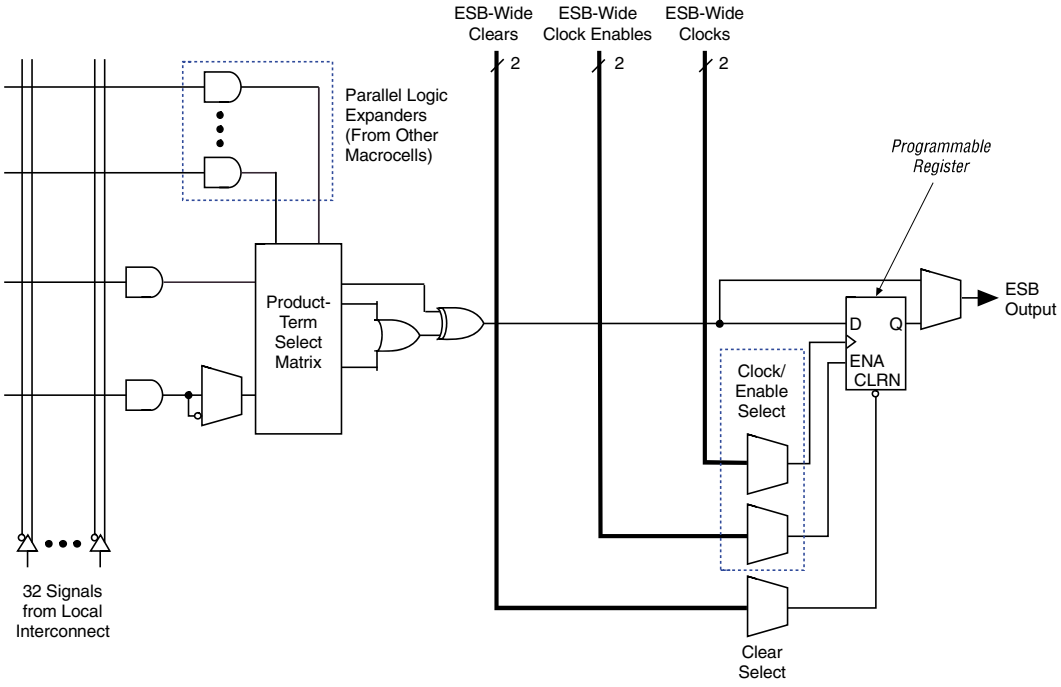

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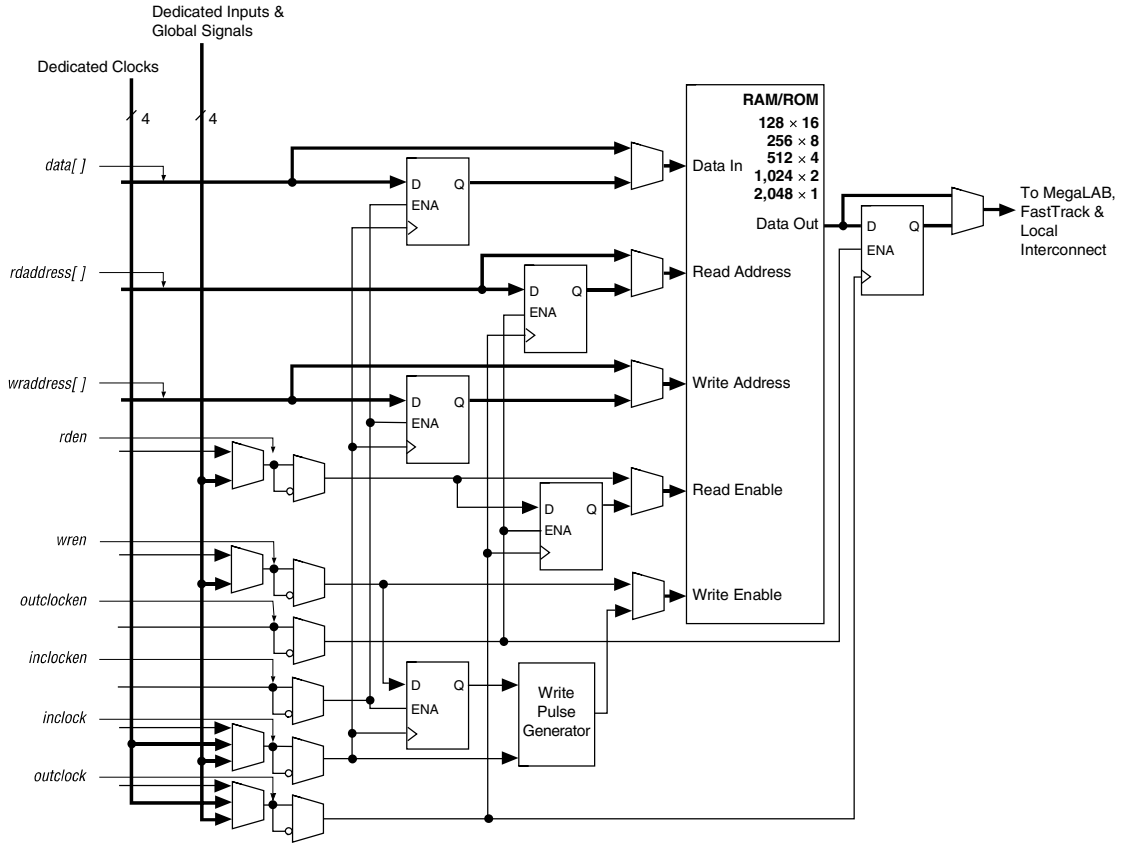
Sfbe0Xsjuf!Dmpdl!Npef

Uif!sfbe0xsjuf!dmpdl!npef!dpoubjot!uxp!dmpdlt/!Pof!dmpdl!dpouspmt!bmm!sfhjtufst!bttpdjbufe!xjui!xsjujoh;!ebub!joqvu-!WE-!boe!xsjuf!beesftt/!Uif!pui fs!dmpdl!dpouspmt!bmm!sfhjtufst!bttpdjbufe!xjui!sfbejoh;!sfbe!fobcmf!)RE)-!sfbe!beesftt-!boe!ebub!pvuqvu/!Uif!FTC!bmtp!tvqqpsut!dmpdl!fobcmf!boe!btzodispopvt!dmfbs!tjhobmt<!uif!tjhobmt!bmtp!dpouspm!uif!sfbe!boe!xsjuf!sfhjtufst!joefqfoefoumz/!Sfbe0xsjuf!dmpdl!npef!jt!dpnnpoz!vtfe!gps!bqqmjdbujpot!xifsf!sfbet!boe!xsjuft!pddvs!bu!ejggfsfou!tztufn!gsfrvfodjft/!Gjhvsf!31!tipxt!uif!FTC!jo!sfbe0xsjuf!dmpdl!npef/

Gjhvsf!31/!FTC!jo!Sfbe0Xsjuf!Dmpdl!Npef!!!!!!!*Note (1)*



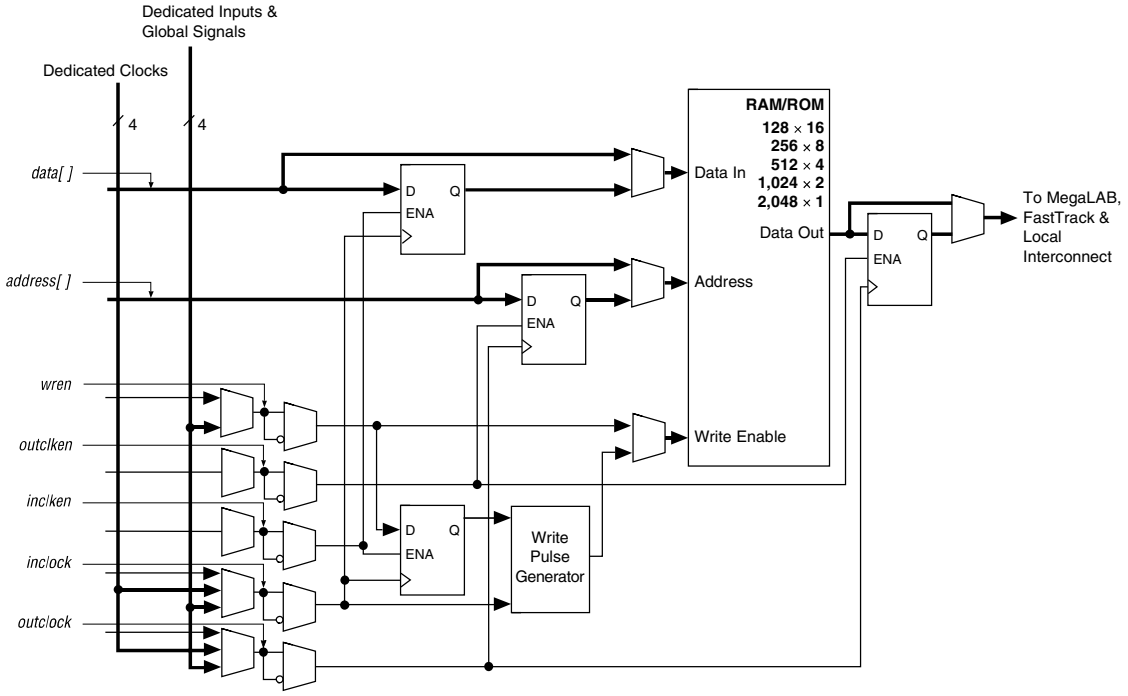
Note:

)2* Bmm!sfhjtufst!dbo!cf!dmfbsfe!btzodispopvtmz!cz!FTC!mpdbm!joufsdpofdu!tjhobmt-!hmpcbm!tjhobmt-!ps!uif!dijq.xjef!sftfu/

Tjohmf.Qpsu!Npef

Uif!BQFY!31LD!FTC!bmtp!tvqqpsut!b!tjohmf.qpsu!npef-!xijdi!jt!vtfe!xifo!tjnvmubofpvt!sfbet!boe!xsjuft!bsf!opu!sfrvjsfe/!Tff!Gjhvsf!33/

Gjhvsf!33/!FTC!jo!Tjohmf.Qpsu!Npef!!!!!!!*Note (1)*



Note:

)2* Bmmsfhjtufst!dbo!cf!btzodispopvtmz!dmfbsfe!cz!FTC!mpdbm!joufsdpoofdu!tjhobmt-!hmpcbm!tjhobmt-!ps!uif!dijq.xjef!sfttu/

Dpoufou.Beesfttbcmf!Nfnpsz

Jo!BQFY!31LD!efwjdft-!uif!FTC!dbo!jnqmfnfou!DBN/!DBN!dbo!cf!uipvhiu!pg!bt!uif!jowfstf!pg!SBN/!Xifo!sfbe-!SBN!pvuqvut!uif!ebub!gps!b!hjwfo!beesfttf/!Dpowfstfmz-!DBN!pvuqvut!bo!beesfttf!gps!b!hjwfo!ebub!xpse/!Gps!fybnqmf-!jg!uif!ebub!FA12!jt!tupsfe!jo!beesfttf!14-!uif!DBN!pvuqvut!14!xifo!FA12!jt!esjwfo!joup!ju/

DBN!jt!vtfe!gps!ijhi.tqffe!tfbsdi!pqfsbujpot/!Xifo!tfbsdijoh!gps!ebub!xjuijo!b!SBN!cmpdl-!uif!tfbsdi!jt!qfsgpsnfe!tfsjbmmz/!Uivt-!gjoejoh!b!qbsujdvmbs!ebub!xpse!dbo!ublf!nboz!dzdmft/!DBN!tfbsdift!bmm!beesfttft!jo!qbsbmmfm!boe!pvuqvut!uif!beesfttf!tupsjoh!b!qbsujdvmbs!xpse/!Xifo!b!nbudi!jt!gpvoe-!b!nbudi!gmbh!jt!tfu!ijhi/!Gjhvsf!34!tipxt!uif!DBN!cmpdl!ejbhsbn/

Ubcmf!23/!BQFY!31LD!Dmpdl!Joqvu! ' !Pvuqvu!Qbsbn fufst!!!)Qbsu!3!pg!3*!!!!!!! *Note (1)*							
Tzncpm	Qbsbn fufs	J0P!Tuboebse	.8!Tqffe!Hsbef		.9!Tqffe!Hsbef		Vojut
			Njo	Nby	Njo	Nby	
f_{CLOCK1_EXT}	Output clock frequency for external clock1 output	3.3-V LVTTL	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		2.5-V LVTTL	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		1.8-V LVTTL	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		GTL+	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		SSTL-2 Class I	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		SSTL-2 Class II	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		SSTL-3 Class I	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		SSTL-3 Class II	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		LVDS	*(5)*	*(5)*	*(5)*	*(5)*	MHz
f_{IN}	Input clock frequency	3.3-V LVTTL	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		2.5-V LVTTL	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		1.8-V LVTTL	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		GTL+	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		SSTL-2 Class I	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		SSTL-2 Class II	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		SSTL-3 Class I	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		SSTL-3 Class II	*(5)*	*(5)*	*(5)*	*(5)*	MHz
		LVDS	*(5)*	*(5)*	*(5)*	*(5)*	MHz

Notes to tables:

)2* Bmm!joqvu!dmpdl!tqfdjgjdbujpot!nvtu!cf!n fu/!Uif!QMM!nbz!opu!mpdl!poup!bo!jodpnjoh!dmpdl!jg!uif!dmpdl!tqfdjgjdbujpot!bsf!opu!n fu-!dsfbujoh!bo!fsspofpvt!dmpdl!xjujo!uif!efwjdf/

)3* Uif!nbyjnvn!mpdl!ujn f!jt!51!ut!ps!3-111!joqvu!dmpdl!dzdmft-!xijdi fwfs!pddvst!gjstu/

)4* Cfgpsf!dpogjhvsbujpo-!uif!QMM!djsdvjut!bsf!ejtbcmf!boe!qpxfsfe!epxo/!Evsjoh!dpogjhvsbujpo-!uif!QMMt!sfnbjo!ejtbcmfe/!Uif!QMMt!cfhjo!up!mpdl!podf!uif!efwjdf!jt!jo!uif!vtfs!npef/!Jg!uif!dmpdl!fobcmf!gfbuvsf!jt!vtfe-!mpdl!cfhjot!podf!uif!CLKLK_ENA!qjo!hpft!ijhi!jo!vtfs!npef/

)5* Uif!QMM!WDP!pqfsbujoh!sbohf!jt!311!NI{!≤ g_{WDP} ≤!951!NI{!gps!MWET!npef/

)6* Dpoubdu!Bmufsb!Bqqmjdbujpot!gps!jogpsnbujpo!po!uif!ftf!qbsbn fufst/

TjhobmUbq! Fncfeefe! Mphjd!Bobmz{fs

BQFY!31LD!efwjdft!jodmvef!efwjdf!foibodfn fout!up!tvqqpsu!uif! TjhobmUbq!fncfeefe!mphjd!bobmz{fs/!Cz!jodmvejoh!uijt!djsdvjusz-!uif! BQFY!31LD!efwjdf!qspwjeft!uif!bcjmjuz!up!npjtups!eftjho!pqfsbujpo!pwfs! b!qfsjpe!pg!ujnf!uispvhi!uif!JFFF!Tue/!225:/2!)KUBH*!djsdvjusz<!b!eftjhofs! dbo!bobmz{f!joufsobm!mphjd!bu!tqffe!xjujpvu!csjohjoh!joufsobm!tjhobmt!up!uif! J0P!qjot/!Uijt!gfbuvsf!jt!qbsujdvmbsmz!jnqpsubou!gps!bewbodfe!qbdlbhft! tvdi!bt!GjofMjof!CHB!qbdlbhft!cfdbvtf!beejoh!b!dpoofdujpo!up!b!qjo! evsjoh!uif!efcvhjoh!qspdftt!dbo!cf!ejggjdvmu!bgufs!b!cpbse!jt!eftjhofe! boe!nbovgbduvsfe/

IEEE Std. 1149.1 (JTAG) Boundary-Scan Support

All APEX 20KC devices provide JTAG BST circuitry that complies with the IEEE Std. 1149.1-1990 specification. JTAG boundary-scan testing can be performed before or after configuration, but not during configuration. APEX 20KC devices can also use the JTAG port for configuration with the Quartus II software or with hardware using either Jam Files (**.jam**) or Jam Byte-Code Files (**.jbc**). Finally, APEX 20KC devices use the JTAG port to monitor the logic operation of the device with the SignalTap embedded logic analyzer. APEX 20KC devices support the JTAG instructions shown in Table 13.

Table 13. APEX 20KC JTAG Instructions

JTAG Instruction	Description
SAMPLE/PRELOAD	Allows a snapshot of signals at the device pins to be captured and examined during normal device operation, and permits an initial data pattern to be output at the device pins. Also used by the SignalTap embedded logic analyzer.
EXTEST	Allows the external circuitry and board-level interconnections to be tested by forcing a test pattern at the output pins and capturing test results at the input pins.
BYPASS	Places the 1-bit bypass register between the TDI and TDO pins, which allows the BST data to pass synchronously through selected devices to adjacent devices during normal device operation.
USERCODE	Selects the 32-bit USERCODE register and places it between the TDI and TDO pins, allowing the USERCODE to be serially shifted out of TDO.
IDCODE	Selects the IDCODE register and places it between TDI and TDO, allowing the IDCODE to be serially shifted out of TDO.
ICR Instructions	Used when configuring an APEX 20KC device via the JTAG port with a MasterBlaster™ or ByteBlasterMV™ download cable, or when using a Jam File or Jam Byte-Code File via an embedded processor.
SignalTap Instructions	Monitors internal device operation with the SignalTap embedded logic analyzer.

Ubcmf!29/!BQFY!31LD!Efwjdf!Sfdpnnfoefe!Pqfsbujoh!Dpoejujpot!!

Tzncpm	Qbsbnfufs	Dpoejujpot	Njo	Nby	Voju
V_{CCINT}	Supply voltage for internal logic and input buffers	*(3)*, *(4)*	1.71 (1.71)	1.89 (1.89)	V
V_{CCIO}	Supply voltage for output buffers, 3.3-V operation	*(3)*, *(4)*	3.00 (3.00)	3.60 (3.60)	V
	Supply voltage for output buffers, 2.5-V operation	*(3)*, *(4)*	2.375 (2.375)	2.625 (2.625)	V
V_I	Input voltage	*(2)*, *(5)*	–0.5	4.1	V
V_O	Output voltage		0	V_{CCIO}	V
T_J	Junction temperature	For commercial use	0	85	° C
		For industrial use	–40	100	° C
t_R	Input rise time (10% to 90%)			40	ns
t_F	Input fall time (90% to 10%)			40	ns

Ubcmf!2:/!BQFY!31LD!Efwjdf!ED!Pqfsbujoh!Dpoejujpot!!!!!!!!! *Notes (6)*, *(7)*

Tzncpm	Qbsbnfufs	Dpoejujpot	Njo	Uzq	Nby	Voju
I_I	Input pin leakage current *(8)*	V_I = 4.1 to –0.5 V	–10		10	µA
I_{OZ}	Tri-stated I/O pin leakage current *(8)*	V_O = 4.1 to –0.5 V	–10		10	µA
I_{CC0}	V_{CC} supply current (standby) (All ESBs in power-down mode)	V_I = ground, no load, no toggling inputs, -7 speed grade		10		mA
		V_I = ground, no load, no toggling inputs, -8, -9 speed grades		5		mA
R_{CONF}	Value of I/O pin pull-up resistor before and during configuration	V_{CCIO} = 3.0 V *(9)*	20		50	kΩ
		V_{CCIO} = 2.375 V *(9)*	30		80	kΩ
		V_{CCIO} = 1.71 V *(9)*	60		150	kΩ

☞ ED!Pqfsbujoh!Tqfdjgjdbujpot!po!BQFY!31LD!J0P!tuboebset!bsf!mjtufe!jo!Ubcmf!32!up!47/

Ubcmf!41/!TTUM.3!Dmbtt!JJ!Tqfdjgjdbujpot						
Tzncpm	Qbsbnfufs	Dpoejujpot	Njojnvn	Uzqjdbm	Nbyjnvn	Vojut
V_{CCIO}	I/O supply voltage		2.375	2.5	2.625	V
V_{TT}	Termination voltage		V_{REF} – 0.04	V_{REF}	V_{REF} + 0.04	V
V_{REF}	Reference voltage		1.15	1.25	1.35	V
V_{IH}	High-level input voltage		V_{REF} + 0.18		V_{CCIO} + 0.3	V
V_{IL}	Low-level input voltage		–0.3		V_{REF} – 0.18	V
V_{OH}	High-level output voltage	I_{OH} = –15.2 mA *(1)*	V_{TT} + 0.76			V
V_{OL}	Low-level output voltage	I_{OL} = 15.2 mA *(2)*			V_{TT} – 0.76	V

Ubcmf!42/!TTUM.4!Dmbtt!JJ!Tqfdjgjdbujpot						
Tzncpm	Qbsbnfufs	Dpoejujpot	Njojnvn	Uzqjdbm	Nbyjnvn	Vojut
V_{CCIO}	I/O supply voltage		3.0	3.3	3.6	V
V_{TT}	Termination voltage		V_{REF} – 0.05	V_{REF}	V_{REF} + 0.05	V
V_{REF}	Reference voltage		1.3	1.5	1.7	V
V_{IH}	High-level input voltage		V_{REF} + 0.2		V_{CCIO} + 0.3	V
V_{IL}	Low-level input voltage		–0.3		V_{REF} – 0.2	V
V_{OH}	High-level output voltage	I_{OH} = –8 mA *(1)*	V_{TT} + 0.6			V
V_{OL}	Low-level output voltage	I_{OL} = 8 mA *(2)*			V_{TT} – 0.6	V

Ubcmft!54!uispvhi!89!tipx!uif!g_{NBY}!boe!fyufsobm!ujnjoh!qbsbnfufst!gps! FQD31L211D-!FQD31L311D-!FQ31L511D-!FQ31L711D-!FQ31L2111D-!boe! FQ31L2611D!efwjdft/

Ubcmf!54/!FQ31L211D!g_{NBY}!MF!Ujnjoh!Qbsbnfufst *Note (1)*

Tzncpm	.8!Tqffe!Hsbef		.9!Tqffe!Hsbef!*(2)*		.:!Tqffe!Hsbef!*(2)*		Voju
	Njo	Nby	Njo	Nby	Njo	Nby	
t_{SU}	0.3						ns
t_H	0.3						ns
t_{CO}		0.3					ns
t_{LUT}		0.7					ns

Ubcmf!55/!FQ31L211D!g_{NBY}!FTC!Ujnjoh!Qbsbnfufst *Note (1)*

Tzncpm	.8!Tqffe!Hsbef		.9!Tqffe!Hsbef!*(2)*		.:!Tqffe!Hsbef!*(2)*		Voju
	Njo	Nby	Njo	Nby	Njo	Nby	
t_{ESBARC}		1.4					ns
t_{ESBSRC}		2.5					ns
t_{ESBAWC}		3.1					ns
t_{ESBSWC}		3.0					ns
$t_{ESBWASU}$	0.5						ns
t_{ESBWAH}	0.5						ns
$t_{ESBWDSU}$	0.6						ns
t_{ESBWDH}	0.5						ns
$t_{ESBRASU}$	1.4						ns
t_{ESBRAH}	0.0						ns
$t_{ESBWESU}$	2.3						ns
$t_{ESBDATASU}$	0.0						ns
$t_{ESBWADDRSU}$	0.2						ns
$t_{ESBRADDRSU}$	0.2						ns
$t_{ESBDATACO1}$		1.0					ns
$t_{ESBDATACO2}$		2.3					ns
t_{ESBDD}		2.7					ns
t_{PD}		1.6					ns
$t_{PTERMSU}$	1.0						ns
$t_{PTERMCO}$		1.0					ns

Ubcmf!63/!FQ31L311D!Njojnvn!Qvmtf!Xjeui!Ujnjoh!Qbsbnfufst!!!!!!! *Note (1)*							
Tzncpm	.8!Tqffe!Hsbef		.9!Tqffe!Hsbef! *(2)*		.:!Tqffe!Hsbef! *(2)*		Voju
	Njo	Nby	Njo	Nby	Njo	Nby	
t_{CH}	2.2						ns
t_{CL}	2.3						ns
t_{CLRP}	0.2						ns
t_{PREP}	0.2						ns
t_{ESBCH}	2.3						ns
t_{ESBCL}	2.3						ns
t_{ESBWP}	1.1						ns
t_{ESBRP}	0.9						ns

Ubcmf!64/!FQ31L311D!Fyufsobm!Ujnjoh!Qbsbnfufst							
Tzncpm	.8!Tqffe!Hsbef		.9!Tqffe!Hsbef! *(2)*		.:!Tqffe!Hsbef! *(2)*		Voju
	Njo	Nby	Njo	Nby	Njo	Nby	
t_{INSU}	2.0						ns
t_{INH}	0.0						ns
t_{OUTCO}	2.0	5.0					ns
$t_{INSUPLL}$	3.3						ns
t_{INHPLL}	0.0						ns
$t_{OUTCOPLL}$	0.5	2.1					ns

Ubcmf!69/!FQ31L511D!Njojnvn!Qvmtf!Xjeui!Ujnjoh!Qbsbnfufst!!!!!!! *Note (1)*							
Tzncpm	.8!Tqffe!Hsbef		.9!Tqffe!Hsbef! *(2)*		.:!Tqffe!Hsbef! *(2)*		Voju
	Njo	Nby	Njo	Nby	Njo	Nby	
t_{CH}	2.0						ns
t_{CL}	2.0						ns
t_{CLRP}	0.2						ns
t_{PREP}	0.2						ns
t_{ESBCH}	2.0						ns
t_{ESBCL}	2.0						ns
t_{ESBWP}	1.0						ns
t_{ESBRP}	0.8						ns

Ubcmf!6:/!FQ31L511D!Fyufsobm!Ujnjoh!Qbsbnfufst							
Tzncpm	.8!Tqffe!Hsbef		.9!Tqffe!Hsbef! *(2)*		.:!Tqffe!Hsbef! *(2)*		Voju
	Njo	Nby	Njo	Nby	Njo	Nby	
t_{INSU}	2.1						ns
t_{INH}	0.0						ns
t_{OUTCO}	2.0	5.0					ns
$t_{INSUPLL}$	3.2						ns
t_{INHPLL}	0.0						ns
$t_{OUTCOPLL}$	0.5	2.1					ns

Ubcmf!71/!FQ31L511D!Fyufsobm!Cjejsfdujpobm!Ujnjoh!Qbsbnfufst!							
Tzncpm	.8!Tqffe!Hsbef		.9!Tqffe!Hsbef! *(2)*		.:!Tqffe!Hsbef! *(2)*		Voju
	Njo	Nby	Njo	Nby	Njo	Nby	
$t_{INSUBIDIR}$	2.4						ns
$t_{INHBIDIR}$	0.0						ns
$t_{OUTCOBIDIR}$	2.0	5.0					ns
$t_{XZBIDIR}$		7.1					ns
$t_{ZXBIDIR}$		7.1					ns
$t_{INSUBIDIRPLL}$	3.8						ns
$t_{INHBIDIRPLL}$	0.0						ns
$t_{OUTCOBIDIRPLL}$	0.5	2.1					ns
$t_{XZBIDIRPLL}$		4.2					ns
$t_{ZXBIDIRPLL}$		4.2					ns

Ubcmf!72/!FQ31L711D!g_{NBY}!MF!Ujnjoh!Qbsbnfufst!!!!!!! *Note (1)*							
Tzncpm	.8!Tqffe!Hsbef		.9!Tqffe!Hsbef! *(2)*		.:!Tqffe!Hsbef! *(2)*		Voju
	Njo	Nby	Njo	Nby	Njo	Nby	
t_{SU}	0.3						ns
t_H	0.3						ns
t_{CO}		0.3					ns
t_{LUT}		0.7					ns

Ubcnf!83/!FQ31L2111D!Fyufsobm!Cjejsfdujpobm!Ujnjoh!Qbsbnfufst!							
Tzncpm	.8!Tqffe!Hsbef		.9!Tqffe!Hsbef! *(2)*		.:!Tqffe!Hsbef! *(2)*		Voju
	Njo	Nby	Njo	Nby	Njo	Nby	
$t_{INSUBIDIR}$	2.4						ns
$t_{INHBIDIR}$	0.0						ns
$t_{OUTCOBIDIR}$	2.0	5.0					ns
$t_{XZBIDIR}$		7.1					ns
$t_{ZXBIDIR}$		7.1					ns
$t_{INSUBIDIRPLL}$	3.8						ns
$t_{INHBIDIRPLL}$	0.0						ns
$t_{OUTCOBIDIRPLL}$	0.5	2.1					ns
$t_{XZBIDIRPLL}$		4.2					ns
$t_{ZXBIDIRPLL}$		4.2					ns

Ubcnf!84/!FQ31L2611D!g_{NBY}!MF!Ujnjoh!Qbsbnfufst!!!!!!! *Note (1)*							
Tzncpm	.8!Tqffe!Hsbef		.9!Tqffe!Hsbef! *(2)*		.:!Tqffe!Hsbef! *(2)*		Voju
	Njo	Nby	Njo	Nby	Njo	Nby	
t_{SU}	0.3						ns
t_{H}	0.3						ns
t_{CO}		0.3					ns
t_{LUT}		0.6					ns

Table 78. EP20K1500C External Bidirectional Timing Parameters

Symbol	-7 Speed Grade		-8 Speed Grade (2)		-9 Speed Grade (2)		Unit
	Min	Max	Min	Max	Min	Max	
$t_{INSUBIDIR}$	2.6						ns
$t_{INHBIDIR}$	0.0						ns
$t_{OUTCOBIDIR}$	2.0	5.0					ns
$t_{XZBIDIR}$		7.1					ns
$t_{ZXBIDIR}$		7.1					ns
$t_{INSUBIDIRPLL}$	3.9						ns
$t_{INHBIDIRPLL}$	0.0						ns
$t_{OUTCOBIDIRPLL}$	0.5	2.1					ns
$t_{XZBIDIRPLL}$		4.2					ns
$t_{ZXBIDIRPLL}$		4.2					ns

Notes to tables:
(1) Timing information is preliminary. Final timing information will be released in a future version of this data sheet.
(2) Timing information for these devices will be released in a future version of this data sheet.

Tables 79 and 80 show selectable I/O standard input and output delays for APEX 20KC devices. If you select an I/O standard input or output delay other than LVCMOS, add the delay for the selected speed grade to the LVCMOS value.

Power Consumption

To estimate device power consumption, use the interactive power estimator on the Altera web site at **http://www.altera.com**.

Configuration & Operation

The APEX 20KC architecture supports several configuration schemes. This section summarizes the device operating modes and available device configuration schemes.

Operating Modes

The APEX architecture uses SRAM configuration elements that require configuration data to be loaded each time the circuit powers up. The process of physically loading the SRAM data into the device is called configuration. During initialization, which occurs immediately after configuration, the device resets registers, enables I/O pins, and begins to operate as a logic device. The I/O pins are tri-stated during power-up, and before and during configuration. Together, the configuration and initialization processes are called *command mode*; normal device operation is called *user mode*.

Before and during device configuration, all I/O pins are pulled to V_{CCIO} by a built-in weak pull-up resistor.

SRAM configuration elements allow APEX 20KC devices to be reconfigured in-circuit by loading new configuration data into the device. Real-time reconfiguration is performed by forcing the device into command mode with a device pin, loading different configuration data, reinitializing the device, and resuming user-mode operation. In-field upgrades can be performed by distributing new configuration files.

Configuration Schemes

The configuration data for an APEX 20KC device can be loaded with one of five configuration schemes (see Table 81), chosen on the basis of the target application. An EPC16, EPC2, or EPC1 configuration device, intelligent controller, or the JTAG port can be used to control the configuration of an APEX 20KC device. When a configuration device is used, the system can configure automatically at system power-up.