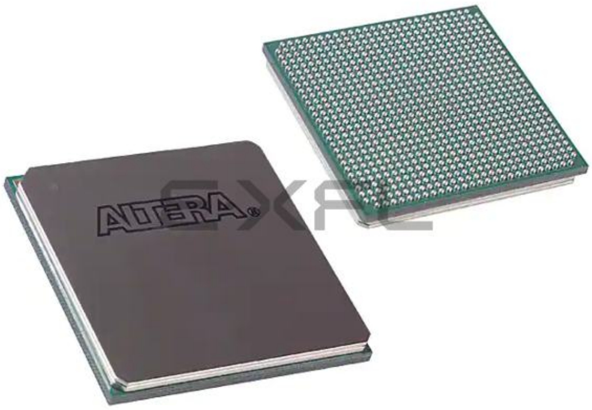
Intel - EP3SL150F780C3N Datasheet



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Understanding Embedded - FPGAs (Field Programmable Gate Array)

Embedded - FPGAs, or Field Programmable Gate Arrays, are advanced integrated circuits that offer unparalleled flexibility and performance for digital systems. Unlike traditional fixed-function logic devices, FPGAs can be programmed and reprogrammed to execute a wide array of logical operations, enabling customized functionality tailored to specific applications. This reprogrammability allows developers to iterate designs quickly and implement complex functions without the need for custom hardware.

Applications of Embedded - FPGAs

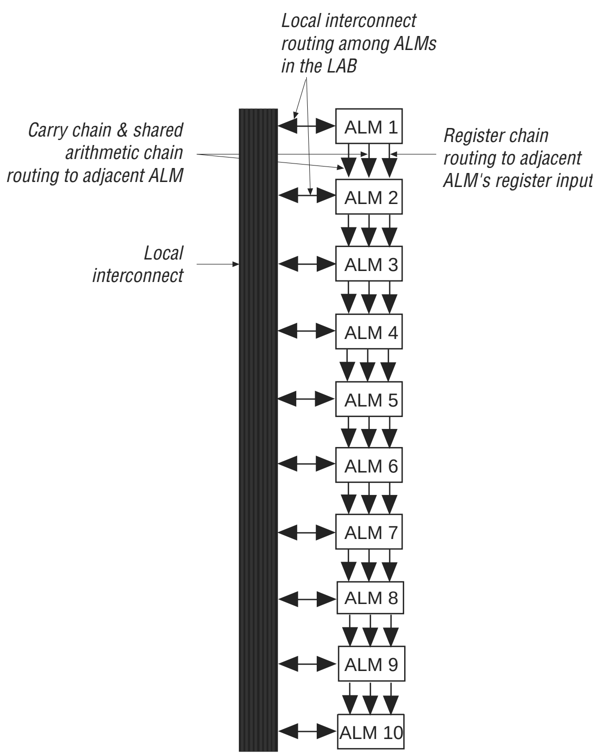
The versatility of Embedded - FPGAs makes them indispensable in numerous fields. In telecommunications,

Details	
Product Status	Obsolete
Number of LABs/CLBs	5700
Number of Logic Elements/Cells	142500
Total RAM Bits	6543360
Number of I/O	488
Number of Gates	-
Voltage - Supply	0.86V ~ 1.15V
Mounting Type	Surface Mount
Operating Temperature	0°C ~ 85°C (TJ)
Package / Case	780-BBGA, FCBGA
Supplier Device Package	780-FBGA (29x29)
Purchase URL	https://www.e-xfl.com/product-detail/intel/ep3sl150f780c3n

ALM Interconnects

There are three dedicated paths between ALMs: Register Cascade, Carry-chain, and Shared Arithmetic chain. Stratix III devices include an enhanced interconnect structure in LABs for routing shared arithmetic chains and carry chains for efficient arithmetic functions. The register chain connection allows the register output of one ALM to connect directly to the register input of the next ALM in the LAB for fast shift registers. These ALM-to-ALM connections bypass the local interconnect. The Quartus II Compiler automatically takes advantage of these resources to improve utilization and performance.Figure 2–18 shows the shared arithmetic chain, carry chain, and register chain interconnects.

Figure 2–18. Shared Arithmetic Chain, Carry Chain, and Register Chain Interconnects



For information about routing between LABs, refer to the *MultiTrack Interconnect in Stratix III Devices* chapter in volume 1 of the *Stratix III Device Handbook*.

Clear and Preset Logic Control

LAB-wide signals control the logic for the register's clear signal. The ALM directly supports an asynchronous clear function. You can achieve the register preset through the Quartus II software's **NOT-gate push-back logic** option. Each LAB supports up to two clears.

Stratix III devices provide a device-wide reset pin (`DEV_CLRn`) that resets all registers in the device. An option set before compilation in the Quartus II software controls this pin. This device-wide reset overrides all other control signals.

LAB Power Management Techniques

The following techniques are used to manage static and dynamic power consumption within the LAB:

- Stratix III low-voltage devices (L ordering code suffix) offer selectable core voltage to reduce both DC and AC power.
- To save AC power, Quartus II forces all adder inputs low when ALM adders are not in use.
- Stratix III LABs operate in high-performance mode or low-power mode. The Quartus II software automatically chooses the appropriate mode for an LAB based on the design to optimize speed vs. leakage trade-offs.
- Clocks represent a significant portion of dynamic power consumption due to their high switching activity and long paths. The LAB clock that distributes a clock signal to registers within a LAB is a significant contributor to overall clock power consumption. Each LAB's clock and clock enable signal are linked. For example, a combinational ALUT or register in a particular LAB using the `labclk1` signal also uses the `labclkena1` signal. To disable LAB-wide clock power consumption without disabling the entire clock tree, use the LAB-wide clock enable to gate the LAB-wide clock. The Quartus II software automatically promotes register-level clock enable signals to the LAB-level. All registers within an LAB that share a common clock and clock enable are controlled by a shared gated clock. To take advantage of these clock enables, use a clock enable construct in your HDL code for the registered logic.

Refer to the *Power Optimization* chapter in section 3 of the *Quartus II Handbook* for details on implementation.

For detailed information about Stratix III programmable power capabilities, refer to the *Programmable Power and Temperature Sensing Diode in Stratix III Devices chapter in volume 1* of the *Stratix III Device Handbook*.

Conclusion

Logic array block and adaptive logic modules are the basic building blocks of the Stratix III device. You can use these to configure logic functions, arithmetic functions, and register functions. The ALM provides advanced features with efficient logic utilization and is completely backward-compatible.

Chapter Revision History

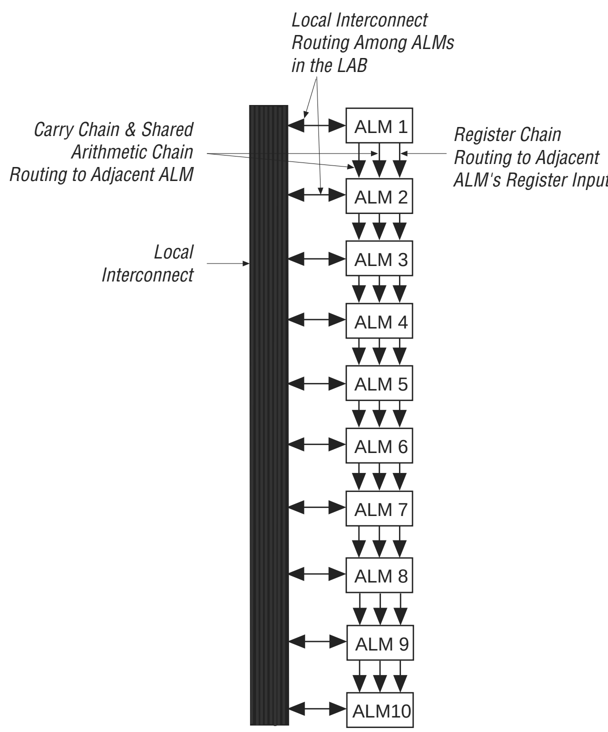
Table 2–1shows the revision history for this document.

Table 2–1. Chapter Revision History(Sheet 1 of 2)

Date and Revision	Changes Made	Summary of Changes
February 2009, version 1.5	Removed “Referenced Documents” section.	—
October 2008, version 1.4	■ Updated “LAB Control Signals”, and “Carry Chain” Sections. ■ Updated New Document Format.	—

Stratix III devices include an enhanced interconnect structure in LABs for routing-shared arithmetic chains and carry chains for efficient arithmetic functions. The register chain connection allows the register output of one ALM to connect directly to the register input of the next ALM in the LAB for fast shift registers. These ALM-to-ALM connections bypass the local interconnect. The Quartus II Compiler automatically takes advantage of these resources to improve utilization and performance. Figure 3–2 shows the shared arithmetic chain, carry chain, and register chain interconnects.

Figure 3–2. Shared Arithmetic Chain, Carry Chain, and Register Chain Interconnects



The C4 interconnects span four adjacent interfaces in the same device column. C4 interconnects also pass by M144K and DSP blocks. A single M144K block utilizes eight adjacent interfaces in the same column. A DSP block utilizes four adjacent interfaces in the same column. Figure 3–3 shows the C4 interconnect connections from a LAB in a column. The C4 interconnects can drive and be driven by all types of architecture blocks, including DSP blocks, TriMatrix memory blocks, and column and row IOEs. For LAB interconnection, a primary LAB or its LAB neighbor can drive a given C4 interconnect. C4 interconnects can drive each other to extend their range as well as drive row interconnects for column-to-column connections.

The structure shown in Figure 5–2 is very useful for building more complex structures, such as complex multipliers and 36 × 36 multipliers, as described in later sections.

Each Stratix III DSP block contains four Two-Multiplier Adder units (two Two-Multiplier Adder units per half-block). Therefore, there are eight 18 × 18 multiplier functionalities per DSP block.

Following the Two-Multiplier Adder units are the pipeline registers, the second-stage adders, and an output register stage. You can configure the second-stage adders to provide the following alternative functions per Half-Block:

Equation 5–2. Four-Multiplier Adder Equation

$$Z[37..0] = P_0[36..0] + P_1[36..0]$$

Equation 5–3. Four-Multiplier Adder Equation (44-Bit Accumulation)

$$W_n[43..0] = W_{n-1}[43..0] \pm Z_n[37..0]$$

In these equations, *n* denotes sample time, and P[36..0] are the results from the Two-Multiplier Adder units.

Equation 5–2 provides a sum of four 18-bit × 18-bit multiplication operations (Four-Multiplier Adder), and Equation 5–3 provides a four 18-bit × 18-bit multiplication operation but with maximum of a 44-bit accumulation capability by feeding the output of the unit back to itself. This is shown in Figure 5–3.

You can bypass all register stages depending on which mode you select.

Figure 6–6. Periphery Clock Networks (EP3SL110, EP3SL150, EP3SE80, and EP3SE110 Devices)

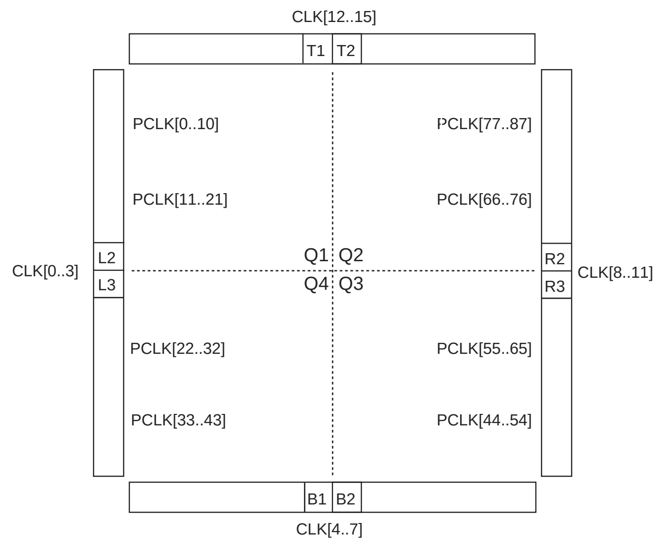


Figure 6–7. Periphery Clock Networks (EP3SL200 Devices)

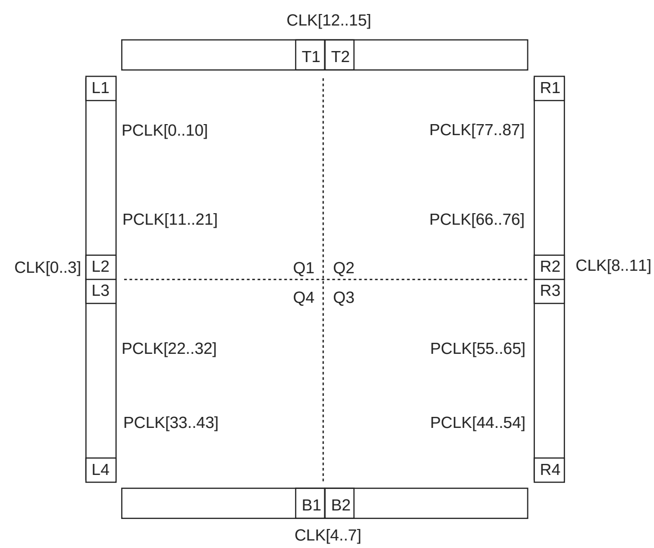


Table 6–6 lists the connectivity between the dedicated clock input pins and RCLKs in device Quadrant 4. A given clock input pin can drive two adjacent regional clock networks to create a dual-regional clock network.

Table 6–6. Clock Input Pin Connectivity to Regional Clock Networks (Quadrant 4)

Clock Resource	CLK (p/n Pins)															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RCLK6	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RCLK7	—	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RCLK8	—	—	✓	—	—	—	—	—	—	—	—	—	—	—	—	—
RCLK9	—	—	—	✓	—	—	—	—	—	—	—	—	—	—	—	—
RCLK10	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RCLK11	—	✓	—	—	—	—	—	—	—	—	—	—	—	—	—	—
RCLK12	—	—	—	—	—	✓	—	—	—	—	—	—	—	—	—	—
RCLK13	—	—	—	—	✓	—	—	—	—	—	—	—	—	—	—	—
RCLK14	—	—	—	—	—	—	—	✓	—	—	—	—	—	—	—	—
RCLK15	—	—	—	—	—	—	✓	—	—	—	—	—	—	—	—	—
RCLK16	—	—	—	—	—	✓	—	—	—	—	—	—	—	—	—	—
RCLK17	—	—	—	—	✓	—	—	—	—	—	—	—	—	—	—	—
RCLK18	—	—	—	—	—	—	—	✓	—	—	—	—	—	—	—	—
RCLK19	—	—	—	—	—	—	✓	—	—	—	—	—	—	—	—	—
RCLK20	—	—	—	—	—	✓	—	—	—	—	—	—	—	—	—	—
RCLK21	—	—	—	—	✓	—	—	—	—	—	—	—	—	—	—	—

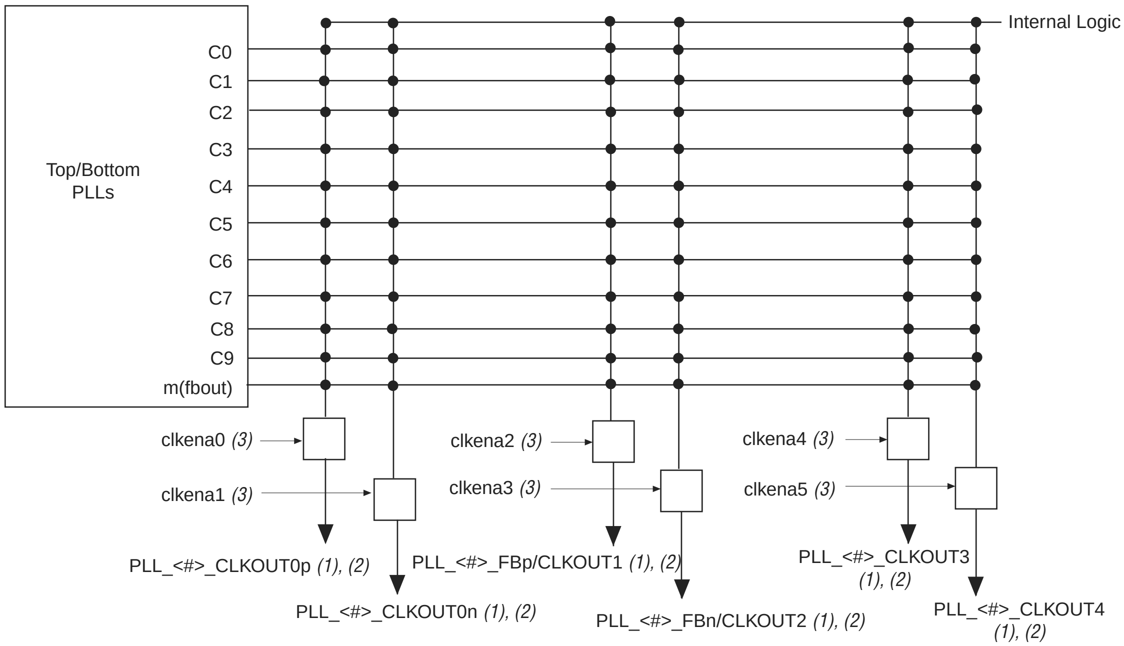
Table 6–7 lists the dedicated clock input pin connectivity to Stratix III device PLLs.

Table 6–7. Stratix III Device PLLs and PLL Clock Pin Drivers (Part 1 of 2) *(Note 1)*

Dedicated Clock Input Pin (CLKp/n pins)	PLL Number											
	L1	L2	L3	L4	B1	B2	R1	R2	R3	R4	T1	T2
CLK0	✓	✓	✓	✓	—	—	—	—	—	—	—	—
CLK1	✓	✓	✓	✓	—	—	—	—	—	—	—	—
CLK2	✓	✓	✓	✓	—	—	—	—	—	—	—	—
CLK3	✓	✓	✓	✓	—	—	—	—	—	—	—	—
CLK4	—	—	—	—	✓	✓	—	—	—	—	—	—
CLK5	—	—	—	—	✓	✓	—	—	—	—	—	—
CLK6	—	—	—	—	✓	✓	—	—	—	—	—	—
CLK7	—	—	—	—	✓	✓	—	—	—	—	—	—
CLK8	—	—	—	—	—	—	✓	✓	✓	✓	—	—
CLK9	—	—	—	—	—	—	✓	✓	✓	✓	—	—
CLK10	—	—	—	—	—	—	✓	✓	✓	✓	—	—
CLK11	—	—	—	—	—	—	✓	✓	✓	✓	—	—
CLK12	—	—	—	—	—	—	—	—	—	—	✓	✓

Figure 6–20 shows the clock I/O pins associated with Top/Bottom PLLs.

Figure 6–20. External Clock Outputs for Top/Bottom PLLs



Notes to Figure 6–20:

(1) These clock output pins can be fed by any one of the `C[9..0]`, m counters.

(2) The `CLKOUT0p` and `CLKOUT0n` pins can be either single-ended or differential clock outputs. `CLKOUT1` and `CLKOUT2` pins are dual-purpose I/O pins that can be used as two single-ended outputs, one differential external feedback input pin pair or one single-ended external feedback input pin (`CLKOUT1` only). `CLKOUT3` and `CLKOUT4` pins are two single-ended output pins.

(3) These external clock enable signals are available only when using the ALTCLKCTRL megafunction.

Any of the output counters (`C[9..0]` on Top/Bottom PLLs and `C[6..0]` on Left/Right PLLs) or the `M` counter can feed the dedicated external clock outputs, as shown in Figure 6–20 and Figure 6–21. Therefore, one counter or frequency can drive all output pins available from a given PLL.

Each Left/Right PLL supports two clock I/O pins, configured as either two single-ended I/Os or one differential I/O pair. When using both pins as single-ended I/Os, one of them can be the clock output while the other pin is the external feedback input (FB) pin. Hence, Left/Right PLLs only support external feedback mode for single-ended I/O standards.

PLL Control Signals

You can use the following three signals to observe and control the PLL operation and resynchronization.

pfdena

Use the `pfdena` signal to maintain the most recent locked frequency so your system has time to store its current settings before shutting down. The `pfdena` signal controls the PFD output with a programmable gate. If you disable the PFD, the VCO is free running and the PLL output drifts. The PLL output jitter may not meet the datasheet specifications. The lock signal cannot be used as an indicator when the PFD is disabled.

areset

The `areset` signal is the reset or resynchronization input for each PLL. The device input pins or internal logic can drive these input signals. When `areset` is driven high, the PLL counters reset, clearing the PLL output and placing the PLL out-of-lock. The VCO is then set back to its nominal setting. When `areset` is driven low again, the PLL will resynchronize to its input as it re-locks.

You should assert the `areset` signal every time the PLL loses lock to guarantee the correct phase relationship between the PLL input clock and output clocks. You can set up the PLL to automatically reset (self reset) upon a loss-of-lock condition using the Quartus II MegaWizard Plug-In Manager. You should include the `areset` signal in designs if the following condition is true:

PLL reconfiguration or clock switchover is enabled in the design.

☞ If the input clock to the PLL is not toggling or is unstable upon power up, assert the `areset` signal after the input clock is stable and within specifications.

locked

The lock signal is an asynchronous output of the PLL. The locked output of the PLL indicates that the PLL has locked onto the reference clock and the PLL clock outputs are operating at the desired phase and frequency set in the Quartus II MegaWizard Plug-In Manager. The lock detection circuit provides a signal to the core logic that gives an indication if the feedback clock has locked onto the reference clock both in phase and frequency.

☞ Altera recommends that you use the `areset` and `locked` signals in your designs to control and observe the status of your PLL.

Clock Switchover

The clock switchover feature allows the PLL to switch between two reference input clocks. Use this feature for clock redundancy or for a dual-clock domain application such as in a system that turns on the redundant clock if the previous clock stops running. The design can perform clock switchover automatically, when the clock is no longer toggling or based on a user control signal, `clkswitch`.

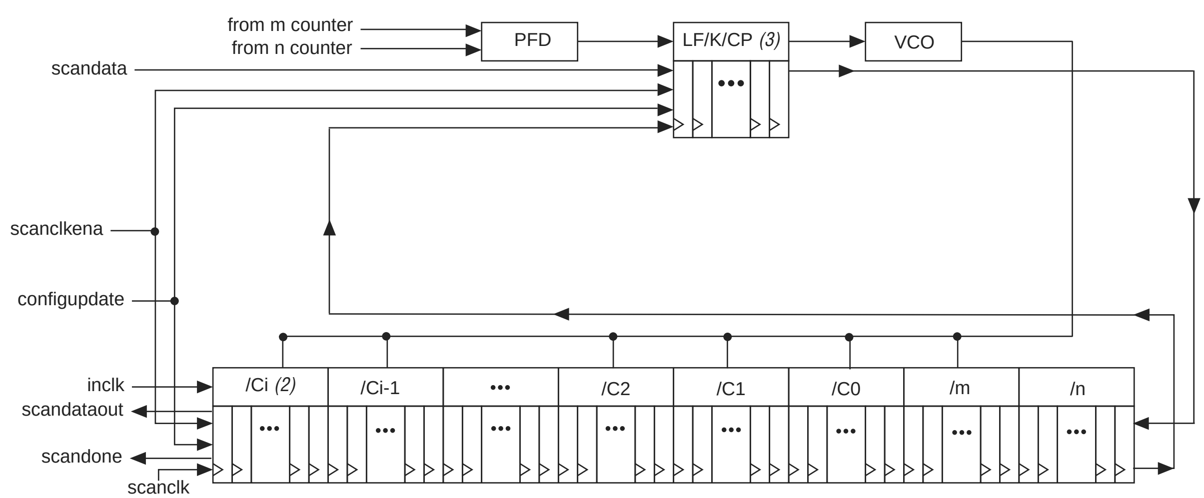
PLL Reconfiguration Hardware Implementation

The following PLL components are reconfigurable in real time:

- Pre-scale counter (`n`)
- Feedback counter (`m`)
- Post-scale output counters (`C0` – `C9`)
- Post VCO Divider (`K`)
- Dynamically adjust the charge-pump current (I_{cp}) and loop-filter components (R, C) to facilitate reconfiguration of the PLL bandwidth

Figure 6–40 shows how PLL counter settings can be dynamically adjusted by shifting their new settings into a serial shift-register chain or scan chain. Serial data is input to the scan chain via the `scandataport` and shift registers are clocked by `scanclk`. The maximum `scanclk` frequency is 100 MHz. Serial data is shifted through the scan chain as long as the `scanclkena` signal stays asserted. After the last bit of data is clocked, asserting the `configupdate` signal for at least one `scanclk` clock cycle causes the PLL configuration bits to be synchronously updated with the data in the scan registers.

Figure 6–40. PLL Reconfiguration Scan Chain



Notes to Figure 6–40:

(1) The Stratix III Left/Right PLLs support `C0 - C6` counters.

(2) i = 6 or i = 9.

(3) This figure shows the corresponding scan register for the `K` counter in between the scan registers for the charge pump and loop filter. The `K` counter is physically located after the VCO.

The counter settings are updated synchronously to the clock frequency of the individual counters. Therefore, all counters are not updated simultaneously.

Table 7–4. Memory Interface Standards Supported (Part 2 of 2)

Memory Interface Standard	I/O Standard
DDR3 SDRAM	SSTL-15
RLDRAM II	HSTL-18
QDR II SRAM	HSTL-18
QDR II+ SRAM	HSTL-15

For more information about external memory interfaces, refer to the *External Memory Interfaces in Stratix III Devices* chapter.

High-Speed Differential I/O with DPA Support

Stratix III devices contain dedicated circuitry for supporting differential standards at speeds up to 1.6 Gbps. The high-speed differential I/O circuitry supports the following high speed I/O interconnect standards and applications: Utopia IV, SPI-4.2, SFI-4, 10 Gigabit Ethernet XSBI, RapidIOTM, and NPSI. Stratix III devices support ×2, ×4, ×6, ×7, ×8, and ×10 SERDES modes for high-speed differential I/O interfaces and ×4, ×6, ×7, ×8, and ×10 SERDES modes with dedicated DPA circuitry. DPA minimizes bit errors, simplifies PCB layout and timing management for high-speed data transfer, and eliminates channel-to-channel and channel-to-clock skew in high-speed data transmission systems.

×2 mode is supported by the DDR registers and is not included in SERDES. For Stratix III devices, SERDES can be bypassed in the Quartus II MegaWizard™ Plug-In Manager for the ALTLVDS megafunction to support DDR (×2) operation.

Stratix III devices have the following dedicated circuitry for high-speed differential I/O support:

- Differential I/O buffer
- Transmitter serializer
- Receiver deserializer
- Data realignment
- DPA
- Synchronizer (FIFO buffer)
- Phase-locked loops (PLLs)

For more information about DPA support, refer to the *High-Speed Differential I/O Interfaces with DPA in Stratix III Devices* chapter.

Programmable Current Strength

The output buffer for each Stratix III device I/O pin has a programmable current-strength control for certain I/O standards. You can use programmable current strength to mitigate the effects of high signal attenuation due to a long transmission line or a legacy backplane. The LVTTL, LVCMOS, SSTL, and HSTL standards have several levels of current strength that you can control. Table 7–5 lists information about programmable current strength.

Table 7–5. Programmable Current Strength *(Note 1)*

I/O Standard	I_{OH} / I_{OL} Current Strength Setting (mA) for Column I/O Pins	I_{OH} / I_{OL} Current Strength Setting (mA) for Row I/O Pins
3.3-V LVTTL	16, 12, 8, 4	12, 8, 4
3.3-V LVCMOS	16, 12, 8, 4	8, 4
3.0-V LVTTL	16, 12, 8, 4	12, 8, 4
3.0-V LVCMOS	16, 12, 8, 4	8, 4
2.5-V LVTTL/LVCMOS	16, 12, 8, 4	12, 8, 4
1.8-V LVTTL/LVCMOS	12, 10, 8, 6, 4, 2	8, 6, 4, 2
1.5-V LVTTL/LVCMOS	12, 10, 8, 6, 4, 2	8, 6, 4, 2
1.2-V LVTTL/LVCMOS	8, 6, 4, 2	4, 2
SSTL-2 Class I	12, 10, 8	12, 8
SSTL-2 Class II	16	16
SSTL-18 Class I	12, 10, 8, 6, 4	12, 10, 8, 6, 4
SSTL-18 Class II	16, 8	16, 8
SSTL-15 Class I	12, 10, 8, 6, 4	8, 6, 4
SSTL-15 Class II	16, 8	—
HSTL-18 Class I	12, 10, 8, 6, 4	12, 10, 8, 6, 4
HSTL-18 Class II	16	16
HSTL-15 Class I	12, 10, 8, 6, 4	8, 6, 4
HSTL-15 Class II	16	—
HSTL-12 Class I	12, 10, 8, 6, 4	8, 6, 4
HSTL-12 Class II	16	—

Note to Table 7–5:

(1) The default setting in the Quartus II software is 50-Ω OCT R_S without calibration for all non-voltage reference and HSTL/SSTL class I I/O standards. The default setting is 25-Ω OCT R_S without calibration for HSTL/SSTL class II I/O standards.

Altera recommends performing IBIS or SPICE simulations to determine the right current strength setting for your specific application.

Programmable Slew Rate Control

The output buffer for each Stratix III device regular- and dual-function I/O pin has a programmable output slew-rate control that you can configure for low-noise or high-speed performance. A faster slew rate provides high-speed transitions for high-performance systems. A slow slew rate can help reduce system noise, but adds a nominal delay to rising and falling edges. Each I/O pin has an individual slew-rate control, allowing you to specify the slew rate on a pin-by-pin basis.

☞ You cannot use the programmable slew rate feature when using OCT R_S.

The Quartus II software allows four settings for programmable slew rate control—0, 1, 2, and 3—where 0 is slow slew rate and 3 is fast slew rate. Table 7–6 lists the default setting for the I/O standards supported in the Quartus II software.

Voltage-Referenced Standards

To accommodate voltage-referenced I/O standards, each Stratix III device I/O bank has one VREF pin feeding a common V_{REF} bus. If it is not used as a VREF pin, it cannot be used as a generic I/O pin and should be tied to V_{CCIO} or GND. Each bank can only have a single V_{CCIO} voltage level and a single V_{REF} voltage level at a given time.

An I/O bank featuring single-ended or differential standards can support voltage-referenced standards as long as all voltage-referenced standards use the same V_{REF} setting.

For performance reasons, voltage-referenced input standards use their own V_{CCPD} level as the power source. This feature allows you to place voltage-referenced input signals in an I/O bank with a V_{CCIO} of 2.5 or below. For example, you can place HSTL-15 input pins in an I/O bank with a 2.5-V V_{CCIO}. However, voltage-referenced input with parallel OCT enabled requires the V_{CCIO} of the I/O bank to match the voltage of the input standard.

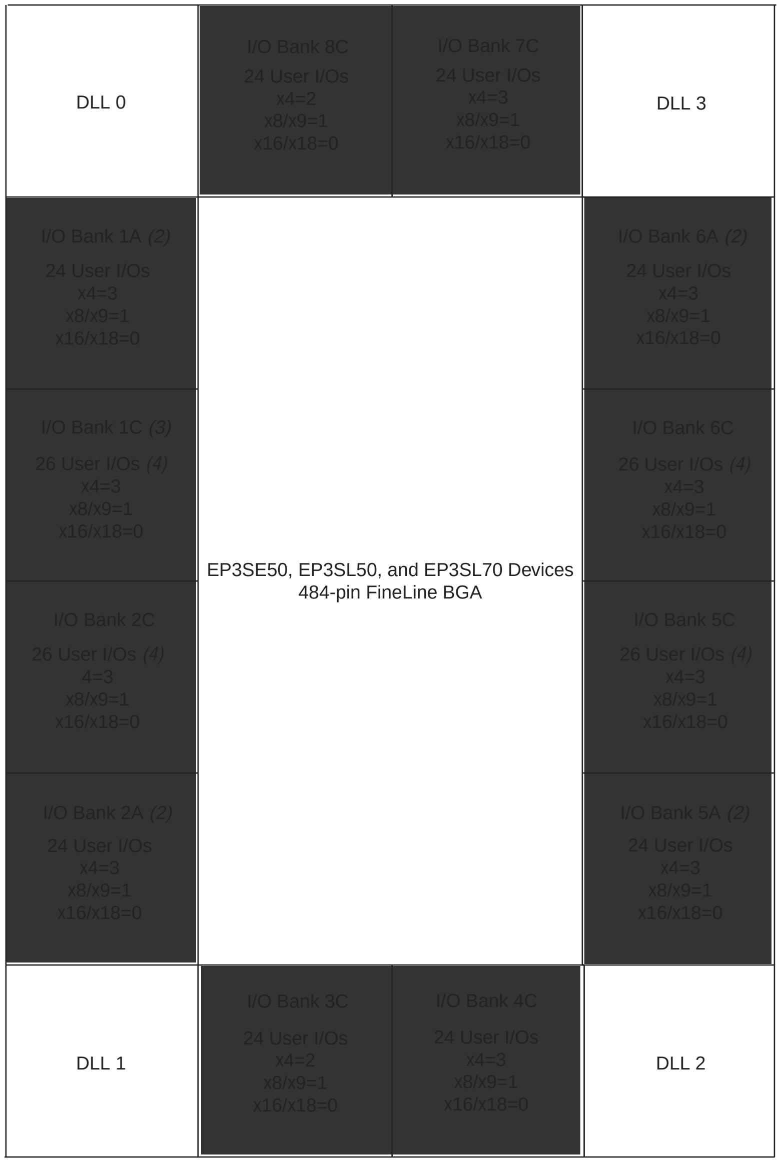
Voltage-referenced bi-directional and output signals must be the same as the I/O bank's V_{CCIO} voltage. For example, you can only place SSTL-2 output pins in an I/O bank with a 2.5-V V_{CCIO}.

Mixing Voltage-Referenced and Non-Voltage-Referenced Standards

An I/O bank can support both non-voltage-referenced and voltage-referenced pins by applying each of the rule sets individually. For example, an I/O bank can support SSTL-18 inputs and 1.8-V inputs and outputs with a 1.8-V V_{CCIO} and a 0.9-V V_{REF}. Similarly, an I/O bank can support 1.5-V standards, 1.8-V inputs (but not outputs), and HSTL and HSTL-15 I/O standards with a 1.5-V V_{CCIO} and 0.75-V V_{REF}.

For pin connection guidelines, refer to the *Stratix III Device Family Pin Connection Guidelines*.

Figure 8–3. Number of DQS/DQ Groups per Bank in EP3SE50, EP3SL50, and EP3SL70 Devices in the 484-pin FineLine BGA Package *(Note 1)*



Notes to Figure 8–3:

(1) This device does not support ×32/×36 mode.

(2) You can also use DQS/DQSn pins in some of the ×4 groups as RUP/RDN pins. You cannot use a ×4 group for memory interfaces if two pins of the group are being used as RUP and RDN pins for OCT calibration. You can still use the ×16/×18 or ×32/×36 groups that includes these ×4 groups. However, there are restrictions on using ×8/×9 groups that include these ×4 groups as described on page 8–5.

(3) Some of the DQS/DQ pins in this bank can also be used as configuration pins. Choose the DQS/DQ pins that are not going to be used by your configuration scheme.

(4) All I/O pin counts include eight dedicated clock inputs (`CLK1p, CLK1n, CLK3p, CLK3n, CLK8p, CLK8n, CLK10p,` and `CLK10n`)

Table 11–10. PS Timing Parameters for Stratix III Devices (Part 2 of 2)

Symbol	Parameter	Minimum	Maximum	Units
t	Input fall time	—	40	ns
t_{CD2UM}	CONF_DONE high to user mode *(2)*	20	100	µs
t_{CD2CU}	CONF_DONE high to CLKUSR enabled	4 × maximum DCLK period	—	—
t_{CD2UMC}	CONF_DONE high to user mode with CLKUSR option on	tCD2CU + (4,436 × CLKUSR period)	—	—

Notes to Table 11–10:

(1) This value is applicable if you do not delay configuration by extending the nCONFIG or nSTATUS low pulse width.

(2) The minimum and maximum numbers apply only if you choose the internal oscillator as the clock source for starting the device.

Device configuration options and how to create configuration files are discussed further in the *Device Configuration Options and Configuration File Formats* chapters in volume 2 of the *Configuration Handbook*.

PS Configuration Using a Microprocessor

In this PS configuration scheme, a microprocessor can control the transfer of configuration data from a storage device, such as flash memory, to the target Stratix III device.

You can do a PS configuration using MicroBlaster™ Passive Serial Software Driver. For more information, refer to *AN423: Configuring the MicroBlaster Passive Serial Software Driver*.

For all configuration and timing information, refer to “PS Configuration Using a MAX II Device as an External Host” on page 11–27. This section is also applicable when using a microprocessor as an external host.

PS Configuration Using a Download Cable

In this section, the generic term *download cable* includes the Altera USB-Blaster USB port download cable, MasterBlaster™ serial/USB communications cable, ByteBlaster II parallel port download cable, ByteBlasterMV™ parallel port download cable, and the EthernetBlaster download cable.

In PS configuration with a download cable, an intelligent host (such as a PC) transfers data from a storage device to the device by using the USB-Blaster, MasterBlaster, ByteBlaster II, EthernetBlaster, or ByteBlasterMV cable.

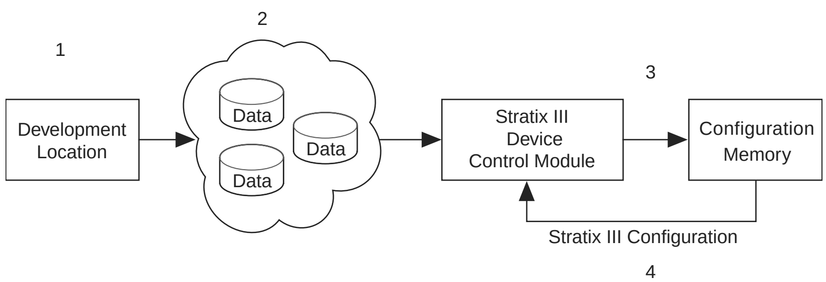
Table 11–14. Dedicated Configuration Pins on the Stratix III Device (Part 3 of 5)

Pin Name	User Mode	Configuration Scheme	Pin Type	Description
nSTATUS	N/A	All	Bi-directional open-drain	The device drives nSTATUS low immediately after power-up and releases it after the POR time. During user mode and regular configuration, this pin is pulled high by an external 10-kΩ resistor. This pin, when driven low by Stratix III, indicates that the device is being initialized and has encountered an error during configuration. Status output. If an error occurs during configuration, nSTATUS is pulled low by the target device. Status input. If an external source drives the nSTATUS pin low during configuration or initialization, the target device enters an error state. Driving nSTATUS low after configuration and initialization does not affect the configured device. If you use a configuration device, driving nSTATUS low will cause the configuration device to attempt to configure the device, but since the device ignores transitions on nSTATUS in user-mode, the device does not reconfigure. To initiate a reconfiguration, nCONFIG must be pulled low. If you have enabled the **Auto-restart configuration after error** option, the nSTATUS pin transitions from high to low and back again to high when a configuration error is detected. This appears as a low pulse at the nSTATUS pin with a minimum pulse width of 10 µs to a maximum pulse width of 500 µs, as defined in the t_{STATUS} specification.
nSTATUS (continued)	—	—	—	If V_{CCPGM} and V_{CCIO} are not fully powered up, the following could occur: ■ V_{CCPGM} and V_{CCIO} are powered high enough for the nSTATUS buffer to function properly, and nSTATUS is driven low. When V_{CCPGM} and V_{CCIO} are ramped up, POR trips and nSTATUS is released after POR expires. ■ V_{CCPGM} and V_{CCIO} are not powered high enough for the nSTATUS buffer to function properly. In this situation, nSTATUS might appear logic high, triggering a configuration attempt that would fail because POR did not yet trip. When V_{CCPD} and V_{CCIO} are powered up, nSTATUS is pulled low because POR did not yet trip. When POR trips after V_{CCPGM} and V_{CCIO} are powered up, nSTATUS is released and pulled high. At that point, reconfiguration is triggered and the device is configured.

3. The Nios II processor (or user logic) initiates a reconfiguration cycle with the new or updated configuration data.
4. The dedicated remote system upgrade circuitry detects and recovers from any error(s) that might occur during or after the reconfiguration cycle, and provides error status information to the user design.

Figure 12–1 shows the steps required for performing remote configuration updates. (The numbers in the figure below coincide with the steps above.)

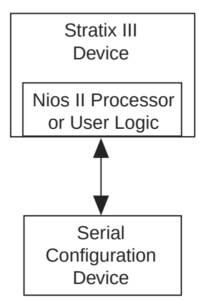
Figure 12–1. Functional Diagram of Stratix III Remote System Upgrade



Stratix III devices only support remote system upgrade in the single device Fast AS configuration scheme.

Figure 12–2 shows the block diagrams for implementing a remote system upgrade with the Stratix III Fast AS configuration scheme.

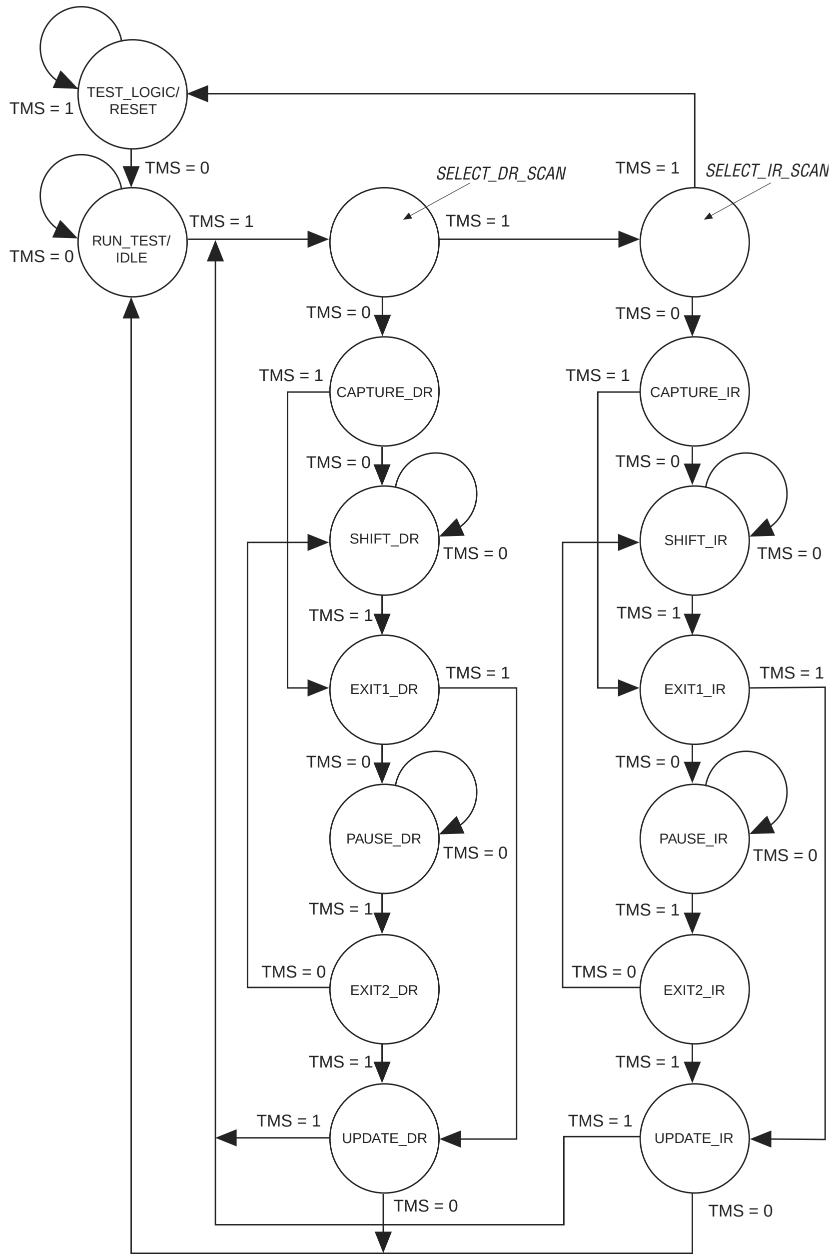
Figure 12–2. Remote System Upgrade Block Diagram for Stratix III Fast AS Configuration Scheme



You must set the mode select pins (`MSEL[2..0]`) to Fast AS mode to use the remote system upgrade in your system. Table 12–1 lists the `MSEL` pin settings for Stratix III devices in standard configuration mode and remote system upgrade mode. The following sections describe the remote update of remote system upgrade mode.

For more information about standard configuration schemes supported in Stratix III devices, refer to the *Configuring Stratix III Devices* chapter in volume 1 of the *Stratix III Device Handbook*.

Figure 13–5. IEEE Std. 1149.1 TAP Controller State Machine



When the TAP controller is in the `TEST_LOGIC/RESET` state, the BST circuitry is disabled, the device is in normal operation, and the instruction register is initialized with `IDCODE` as the initial instruction. At device power-up, the TAP controller starts in this `TEST_LOGIC/RESET` state. In addition, forcing the TAP controller to the `TEST_LOGIC/RESET` state is achieved by holding `TMS` high for five `TCK` clock cycles, or by holding the `TRST` pin low. In the `TEST_LOGIC/RESET` state, the TAP controller remains in this state as long as `TMS` is held high (while `TCK` is clocked) or `TRST` is held low. Figure 13–6 shows the timing requirements for the IEEE Std. 1149.1 signals.