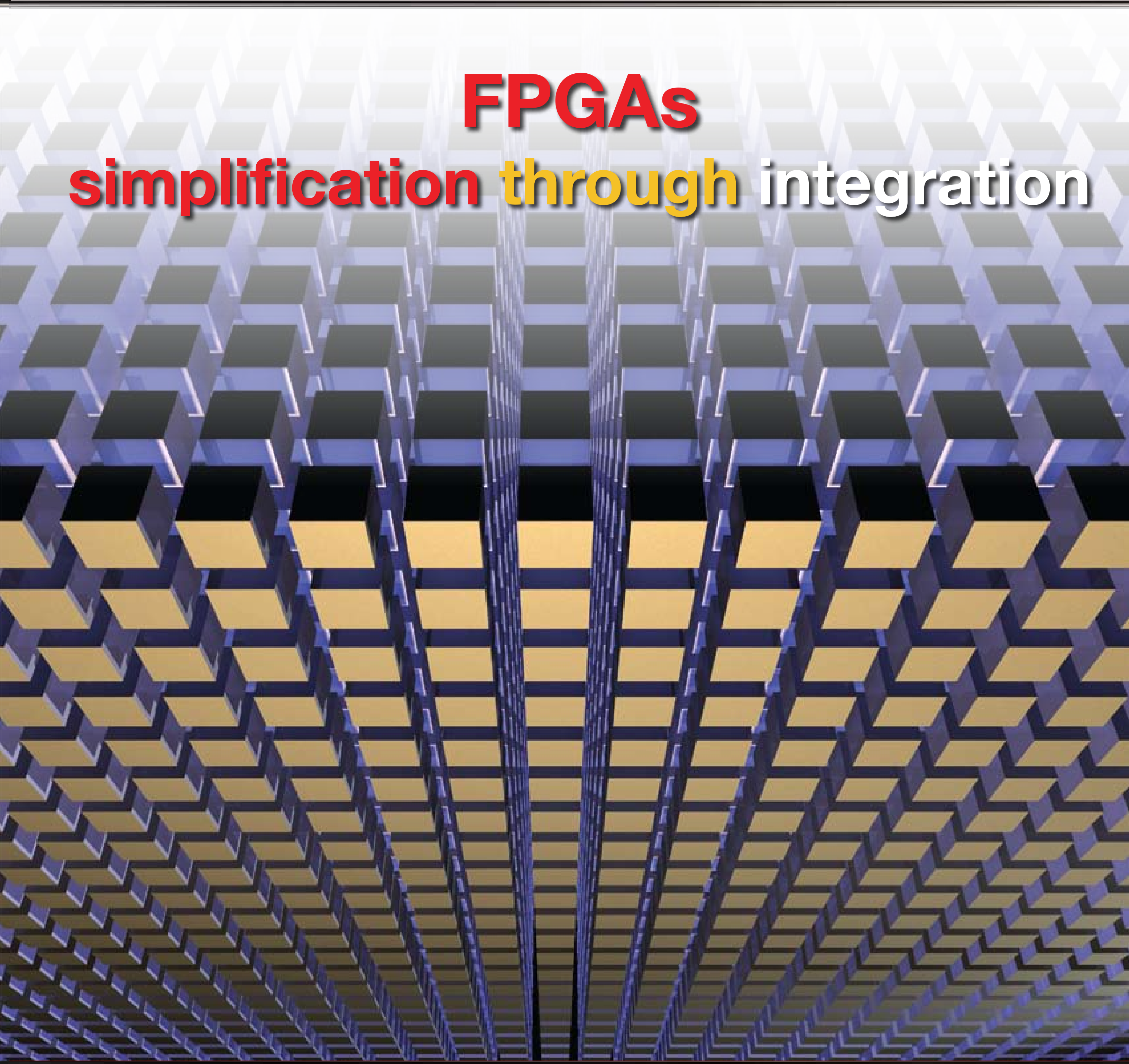
FPGA Solutions Guide

FPGAs
simplification through integration



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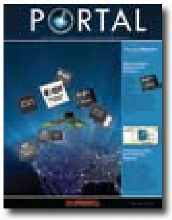

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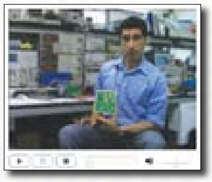

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FPGAs Solutions Guide

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Speed Design and Debug with the Nu Horizons Xilinx Virtex-5 FXT Development Board

Many modern applications use FPGAs to implement complex system level building blocks. In order to quickly and easily design, prototype and debug these systems it can be helpful to use an FPGA-based Development Board. A Development Board has a high-capacity FPGA, like the Xilinx Virtex-5 FXT family, and a variety of proven peripherals, industry standard interfaces, power supply circuits and status indicators and control switches to make it easy to create a prototype system for even the most complex applications.

The recently introduced Nu Horizons Virtex-5 FXT Development Board contains a wide variety of interfaces, peripherals a supporting circuitry to make it easy to design, prototype and debug your application. The Development Board contains the following key functions/devices:

FPGA:
- Xilinx XC5VFX30T (FF665 Package)

Memory:
- Xilinx XCF16 Platform Flash
- Micron 64M DDR SDRAM
- Micron 2x8Gb NAND Flash

Interfaces:
- Tianma LCD Display
- Video DAC
- SFP Module
- Marvell 10/100/1G Ethernet PHY
- Exar RS-232

Clocking:
- IDT Femtoclock Frequency Synthesizer
- Pletronics Oscillators and Crystals

Power:
- Linear Tech Power Modules Regulators

Each of these features/devices will be explained in more detail and the ways in which they can be used to easily support design, prototype and debug a target application will be summarized. The descriptions will be organized by the functional sub-blocks used in the above outline.

In many cases, additional information is available in the body of the surrounding magazine and pointers to this information will be provided for the reader wishing even more details.

A picture of the Nu Horizons Virtex-5 FXT Development Board is shown in Figure 1.

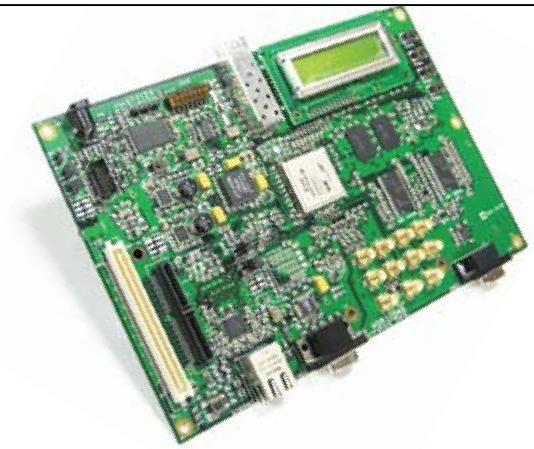


Figure 1: Nu Horizons Virtex-5 FXT Development Board

Figure 1: Nu Horizons Virtex-5 FXT Development Board

FPGA Sub-Section

The Nu Horizons Virtex-5 FXT Development Board includes an XC5VFX30T FPGA with a variety of advanced features that make it a perfect target for a wide range of applications. The XC5VFX30T is just one device in the extensive Virtex-5 Family.

The Virtex-5 family contains four distinct platforms (sub-families), the most choice offered by any FPGA family. Each platform contains a different ratio of features to address the needs of a wide variety of advanced logic designs. In addition to the most advanced, high-performance logic fabric, Virtex-5 FPGAs contain many hard-IP system level blocks, including powerful 36-Kbit block RAM/FIFOs, second generation 25 x 18 DSP slices, Select IO™ technology with built-in digitally controlled impedance, ChipSync™ source-synchronous interface blocks, system monitor functionality, enhanced clock management tiles with integrated DCM (Digital Clock Managers) and phase-locked-loop (PLL) clock generators, and advanced configuration options.

Additional platform dependant features include power-optimized high-speed serial transceiver blocks for enhanced serial connectivity, PCI Express™ compliant integrated Endpoint blocks, tri-mode Ethernet MACs (Media Access Controllers), and high-performance PowerPC® 440 microprocessor embedded blocks. These features allow advanced logic designers to build the highest levels of performance and functionality into their FPGA-based systems. Built on a 65-nm state-of-the-art copper process technology, Virtex-5 FPGAs are a programmable alternative to custom ASIC technology. Most advanced system designs require the programmable strength of FPGAs. Virtex-5 FPGAs offer the best solution for addressing the needs of high-performance logic designers, high-performance DSP designers, and high-performance embedded systems designers with unprecedented logic, DSP, hard/soft microprocessor, and connectivity capabilities. A summary of the differences between each Virtex-5 platform is given below:

LX: High-performance general logic applications
LXT: High-performance logic with advanced serial connectivity
SXT: High-performance signal processing applications with advanced serial connectivity
FXT: High-performance embedded systems with advanced serial connectivity

A selector guide for the entire Virtex-5 Family is included in the accompanying magazine and shows the capabilities of each family member. The XC5VFX30T device used on the development board contains 5,120 logic slices, up to 380Kb of distributed RAM, 64 DSP 48E slices, 136 18Kb and 68 36Kb RAM blocks, 2 CMTs, 1 Power PC Processor Blocks, 1 hard PCI Express Endpoint , 4 hard Ethernet MACs, 8 GTX Rocket IO Transceivers and 360 general purpose IOs. Each of these features is supported with additional devices on the Development Board so that even the most complex designs can be prototyped.

For more details on using the Xilinx Virtex-5 Family in embedded applications refer to the companion article in the accompanying magazine.

Memory Sub-System

The memory devices used on the development board complement the Xilinx Virtex-5 XC5VFX30T FPGA by providing configuration data, program data for embedded processing and storage data for a variety of data processing applications. The following sections provide a quick overview of the memory devices and their typical use during design, prototype and debugging.

Xilinx XCF16 Platform Flash

The Xilinx platform flash device is used to configure the XC5VFX30T. It holds enough configuration data to contain multiple configuration images. This is useful when bringing up the initial design since multiple test cases can be loaded and selected during debugging. Later in the development cycle multiple images can store manufacturing tests, specialized conformance or compliance tests or other manufacturing or field related applications.

Micron 64M DDR SDRAM

Included on the development board is a 64M DDR SDRAM from Micron Technology, the MT46V16M16. There are two of the devices to create a 32-bit data interface. This memory sub-system is useful for storing program code for the embedded Power PC processor in the Virtex-5 FPGA or to be used as buffer storage for video, networking or communications applications.

Xilinx provides an easy to use Memory Controller Generator (MIG) tool that is integrated into ISE 10.1 and can generate a memory controller for the MT46V16M16 based subsystem. Nu Horizons has a useful application note showing how to interface Micron DDR memories to the Virtex-5 Family using MIG and it can be found on the Nu Horizons web site by clicking on the Application Notes banner at the top of the page.

Micron 8Gb NAND Flash

There are two MT29H8G08ACAH1 devices on the development board and these can be used for embedded processor code storage, FPGA configuration data or for application oriented data for code conversion, video processing or DSP related algorithms. Micron NAND memory devices can be used in a variety of FPGA-based applications and provide higher speed, larger storage and improved reliability over other non-volatile alternatives. NAND devices are finding new uses in Solid State Storage (SSD), hybrid hard drives, video on demand and in memory back-up systems. For more information on the capabilities, features and uses of Micron NAND devices refer to the brochure included in the accompanying magazine.

Because the NAND Flash is non-volatile it is useful for storing code and algorithm updates so that field changes, in the final product, can be made remotely. Debugging these capabilities first on the development board can be important since bugs in this part of the design will make it difficult to provide bug fixes in the field.

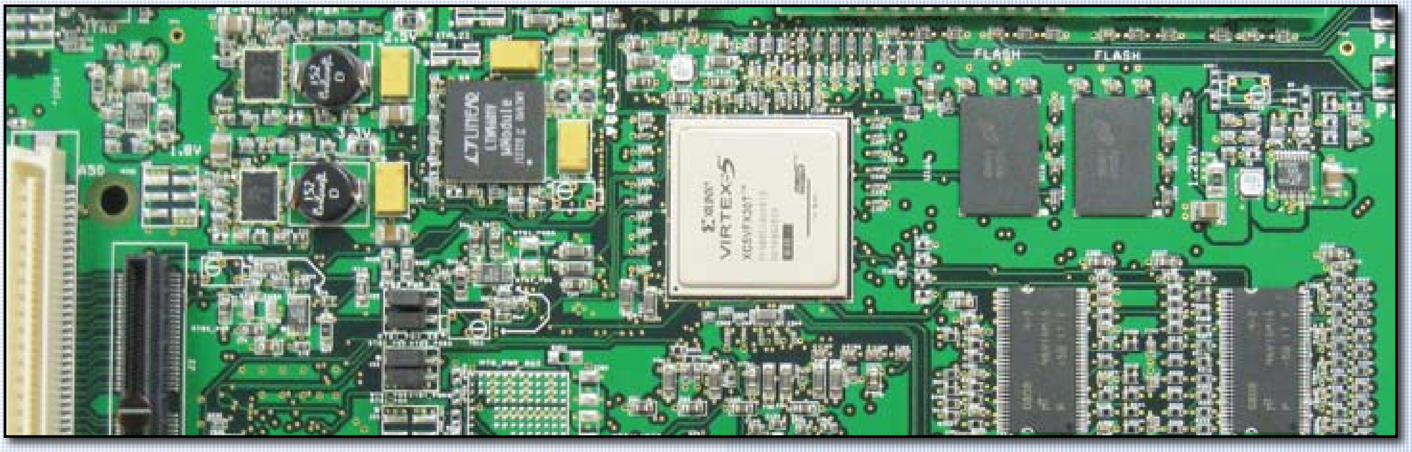
Standard Interfaces

The interfaces available on the development board allow the designer to get high speed data on and off the FPGA in a variety of ways. 10/100/1G Ethernet, SMA and an SFP module are available for high speed data transfer. In addition, RS-232, a Tianma LCD display and a Video DAC are available for slower speed applications.

Marvell 10/100/1G Ethernet PHY

The development board includes a Marvell 88E1119R 10/100/1G Ethernet PHY in a QFN72 package. This is connected to the hard Ethernet MAC included in the Virtex-5 device. The combination of these two devices provides a flexible Ethernet interface that can be used for a host of common applications.

The 88E1119R is just one of the Alaska® Family of Gigabit Ethernet transceivers



from Marvell. These PHY devices are ideal solutions for a wide range of applications including hubs, switches, routers, PCs, gaming consoles, DVRs, media vaults as well as high performance embedded computing applications in industrial, instrumentation, test and measurement and communications. The current selector guide for the Marvell Ethernet Transceiver series is included in the accompanying magazine. You can select the right device based on the standard supported (10/100/1G/10G Ethernet), the number of ports required (1, 2 or 4), the type of interface (SGMII, MII, RMII, SSSMII, GMII, etc) and a variety of other key characteristics.

SMA and SFP Connectors

In addition to the other standard interfaces the development board also contains two generic interfaces in the form of SMA and an SFP module. These connections allow the use of a variety of interconnect protocols (10Gig Ethernet for example) or alternate, off board, clock sources. These are also useful sources for data during system testing and debugging. Source data, which may not be readily available in the eventual, production format, can be transferred over these connections using test equipment or other similar data generators.

Clocking Sub-System

There are a variety of clocking sources and option required on the development board. Some of these are relatively fixed frequencies and others are selectable depending on the interface standard being implemented. The IDT Femtoclock Frequency Synthesizer, ICS843001, is used to provide a programmable clock so that a variety of standards can be supported on the SFP port.

Pletronics Oscillators and Crystals

Pletronics oscillators and crystals are used to create clocks for the main board as well as several of the peripheral Interfaces. Oscillators are used to create 25MHz and 50MHz clocks for the FPGA, and the Ethernet PHY. Crystals (26.5625MHz, and 19.44MHz) are used to control the Frequency Synthesizer, and the Ethernet PHY.

Pletronics supplies a wide range of oscillators and crystals for every application. Common frequencies are available for Gigabit Ethernet, 10Gigabit Ethernet, Fibre Channel, Infiniband, ADSL, Serial ATA, PCI Express and Sonet. The selector guide available in the accompanying magazine details the exact frequencies for each of these standards. It also identifies the selection based on IO standard for all the Xilinx FPGA Families.

Power Sub-System

The power sub-system on the development board provides power to all the devices on the board- FPGA, DDR SDRAM and NAND Flash memory, LCD display, etc. Linear Technology has a wide variety of applicable regulators and modules to supply power to the board.

Linear Technology Regulators and Modules

Linear Technology has created a useful selector guide when powering the Xilinx Virtex-5 Family. As shown in the Virtex-5 portion of the selector guide, the Virtex-5 Family devices require a core voltage of 1.0V. Depending on the Input Voltage, shown in the left column and the Current Required, shown in the top row, the appropriate LTC power solution products are given in the intersection of the row and column. For example, if we need 5A, and we will have a voltage input source between 2.5V to 5V. We can select between the LTC34XX regulators, the LTM4601 µModule and various LTC controllers. On the development board the LTC 3418/3412 and LTC4601 modules are used to supply power, just as recommended.

The entire selector guide is available on page 28. Refer to this to discover how these device can save you board space and component count in high-power FPGA-based applications.

Conclusion

The Nu Horizons Virtex-5 FXT Development Board has a variety of key devices useful for the design, prototype and debug of a wide range of high-speed embedded functions. Using the FPGA-native PowerPC processor, on-board DDR SDRAM, NAND Flash, 10/100/1000 Ethernet and other key interfaces even the most complex design can get a jump start using the board, documentation, design files and example designs available with the development board. In comparison to building a board from scratch it is possible to save weeks or even months of effort, and avoid common pitfalls and dead ends while leveraging the investment Nu Horizons has made in bringing you this advanced development environment.

Embedded Processing Innovations with Virtex-5 FXT Devices

With the advent of the Xilinx® Virtex™-5 FXT FPGA, you have an opportunity to get ahead of the embedded system design curve. The need to quickly develop and validate embedded systems has never been more apparent than in the realm of embedded system design.

Combining software and hardware to demonstrate this at a system level (as quickly as time permits) has become commonplace in the industry. By providing a more tightly coupled, flexible, scalable solution, you have a means to address many hardware and software SOC design challenges.

FPGAs provide a significantly faster path for designers to rapidly develop, prototype, and test their embedded designs. The Virtex-5 FXT device platform, the third generation FPGA to feature a PowerPC processor, has added an embedded block that will help you meet more demanding design requirements while allowing you to finish your designs quickly and easily.

In this article, we'll provide a detailed description of the embedded processing innovations in the PowerPC 440 processor block and system interconnect. A key area of focus in the Virtex-5 FXT FPGA processor block is simplification through integration.

A corollary to this is ease of development and test. Quickly bringing up a system to allow software developers to get a head start on actual hardware is a major emphasis for the Virtex-5 FXT device's PowerPC 440 processor.

Simplification Through Integration

Integration is key. We have reduced the amount of FPGA logic needed to build a high-performance processing system while still allowing a wide variety of topologies. You still have the flexibility and advantages of an FPGA-based implementation, but you now also have the added benefit of a hardened, integrated interconnect architecture that (among other things) maximizes access to external memory.
As you will see, the result is an embedded block that allows you to develop a wider range of high-performance processing architectures in a shorter period of time. PowerPC processors generically have three interfaces: instruction read, data read, and data write. In previous Virtex device architectures, which embedded the PowerPC 405, these processor buses would connect to FPGA fabric. The timing closure requirements of this circuitry would vary based on how many and what types of loads the design presented to the buses.

In the Virtex-5 FXT FPGA (where the processor is now the PowerPC 440), these buses are hardened and hooked directly to a new structure, an integrated 5 x 2 crossbar switch – generically referred to as the crossbar. This hardened interconnect provides significantly higher performance (with virtually no consumption of FPGA logic resources and fixed timing) when combined with the rest of the architectural enhancements in the Virtex-5 FXT device's embedded processor block. This results in an overall system cost reduction and invariably a more tightly integrated processor system.

The processor buses only take up three of the five "crossbar master" ports on the 5 x 2 crossbar (see Figure 1). The crossbar includes two additional master ports, because in many real-

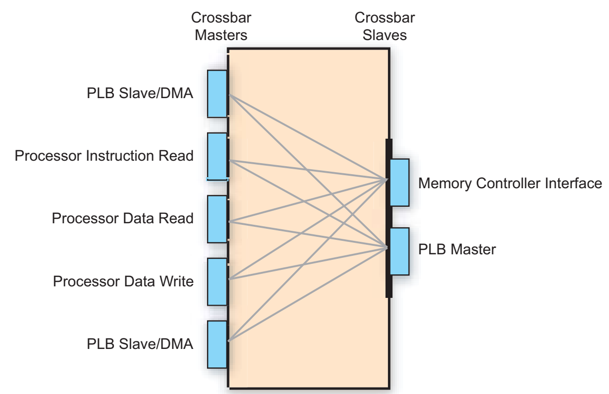


Figure 1 – The crossbar

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world applications it's not just the processor that needs access to memory or peripherals. Each of these "crossbar master" ports comprises a processor local bus (PLB) slave interface, as well as two channels of scatter-gather direct memory access (DMA).

The "slave" side of the crossbar comprises two ports. One port is a dedicated memory controller interface that provides a high-throughput generic interface to soft memory controllers. The other is a bus for attaching I/O devices and peripherals.

A Better Processor

Providing all of this extra functionality in the embedded processor block would be of little consequence if there were not a processor with the horsepower to take advantage of it. The Virtex-5 FXT FPGA represents the first time anyone has embedded a PowerPC 440-class processor in an FPGA.

The PowerPC 440 offers a significant performance improvement over the PowerPC 405 (which was embedded in previous Virtex families) in a number of areas.

First, the PowerPC 440, when in the fastest speed-grade FPGA, can be clocked at 550 MHz. The PowerPC 405 topped out at 450 MHz. This is almost a 20% performance improvement. But add to that the fact that the I and D cache sizes are doubled, the instruction pipeline is seven instead of five stages, and the execution unit can now execute two instructions out of order and in parallel.

	PPC405 (Virtex-4 FX FPGA)	PPC440 (Virtex-5 FXT FPGA)	Benefit
Architecture	32-bit instruction, 32-bit address, 64-bit data	32-bit instruction, 36-bit address, 128-bit data, Book E compliant	Access more physical memory, higher speed data movement
Pipline	Single instruction/cycle, five-stage pipeline, in-order issue	Two instructions/cycle, seven-stage pipeline, out-of-order issue	More efficient instruction execution
Caches – I/D	16K/16K, two-way set associative, no locking	32K/32K, 64-way set associative, locking	Less memory access latency
MMU	Page size: 1 KB to 16 MB	Page size: 1 KB to 256 MB	Less page swapping
DMPS Estimate	Page size: 1 KB to 16 MB	1000+ DMIPS	Better benchmarks equal higher performance

The result? You've got a processor with performance sufficient to handle a great many of today's embedded processing challenges. There are a number of other advantages to moving from the PowerPC 405 to the PowerPC 440, as shown in Table 1. The PowerPC 440 embedded block is shown in Figure 2.

High-Throughput Switch Matrix

The 5 x 2 crossbar is more than just a big switch. It provides non-blocking pipelined access from the five crossbar masters to the two crossbar slaves (see Figure 1). It allows concurrent transfers between different agents on the crossbar at the same time.

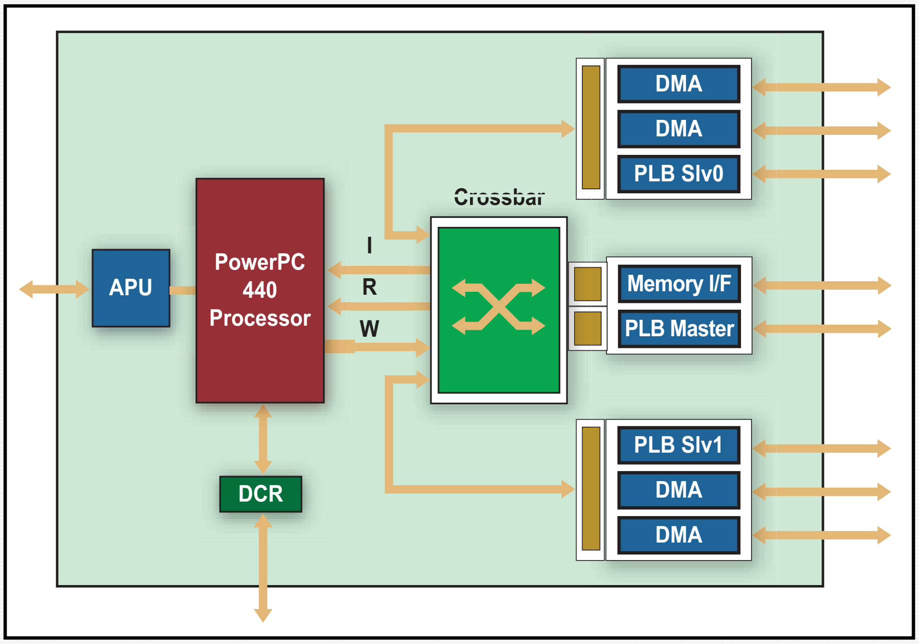


Figure 2 – The PowerPC 440 embedded processor block

As shown, we'll call the buses going into the crossbar "crossbar masters" and the buses coming out "crossbar slaves." These interfaces are highly pipelined, thus allowing a large number of transactions to be in progress at the same time.

In fact, up to four concurrent transactions can exist: two for each crossbar slave (such as the memory controller or PLB master). Additionally, each crossbar master (that is, the three processor PLBs and the two PLB slave interfaces) can pipeline four read and four write transactions to the same slave.

Another key feature of the crossbar is its highly programmable memory mapping. You can think of the entire system of having available memory space of 4 GB. Both the memory controller interface and the PLB master can have different memory windows mapped into the memory space of any of the crossbar masters. These memory spaces can be programmed through the FPGA bitstream, by the processor at run time, or even by external logic on the FPGA using the crossbar's sideband bus, called the device control register (DCR) bus.

Integrated PLB Interfaces

As we mentioned earlier, many of the buses connected to the crossbar are processor local buses, also called PLBs.

The PLB is one of the standard CoreConnect buses as defined by IBM. An earlier version of the PLB (version 3.4) was used as one of the standard buses on PowerPC 405 designs in Virtex-II Pro and Virtex-4 FX FPGAs and is also used in the new PowerPC 440 embedded processor block.

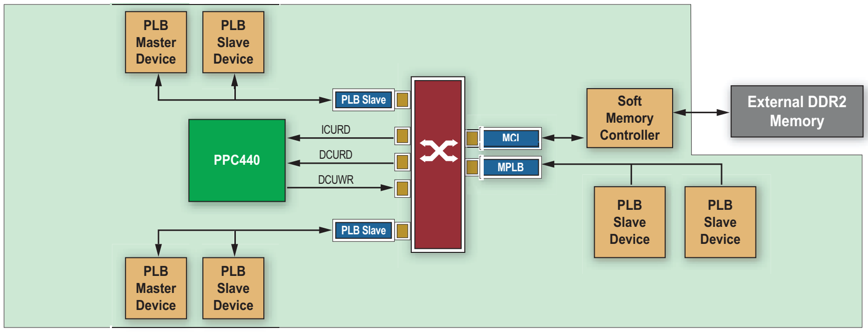


Figure 3 – PLB masters and slaves

In the PowerPC 440 embedded processor block, the PLBs connect the processor's internal caches to the input side of the crosspoint.

The buses are:

- ICURD: instruction cache unit read
- DCURD: data cache unit read
- DCUWR: data cache unit write

The PLB used in the Virtex-5 FXT device is version 4.6 (PLB46). The PLB46 bus architecture brings with it a number of new capabilities that give it a nice performance boost over its predecessor. The most obvious is the fact that while PLB34 was 64 bits, PLB46 is 128 bits. But not to worry – if the IP connected to the bus is less than that, the bus will perform dynamic bus sizing as required to accommodate 32- and 64-bit transactions.

We should also point out that the PLB46 version is a Xilinx implementation of the IBM-defined PLB46, optimized to take advantage of FPGA resources.

PLB46 – and indeed all versions of PLB – have the concept of master and slave. This should not be confused with crossbar master and crossbar slave. (Again, refer to Figure 1.) As we stated earlier, there are two PLB slave port interfaces on the crossbar; they are crossbar masters. These slave ports are connected to the FPGA fabric.

In a processor system there is often the need to allow something besides the processor to access external memory or on-chip peripherals. The PLB slave interfaces allow just that. PLB masters, built from FPGA logic, connected to the PLB Slave ports (see Figure 3) can access either the MCI or the MPLB through the crossbar.

Similarly, the function of the PLB master (the one that is the crossbar slave) is to have a PLB to hook to I/O devices and soft peripherals. And because the PLB master is a crossbar slave, anything hooked to a crossbar master port can access it.

Note that there can be no more than four PLB masters connected to each PLB slave bus. Few systems are likely to need more than four masters, but if you did need more, you could always use the PLB/PLB bridge IP provided with the Embedded Development Kit (EDK) *(see www.xilinx.com/support/documentation/ipembedprocess_coreconnect_plbbusstruct.htm).*

Figure 3 is a simplified system diagram showing how PLB peripherals can be hooked to crossbar master and crossbar slave ports. Note that if you have multiple masters on any PLB, arbitration is handled by the IP for the bus. You do not need a separate arbiter.

Optimized DMA Engines

There are four additional crossbar masters; they are the four DMA channels. Each DMA channel has separate 32-bit transmit and 32-bit receive interfaces. They share crossbar arbitration with PLB slave interfaces, as shown in Figure 4.

All DMA ports can be operating at the same time. Each one has a dedicated FIFO, so as one DMA is accumulating data, the other DMA can be pumping data through the crossbar. Each DMA channel operates asynchronously to the processor clock.

The interface into the DMA channels is through an interface called LocalLink. Xilinx uses the LocalLink interface in a number of IP blocks. LocalLink is a pointto- point interface that sends packets to, or receives packets from, some external device.

The most notable type of processor IP that uses the LocalLink interface is the hard embedded tri-mode Ethernet media access controller (TEMAC) block. The TEMAC has a wrapper that allows it to communicate directly with the PowerPC 440 DMA. Although all data paths through the crossbar are 128 bits, the LocalLink interface into and out of the DMA channels are all 32 bits. As such, there is built-in logic between the DMA controller and the crossbar that realigns data.

To maximize throughput and performance, the PowerPC 440 embedded block employs scatter/gather DMA. To make using this capability as easy as possible, Xilinx provides wrappers for the various pieces of IP and embedded blocks it offers.

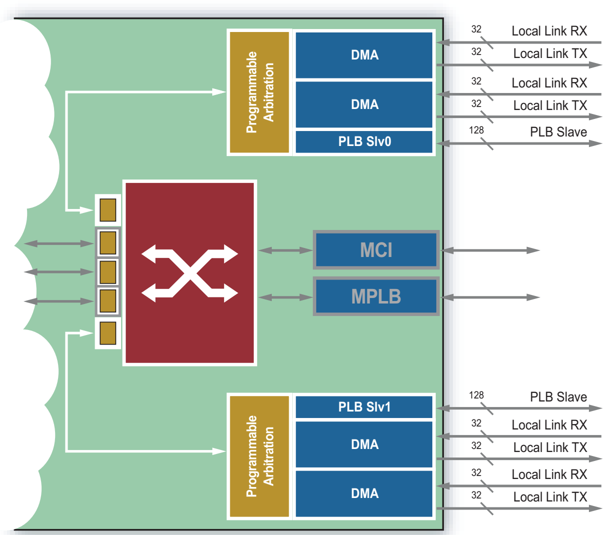


Figure 4 – PLB slave buses and DMA channels share crossbar arbitration.

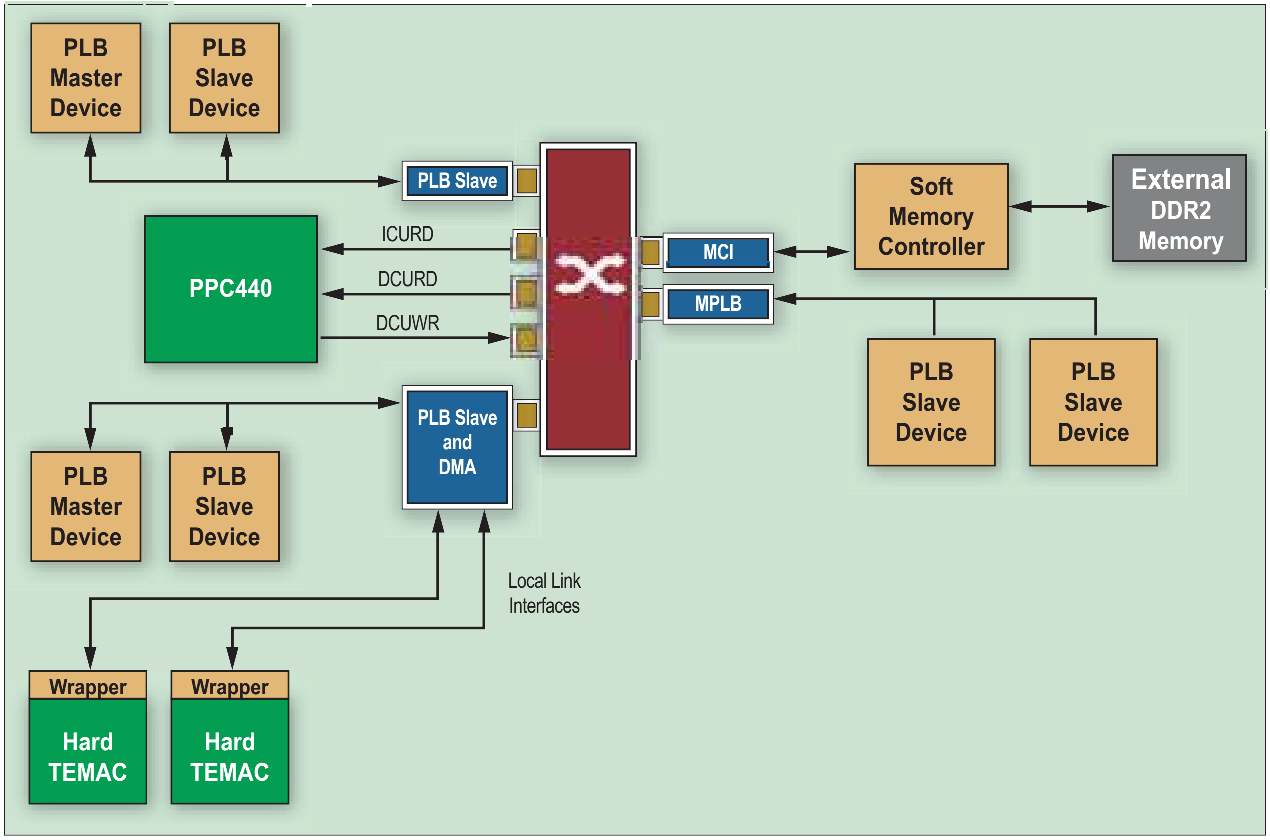


Figure 5 – Sample system with both PLB and DMA peripherals

The first one targeted specifically toward the PowerPC 440 is the soft wrapper for the embedded TEMAC blocks. This wrapper, combined with the functionality of the DMA engine in the PowerPC 440 embedded block, allows you to easily build a processing system with a high-performance TEMAC connected directly to the PowerPC 440 DMA channels. Figure 5 is a simplified system showing how both DMA and PLB peripherals can be hooked to crossbar master and crossbar slave ports.

The DMA channels are controlled by descriptors, small blocks of memory that are set up by the PowerPC 440 processor before commencing DMA operations. The descriptors control how much data is transferred and where data is located in system memory.

Descriptors can be chained together if need be, effectively creating a sequence of commands to control a DMA channel. The DMA controller is covered in its entirety in the reference guide, entitled "Embedded Processor Block in Virtex-5 FPGAs" *(http://www.xilinx.com/support/ documentation/user_ guides/ug200pdf)*.

High-Performance Dedicated Memory Interface

Rounding out the new processor block is the dedicated memory controller interface. The purpose of this interface is to provide a dedicated link out to external memory, but at the same time not be tied to any specific memory technology.

At this time, the memory controller interface supports a stand-alone DDR2 controller and MPMC4 controller, all available through Xilinx Platform Studio, EDK 10.1. This interface provides the flexibility to connect to virtually any memory technology now or in the future.

The memory controller interface is streamlined, comprising address/data/ control. It can be programmed to support 128-, 64-, 32-, or even 16-bit memory. It does width and burst realignment, so while the DMA may be bursting one size packet, the memory controller can buffer and realign the packet data to maximize the bandwidth to the memory. Burst size is programmable and can be 1, 2, 4, or 8, and the memory controller interface will automatically adjust the address to accommodate the various burst widths.

The majority of soft memory controller handshaking signals are generated by the interface on behalf of the memory controller. They are provided ahead of time such that the soft memory controller can generate throttling signals back to the memory interface. The memory controller interface – on behalf of the soft memory controller – can also be programmed to detect bank and row misses ahead of time and will inform the soft memory controller to anticipate a bank or row miss. All of these features together provide a solution whose primary goal is to maximize memory throughput.

Tuning the System

In some situations, a PLB or DMA interface just may not be the right solution. For instance, you might find that you have a software algorithm that takes too many cycles to execute and is affecting your system bandwidth. That algorithm is a great candidate for implementation in hardware, and the interface to which you may want that hardware connected would be the auxiliary processing unit, or APU interface.

The PowerPC 440 has a second-generation APU interface that is tightly coupled to the execution units of the processor. The interface is controlled by 16 user defined instructions (UDIs). The data path of the APU interface is 128 bits.

Perhaps the most common use of the APU interface is for connecting to a floating-point unit (FPU). The FPU is IEEE754-compatible and supports both single- and double-precision operations for the PowerPC 440.

The FPU is implemented in the FPGA soft logic fabric and utilizes the DSP48E blocks. The soft logic implementation operates up to half the frequency of the hard embedded processor.

Other uses of the APU interface include hardware algorithm acceleration, as well as an alternative high-bandwidth link to block RAM.

Configuring the Embedded Block

By integrating the PowerPC 440 block in the FPGA, the processor block can be configured in multiple ways. Virtually every interface is programmable.

For example, when you build your processing system in the Xilinx Platform Studio development environment and a bitstream is created, all of the specifications of the processing system are in the bitstream. Thus, when the FPGA starts up, your processor is up and running.

Now, let's say the processing system is up and running and you want to modify the operation of one of the DMA channels. You would do that through the DCR interface. There are DCR registers to control every aspect of DMA operation.

In fact, there is DCR access to virtually every other subsystem of the embedded block: the PLBs and crossbar, memory controller interface, and the APU controller. Refer to Figure 2 for more details.

Putting It All Together

This innovation would be for naught if Xilinx did not provide a comprehensive infrastructure to take advantage of all of the architectural enhancements. We should point out that the Virtex-5 FXT FPGA with the PowerPC 440 block represents our eighth year in embedded processing and our third generation FPGA with a hardened processor.

Throughout that time we've been constantly updating EDK, our award-winning Embedded Development Kit. EDK includes Platform Studio, with its comprehensive library of IP for hardware design, and Platform Studio SDK, a software development environment familiar to many embedded software engineers.

With the introduction of the Virtex-5 FXT family of devices, we continue to further strengthen our third-party alliances with support from industry-leading operating system providers, including WindRiver Systems with VxWorks and Green Hills Integrity.

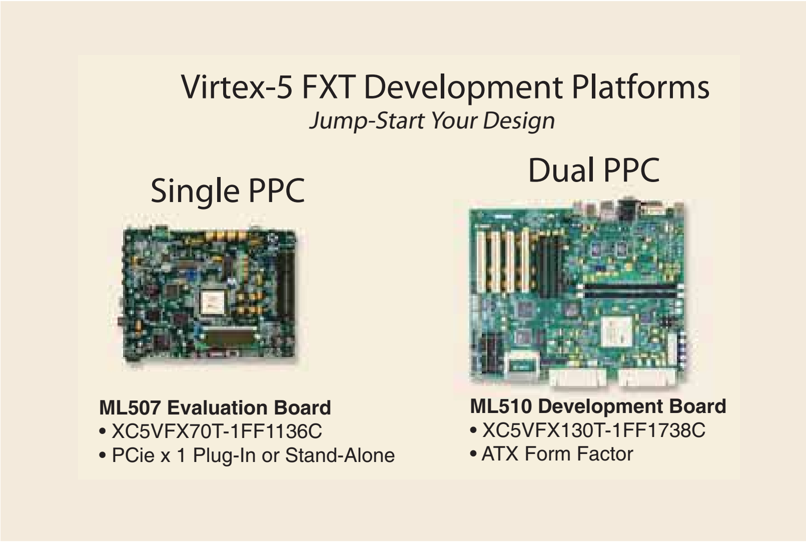


Figure 6 – Xilinx ML507 evaluation and ML510 development boards

Linux support is provided through LynuxWorks, Monta Vista, and WindRiver Systems. In addition, Xilinx recognizes the importance of open-source Linux, and we're moving forward on that front.

Xilinx and its partner companies are also developing a wide variety of boards. Xilinx has multiple boards for the Virtex-5 FXT device: the ML507 with the XC5VFX70T and the ML510 with the XC5VFX130T, as shown in Figure 6. The ML507 evaluation platform enables your team to quickly begin developing hardware, software, or both. When multiple processors or a motherboard-type platform are required, the ML510 with the dualprocessor XC5VFX130T is ideal.

Conclusion

A high-performance processing solution with optimized data throughput is high on the wish list of embedded designers everywhere. This is true whether you are running critical algorithms at the heart of the latest wireless base station, switching high bandwidth data through a video switch, performing advanced signal processing for guidance systems using coprocessor acceleration, or handling complex control and system management tasks.

The Virtex-5 FXT embedded processor block, with a multi-ported non-blocking integrated processor interconnect and high-performance integrated DMA, offers a solution that allows you to focus on the key elements of your embedded design.

With a virtually unlimited number of ways to harness these embedded capabilities, the Virtex-5 FXT FPGA embedded processing solution provides a highly integrated platform for high-performance, high-throughput SOC designs. ■ ■ ■

Virtex-4 Family FPGAs

		Virtex-4 LX FPGA Platform Optimized for High-performance Logic (1.2 Volt)								Virtex-4 SX FPGA Platform Optimized for DSP (1.2 Volt)			Virtex-4 FX FPGA Platform Optimized for Embedded Processing & Serial Connectivity (1.2 Volt)					
	Part Number	XC4VLX15	XC4VLX25	XC4VLX40	XC4VLX60	XC4VLX80	XC4VLX100	XC4VLX160	XC4VLX200	XC4VSX25	XC4VSX35	XC4VSX55	XC4VFX12	XC4VFX20	XC4VFX40	XC4VFX60	XC4VFX100	XC4VFX140
	Easypath™ Cost Reduction Solutions [1]	—	—	XCE4VLX40	XCE4VLX60	XCE4VLX80	XCE4VLX100	XCE4VLX160	XCE4VLX200	—	XCE4VSX35	XCE4VSX55	—	—	XCE4VFX40	XCE4VFX60	XCE4VFX100	XCE4VFX140
Logic Resources	Slices [2]	6,144	10,752	18,432	26,624	35,840	49,152	67,584	89,088	10,240	15,360	24,576	5,472	8,544	18,624	25,280	42,176	63,168
	Logic Cells	13,824	24,192	41,472	59,904	80,640	110,592	152,064	200,448	23,040	34,560	55,296	12,312	19,224	41,904	56,880	94,896	142,128
	CLB Flip-Flops	12,288	21,504	36,864	53,248	71,680	98,304	135,168	178,176	20,480	30,720	49,152	10,944	17,088	37,248	50,560	84,352	126,336
Memory Resources	Maximum Distributed RAM (Kbits)	96	168	288	416	560	768	1,056	1,392	160	240	384	86	134	291	395	659	987
	Block RAM/FIFO w/ECC (18 Kbits each)	48	72	96	160	200	240	288	336	128	192	320	36	68	144	232	376	552
	Total Block RAM (Kbits)	864	1,296	1,728	2,880	3,600	4,320	5,184	6,048	2,304	3,456	5,760	648	1,224	2,592	4,176	6,768	9,936
Clock Resources	Digital Clock Managers (DCM)	4	8	8	8	12	12	12	12	4	8	8	4	4	8	12	12	20
	Phase-matched Clock Dividers (PMCD)	0	4	4	4	8	8	8	8	0	4	4	0	0	4	8	8	8
I/O Resources [3]	Maximum Single-Ended I/Os	320	448	640	640	768	960	960	960	320	448	640	320	320	448	576	768	896
	Maximum Differential I/O Pairs	160	224	320	320	384	480	480	480	160	224	320	160	160	224	228	384	448
	I/O Standards	LDT-25, LVDS-25, LVDSEXT-25, BLVDS-25, ULVDS-25, LVPECL-25, LVCMOS25, LVCMOS18, LVCMOS15, PCI33, LVTTL, LVCMOS33, PCI-X, PCI66, GTL, GTL+, HSTL I (1.5V,1.8V), HSTL II (1.5V,1.8V), HSTL III (1.5V,1.8V), HSTL IV (1.5V,1.8V), SSTL2I, SSTL2II, SSTL18 I, SSTL18 II																
Embedded Hard IP Resources	DSP48 Slices	32	48	64	64	80	96	96	96	128	192	512	32	32	48	128	160	192
	PowerPC™ Processor Blocks	—	—	—	—	—	—	—	—	—	—	—	1	1	2	2	2	2
	10/100/1000 Ethernet MAC Blocks	—	—	—	—	—	—	—	—	—	—	—	2	2	4	4	4	4
	RocketIO™ Serial Transceivers	—	—	—	—	—	—	—	—	—	—	—	0	8	12	16	20	24
Speed Grades	Commercial	-10, -11, -12	-10, -11, -12	-10, -11, -12	-10, -11, -12	-10, -11, -12	-10, -11, -12	-10, -11, -12	-10, -11	-10, -11, -12	-10, -11, -12	-10, -11, -12	-10, -11, -12	-10, -11, -12	-10, -11, -12	-10, -11, -12	-10, -11, -12	-10, -11
	Industrial	-10, -11	-10, -11	-10, -11	-10, -11	-10, -11	-10, -11	-10, -11	-10	-10, -11	-10, -11	-10, -11	-10, -11	-10, -11	-10, -11	-10, -11	-10, -11	-10
Configuration	Configuration Memory (Mbits)	4.8	7.8	12.3	17.7	23.3	30.7	40.3	51.4	9.1	13.7	22.7	4.8	7.2	13.6	21.0	33.0	47.9
Package [4,5,6]	Area	Available User I/Os																
SFA Packages (SF): flip-chip fine-pitch BGA (0.8 mm ball spacing)																		
SF363	17 x 17 mm	240	240										240					
FFA Packages (FF): flip-chip fine-pitch BGA (1.0 mm ball spacing)																		
FF668	27 x 27 mm	320	448	448	448					320	448		320					
FF1148	35 x 35 mm			640	640	768	768	768				640						
FF1513	40 x 40 mm						960	960	960									
FF672	27 x 27 mm													320 (8)	352 (12)	352 (12)		
FF1152	35 x 35 mm														448 (12)	576 (16)	576 (20)	
FF1517	40 x 40 mm																768 (20)	768 (24)

Notes:
1. EasyPath™ solutions provide a conversion-free path for volume production.
2. Each slice comprises two 4-input logic function generators (LUTs), two storage elements, wide-function multiplexers, and carry logic.
3. Digitally Controlled Impedance (DCI) is available on I/Os of all devices.
4. Available I/O for each device-package combination: number of SelectIO pins (number of RocketIO transceivers).
5. All Virtex-4 LX and Virtex-4 SX devices available in the same package are footprint-compatible.
6. All products available Pb-free and RoHS-Compliant.

Important: Verify all data in this document with the device data sheets found at *www.xilinx.com/virtex4*

Spartan-3A, 3AN & 3A DSP FPGAs

Delivers the industry's lowest total cost. Period.

- *Device DNA Security to deter reverse-engineering, cloning, and overbuilding*
- *Dual power management modes*
- *Breakthrough DSP performance using DSP48A slices with advanced Multiply-Accumulator (3A DSP Only)*
- *Up to 11 Mb on-chip User Flash (3AN Only)*
- *Supports 26 differential and single-ended I/O standards*

Extended Spartan-3A Family
Optimized for Lowest Total Cost

	Part Number	XC3S50A	XC3S200A	XC3S400A	XC3S700A	XC3S1400A	XC3SD1800A	XC3SD3400A
Logic Resources	System Gates [1]	50K	200K	400K	700K	1400K	1800K	3400K
	Slices [2]	704	1,792	3,584	5,888	11,264	16,640	23,872
	Logic Cells	1,584	4,032	8,064	13,248	25,344	37,440	53,712
	CLB Flip-Flops	1,408	3,584	7,168	11,776	22,528	33,280	47,744
Memory Resources	Maximum Distributed RAM (Kbits)	11	28	56	92	176	260	373
	Block RAM Blocks	3	16	20	20	32	84	126
	Total Block RAM (Kbits)	54	288	360	360	576	1,512	2,268
Non-Volatile Capability	Single Chip Option	Yes	Yes	Yes	Yes	Yes	No	No
	User Flash (Kbits) [3,6]	627	3,054	2,380	5,779	12,251	—	—
Clock Resources	Digital Clock Managers (DCMs)	2	4	4	8	8	8	8
I/O Resources	Maximum Single Ended I/Os	144/108 [6]	248/195 [6]	311	372	502	519	469
	Maximum Differential I/O Pairs	64/50 [6]	112/90 [6]	142	165	227	227	213
	I/O Standards Supported	LVTTL, LVCMOS33, LVCMOS25, LVCMOS18, LVCMOS15, LVCMOS12, HSTL15 Class I, HSTL15 Class III, HSTL18 Class I, HSTL18 Class II, HSTL18 Class III, PCI 3.3V 32/64bit 33MHz, PCI 3.3V 64bit/66MHz, PCI-X 3.3V, SSTL3 Class I, SSTL3 Class II, SSTL2 Class I, SSTL2 Class II, SSTL18 Class I, SSTL18 Class II, Bus LVDS, LVDS25 & 33, LVPECL25 & 33, Mini-LVDS25 & 33, RSDS25 & 33, TMDS33, PPDS25 & 33						
Embedded Hard IP Resources	Multipliers/DSP48A Blocks	3/0	16/0	20/0	20/0	32/0	0/84 [4]	0/126 [4]
	Device DNA Security	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Speed Grades	Commercial	-4, -5	-4, -5	-4, -5	-4, -5	-4, -5	-4, -5	-4, -5
	Industrial	-4	-4	-4	-4	-4	-4 [5]	-4 [5]
Configuration	Configuration Memory Bits (Kbits)	0.4	1.2	1.9	2.7	4.8	8.2	11.7

Package [7]	Size	Maximum User I/Os						
VQFP Packages (VQ): very thin QFP (0.5 mm lead spacing)								
VQ100	16 x 16 mm	68	68					
TQFP Packages (TQ): thin QFP (0.5 mm lead spacing)								
TQ144	22 x 22 mm	108 [8]						
FGA Packages (FT): wire-bond fine-pitch thin BGA (1.0 mm ball spacing)								
FT256	17 x 17 mm	144	195 [8]	195	161	161		
Chip Scale Packages (CS): wire-bond chip-scale BGA (0.8 mm ball spacing)								
CS484	19 x 19 mm						309 [5]	309 [5]
FGA Packages (FG): wire-bond fine-pitch BGA (1.0 mm ball spacing)								
FG320	19 x 19 mm		248	251				
FG400	21 x 21 mm			311 [8]	311			
FG484	23 x 23 mm				372 [8]	375		
FG676	27 x 27 mm					502 [8]	519	469

Notes: 1. System Gates include 20%-30% of CLBs used as RAMs 2. Each slice comprises two 4-input logic function generators (LUTs), two storage elements, wide-function multiplexers, and carry logic 3. User Flash is the space left in the on-chip Flash after a portion is used to store configuration bitstream
4. Integrated in the DSP48A slices (Advanced Multiply Accumulate element) 5. The L low-power option is exclusively available in CS(G)484 package and Industrial temperature range 6. Spartan-3AN only 7. All products available Pb-free and RoHS-Compliant, check datasheet for Pb package availability
8. Single chip non-volatile option available for this package

Important: Verify all data in this document with the device data sheets found at *www.xilinx.com*

Xilinx Virtex®-5 Family FPGAs

Virtex-5 Family FPGAs

		Virtex®-5 LX FPGA Platform Optimized for High-performance Logic (1.0 Volt)							Virtex-5 LXT FPGA Platform Optimized for High-performance Logic with Low-power Serial Connectivity (1.0 Volt)							
	Part Number	XC5VLX30	XC5VLX50	XC5VLX85	XC5VLX110	XC5VLX155	XC5VLX220	XC5VLX330	XC5VLX20T	XC5VLX30T	XC5VLX50T	XC5VLX85T	XC5VLX110T	XC5VLX155T	XC5VLX220T	XC5VLX330T
	EasyPath™ Cost Reduction Solutions (1)	—	—	XCE5VLX85	XCE5VLX110	XCE5VLX155	XCE5VLX220	XCE5VLX330	—	—	—	XCEVLXT85T	XCE5VLX110T	XCE5VLX155T	XCE5VLX220T	XCE5VLX330T
Logic Resources	Slices (2)	4,800	7,200	12,960	17,280	24,320	34,560	51,840	3,120	4,800	7,200	12,960	17,280	24,320	34,560	51,840
	Logic Cells (3)	30,720	46,080	82,944	110,592	155,648	221,184	331,776	19,968	30,720	46,080	82,944	110,592	155,648	221,184	331,776
	CLB Flip-Flops	19,200	28,800	51,840	69,120	97,280	138,240	207,360	12,480	19,200	28,800	51,840	69,120	97,280	138,240	207,360
Memory Resources	Maximum Distributed RAM (Kbits)	320	480	840	1,120	1,640	2,280	3,420	210	320	480	840	1,120	1,640	2,280	3,420
	Block RAM/FIFO w/ECC (36Kbits each)	32	48	96	128	192	192	288	26	36	60	108	148	212	212	324
	Total Block RAM (Kbits)	1,152	1,728	3,456	4,608	6,912	6,912	10,368	936	1,296	2,160	3,888	5,328	7,632	7,632	11,664
Clock Resources	Digital Clock Managers (DCM)	4	12	12	12	12	12	12	2	4	12	12	12	12	12	12
	Phase Locked Loop (PLL)/PMCD	2	6	6	6	6	6	6	1	2	6	6	6	6	6	6
I/O Resources (4)	Maximum Single-Ended Pins	400	560	560	800	800	800	1,200	172	360	480	480	680	680	680	960
	Maximum Differential I/O Pairs	200	280	280	400	400	400	600	86	180	240	240	340	340	340	480
	I/O Standards	HT, LVDS, LVDSEXT, RSDS, BLVDS, ULVDS, LVPECL, LVCMOS33, LVCMOS25, LVCMOS18, LVCMOS15, LVTTL, PCI33, PCI66, PCI-X, GTL, GTL+, HSTL I (1.2V,1.5V,1.8V), HSTL II (1.5V,1.8V), HSTL III (1.5V,1.8V), HSTL IV (1.5V,1.8V), SSTL2 I, SSTL2 II, SSTL18 I, SSTL18 II														
Embedded (5) Hard IP Resources	DSP48E Slices	32	48	48	64	128	128	192	24	32	48	48	64	128	128	192
	PowerPC® 440 Processor Blocks	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	PCI Express Endpoint Blocks	—	—	—	—	—	—	—	1	1	1	1	1	1	1	1
	10/100/1000 Ethernet MAC Blocks	—	—	—	—	—	—	—	2	4	4	4	4	4	4	4
	RocketIO™ GTP Low-Power Transceivers	—	—	—	—	—	—	—	4	8	12	12	16	16	16	24
	RocketIO™ GTX High-Speed Transceivers	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Speed Grades	Commercial	-1, -2, -3	-1, -2, -3	-1, -2, -3	-1, -2, -3	-1, -2, -3	-1, -2	-1, -2	-1, -2	-1, -2, -3	-1, -2, -3	-1, -2, -3	-1, -2, -3	-1, -2, -3	-1, -2	-1, -2
	Industrial	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1, -2	-1
Configuration	Configuration Memory (Mbits)	8.4	12.6	21.9	29.1	42.7	53.2	79.8	6.3	9.4	14.1	23.4	31.2	43.1	55.2	82.7
Package (6,7)	Area	Available User I/Os														
FFA Packages (FF): flip-chip fine-pitch BGA (1.0 mm ball spacing)																
FF324	19 x 19 mm	220	220													
FF676	27 x 27 mm	400	440	440	440											
FF1153	35 x 35 mm		560	560	800	800										
FF1760	42.5 x 42.5 mm				800	800	800	1200								
FF323	19 x 19mm								172 (4)	172 (4)						
FF665	27 x 27mm									360 (8)	360 (8)					
FF1136	35 x 35mm										480 (12)	480 (12)	640 (16)	640 (16)		
FF1738	42.5 x 42.5mm												680 (16)	680 (16)	680 (16)	960 (24)

Notes:
1. EasyPath™ solutions provide a conversion-free path for volume production.
2. A single Virtex-5 CLB comprises two slices, with each containing four 6-input LUTs and four Flip-Flops (twice the number found in a Virtex-4 slice), for a total of eight 6-LUTs and eight Flip-Flops per CLB.
3. Virtex-5 logic cell ratings reflect the increased logic capacity offered by the new 6-input LUT architecture.
4. Digitally Controlled Impedance (DCI) is available on I/Os of all devices.
5. One system monitor block included in all devices.
6. Available I/O for each device-package combination: number of SelectIO pins (number of RocketIO transceivers).
7. All products available Pb-free and RoHS-Compliant.

Important: Verify all data in this document with the device data sheets found at *www.xilinx.com/virtex5*

Virtex-5 FPGAs deliver the industry's highest performance and low power with no compromises.

- *Low dynamic power with 65nm ExpressFabric ™ technology and power-saving IP blocks*
- *Built-in PCI Express® and Ethernet connectivity*
- *Lowest power serial transceivers: less than 100mW at 3.2Gbps*
- *Highest performance processing with built in PowerPC 440 blocks and DSP48E slices*

		Virtex-5 SXT FPGA Platform Optimized for DSP with Low-power Serial Connectivity (1.0 Volt)				Virtex-5 FXT FPGA Platform Optimized for Embedded Processing with High-Speed Serial Connectivity (1.0 Volt)					Virtex-5 TXT Platform Optimized for Ultra-High Bandwidth	
	Part Number	XC5VSX35T	XC5VSX50T	XC5VSX95T	XC5VSX240T	XC5VFX30T	XC5VFX70T	XC5VFX100T	XC5VFX130T	XC5VFX200T	XC5VTX150T	XC5VTX240T
	EasyPath™ Cost Reduction Solutions [1]	—	XCE5VSX50T	XCE5VSX95T	XCE5VSX240T	—	XCE5VFXT70T	XCE5VFXT100T	XCE5VFXT130T	XCE5VFXT200T	XCE5VTXT150T	XCE5VTXT240T
Logic Resources	Slices [2]	5,440	8,160	14,720	37,440	5,120	11,200	16,000	20,480	30,720	23,200	37,440
	Logic Cells [3]	34,816	52,224	94,208	239,616	32,768	71,680	102,400	131,072	196,608	148,480	239,616
	CLB Flip-Flops	21,760	32,640	58,880	149,760	20,480	44,800	64,000	81,920	122,880	92,800	149,760
Memory Resources	Maximum Distributed RAM (Kbits)	520	780	1,520	4,200	380	820	1,240	1,580	2,280	1,500	2,400
	Block RAM/FIFO w/ECC (36Kbits each)	84	132	244	516	68	148	228	298	456	228	324
	Total Block RAM (Kbits)	3,024	4,752	8,784	18,576	2,448	5,328	8,208	10,728	16,416	8,208	11,664
Clock Resources	Digital Clock Managers (DCM)	4	12	12	12	4	12	12	12	12	12	12
	Phase Locked Loop (PLL)/PMCD	2	6	6	6	2	6	6	6	6	6	6
I/O Resources [4]	Maximum Single-Ended Pins	360	480	640	960	360	640	680	840	960	680	680
	Maximum Differential I/O Pairs	180	240	320	480	180	320	340	420	480	340	340
	I/O Standards	HT, LVDS, LVDSEXT, RSDS, BLVDS, ULVDS, LVPECL, LVCMOS33, LVCMOS25, LVCMOS18, LVCMOS15, LVTTL, PCI33, PCI66, PCI-X, GTL, GTL+, HSTL I (1.2V,1.5V,1.8V), HSTL II (1.5V,1.8V), HSTL III (1.5V,1.8V), HSTL IV (1.5V,1.8V), SSTL2 I, SSTL2 II, SSTL18 I, SSTL18 II										
Embedded [5] Hard IP Resources	DSP48E Slices	192	288	640	1,056	64	128	256	320	384	80	96
	PowerPC® 440 Processor Blocks	—	—	—	—	1	1	2	2	2	—	—
	PCI Express Endpoint Blocks	1	1	1	1	1	3	3	3	4	1	1
	10/100/1000 Ethernet MAC Blocks	4	4	4	4	4	4	4	6	8	4	4
	RocketIO™ GTP Low-Power Transceivers	8	12	16	24	—	—	—	—	—	—	—
	RocketIO™ GTX High-Speed Transceivers	—	—	—	—	8	16	16	20	24	40	48
Speed Grades	Commercial	-1, -2, -3	-1, -2, -3	-1, -2	-1, -2	-1, -2, -3	-1, -2, -3	-1, -2, -3	-1, -2, -3	-1, -2	-1, -2	-1, -2
	Industrial	-1, -2	-1, -2	-1, -2	-1	-1, -2	-1, -2	-1, -2	-1, -2	-1	-1, -2	-1, -2
Configuration	Configuration Memory (Mbits)	13.4	20.0	35.8	79.7	13.6	27.1	39.4	49.3	70.9	43.4	65.8
Package [6,7]	Area	Available User I/Os										
FFA Packages (FF): flip-chip fine-pitch BGA (1.0 mm ball spacing)												
FF665	27 x 27mm	360 (8)	360 (8)			360 (8)	360 (8)					
FF1136	35 x 35mm		480 (12)	640 (16)			640 (16)	640 (16)				
FF1738	42.5 x 42.5mm				960 (24)			680 (16)	840 (20)	960 (24)		
FF1156	35 x 35mm										360 (40)	
FF1759	42.5 x 42.5mm										680 (40)	680 (48)

Notes:

1. EasyPath™ solutions provide a conversion-free path for volume production.
2. A single Virtex-5 CLB comprises two slices, with each containing four 6-input LUTs and four Flip-Flops (twice the number found in a Virtex-4 slice), for a total of eight 6-LUTs and eight Flip-Flops per CLB.
3. Virtex-5 logic cell ratings reflect the increased logic capacity offered by the new 6-input LUT architecture.
4. Digitally Controlled Impedance (DCI) is available on I/Os of all devices.
5. One system monitor block included in all devices.
6. Available I/O for each device-package combination: number of SelectIO pins (number of RocketIO transceivers).
7. All products available Pb-free and RoHS-Compliant.

Important: Verify all data in this document with the device data sheets found at *www.xilinx.com/virtex5*

Associated Products

Marvell Ethernet Transceivers

PRODUCT OVERVIEW

With the proliferation of today's advanced system of broadband networks, the need for reliable performance and faster throughput is increasing. Marvell addresses these growing demands with a complete suite of innovative Ethernet PHY transceivers that meet the unique configurations and requirements of today's vast networking environments. From the completely networked home to the infrastructure that drives it, Marvell's industry-leading transceivers are utilized for a wide array of applications including hubs, switches, routers, PCs, gaming consoles, DVRs, and media vaults.

In addition, Marvell® transceivers include a suite of advanced features that enable optimized form factors and multiple port and cable options, and provide efficient power consumption, high performance, and simple plug-and-play functionality. As an industry leader in the innovation and development of transceiver solutions, Marvell is able to continuously deliver the most advanced and complete PHY products to the broadband market.

GIGABIT ETHERNET

The Marvell Alaska® Gigabit Ethernet (GbE) PHY transceivers address the full range of demands for lower power dissipation, reduced PCB real estate, simplified layout, and higher performance. The quad-port 88E1240 is the latest addition to the Alaska GbE PHY family. The 88E1240 offers the most advanced feature set for low-power, high-port-density switching applications. Also new in the GbE PHY family is the 88E1121R dual-port GbE PHY. The 88E1121R is ideal for DVRs, set-top boxes, and IP phones.

FAST ETHERNET

Products in the Fast Ethernet (FE) family are Marvell's third- and fourth-generation DSP-based FE PHY transceivers. Each device in the FE PHY family offers very low power dissipation, enabling manufacturers to decrease their system costs by reducing power supply requirements. Additionally, the 88E3016 and 88E3018 single-port FE devices are pin-upgradeable to Marvell's 88E1116R Gigabit Ethernet PHY which allows for design flexibility and dual layout for both FE and Gigabit Ethernet applications.

10 GIGABIT ETHERNET

Marvell's 88X201x series of IEEE 802.3ae compliant 10 GbE PHYs enable short reach (SR/SW), long reach (LR/LW), or extended reach (ER/EW) applications for module implementation or system board implementation in LAN or LAN/WAN form. The X2010, X2011, X2012, and X2013 transceivers are fully integrated single-chip devices that perform all the physical functions for 10 GbE and 10 Gigabit Fibre Channel applications, delivering high-speed bi-directional point-to-point data transmissions. The devices provide flexibility by supporting the 10 Gigabit Attachment Unit Interface (XAUI) with the X2010 and X2011 and the 10 Gigabit Media Independent Interface (XGMII) with the X2012 and X2013; each adhering to IEEE 802.3ae specifications.

THE MARVELL ADVANTAGE: Marvell chipsets come with complete reference designs which include board layout designs, software, manufacturing diagnostic tools, documentation, and other items to assist customers with product evaluation and production. Marvell's worldwide field application engineers collaborate closely with end customers to develop and deliver new leading-edge products for quick time-to-market. Marvell utilizes worldleading semiconductor foundry and packaging services to reliably deliver high-volume and low-cost total solutions. ABOUT MARVELL: Marvell is a leader in storage, communications, and consumer silicon solutions. Marvell's diverse product portfolio includes switching, transceiver, communications controller, processor, wireless, power management, and storage solutions that power the entire communications infrastructure, including enterprise, metro, home, storage, and digital entertainment solutions. For more information, visit our Web site at www.marvell.com.

MARVELL®

GIGABIT ETHERNET

	LINE INTERFACES					MAC INTERFACES										POWER & FEATURES									
Part Number	Number of Ports	10/100/1000BASE-T	100BASE-FX	1000BASE-X	SGMII	MII	RMII	SMII	SSSMII	GMII	RGMII	SGMII	TBI	RTBI	SerDes	Internal Regulator (w/External PNP)	Integrated Passives	Virtual Cable Tester	Programmable LED	JTAG	125 MHz CLK_OUT	I-Temp	RoHS 6/6, Green*	Production	Package Type
Single-Port Devices																									
88E1111-BAB	1	X		X	X					X	X	X	X	X	X			X	X	X	X	X	R	X	117-BGA
88E1111-CAA	1	X		X	X					X	X	X	X	X	X			X	X	X	X	X	R	X	96-BCC
88E1111-RCJ	1	X		X	X					X	X	X	X	X	X			X	X	X	X		R	X	128-PQFP
88E1112-NNC	1	X	X	X	X							X			X			X	X			X	R	X	64-QFN
88E1113-NNC	1		X	X								X			X			X	X				R	X	64-QFN
88E1114-NNC	1	X										X			X			X	X				R	X	64-QFN
88E1115-RCJ	1	X								X	X							X	X	X	X		R	X	128-PQFP
88E1116R-NNC	1	X									X					X	X	X	X	X			R	X	64-QFN
88E1118R-NNC	1	X									X					X	X	X	X	X	X		G	X	64-QFN
Dual-Port Devices																									
88E1121R-TFE	2	X									X					X	X	X	X	X			R	X	100-TQFP
Quad-Port Devices																									
88E1141-BBT	4	X	X	X	X					X	X	X	X	X	X			X	X	X			R	X	388-HSBGA
88E1143-BAT	4		X	X	X					X	X								X	X			R	X	364-PBGA
88E1145-BBM	4	X	X	X	X					X	X	X	X	X	X			X	X	X		X	R	X	364-HSBGA
88E1149R-BAM	4	X										X					X	X	X	X			R	X	196-TFBGA
88E1149R-TAH	4	X										X					X	X	X	X			R	X	176-TQFP
88E1240-BAM	4	X										X					X	X	X	X			R	X	196-TFBGA
88E1240-TAH	4	X										X					X	X	X	X			G	X	176-TQFP

* Green: Lead free, Halogen free

FAST ETHERNET

	LINE INTERFACES					MAC INTERFACES										POWER & FEATURES									
Part Number	Number of Ports	10/100BASE-T	100BASE-FX	1000BASE-X	SGMII	MII	RMII	SMII	SSSMII	GMII	RGMII	SGMII	TBI	RTBI	DDR-SSSMII	Internal Regulator (w/External PNP)	Integrated Passives	Virtual Cable Tester	Programmable LED	JTAG	25 MHz Clock	I-Temp	RoHS 6/6	Production	Package Type
Single-Port Devices																									
88E3015-NNP	1	X	X			X					X					X		X	X				X	X	56-QFN
88E3016-NNC	1	X	X								X					X		X	X	X			X	X	64-QFN
88E3018-NNC	1	X	X			X					X					X		X	X	X		X	X	X	64-QFN
Octal-Port Devices																									
88E3082-BAR	8	X	X				X	X	X						X			X	X	X		X	X	X	224-TFBGA
88E3083-LKJ	8	X	X					X	X						X			X	X	X			X	X	128-LQFP

10 GIGABIT ETHERNET

	LINE INT.			MAC INTERFACES					POWER & FEATURES					
Part Number	Number of Ports	10GBASE-SR/ER/LR	10GBASE-SW/EW/LW	XAUI	XGMII	XENPAK	X2	XFP	Programmable LED	JTAG	Reference Clock	I-Temp	RoHS 6/6	Production	Package Type
Single-Port Devices															
88X2010-BAN	1	X		X		X	X	X	X	X	156.25/159.375 MHz		X	X	256-TFBGA
88X2011-BAN	1	X	X	X		X	X	X	X	X	156.25/159.375 MHz	X	X	X	256-TFBGA
88X2012-BAN	1	X			X			X	X	X	156.25/159.375 MHz		X	X	256-TFBGA
88X2013-BAN	1	X	X		X			X	X	X	156.25/159.375 MHz		X	X	256-TFBGA
XGXS Devices															
88X2040-BAN	1			X	X	X	X		X	X	62.5/125/156.25/159.375 MHz		X	X	256-TFBGA
88X2080-BBU	2			X	X	X	X		X	X	62.5/125/156.25/159.375 MHz		X	X	448-PBGA

MARVELL®

Micron High-Performance Data Storage Solutions

Are your high-performance NAND Flash designs bogged down by bottlenecks and bulky designs? If you've been looking for a pathway to greater read/write performance than traditional NAND Flash can deliver, look at what Micron's High-Speed NAND has to offer. Our High-Speed NAND parts deliver the fastest read and write throughputs ever for a NAND Flash device—five times the performance of existing SLC NAND devices. If we were talking cars, we'd be talking Formula 1 fast—something built to get you to market quickly with a top-notch, high-performance design.

Features

Organization

- Page size – x8: 4,320 bytes (4,096 + 224 bytes)
- Block size: 128 pages (512K + 28K bytes)
- Plane size: 4 planes x 512 blocks per plane
- Device size – 8Gb: 2,048 blocks; 16Gb: 4,096 blocks; 32Gb: 8,192 blocks

I/O and Array Performance

- Up to 200 MB/s read speed
- Up to 100 MB/s write speed
- 100,000 program/erase cycles, 10-year data retention

Operating Temperature

- –25°C to +85°C

Applications

- SSDs
- Hybrid hard drives
- Networking video-on-demand applications
- Memory backup systems
- High-performance flash cards

4 Advantages of Designing with High-Speed NAND

1. Breakthrough Performance

The high-speed interface delivers the fastest read and write throughputs ever for a NAND Flash device.

2. Simplified Design

Compatibility with ONFI 1.0/2.0 asynchronous/synchronous interface enables both backward-compatible and forward-looking designs.

3. Cost Savings

Reduced system complexity provides better performance at a lower cost.

4. An Evolution of NAND

Traditional NAND benefits like nonvolatility, reliability, and density still apply, enabling leading-edge applications to store more data.

High-Speed NAND Flash Memory

Speed is the Thing

We developed High-Speed NAND to provide new levels of performance for mass storage applications. And we did it with a quad-plane architecture, synchronous DDR interface, and speed-optimized read and write logic. The result is a measurable competitive advantage—
5 times the performance of existing SLC and 30 times the performance of existing MLC devices. The fast read and write throughputs will break through any bottleneck you may have experienced with traditional NAND and provide a powerful data storage solution for your design.

Implementation is Easy

We collaborated with the Open NAND Flash Interface (ONFI) Working Group and designed our High Speed NAND family to the ONFI 2.0 standard to make it easier to design in to future high-performance applications. And the common footprint, command set, and interface promotes interoperability between NAND densities and process technologies. Our High-Speed NAND is definitely forward looking and focused on speed, but its backward compatibility with ONFI 1.0 asynchronous NAND Flash makes it a smooth, scalable transition to higher performance.

Cost Savings is a Plus

If you're calculating costs, you'll see that you'll save money on overall system costs using High-Speed NAND Flash. By combining a new high-speed interface with NAND's inherent cost advantages, we've optimized the price/performance model. High-Speed NAND requires fewer interleaved channels compared to traditional high-performance NAND designs that require sophisticated caching techniques and multi-channel interleaving to achieve high data throughput. Reducing the number of memory channels and overall system complexity is one way High-Speed NAND can deliver equal or greater performance at a lower cost. It also achieves higher performance with lower densities and fewer devices.

High-Speed NAND is the Road Map for the Future

With the introduction of this high-speed architecture, High-Speed NAND is meeting demands for higher performance and opening doors to new applications, including opportunities in the computing, industrial, and consumer electronics segments. Not surprisingly, Micron is satisfying current requirements and paving the way for new applications by being the first to create a new category of High-Speed NAND products based on the ONFI 2.0 standard.

Visit www.micron.com/highspeed for more details about how High-Speed NAND can enhance your next performance-focused or mission critical mass storage application.

Comparison of Flash Family Features

	High-Speed NAND	SLC NAND	MLC NAND	MLC NOR
Read Performance	200 MB/s	40 MB/s	33 MB/s	103 MB/s
Write Performance	100 MB/s	15 MB/s	3.5 MB/s	<1.0 MB/s
Erase Performance	1.5ms	1.5ms	2ms	900ms
Endurance (cycles)	100,000	100,000	10,000	100,000
Density	8Gb–32Gb*	1Gb–64Gb	8Gb–64Gb	1Mb–1Gb
Interface	Async/Sync ONFI 1.0/2.0	ONFI 1.0	ONFI 1.0	Random Access

Note: Monolithic dual-die and quad-die packages available

micron.com

Products are warranted only to meet Micron's production data sheet specifications. Products and specifications are subject to change without notice.

Emerson Network Power Solutions for FPGAs and CPLDs

Emerson Network Power has the broadest DC-DC product offering in the industry and our DC-DC products are well-suited to power FPGA and CPLD Core and I/O requirements from 0.9 V to 5.0 V @ 1 to 30 amps. Many power silicon suppliers offer power solutions for FPGAs and CPLDs using discrete solutions (PWM controllers, MOSFETs, capacitors, resistors, output inductors). These types of discrete solutions may seem attractive initially from a pure BOM cost assessment. However, modular solutions can be a lower total cost solution in many applications and offer the following significant advantages to designers.

Point of Load (POL) Modular Solution Advantages

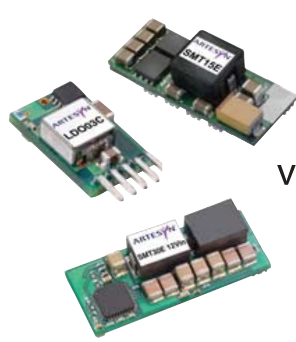
- Faster time to market with minimal engineering resources
- Scalable footprints and pin-outs from 2.5 to 10 amps and from 15 to 30 amps
- Wide input voltage range from 3.0 V to 13.8 V
- Programmable outputs from 0.59 V to 5.1 V to source any FPGA Core or I/O voltage from 0.9 V to 3.3 V
- Better efficiency - up to 95%
- Reduced BOM parts count - 1 part number versus 20+ different discrete part numbers
- Reduced PC board real estate
- Proven reliability - MTBF up to 10 million hours
- International safety approvals
- Lower total cost solution

Emerson Network Power.

The world leader in business-critical continuity solutions.

- AC Power
- Connectivity
- DC Power
- Embedded Power
- Inbound Power
- Integrated Cabinet Solutions
- Outside Plant
- Precision Cooling
- Site Monitoring and Services

Modular vs. Discrete Power Solutions



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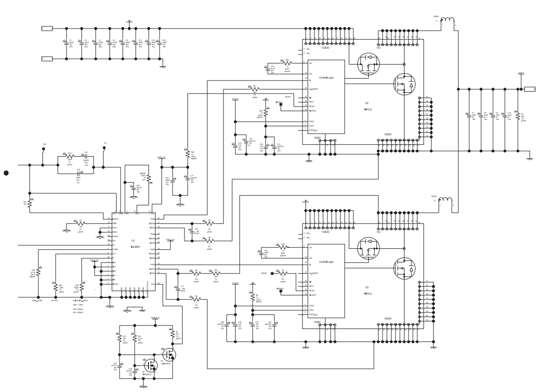

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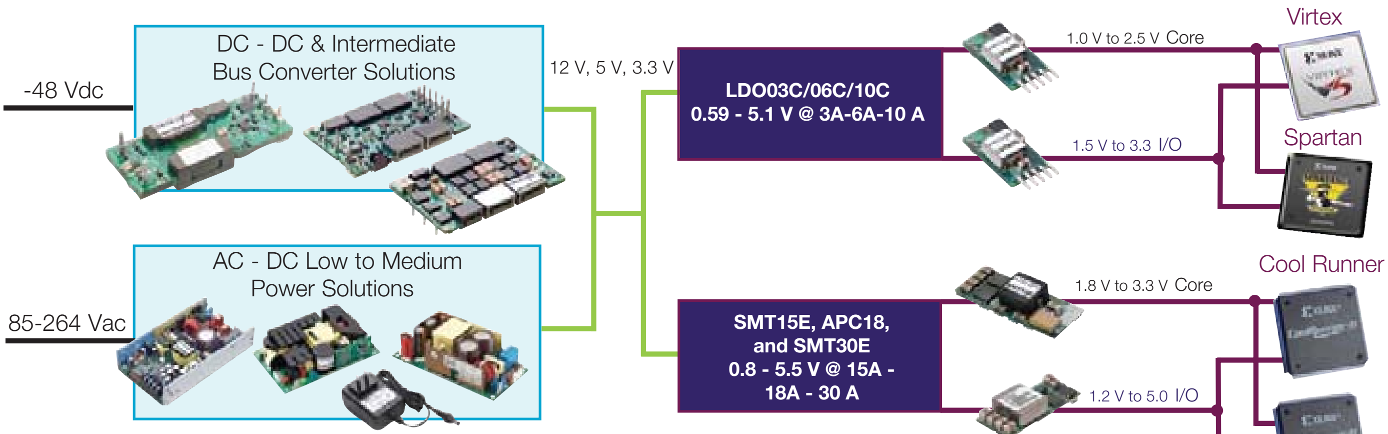
Network Power



XILINX® POL Cross-reference

Output 1 - Core

Virtex ™ E - II - II Pro - 4 - 5			Core Voltage: 1.8 V / 1.5 V / 1.2 V / 1.0 V			
Input Voltage	1 to 2.0 A	2.0 to 2.5 A	2.5 to 5 A	5 to 10 A	10 to 15 A	15 to 30 A
3.3 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-05W3V3J	
5 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-05W3V3J	
12 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-12W3V3J	SMT30E-12W3V3J

Spartan ™ II - IIE - 3			Core Voltage: 2.5 V / 1.8 V / 1.2 V			
Input Voltage	1 to 2.0 A	2.0 to 2.5 A	2.5 to 5 A	5 to 10 A	10 to 15 A	15 to 30 A
3.3 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-05W3V3J	
5 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-05W3V3J	
12 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-12W3V3J	SMT30E-12W3V3J

CoolRunner ™ - II - XPLA3			Core Voltage: 3.3 V / 1.8 V			
Input Voltage	1 to 2.0 A	2.0 to 2.5 A	2.5 to 5 A	5 to 10 A	10 to 15 A	15 to 30 A
3.3 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-05W3V3J	
5 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-05W3V3J	
12 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-12W3V3J	SMT30E-12W3V3J

Output 2 - I/O

Virtex ™ E - II - II Pro - 4 - 5			I/O Voltage: 1.2 V to 3.3 V			
Input Voltage	1 to 2.0 A	2.0 to 2.5 A	2.5 to 5 A	5 to 10 A	10 to 15 A	15 to 30 A
3.3 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-05W3V3J	
5 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-05W3V3J	
12 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-12W3V3J	SMT30E-12W3V3J

Spartan ™ II IIE - 3			I/O Voltage: 1.2 V to 3.3 V			
Input Voltage	1 to 2.0 A	2.0 to 2.5 A	2.5 to 5 A	5 to 10 A	10 to 15 A	15 to 30 A
3.3 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-05W3V3J	
5 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-05W3V3J	
12 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	SMT15E-12W3V3J	SMT30E-12W3V3J

CoolRunner ™ - II - XPLA3			I/O Voltage: 1.5 V to 5.0 V			
Input Voltage	1 to 2.0 A	2.0 to 2.5 A	2.5 to 5 A	5 to 10 A	10 to 15 A	15 to 30 A
3.3 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	APC18T04-9L	
5 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	APC18T04-9L	
12 V	LDO03C-005W05-HJ	LDO03C-005W05-HJ	LDO06C-005W05-HJ	LDO10C-005W05-HJ	APC18T12-9L	SMT30E-12W3V3J

Scalable footprints and pinouts from
2.5 to 10 A to 10 to 30 A

Exar Power Management Solutions for Xilinx Devices

Need Market Proven Power Management Solutions for your FPGA, or PLD designs?

Targeting Point-of-Load applications requiring:

- High current density
- Power sequencing
- High efficiency
- Wide input low duty cycle voltage conversions

See how Exar's **step down controllers** and **regulators** such as the PowerBlox™ family of scalable, synchronous and non-synchronous **converters** can get your designs to market faster – Try our on-line design tools too!

Core or I/O Voltage	Input Voltage	≤ 600mA	≤ 1.5A	≤ 3A	≤ 6A	≤ 12A	≤ 12A - 20A
1.0V Virtex-5®	3.0V - 5.5V	SP6669	XRP6657[2]	**SP7661[1]**	**SP7663[1]**	**SP7662[1]**	SP6133[1]
	≤ 16V	**SP7656**	**SP7656**	**SP7662**	**SP7662**	**SP7662**	SP6133
1.2V Virtex-4® Spartan-3®	3.0V - 5.5V	SP6669	XRP6657[2]	**SP7661**	**SP7663**	**SP7662**	SP6133[1]
	≤ 18V	**SP7656**	**SP7656**	**SP7662**	**SP7662**	**SP7662**	SP6133
1.8V Virtex-E® CoolRunner II® Spartan-IIE®	3.0V - 5.5V	SP6669	XRP6657[2]	**SP7661[1]**	**SP7663[1]**	**SP7662[1]**	SP6133[1]
	≤ 15V	**SP7656**	**SP7661**	**SP7661**	**SP7663**	**SP7662**	SP6133
	≤ 22V	**SP7656**	**SP7656**	**SP7662**	**SP7662**	**SP7662**	SP6133
	≤ 26V	**SP7656**	**SP7656**	SP6132H	SP6132H	SP6132H	SP6132H
2.5V Spartan-II®	3.0V - 5.5V	SP6669	XRP6657[2]	**SP7661[1]**	**SP7663[1]**	**SP7662[1]**	SP6133[1]
	≤ 20V	**SP7661**	**SP7661**	**SP7661**	**SP7663**	**SP7662**	SP6133
	≤ 22V	**SP7656**	**SP7656**	**SP7662**	**SP7662**	**SP7662**	SP6133
	≤ 28V	**SP7656**	**SP7656**	**SP7656**	SP6132H	SP6132H	SP6132H
3.3V CoolRunner XPLA3™	3.0V - 5.5V	SP6669	XRP6657[2]	**SP7661[1]**	**SP7663[1]**	**SP7662[1]**	SP6133[1]
	≤ 22V	**SP7661**	**SP7661**	**SP7661**	**SP7663**	**SP7662**	SP6133
	≤ 28V	**SP7656**	**SP7656**	**SP7656**	SP6132H	SP6132H	SP6132H

[1] Requires 5V bias voltage for input voltages < 4.5V
[2] Coming Soon

Note: Parts in bold are from the PowerBlox™ family

EXAR Powering Connectivity™

PowerBlox™ PowerLab™ power design made easy

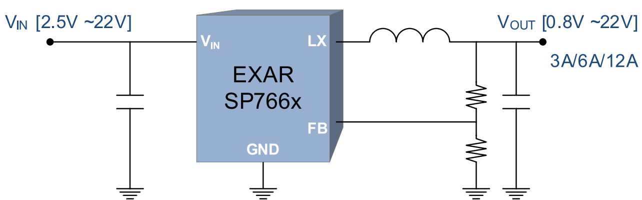
Exar PowerBlox™ for FPGA Designers

PowerBlox™

- High power density single chip synchronous buck regulator family
- High efficiency and performance
- Achieves up to 95%
- Outstanding thermal management
- FPGA and PLD centric solutions
- Scalable solution

Unique footprint for 3A to 12A design

- Easily upgradable or cost reduced design
- Customizable and flexible prototyping
- Simple clock rate migration
- Multiple sequencing options



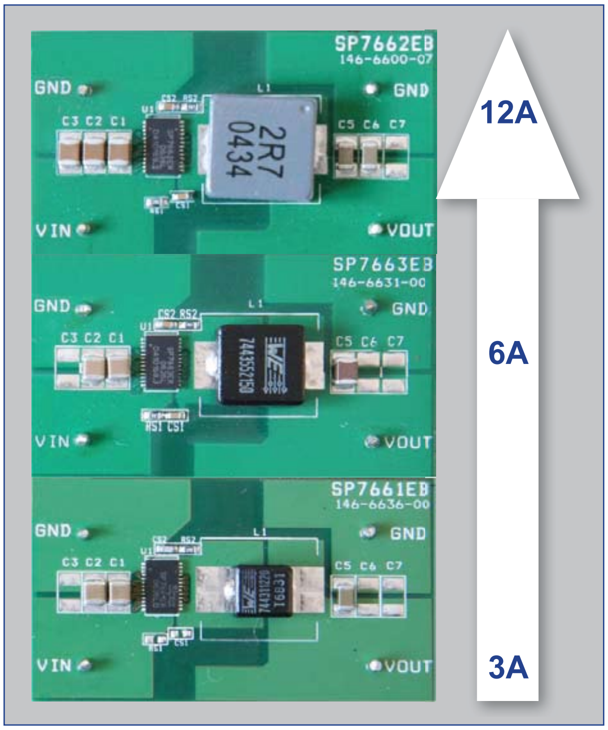
Power Lab™

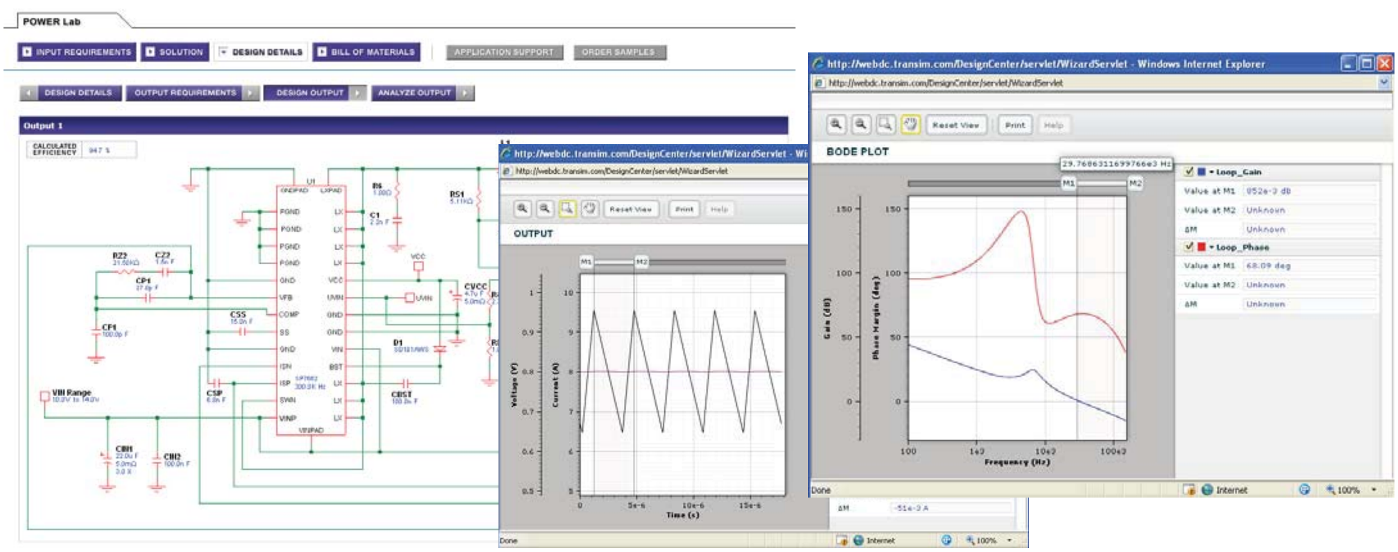
power design made easy

http://www.exar.com/powerlab

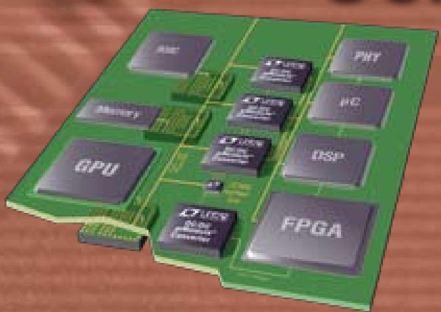
High performance design solution generator and simulator

- As simple as entering Vin, Vout and current load
- Schematics and Bill of Material generator
- Extensive waveforms viewer and transient analysis capability
- Supports multiple outputs
- **All in less than 10 minutes!**





Linear Technology Compact Power Supplies FPGA-Based Systems



Tiny µModule™ Power Supplies Fit on Both Sides of PC Board

Our µModule DC/DC point-of-load power supply family is complete with built-in inductor, MOSFETs, bypass capacitors and compensation circuitry. At only 2.8mm height, these tiny, lightweight (1.7g) point-of-load regulators fit the tightest spaces on top and bottom of your board. Small size and impressive low thermal impedance allow high power conversion from a wide range of voltages. Our µModule DC/DC converters simplify the design of your FPGA-based system and are backed by rigorous testing and high product reliability.

µModule DC/DC Converters for Core, I/O, Clock & System Power

V_{IN}: 4.5V-28V; V_{OUT}: 0.6V-5V						LGA Package (15°C/W)	
Part No.	**I_{OUT} (A)**	**Current Share**	**PLL**	**Track, Margin**	**Remote Sense**	**Height (mm)**	**Area (mm)**
LTM4602	6	Combine two for 12A to 24A or 4x LTM4601 for ≤48A				2.8	15x15
LTM4603	6		✔	✔	✔		
LTM4603-1	6		✔	✔			
LTM4600	10						
LTM4601	12		✔	✔	✔		
LTM4601-1	12		✔	✔			
V_{IN}: 2.375V-5.5V; V_{OUT}: 0.8V-5.0V							
LTM4604	4	Combine two for 8A	✔			2.3	9x15

LINEAR TECHNOLOGY

Power Management Solutions for Xilinx Programmable Logic Devices

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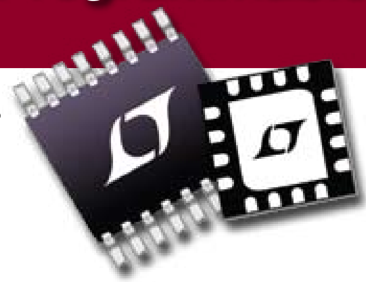

LINEAR TECHNOLOGY

VIRTEX™-5 — Core Voltage: 1.0V

Input Supply	≤200mA	≤500mA	≤1A – 1.5A	≤2A – 5A	5A – 10A	Up to 25A
1.8V	LT®3020 Linear LTC®3549 Buck	**LT3080 Linear** LTC3409 Buck	**LT3080 Linear** LTC3026 Linear	LTC3713 Controller	LTC3713 Controller	N/A
2.5V to 5V	LT3020 Linear LTC3549 Buck LTC3410 Buck	**LT3080 Linear** **LTC3406A Buck** LTC3542 Buck	**LTC3561 Buck** **LTC3411A Buck** **LTC3564 Buck** **LTC3568 Buck**	LTC3412A Buck LTC3414 Buck LTC3801 Controller LTC3809 Controller	LTC3418 Buck LTC3822 Controller **LTM®4601 µModule™*** LTC1778 Controller	LTC3822 Controller LTC3713 Controller LTC3832 Controller LTC1778 Controller
≤12V to 24V	**LT3502 Buck**	**LT3502 Buck**	LT3493 Buck **LT3685 Buck** LT3481 Buck **LT3505 Buck**	**LT3680 Buck** LTC1771 Controller LTC1778 Controller LTC3770 Controller	**LTM4601 µModule*** LTC3832 Controller LTC1778 Controller **LTC3823 Controller**	**2 x LTM4601 µModule*** LTC1778 Controller **LTC3823 Controller**

VIRTEX-4 & Spartan™-3 Family — Core Voltage: 1.2V

Input Supply	≤200mA	≤500mA	≤1A – 1.5A	≤2A – 5A	5A – 10A	Up to 25A
1.8V	LT1761 Linear LTC3035 Linear LTC3549 Buck	**LT1965 Linear** **LT3080 Linear** LT1763 Linear LTC3409 Buck	**LT1965 Linear** **LT3080 Linear** LTC3026 Linear	LTC3713 Controller	LTC3713 Controller	LTC3713 Controller
2.5V to 5V	LT3020 Linear LTC3035 Linear LTC3410 Buck LTC3549 Buck	**LT1965 Linear** LT1763 Linear **LTC3542 Buck** **LTC3560 Buck**	**LT1965 Linear** **LT3080 Linear** **LTC3411A Buck** **LTC3564/8 Bucks**	LTC3412A Buck LTC3414 Buck LTC3801/9 Controllers LTC1773 Controller	LTC3418 Buck LTC3822 Controller **LTM4601 µModule*** LTC1778 Controller	LTC3713 Controller LTC3832 Controller LTC1778 Controller LTC3778 Controller
≤12V to 24V	**LT3502 Buck**	LT1933 Buck LT3493 Buck **LT3502 Buck**	**LT3503 Buck** **LT3505 Buck** LT1936 Buck LT3481Buck	**LT3680 Buck** LTC1771 Controller **LTM4603 µModule*** LTC1778 Controller	**LTM4601 µModule*** LTC3772 Controller LTC1778 Controller **LTC3823 Controller**	**2 x LTM4601 µModule*** LTC1778 Controller **LTC3823 Controller**

VIRTEX-II PRO™ & VIRTEX-II — Core Voltage: 1.5V

Input Supply	≤200mA	≤500mA	≤1A – 1.5A	≤2A – 5A	5A – 10A	Up to 25A
1.8V	LTC1844 Linear LTC3035 Linear LT1962 Linear LTC3549 Buck	LT1763 Linear **LT1965 Linear** **LT3080 Linear** LTC3409 Buck	**LT1965 Linear** **LT3080 Linear** LTC3026 Linear	LTC3713 Controller	LTC3713 Controller	LTC3713 Controller
2.5V to 5V	LT1762 Linear LTC3035 Linear LTC3410 Buck LTC3549 Buck	**LT1965 Linear** **LT3080 Linear** LT1763 Linear **LTC3542 Buck** **LTC3406A Buck**	**LT1965 Linear** **LT3080 Linear** LT1963A Linear **LTC3561 Buck** **LTC3411A Buck**	LTC3412A Buck LTC3414 Buck LTC3801 Controller LTC3809 Controller	LTC3418 Buck LTC3822 Controller **LTM4601 µModule*** LTC1778 Controller	LTC3713 Controller LTC3832 Controller LTC1778 Controller LTC3778 Controller
≤12V to 24V	LT3470 Buck **LT3502 Buck** LT1616 Buck	LT1616 Buck LT1933 Buck LT3493 Buck	**LT3503 Buck** **LT3505 Buck** **LT3481 Buck** **LT3684 Buck**	**LT3680 Buck** LTC1771 Controller **LTM4603 µModule*** LTC1778 Controller	**LTM4601 µModule*** **LTC3610 Buck** LTC3772 Controller LTC1778 Controller LTC3823 Controller	**2 x LTM4601 µModule*** LTC1778 Controller LTC3823 Controller LT1952 Controller

VIRTEX-E, Spartan-IIE & CoolRunner™-II — Core Voltage: 1.8V

Input Supply	≤200mA	≤500mA	≤1A – 1.5A	≤2A – 5A	5A – 10A	Up to 25A
0.9V to 1.8V	LTC3525 Boost LTC3429 Boost LTC3526 Boost	LT1613 Boost	N/A	N/A	N/A	N/A
2.5V to 5V	LTC1844 Linear LTC3035 Linear LT1762 Linear LTC3405A Buck LTC3410 Buck	**LT1965 Linear** **LT3080 Linear** **LTC3542 Buck** **LTC3406A Buck**	**LT1965 Linear** **LT3080 Linear** LT1963A Linear **LTC3561 Buck** **LTC3411A Buck**	LTC3414 Buck LTC3801/9 Controllers **LTM4603 µModule*** LTC1773 Controller	LTC3418 Buck LTC3822 Controller **LTM4601 µModule*** **LTC3610 Buck**	LTC3822 Controller LTC3713 Controller LTC3832 Controller LTC3778 Controller
≤12V to 24V	LT3470 Buck LT1934 Buck LT1616 Buck **LT3502 Buck**	LT1616 Buck **LT3502 Buck** LT1933 Buck LT3493 Buck	**LT3503 Buck** **LT3505 Buck** LT3481 Buck **LT3684 Buck**	**LT3680 Buck** LTC1771 Controller **LTM4603 µModule*** LTC1778 Controller	**LTM4601 µModule*** **LTC3610 Buck** LTC1778 Controller LTC3823 Controller	**2 x LTM4601 µModule*** LTC1778 Controller LTC3823 Controller LT1952 Controller

Spartan-II — Core Voltage: 2.5V

Input Supply	≤200mA	≤500mA	≤1A – 1.5A	≤2A – 5A	5A – 10A	Up to 25A
1.8V	LTC3525 Boost LTC3427 Boost LTC3429 Boost LTC3499 Boost	LTC3499 Boost LTC3426 Boost LTC3422 Boost	LTC3421 Boost LTC3428 Boost LTC3426 Boost	LTC3425 Boost LTC1872 Boost Controller LTC1700 Boost Controller	N/A	N/A
2.5V to 5V	LTC1844 Linear LTC3035 Linear LT1962 Linear LTC3410 Buck	**LT3080 Linear** LT1763 Linear **LT1965 Linear** **LTC3542 Buck** **LTC3560 Buck**	**LTC3561 Buck** **LTC3411A Buck** LT1619 SEPIC Controller	LTC3414 Buck LTC3801 Controller LTC3809 Controller LT1619 SEPIC Controller	LTC3418 Buck **LTM4601 µModule*** **LTC3610 Buck** LTC3822 Controller	LTC3822 Controller LTC3713 Controller LTC3832 Controller LTC1778 Controller
≤12V to 24V	LT3470 Buck LT1934 Buck LT1616 Buck **LT3502 Buck**	LT1616 Buck **LT3502 Buck** LT1933 Buck LT3493 Buck	**LT3503 Buck** **LT3505 Buck** **LT3684 Buck** LT1936 Buck	**LT3680 Buck** LTC1771 Controller **LTM4603 µModule*** LTC1778 Controller	**LTM4601 µModule*** **LTC3610 Buck** LTC1778 Controller LTC3823 Controller	**2 x LTM4601 µModule*** LTC1778 Controller **LTC3823 Controller** **LT1952 Controller**

CoolRunner XPLA3 — Core Voltage: 3.3V

Input Supply	≤200mA	≤500mA	≤1A – 1.5A	≤2A – 5A	5A – 10A	Up to 25A
1.8V to 2.5V	LTC3525 Boost LTC3526 Boost LTC3429 Boost	LTC3426 Boost LTC3421 Boost LTC3422 Boost LTC3499 Boost	LTC3426 Boost LTC3421 Boost LTC3428 Boost	LTC3428 Boost LTC3425 Boost LTC1871 Boost Controller	N/A	N/A
Li-Ion 2.7V to 4.2V	LTC3531 Buck-Boost LTC3530 Buck-Boost LTC3440 Buck-Boost	LTC3530 Buck-Boost LTC3440 Buck-Boost **LTC3538 Buck-Boost**	LTC3442 Buck-Boost LTC3443 Buck-Boost LTC1871 SEPIC Controller	**LTC3785 Buck-Boost Controller** LTC1872 SEPIC Controller LTC1871 SEPIC Controller LT1619 SEPIC Controller	**LTC3785 Buck-Boost Controller** LT1619 SEPIC Controller	LTC1682 + LTC1778
≤5V	LTC1844 Linear LTC3035 Linear LT1962 Linear LTC3410 Buck	**LT1965 Linear** **LT3080 Linear** LT1763 Linear **LTC3560 Buck**	LT1963A Linear **LTC3561 Buck** **LTC3411A Buck**	LTC3414 Buck LTC3415 Buck LTC3809 Controller **LTM4603 µModule***	LTC3418 Buck **LTM4601 µModule*** **LTC3610 Buck** LTC3778 Controller	LTC3830 Controller LTC3832 Controller LTC3770 Controller LTC3778 Controller
≤12V to 24V	LT3470 Buck LT1934 Buck LT1616 Buck **LT3502 Buck**	LT1616 Buck **LT3502 Buck** LT1933 Buck LT3493 Buck	**LT3503 Buck** **LT3505 Buck** LT1936 Buck **LT3684 Buck**	**LT3680 Buck** LTC1771 Controller **LTM4603 µModule*** LTC1778 Controller	**LTM4601 µModule*** **LTC3610 Buck** LTC1778 Controller **LTC3823 Controller**	**2 x LTM4601 µModule*** LTC1778 Controller **LTC3823 Controller** **LT1952 Controller**

Power Supplies for I/O

I/O Voltage	Input Voltage	500mA	1A	2A – 5A	6A – 10A	20A
3.3V	12V	LT1616, LT1933	LT1936, LT1767	**LT3680**, LTC1778, LTC3770	**LTM4601**, LTC1778	**2 x LTM4601**, LTC1778
	5V	**LTC3406A**, LT1962, **LT1965**	**LT1965**, **LTC3411A**	LTC3412/A, LTC3414, LTC3809	LTC3415, LTC3418, LTC1778	LTC1778
2.5V	12V	LT1616, LT1933	LT1936, LT1767	**LT3680**, LTC1778, LTC3770	**LTM4601**, LTC1778	LTC1778
	5V	**LTC3560**, LT1962, **LT1965**	LT1963A, **LT1965**, **LTC3411A**	LTC3412/A, LTC3414, LTC3809	**LTM4601**, LTC3415, LTC3418	**2 x LTM4601**, LTC1778
	3.3V	**LTC3560**, LT1962, **LT1965**	LT1963A, **LT1965**, **LTC3411A**	LTC3412/A, LTC3414, LTC3809	LTC3832, LTC3822, LTC3418	**LTC3836**, **LT3740**
1.8V	5V	**LTC3560**	**LTC3411A**, LT1767	LTC3412/A, LTC3414, LTC3809	**LTM4601**, LTC3418	**2 x LTM4601**, LTC1778
	3.3V	**LTC3560**	LT1963A, **LT1965**, **LTC3411A**	LTC3412/A, LTC3414, LTC3809	LTC3832, LTC3822, LTC3418	**LTC3836**, **LT3740**
	2.5V	**LTC3560**, **LTC3406A**, **LT1965**	LT1963A, **LT1965**, **LTC3411A**	LTC3412/A, LTC3414, LTC3801	LTC3418, **LT3740**	**LT3740**
1.5V	5V	**LTC3560**	**LTC3411A**, LT1767	LTC3412/A, LTC3414, LTC3809	**LTM4601**, LTC3418	**2 x LTM4601**, LTC1778
	3.3V	**LTC3560**	LT1963A, **LT1965**, **LTC3411A**	LTC3412/A, LTC3414, LTC3809	LTC3832, LTC3822, LTC3418	**LTC3836**, **LT3740**
	2.5V	**LTC3560**, **LTC3406A**, LT3021	LT1963A, **LT1965**, **LTC3411A**	LTC3412/A, LTC3414, LTC3801	LTC3415, LTC3418, **LT3740**	**LT3740**
	1.8V	**LTC3406A**, LT3021, **LT1965**	**LT3080**, **LT1965**, LT1764A	LT1764A, **2 x LT3080**, LT3150	LT3150, LTC3713	LTC3713

Dual Output Switching Regulators

Part Number	Architecture	V_{IN} Range (V)	Max $I_{OUT(1)}/I_{OUT(2)}$ (A)	Part Number	Architecture	V_{IN} Range (V)	Max $I_{OUT(1)}/I_{OUT(2)}$ (A)
LTC3547	Monolithic	2.5 – 5.5	0.3/0.3	**LTC3546**	Monolithic	2.25 – 5.5	2/2 or 3/1
LTC3548	Monolithic	2.5 – 5.5	0.4/0.8	LT3501	Monolithic	3 – 30	3/3
LTC3419	Monolithic	2.5 – 5.5	0.6/0.6	LTC3736/–1	Controller	2.7 – 9.8	5/5
LTC3407–2	Monolithic	2.5 – 5.5	0.8/0.8	LTC3737	Controller	2.7 – 9.8	5/5
LTC3417	Monolithic	2.25 – 5.5	0.8/1.4	**LTC3850**	Controller	4 – 24	20/20
LTC3417A	Monolithic	2.25 – 5.5	1.0/1.5	LTC3728	Controller	4 – 36	20/20
LT3508	Monolithic	3.7 – 36	1.4/1.4	LTC3708	Controller	4 – 36	20/20
LT1940	Monolithic	3.6 – 25	1.4/1.4	LTC3728	Controller	4 – 36	20/20
LT3506/A	Monolithic	3.6 – 25	1.6/1.6	LTC3827	Controller	4 – 36	25/25
LT3510	Monolithic	3.3 – 25	2/2	LTC3727	Controller	4.5 – 36	25/25

Additional Power Support Products

- Trackers/Sequencers
- Margining Controllers
- Silicon Oscillators
- µP/DSP/FPGA Supervisor Circuits
- PMBus Interface Products

SwitcherCAD™/LTspice is a SPICE simulator for power supply, amplifier and filter designs

LINEAR TECHNOLOGY

www.linear.com

VIRTEX-5 Family						Core Voltage: 1.0V
Input Supply	≤ 200mA	≤500mA	≤1A - 1.5A	≤2A - 5A	5A - 10A	Up to 25A
1.8V	MIC5309	MIC68200	MIC68200	"MIC68400 (4A) MIC69502 (5A)"		
2.5V to 5V	"MIC5309, MIC2203"	"MIC23050/1, MIC33050 ½ MIC23250*, ½ MIC2238"	"MIC4720, MIC4721"	"MIC22400 (4A)*, MIC4722, MIC4723"	MIC22600 (6A)	"MIC2169 (15A, Controller) MIC2159 (20A, Controller)"
≤12V to 24V			"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"

"VIRTEX-4 and Spartan-3 Family"						Core Voltage: 1.2V
Input Supply	≤ 200mA	≤500mA	≤1A - 1.5A	≤2A - 5A	5A - 10A	Up to 25A
1.8V	MIC5309	MIC68200	MIC68200	"MIC68400 (4A) MIC69502 (5A)"		
2.5V to 5V	"MIC5309, MIC2203"	"MIC2205/06/45/85, MIC23050/1, MIC33050 ½ MIC23250*, ½ MIC2238"	"MIC4720, MIC4721"	"MIC2207, MIC22400 (4A)*, MIC4722, MIC4723"	MIC22600 (6A)	"MIC2169 (15A, Controller) MIC2159 (20A, Controller)"
≤12V to 24V			"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"

Spartan-2 Family						Core Voltage: 2.5V
Input Supply	≤ 200mA	≤500mA	≤1A - 1.5A	≤2A - 5A	5A - 10A	Up to 25A
1.8V	MIC2570 (Boost)	MIC2570(Boost)				
2.5V to 5V	"MIC5319, MIC5259"	"MIC2205/06/45/85, MIC23050/1, MIC33050 ½ MIC23250*, ½ MIC2238"	"MIC4720, MIC4721"	"MIC2207, MIC22400 (4A)*, MIC4722, MIC4723"	MIC22600 (6A)	"MIC2169 (15A, Controller) MIC2159 (20A, Controller)"
≤12V to 24V	MIC4680/90	MIC4680/90	MIC4682	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"

Virtex-II PRO & Virtex-II Family						Core Voltage: 1.5V
Input Supply	≤ 200mA	≤500mA	≤1A - 1.5A	≤2A - 5A	5A - 10A	Up to 25A
1.8V	MIC5309	MIC68200	MIC68200	"MIC68400 (4A) MIC69502 (5A)"		

Virtex-II PRO & Virtex-II Family continued — Core Voltage: 1.5V

Input Supply	≤ 200mA	≤500mA	≤1A - 1.5A	≤2A - 5A	5A - 10A	Up to 25A
≤12V to 24V	MIC4680/90	MIC4680/90	MIC4682	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"

Virtex-E & Spartan-IIE & CoolRunner-II Family — Core Voltage: 1.8V

Input Supply	≤ 200mA	≤500mA	≤1A - 1.5A	≤2A - 5A	5A - 10A	Up to 25A
1.8V	MIC5309	MIC68200	MIC68200	"MIC68400 (4A) MIC69502 (5A)"		
2.5V to 5V	"MIC5309, MIC2203"	"MIC2205/06/45/85, MIC23050/1, MIC33050 ½ MIC23250*, ½ MIC2238"	"MIC4720, MIC4721"	"MIC2207, MIC22400 (4A)*, MIC4722, MIC4723"	MIC22600 (6A)	"MIC2169 (15A, Controller) MIC2159 (20A, Controller)"
≤12V to 24V	MIC4680/90	MIC4680/90	MIC4682	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"

Power Supplies for I/O

I/O Voltage	Input Voltage	500mA	1A	2A - 5A	6A - 10A	20A
3.3V	12V	MIC4680/90	MIC4680/90	MIC4686,MIC4685	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller), MIC2168 (10A, Controller), MIC2169 (15A, Controller), MIC2159 (20A, Controller)"
	5V	MIC2202, MIC2204	MIC4721	"MIC22400(4A)*, MIC4720, MIC4721, MIC4722"	"MIC22600(6A), MIC2168 (10A, Controller)"	"MIC2169 (15A, Controller), MIC2159 (20A, Controller), MIC2198/9 (20A, Controller)"
2.5V	12V	MIC4680/90	MIC4680/90	MIC4686,MIC4685	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller), MIC2168 (10A, Controller), MIC2169 (15A, Controller), MIC2159 (20A, Controller)"
	5V	MIC2202, MIC2204	MIC4721	"MIC22400(4A)*, MIC4720, MIC4721, MIC4722"	"MIC22600(6A), MIC2168 (10A, Controller)"	"MIC2169 (15A, Controller), MIC2159 (20A, Controller), MIC2198/9 (20A, Controller)"
	3.3V	MIC2202, MIC2204	MIC4721	"MIC22400(4A)*, MIC4720, MIC4721, MIC4722"	"MIC22600(6A), MIC2168 (10A, Controller)"	"MIC2169 (15A, Controller) MIC2159 (20A, Controller)"
1.8V	12V	MIC4680/90	MIC4680/90	MIC4686,MIC4685	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller), MIC2168 (10A, Controller), MIC2169 (15A, Controller), MIC2159 (20A, Controller)"
	5V	MIC2202, MIC2204	MIC4721	"MIC22400(4A)*, MIC4720, MIC4721, MIC4722"	"MIC22600(6A), MIC2168 (10A, Controller)"	"MIC2169 (15A, Controller), MIC2159 (20A, Controller), MIC2198/9 (20A, Controller)"
	3.3V	MIC2202, MIC2204	MIC4721	"MIC22400(4A)*, MIC4720, MIC4721, MIC4722"	"MIC22600(6A), MIC2168 (10A, Controller)"	"MIC2169 (15A, Controller) MIC2159 (20A, Controller)"
1.5V	12V	MIC4680/90	MIC4680/90	MIC4686,MIC4685	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller)"	"MIC2130/1 (15A, Controller), MIC2198/9 (20A, Controller), MIC2168 (10A, Controller), MIC2169 (15A, Controller), MIC2159 (20A, Controller)"
	5V	MIC2202, MIC2204	MIC4721	"MIC22400(4A)*,MIC4720, MIC4721, MIC4722"	"MIC22600(6A), MIC2168 (10A, Controller)"	"MIC2169 (15A, Controller), MIC2159 (20A, Controller), MIC2198/9 (20A, Controller)"
	3.3V	MIC2202, MIC2204	MIC4721	"MIC22400(4A)*,MIC4720, MIC4721, MIC4722"	"MIC22600(6A), MIC2168 (10A, Controller)"	"MIC2169 (15A, Controller) MIC2159 (20A, Controller)"
	1.8V	MIC68200	MIC68200	"MIC68400 (4A) MIC69502 (5A)"		

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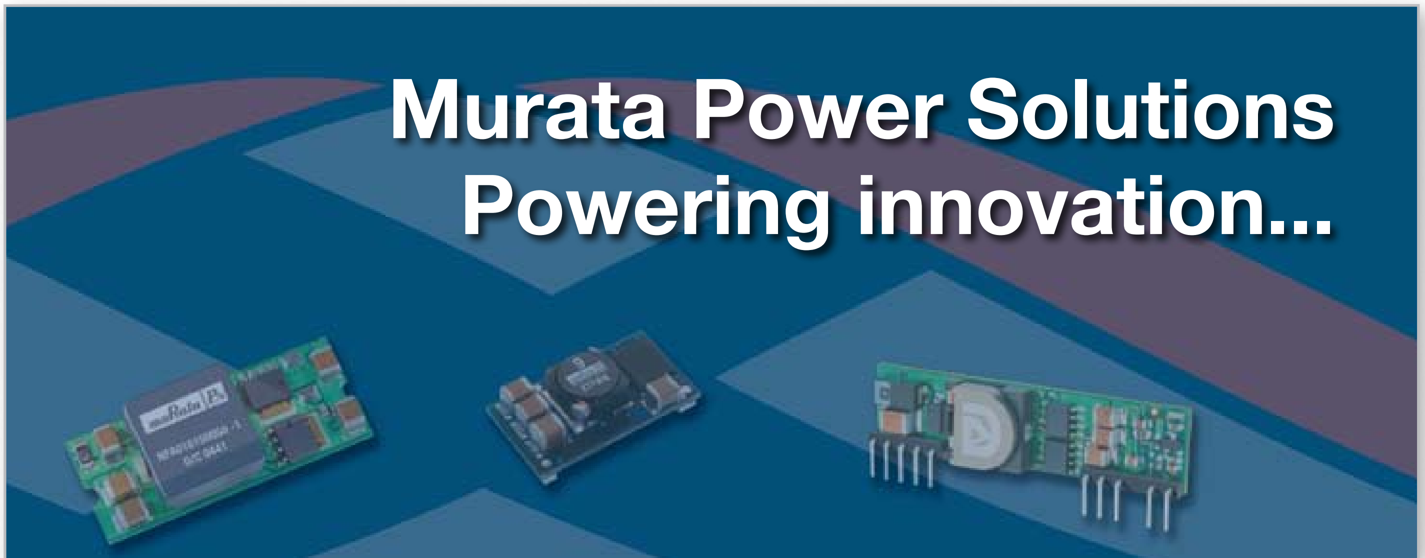
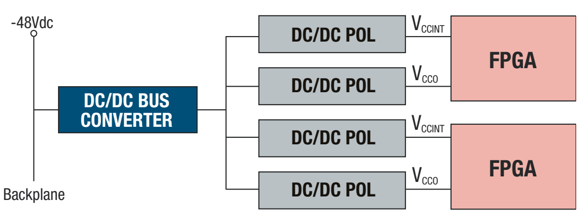
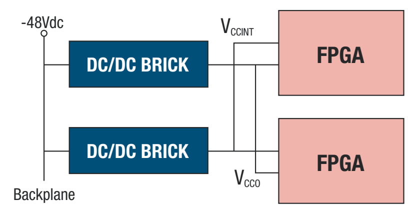


Murata Power Solutions' broad selection of DC/DC converters is well suited to powering modern FPGA products. A combination of distributed power and intermediate bus architecture products can effectively be deployed to meet the power requirements of leading FPGA products. These products include standard "brick" isolated converters as well as intermediate bus converters and non-isolated point-of-load (POL) converters. Examples of distributed and intermediate bus power architectures for powering FPGAs are provided here.

Intermediate Bus Power Solution for FPGA



Distributed Power Solution for FPGA



Steady State Power Requirements for FPGA Families in Typical Applications

Xilinx	Virtex-5	Virtex-4FX, SX, LX	Virtex-II Pro	Virtex-II	Virtex-E	Virtex	Spartan-3, -3E, -3L	Spartan-IIE	Spartan-II
V_{CCINT} (Core)	1V ± 5% @ 200mA to 5A	1.2V ± 5% @ 200mA to 5A	1.5V ± 5% @ 200mA to 12A	1.5V ± 5% @ 200mA to 12A	1.8V ± 5% @ 200mA to 7A	2.5V ± 5% @ 200mA to 7A	1.2V ± 5% @ 200mA to 5A	1.8V ± 5% @ 200mA to 3A	2.5V ± 5% @ 200mA to 2A
V_{CCO} (Vo)	3.3V, 2.5V, 1.8V, 1.5V and/or 1.2V ± 5% @ 50mA to 4A	3.3V, 2.5V, 1.8V, 1.5V and/or 1.2V ± 5% @ 50mA to 4A	3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 50mA to 5A	3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 50mA to 5A	3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 500mA to 5A	3.3V, 2.5V and/or 1.5V ± 5% @ 50mA to 5 A	3.3V, 3.0V, 2.5V, 1.8V, 1.5V and/or 1.2V ± 5% @ 50mA to 4A	3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 50mA to 750mA	3.3V, 2.5V and/or 1.5V @ 50mA to 500mA
V_{CCAUX} (Aux)	2.5V ± 5% @ 300mA	2.5V ± 5% @ 300mA	2.5V ± 5% @ 300mA	3.3V ± 5% @ 300mA	–	–	2.5V ± 5% @ 300mA	–	–

Some models have reduced output currents for the higher output voltage.
For more precise power requirements for specific FPGA applications please refer to the Xilinx Power Estimators available at www.xilinx.com/power.

Murata Power Solutions FPGA Power Guide

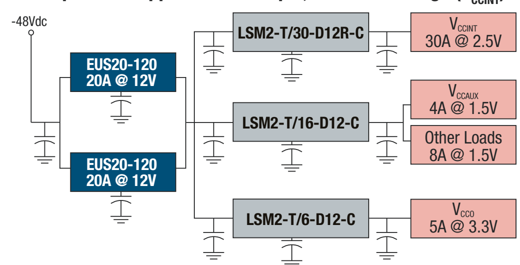
Modular vs Discrete Power Solutions for FPGAs

Many vendors currently offer power solutions for FPGAs using discrete based power solutions. While these solutions may seem attractive initially from a pure cost assessment, modular solutions offer many key advantages: **minimal design resources; reduced parts count and board real estate; multiple sourcing.**

Intermediate Bus Power Solutions

- Modular DC/DC converter solution requires minimal design resources and is suitable for powering one or more FPGAs
- Highly efficient solution with POL conversion efficiencies approaching 93%
- Space efficient SMT packages designed for use in low-cost automated manufacturing environments
- Reliable power conversion solution with typical converter MTTF in excess of 1 million hours per Telcordia standards

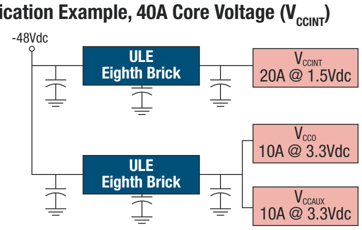
Xilinx Spartan-3 Application Example, 10A Core Voltage (V_{CCINT})



Distributed Power Solutions

- Modular DC/DC converter solution suitable for powering one or more FPGAs from standard telecomm -48Vdc bus
- Low profile, industry standard open frame converters with conversion efficiencies approaching 90%
- Space efficient, high power density power conversion solution available in both through hole and SMT packaging
- Reliable power conversion solution with typical converter MTTF in excess of 1 million hours per Telcordia standards

Xilinx Virtex-II Application Example, 40A Core Voltage (V_{CCINT})



Design Considerations

- Core and I/O power consumption are design and application dependent. For more precise power requirements for specific FPGA applications please refer to the Xilinx Power Estimators available at www.xilinx.com/power.
- Bulk and/or bypass capacitors will be required between the input supply and DC/DC converters depending on the placement of the input supply relative to the converters. Consult FPGA manufacturers datasheets to ensure adequate bulk and bypass capacitors are used.
- Start-up profile requirements vary by FPGA families and manufacturers; review FPGA device specifications for design considerations such as ramp-up and inrush current.

Murata Power Solutions DC/DC Converter Modules Reduce System Parts Count and Simplify Solution Design…

Product	Description	Power (W)	Input Voltage (Vdc)	Output Voltage(s) (Vdc)	Output Current (A)
Isolated Converters					
ULQ	Single Output, Quarter Brick, Through Hole/Surface Mount	66	18-36 & 36-75	1.2-12	25
ULE	Single Output, Eighth Brick, Through Hole/Surface Mount	60	9-18, 18-36, & 36-75	1.2-24	30
UHP	Single Output, Half Brick, Through Hole	148	36-75	1.5, 1.8, 2.5, 3.3	60
A Series 7-15W	Single Output, 1" x 2", Through Hole	15	10-18, 18-36 & 36-75	1.2, 1.5, 1.8, 2.5, 3.3, 5.0, 12, 15	10
UHE 12-30W	Single Output, 1.6" x 2", Through Hole	10	9-18, 9-36, & 36-75	1.2, 1.5, 1.8, 2.5, 3.3, 5.0, 12, 15	10
Q-Class	Single Output, Quarter Brick Single Board, PTH	144	36-75	1.2, 1.5, 1.8, 2.5, 3.3, 12	55
UWR 7-15W	1" x 2", Through Hole	15	10-8, 18-36, & 36-75	1.2-15	6
HPH	70A Half Brick	350	36-75	1-5	70
UVQ	Low-Profile Quarter Brick	125	18-36 & 36-75	1.2-48	40
UQQ	Wide Input Quarter Brick	105	9-36 & 18-75	3.3-15	25
UCQ	Low-Cost Quarter Brick	115	18-36 & 36-75	3.3 & 5	35
Bus Converters					
EUS15-120	Single Output Eighth Brick, Pth	180	36V – 55V	12	15
EUS20-120	Single Output Eighth Brick, Pth	240	36V – 55V	12	20
QUS20-120	Single Output Quarter Brick, Pth	240	36V – 55V	12	20
Non-Isolated (POL) Converters					
NGA	Single Adjustable and Fixed Output, SIP/DIP	10	4.75-28	1.8, 2.5, 3.3, 5.0	2
LSM/LSN-10A	Single Fixed Output, SMT/SIP	50	3.0-3.6, 4.5-5.0, 10.8-13.2	1.0, 1.2, 1.5, 1.8, 2.5, 3.3, 5.0	10
LSM/LSN-16A	Single Adjustable and Fixed Output, SMT/SIP	50	3.0-5.5 & 10-14	0.75-5.0	16
LSM/LSN2	Adjustable Output SMT/SIP	52	2.4-5.5 8.3-14	0.75-5	6, 10, 16
LSN2-T/22	Adjustable Output SMT/SIP 22A	112	8.3-14	0.8-5	22
LSN2-T30	Adjustable Output SMT/SIP 30A	150	6-14	0.8-5	30
LEN	Single Output, Eighth Brick, Through Hole/SMT	125	10.2-13.8	0.8, 1.0, 1.2, 1.5, 1.8, 2.5, 3.3, 5.0	28
HEN	Single Output, Eighth Brick, Through Hole/SMT, High di/dt	125	10.2-13.8	0.8, 1.0, 1.2, 1.5, 1.8, 2.5, 3.3, 5.0	25
LQN	Single Output, Quarter Brick, Through Hole/SMT	225	10.2-13.8	0.8, 1.0, 1.2, 1.5, 1.8, 2.5, 3.3, 5.0	50
VCN60	Single Adjustable Output, Through Hole, Vertical Mount	120	10.2-13.2	0.6-3.5	60
VCN70		140	10.2-13.2	0.6-3.5	70
NCA005	Single Adjustable Output, SMT/SIP	16.5	3.0V-5.5V	0.75-3.3	5
NCA015		49.5	3.0V-5.5V	0.75-3.3	15
NEA005		25	8.3V-14V	0.75-5.0	5
NEF010	Single Fixed Output, SMT/SIP	50	8.3V-14V	1.0, 1.2, 1.5, 1.8, 2.0, 2.5, 3.3, 5.0	10
NEA010	Single Adjustable Output, SMT/SIP	50	8.3V-14V	0.75-5.0	10
NEA016		80	8.3V-14V	0.75-5.0	16
NFA010		50	6.0V-14V	0.75-5.0	10
NFA016		80	6.0V-14V	0.75-5.0	16
NFA020		100	6.0V-14V	0.75-5.0	20

Filtering

Our extensive range of inductors has been specifically designed to operate at the high current levels required by FPGA applications. For technical details and full product datasheets, or to request a copy of our Magnetics data book. Visit us at : **www.murata-ps.com/magnetics**

Murata Power Solutions

Virtex®-5						Core Voltage: 1.0 V
Input Supply	<=200 mA	<=500 mA	<=1 to 1.5 A	<=2 to 2.5 A	<=3 to 5 A	<=25 A
2.5 to 5.5 V	NCP1521/2/3 Buck Controller NCP5211 Buck Controller NCP1529 Buck Controller	NCP1521/2/3 Buck Controller NCP5211 Buck Controller NCP1529 Buck Controller	NCP565 Linear NCP5661 Linear NCP5211 Buck Controller NCP1595 Buck Controller	NCP5662 Linear NCP5211 Buck Controller	NCP5663 Linear NCP5211 Buck Controller	NCP1582/3 Buck Controller
<=24 V	NCP5211 Buck Controller	NCP5211 Buck Controller	NCP5211 Buck Controller	NCP5211 Buck Controller	NCP5211 Buck Controller	NCP1582/3 Buck Controller

Virtex-4, Spartan™-3, Spartan-3A, Spartan-3E						Core Voltage: 1.2 V
Input Supply	<=200 mA	<=500 mA	<=1 to 1.5 A	<=2 to 2.5 A	<=3 to 5 A	<=25 A
1.8 V	LM2931 Linear NCP584 Linear					
2.5 to 5.5 V	LM2931 Linear NCP584/5 Linear NCP5211 Buck Controller NCP1521/2/3 Buck Converter	NCP565 Linear NCP5661 Linear NCP5211 Buck Controller NCP1521/2/3 Buck Converter	NCP565 Linear NCP5661 Linear NCP5211 Buck Controller	NCP5662 Linear NCP5211 Buck Controller	NCP5663 Linear NCP5211 Buck Controller	NCP1582/3 Buck Controller
<=24 V	NCP5211 Buck Controller	NCP5211 Buck Controller	NCP5211 Buck Controller	NCP5211 Buck Controller	NCP5211 Buck Controller	NCP1582/3 Buck Controller

Virtex-II Pro, Virtex-II						Core Voltage: 1.5 V
Input Supply	<=200 mA	<=500 mA	<=1 to 1.5 A	<=2 to 2.5 A	<=3 to 5 A	<=25 A
1.8 V	NCP551 Linear	NCP3335 Linear NCP5500/1 Linear				
2.5 to 5.5 V	NCP551 Linear NCP582/3 Linear NCP1521/2/3 Buck Converter	NCP1521/2/3 Buck Converter	NCP565 Linear NCP5661 Linear NCP3163 Buck Converter CS51031 Buck Controller	NCP5662 Linear NCP3163 Buck Converter CS51031 Buck Controller	NCP5663 Linear NCP630 Linear CS51031 Buck Controller	
<=12 V	NCP3163 Buck Converter CS51033 Buck Converter	NCP3163 Buck Converter CS51033 Buck Converter	CS51413 Buck Converter CS51033 Buck Controller	NCP3163 Buck Converter CS51033 Buck Controller	NCP5211 Buck Controller CS51033 Buck Controller	NCP1582/3 Buck Controller
<=24 V	NCP3163 Buck Converter LM2574 Buck Converter	NCP3163 Buck Converter LM2574 Buck Converter	CS51413 Buck Converter LM2574 Buck Converter	NCP3163 Buck Converter LM2576 Buck Converter	CS51033 Buck Controller	

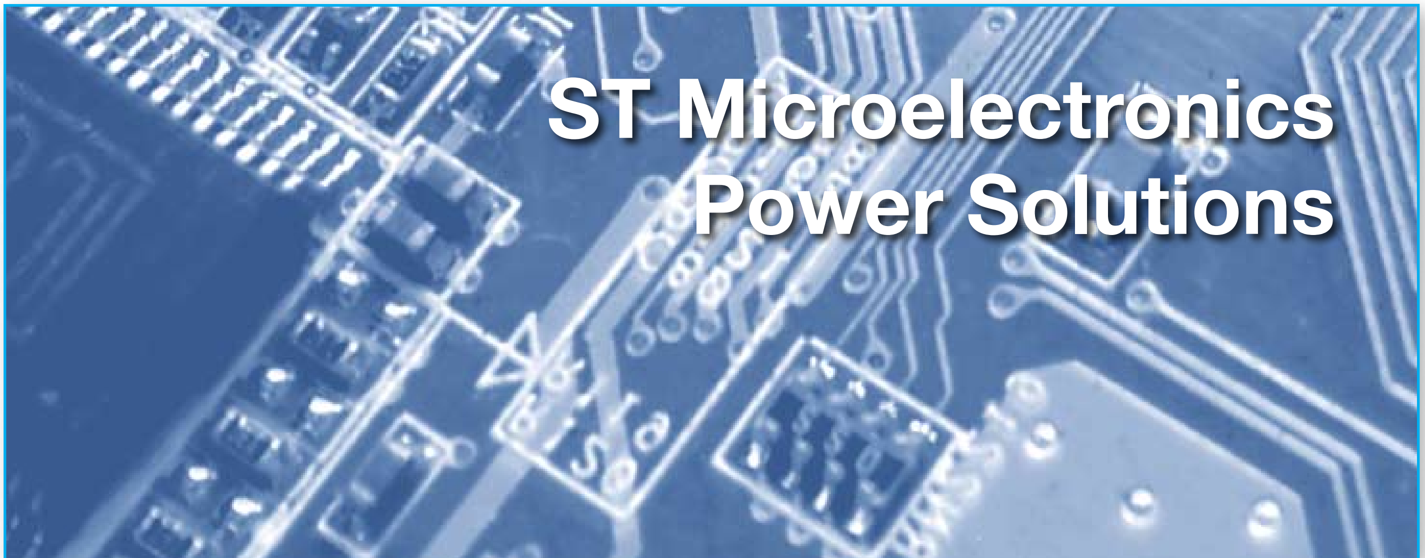
Virtex-E, Spartan-IIE, CoolRunner®-II, CoolRunner-IIA						Core Voltage: 1.8 V
Input Supply	<=200 mA	<=500 mA	<=1 to 1.5 A	<=2 to 2.5 A	<=3 to 5 A	<=25 A
2.5 to 5.5 V	NCP584 Linear NCP561 Linear NCP1521/2/3 Buck Converter	NCP3335 Linear NCP5500/1 Linear NCP1521/2/3 Buck Converter	NCP565 Linear NCP5661 Linear NCP3163 Buck Converter	NCP5662 Linear NCP1550 Buck Controller NCP3163 Buck Converter	NCP5663 Linear NCP630 Linear CS51031 Buck Controller	
<=12 V	NCP3163 Buck Converter CS51033 Buck Controller	NCP3163 Buck Converter CS51033 Buck Controller	CS51413 Buck Converter CS51033 Buck Controller	NCP3163 Buck Converter LM2576 Buck Converter	CS51031 Buck Controller NCP5211 Buck Controller	NCP1582/3 Buck Controller
<=24 V	NCP3163 Buck Converter LM2574 Buck Converter	NCP3163 Buck Converter LM2574 Buck Converter	CS51413 Buck Converter LM2574 Buck Converter	NCP3163 Buck Converter LM2576 Buck Converter	CS51033 Buck Controller	

Spartan-II, XC9500XV						Core Voltage: 2.5 V
Input Supply	<=200 mA	<=500 mA	<=1 to 1.5 A	<=2 to 2.5 A	<=3 to 5 A	<=25 A
1.8 to 2.5 V	NCP1410 Boost Converter NCP1423 Boost Converter	NCP1421 Boost Converter NCP1422 Boost Converter				
3 to 5.5 V	NCP582 Linear NCP583 Linear NCP1521/2/3 Buck Converter	NCP3335 Linear NCP5500/1 Linear NCP1521/2/3 Buck Converter	NCP565 Linear NCP5661 Linear NCP3163 Buck Converter	NCP5662 Linear NCP1550 Buck Controller NCP3163 Buck Converter	NCP5663 Linear NCP630 Linear CS51031 Buck Controller	
<=12 V	NCP3063 Buck Converter LM2574 Buck Converter	NCP3063 Buck Converter LM2574 Buck Converter	CS51413 Buck Converter CS51033 Buck Controller	NCP3163 Buck Converter LM2576 Buck Converter	CS51031 Buck Controller NCP5211 Buck Controller	NCP1582/3 Buck Controller
<=24 V	NCP3063 Buck Converter LM2574 Buck Converter	NCP3063 Buck Converter LM2574 Buck Converter	CS51413 Buck Converter LM2574 Buck Converter	NCP3163 Buck Converter LM2576 Buck Converter	CS51033 Buck Controller	

CoolRunner XPLA3, XC9500XL						Core Voltage: 3.3 V
Input Supply	<=200 mA	<=500 mA	<=1 to 1.5 A	<=2 to 2.5 A	<=3 to 5 A	<=25 A
1.8 to 3 V	NCP1402 Boost Converter NCP1410 Boost Converter NCP1423 Boost Converter	NCP1421 Boost Converter NCP1422 Boost Converter NCP1450A Boost Converter				
3 to 3.6 V	NCP1521/2/3 Buck Converter NCP3063 Buck Converter	NCP1521/2/3 Buck Converter NCP3063 Buck Converter	NCP3163 Buck/Boost	NCP3163 Buck/Boost		
3.3 to 5.5 V	NCP511 Linear NCP1521/2/3 Buck Converter NCP3063 Buck Converter	NCP3335 Linear NCP5500/1 Linear NCP1521/2/3 Buck Converter NCP3063 Buck Converter	NCP565 Linear NCP5661 Linear NCP3163 Buck Converter	NCP5662 Linear NCP1550 Buck Controller NCP3163 Buck Converter	NCP5663 Linear NCP630 Linear CS51031 Buck Controller	
<=12 V	NCP3063 Buck Converter CS51033 Buck Controller	NCP3063 Buck Converter CS51033 Buck Controller	CS51413 Buck Converter CS51033 Buck Controller	NCP3163 Buck Converter LM2576 Buck Converter	CS51031 Buck Controller NCP5211 Buck Controller	NCP1582/3 Buck Controller
<=24 V	NCP3063 Buck Converter LM2574 Buck Converter	NCP3063 Buck Converter LM2574 Buck Converter	CS51413 Buck Converter LM2574 Buck Converter	NCP3163 Buck Converter LM2576 Buck Converter	CS51033 Buck Controller	

XC9500						Core Voltage: 5.0 V
Input Supply	<=200 mA	<=500 mA	<=1 to 1.5 A	<=2 to 2.5 A	<=3 to 5 A	<=25 A
1.8 V	NCP1402 Boost Converter NCP1410 Boost Converter	NCP1421 Boost Converter NCP1422 Boost Converter NCP1450A Boost Converter				
2.5 to 4.5 V	NCP1402 Boost Converter NCP1410 Boost Converter	NCP1421 Boost Converter NCP1422 Boost Converter NCP1450A Boost Converter	NCP3163 Buck Converter	NCP3163 Buck Converter	NCP1442 Boost Converter CS51033 Buck Controller	
4.5 to 5.5 V	NCP3063 Buck Converter	NCP3063 Buck Converter	NCP3163 Buck Converter	NCP3163 Buck Converter	CS51031 Buck Controller	
<=12 V	NCP3063 Buck Converter LM2574 Buck Converter	NCP3063 Buck Converter LM2574 Buck Converter	CS51413 Buck Converter CS51033 Buck Controller	NCP3163 Buck Converter LM2576 Buck Converter	CS51031 Buck Controller NCP5211 Buck Controller	NCP1582/3 Buck Controller
<=24 V	NCP3063 Buck Converter LM2574 Buck Converter	NCP3063 Buck Converter LM2574 Buck Converter	CS51413 Buck Converter LM2574 Buck Converter	NCP3163 Buck Converter LM2576 Buck Converter	MC33167 Buck Converter CS51033 Buck Controller	

ST Microelectronics Power Solutions



ST Microelectronics Voltage Regulators

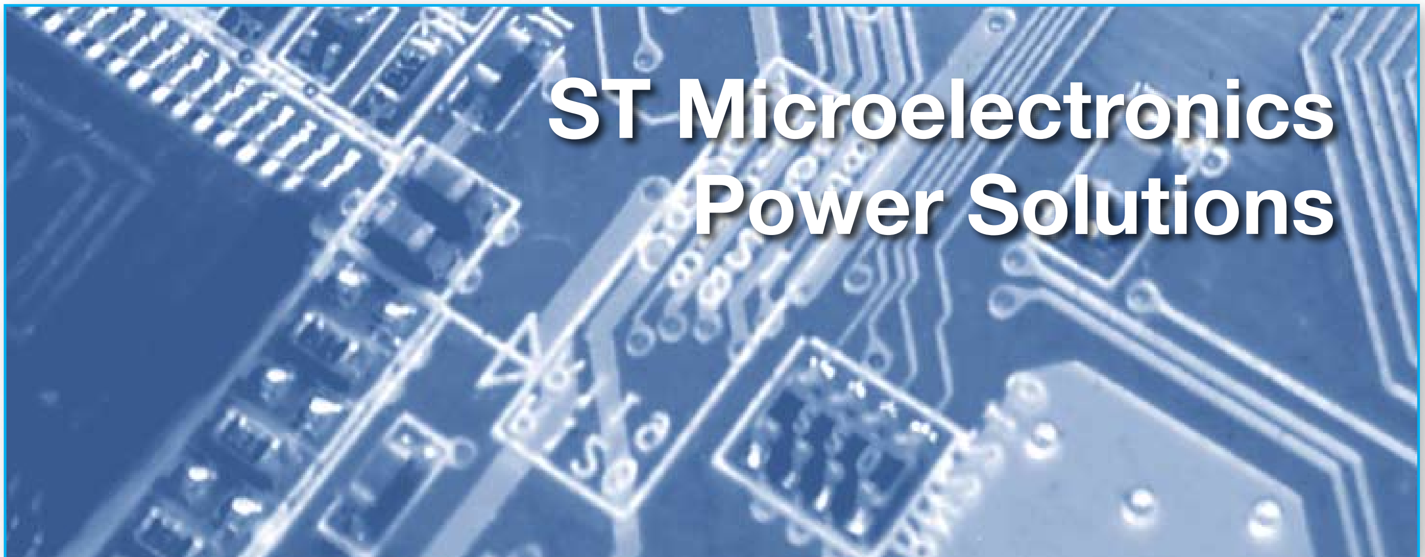
Xilinx Part Number	LINEAR			SWITCHING		
Virtex-4™	**Vccint (1.2V)**	**Vccaux (2.5V)**	**Vcco[1]**	**Vccint (1.2V)**	**Vccaux (2.5V)**	**Vcco[1]**
XC4VLX15, 25, 40	LD1117xx12	L4931ABD25x	L4931, LD29300	L6926D	ST750	L5972D
XC4VLX60, 80, 100	LD1117xx12	KF25	L4931, LD29300	L6926D	ST750	L5972D
XC4VLX160, 200	LD1117Axx12	LD29080 x25	L4931, LD29300	L5970	L6926D	L4973
XC4VSX25	LD1117xx12	L4931ABD25x	L4931, LD29300	L6926D	ST750	L5972D
XC4VSX35, 55	LD1117xx12	KF25	L4931, LD29300	L6926D	ST750	L5972D
XC4VFX12, 20, 40	LD1117xx12	L4931ABD25x	L4931, LD29300	L6926D	ST750	L5972D
XC4VFX60, 100	LD1117xx12	KF25	L4931, LD29300	L6926D	ST750	L5972D
XC4VFX140	LD1117Axx12	LD29080 x25	L4931, LD29300	L5970	L6926D	L4973

Virtex-II Pro™ Virtex-II Pro X™	**Vccint (1.5V)**	**Vccaux (2.5V)**	**Vcco[1]**	**Vccint (1.5V)**	**Vccaux (2.5V)**	**Vcco[1]**
XC2VP2, 4, 7	KF15	L4931ABD25x	L4931, LD29300	L6926D	ST750A	ST750A
XC2VP20, x20, 30	LD1117[2]	L4931ABD25x	L4931, LD29300	L5970D	ST750A	L5970
XC2VP40, 50,	LD29150xx15	L4931ABD25x	L4931, LD29300	L5972D	ST750A	L5970
XC2VP70, X70, 100, 125	LD29300xx15	L4931ABD25x	L4931, LD29300	L5973D	ST750A	L5970

Virtex-II™	**Vccint (1.5V)**	**Vccaux (3.3)**	**Vcco[1]**	**Vccint (1.5)**	**Vccaux (3.3)**	**Vcco[1]**
XC2V40 - XC2V1000	L4931ABD15TR	LD2981Cxx33	L4931, LD29300	L5970	ST763A	ST750A
XC2V1500 - XC2V3000	KF15	LD2981Cxx33	L4931, LD29300	ST1S03	ST763A	ST750A
XC2V4000, XC2V6000	LD1117[2]	LD2981Cxx33	L4931, LD29300	L4973	ST763A	ST750A
XCE2V8000	LD29150xx15	LD2981Cxx33	L4931, LD29300	L4973	ST763A	ST750A

Virtex-EM™ Virtex-E™	**Vccint (1.8)**	**Vcco[1]**	**Vccint**	**Vcco[1]**
XCV50E – XVC600E (Commercial grade)	LF18Cxx	L4931	L6926D or L5970D	ST750A
XCV812E – XCV200E (Commercial grade)	LD1117Axx18	L4931	L5970D	ST750A
XCV2600E - XCV3200 (Commercial grade)	LD1086xx18	L4931	L5972D	ST750A
XCV50E - XCV3200E (Industrial grade)	LD1085xx18	L4931	L5973D	ST750A

[1] The required I/O current will depend on several design specific factors, including I/O usage, loading, etc. Designers should use FPGA power estimator tools to determine the required Iccio current.
[2] The adjustable version of the LD1117 regulator can be configured to supply 1.5V.



ST Microelectronics Power Solutions

ST Microelectronics Voltage Regulators						
Xilinx Part Number	***LINEAR***			***SWITCHING***		
Spartan-3™, Spartal-3L™ Spartan -3E™	**Vccint** (1.2V)	**Vccaux** (2.5)	**Vcco**[1]	**Vccint** (1.2)	**Vccaux** (2.5V)	**Vcco**[1]
XC3S50 – XCS1000	LD1117xx12	L4931xx25	Icc< 500mA LExx	L5970	ST750A	Icc<450mA ST750A
XC3S100E – XCS250E	LD1117xx12	L4931xx25	Icc< 1A LD1117A	L5970	ST750A	Icc< 1.0A L5970
XC3S1000L – XC3S4000L	LD1117xx12	L4931xx25	Icc< 1.5A LD29150	L5970	ST750A	Icc< 2.0A L5973
XC3S1500 - XC3S5000	LD1117Axx12	L4931xx25	Icc< 3A LD29300	L4973	ST750A	Icc< 3.5A L4973
XC3S500E – XCS1600E	LD1117Axx12	L4931xx25	Icc< 5A LD1084	L4973	ST750A	Icc> 3.5A L6910

Spartan-IIE™	**Vccint** (1.8V)	**Vcco**[1]	**Vccint** (1.8V)	**Vcco**[1]
XC2S50E – XC2S300E (C) (Before PCN)[2]	LF18C (500mA)[4]	Icc< 500mA LExx	L5970	Icc<450mA ST750A
XC2S50E – XC2S300E (C) (After PCN)[2]	LF18C (300mA)[4]	Icc< 1A LD1117A	ST750A	Icc< 1.0A L5970
XC2S400E – XC2S600E (C)	LF18C (500mA)[4]	Icc< 1.5A LD29150	L5970	Icc< 2.0A L5973
XC2S50E – XC2S300E (I) (Before PCN)[2]	LD1086xx18 (2A)[4]	Icc< 3A LD29300	L5973D or L4973	Icc< 3.5A L4973
XC2S50E – XC2S300E (C) (After PCN)[2]	LF18C (500mA)[4]	Icc< 5A LD1084	L5970	Icc> 3.5A L6910
XC2S400E – XC2S600E (I)	LD1117xx18 (700mA)[4]		L5970	

Spartan-II™	**Vccint** (2.5V)	**Vcco**[1]	**Vccint** (2.5V)	**Vcco**[1]
XC2S15 - XC2S 150 (I) (0°C < Tj) (data code 0321 or later)[3]	KF25xx (500mA)[4]	Icc< 500mA LExx	L5970D	Icc<450mA ST750A
XC2S15 - XC2S 150 (I) (Tj <0°C) (data code 0321 or later)[3]	LD29150xx25 (1.5A)[4]	Icc< 1A LD1117A	L5972D	Icc< 1.0A L5970
XC2S15 - XC2S 150 (C) (data code 0321 or later)[3]	L4931 (250mA)[4]	Icc< 1.5A LD29150	ST750A	Icc< 2.0A L5973
XC2S15 - XC2S 150 (I) (0°C < Tj) (data code before 0321)[3]	KF25xx (500mA)[4]	Icc< 3A LD29300	L5970D	Icc< 3.5A L4973
XC2S15 - XC2S 150 (I) (Tj <0°C) (data code before 0321)[3]	LD29300xx25 (2A)[4]	Icc< 5A LD1084	L5972D	Icc> 3.5A L6910
XC2S15 - XC2S 150 (C) (data code before0321)[3]	KF25xx (500mA)[4]		L5970D	

[1] The required I/O current will depend on several design specific factors, including I/O usage, loading, etc. Designers should use FPGA power estimator tools to determine the required Iccio current.

[2] Devices built after the Product Change Notice PCN 2002-05 (see http://www.xilinx.com/bvdocs/notifications/pcn2002-05.pdf) have improved power-on requirements. Devices after the PCN have a 'T' preceding the date code as referenced in the PCN. Note that the XC2S150E, XC2S400E, and XC2S600E always have this mark. Devices before the PCN have an 'S' preceding the date code. Note that devices before the PCN are measured with VCCINT and VCCO powering up simultaneously.

[3] The date code is printed on the top of the device's package.

[4] The minimum supply current ICCPO required for a successful power-on. If more current is available, the FPGA can consume more than ICCPO minimum, though this cannot adversely affect reliability.

ST Microelectronics Power Solutions

Design Guide for Xilinx FPGA Power Management Systems

The following table lists the output current for the recommended voltage regulators in this application note. Other regulators are also available, please consult your ST sales representative or the ST website: http://www.st.com, for the complete product portfolio.

ST Voltage Regulator Max Output Current

Part Number	Input Voltage	Output Voltage	Output Current	Topology	Evaluation Board	On Line Simulation
LD2981	(Vout+1V) – 16V	1.5 – 5.0V	100mA	Linear		
L4931	3.3 - 20V	1.25 – 12V	250mA	Linear		
ST730A	5.2 – 11V	5V	450mA	Switching		
ST750A	4 – 11V	Adj.	450mA	Switching		
ST763A	3.3 – 11V	3.3V	500mA	Switching		
KFxx Series	2.5 – 20V	1.5V	500mA	Linear		
LF18	2.5 – 20V	1.8V	500mA	Linear		
KF25	2.5 – 20V	2.5V	500mA	Linear		
LD1117	2.4 – 15V	1.2 – 5.0V, Adj	800mA	Linear		
LD29080	2.5 – 13V	1.5 – 9V, Adj	800mA	Linear		
L6926D	2 – 5.5V	Adj (0.6 - 5V)	800mA	Switching	Yes	
L5970	4.4 – 36V	Adj (1.23 – 35V)	1A	Switching	Yes	Yes
LD1117A	2.5 -10V	1.2 – 5V, Adj	1A	Linear		
LD1086	4.1 - 30V	1.5 – 12V, Adj	1.5A	Linear		
LD29150	2.5 – 13V	1.5 – 8V, Adj	1.5A	Linear		
MC34063	3 – 40V	Adj	1.5A (switch current)	Switching		
ST1S03	3V to 16V	Adj down to 0.8V	1.5A	Switching	Yes	
L5972D	4.4 – 36V	Adj (1.235 – 35V)	2A (switch current)	Switching	Yes	Yes
L5973	4.4 – 36V	Adj (1.235 – 35V)	2.5A (switch current)	Switching	Yes	Yes
LD1085	2.85 – 30V	1.5 – 12V, Adj	3A	Linear		
LD29300	2.5 – 13V	1.5 – 9V, Adj	3.0A	Linear		
L4973	8 – 55V	Adj (0.5 – 50V)	3.5A	Switching	Yes	Yes
LD1084	3 – 30V	1.5 – 12V, Adj	5A	Linear		
L6910	5 – 12V	Adj (0.9 – 5V)	20A	Driver	Yes	

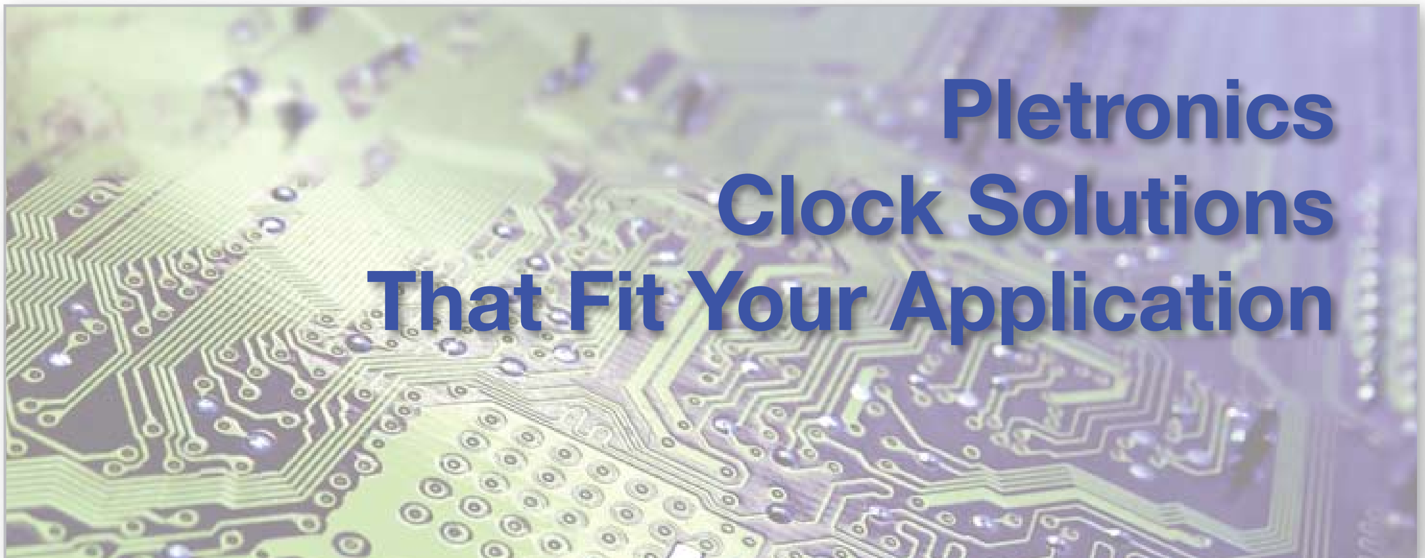
L497x & L597x On-Line Simulators

Besides support material such as application notes and evaluation boards, ST also provides online simulation software ("SW") which can be accessed at:

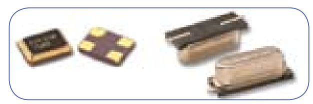
http://www.st.com/stonline/products/support/designin/switchingl.htm

This software is dedicated to switching regulators up to 2A.

Pletronics Clock Solutions That Fit Your Application



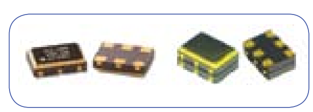
Xilinx I/O Standards	Pletronics Oscillator Family	Frequency Range (MHz)	Package Size (mm)	Voltage
Differential Outputs				
LVDS, 2.5V	LV77DW	1 - 250	5x7	2.5V
LVDS, 2.5V	LV55DW	1 - 250	3.2x5	2.5V
LVDS, 3.3V	LV99DV	10 - 670	5x7	3.3V
LVDS, 3.3V	LV77DV	1 - 250	5x7	3.3V
LVDS, 3.3V	LV55DV	1 - 250	3.2x5	3.3V
LVDS, 3.3V	VLU7 (VCXO)	10 - 670	5x7	3.3V
LVPECL, 2.5V	PE77DW	40 - 325	5x7	2.5V
LVPECL, 2.5V	PE55DW	40 - 250	3.2x5	2.5V
LVPECL, 3.3V	PE99DV	10 - 1170	5x7	3.3V
LVPECL, 3.3V	PE77DV	40 - 325	5x7	3.3V
LVPECL, 3.3V	PE55DV	40 - 250	3.2x5	3.3V
LVPECL, 3.3V	VPU7 (VCXO)	10 - 766, 876 - 1170	5x7	3.3V
Single Ended Outputs				
LVTTL, 3.3V	SM77HV	1.5 - 70	5x7	3.3V
LVTTL, 3.3V	SM77DV	70 - 180	5x7	3.3V
LVTTL, 3.3V	SM55TV	1.5 - 125	3.2x5	3.3V
LVTTL, 3.3V	SM44TV	16 - 80	2.5x3.2	3.3V
LVCMOS 1.8V	SM77HX	1.5 - 70	5x7	1.8V
LVCMOS 1.8V	SM77DX	70 - 180	5x7	1.8V
LVCMOS 1.8V	SM55TX	1.5 - 125	3.2x5	1.8V
LVCMOS 1.8V	SM44TX	16 - 80	2.5x3.2	1.8V
LVCMOS 2.5V	SM77HW	1.5 - 70	5x7	2.5V
LVCMOS 2.5V	SM77DW	70 - 180	5x7	2.5V
LVCMOS 2.5V	SM55TW	1.5 - 125	3.2x5	2.5V
LVCMOS 2.5V	SM44TW	16 - 80	2.5x3.2	2.5V
LVCMOS 3.3V	SM77HV	1.5 - 70	5x7	3.3V
LVCMOS 3.3V	SM77DV	70 - 180	5x7	3.3V
LVCMOS 3.3V	SM55TV	1.5 - 125	3.2x5	3.3V
LVCMOS 3.3V	SM44TV	16 - 80	2.5x3.2	3.3V
Real Time Clocks	**Real Time Clocks**	**Real Time Clocks**	**Real Time Clocks**	**Real Time Clocks**
CMOS WATCH CRYSTAL OSCILLATOR	S3883	32.768 KHz	4x6.5	1.5V - 5.0V
CMOS WATCH CRYSTAL OSCILLATOR	S3881	32.768 KHz	2.5x4	1.3V - 5.5V
WATCH CRYSTALS	SM20S	32.768 KHz	3.8x8	Plastic
WATCH CRYSTALS	SM13S	32.768 KHz	1.5x7	Plastic
WATCH CRYSTALS	SM12S	32.768 KHz	1.8x4.9	Ceramic
WATCH CRYSTALS	SM8S	32.768 KHz	1.2x3.2	Ceramic



VIRTEX™ 5

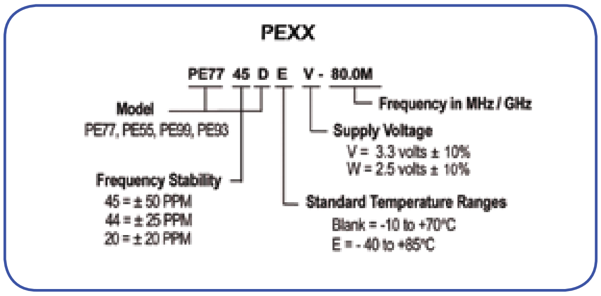
VIRTEX™ 4

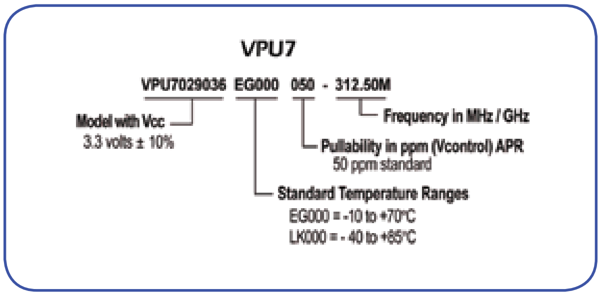
SPARTAN-3A FAMILY EXTENDED

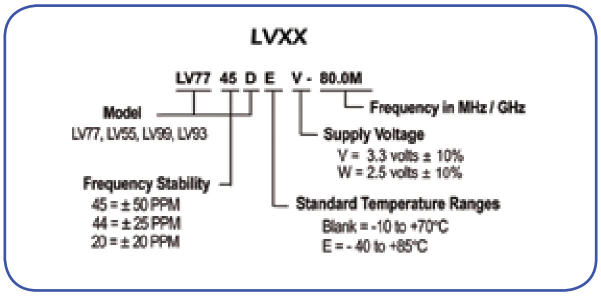


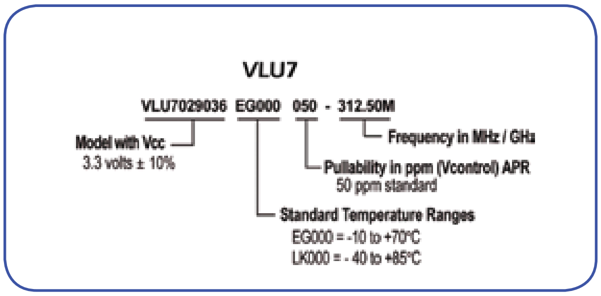
PLETRONICS

Application Examples The output logic required for various applications could be CMOS, LVPECL, or LVDS.	**Common Frequencies**
Gbe =Gigabit Ethernet PHY	25.0M
	62.5M
	125.0M
10Gbe = 10 Gigabit Ethernet PHY/XAUI	156.25M
	161.1328M
	187.5M
	312.5M
	625.0M
	644.5312M
2FC =Fibre Channel connection protocol SAS PHY and Controller Fibre Channel/SAN	53.125M
	106.25M
	159.375M
	212.5M
Infiniband = connection protocal	62.5M
	100.0M
	125.0M
	250.0M
ADSL = Modem Internet Connection moving data for WAN (Wide Area Network)	2.048M
	8.192M
	16.0M
	20.0M
	34.56M
	35.328M
Serial ATA (Advanced Technology Attachment)	25.0M
	50.0M
	75.0M
	150.0M
	300.0M
PCI/PCI Express	33.333M
	66.667M
	100.0M
	133.333M
	266.666M
	400.0M
Sonet: Long distance Optical Networking Ring	19.44M
	44.736M
	51.840M
	77.760M
	155.52M
	311.04M
	622.08M









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