Up to 50% Lower Power   100K to 500K LEs   12.7G Transceivers

Rethink FPGAs

Microsemi
Power Matters.™

PolarFire™ FPGA

Cost-optimized
Lowest Power
Mid-range Densities

Microsemi
Power Matters.™

PolarFire FPGAs

PolarFire Cost-optimized FPGAs Deliver the Lowest Power at Mid-range Densities

Microsemi extends its non-volatile FPGA leadership with the PolarFire family of cost-optimized FPGAs. PolarFire FPGAs deliver up to 50% lower power than equivalent SRAM FPGAs. The devices are ideal for a wide range of applications within wireline access networks and cellular infrastructure, defense and commercial aviation markets, as well as industrial automation and IoT markets.

As a true broad-range FPGA supplier, Microsemi offers FPGA product families spanning 1K to 500K logic elements (LEs).

The devices offer unprecedented capabilities while maintaining all the advantages traditionally associated with non-volatile FPGAs such as the lowest static power, security, and single event upset (SEU) immunity.

Cost-optimized Architecture

- Transceiver performance optimized for 12.7 Gbps, which yields smaller size
- Architecture and process optimizations for specific bandwidths (10 Gbps–40 Gbps) at specific densities
- 1.6 Gbps I/Os—best-in-class hardened I/O gearing logic with CDR (supports SGMII/GbE links on these GPIOs)
- High-performance, best-in-class hardened security IP in mid-range devices

Power Optimization

- The lowest static power—28nm non-volatile process yields very low static power
- Optimized for 12.7 Gbps, which yields the lowest power
- Low power modes—Flash*Freeze yields best-in-class standby power
- Integrated hard IP—DDR PHY, PCIe endpoint/root port, crypto processor
- Total power (static and dynamic)—up to 50% lower power

Solving Key Market Issues

Communications

- Significantly improved network capacity and coverage with limited spectrum and CAPEX
- Delivers 4K video
- Lower OPEX
- IoT growth with minimal energy consumption
- Lower physical and carbon footprint

Defense

- Anti-tamper for Foreign Military Sales (FMS)
- Increasing automation in vehicles and weaponry
- Enhancing operator situational awareness
- Battlefield portability and increased mission life
- Increased cybersecurity
- Supply chain security

Industrial

- Increased networking of factory automation
- M2M—growth of additional sensors and nodes
- Rise of cloud services requiring decentralized, secure computing
- Portability becoming more prevalent
- Cyber security threats
- Functional safety

PolarFire Architecture

PolarFire FPGAs Deliver Up to 500K Logic Elements, 12.7G Transceivers at 50% Lower Power

- High-speed serial connectivity with built-in multi-gigabit/multi-protocol transceivers from 250 Mbps to 12.7 Gbps
- Up to 481K logic elements consisting of a 4-input look-up table (LUT) with a fractureable D-type flip-flop
- Up to 33 Mbits of RAM

- Up to 1480 18x18 multiply accumulate blocks with hardened pre-adders
- Integrated dual PCIe for up to x4 Gen 2 endpoint (EP) and root port (RP) designs
- High-speed I/O (HSIO) supporting up to 1600 Mbps DDR4, 1333 Mbps DDR3L, and 1333 Mbps LPDDR3/DDR3

memories with integrated I/O gearing

- General purpose I/O (GPIO) supporting 3.3 V built-in CDR to support SGMII for serial gigabit Ethernet, 1067 Mbps DDR3, and 1600 Mbps LVDS I/O speed with integrated I/O gearing logic
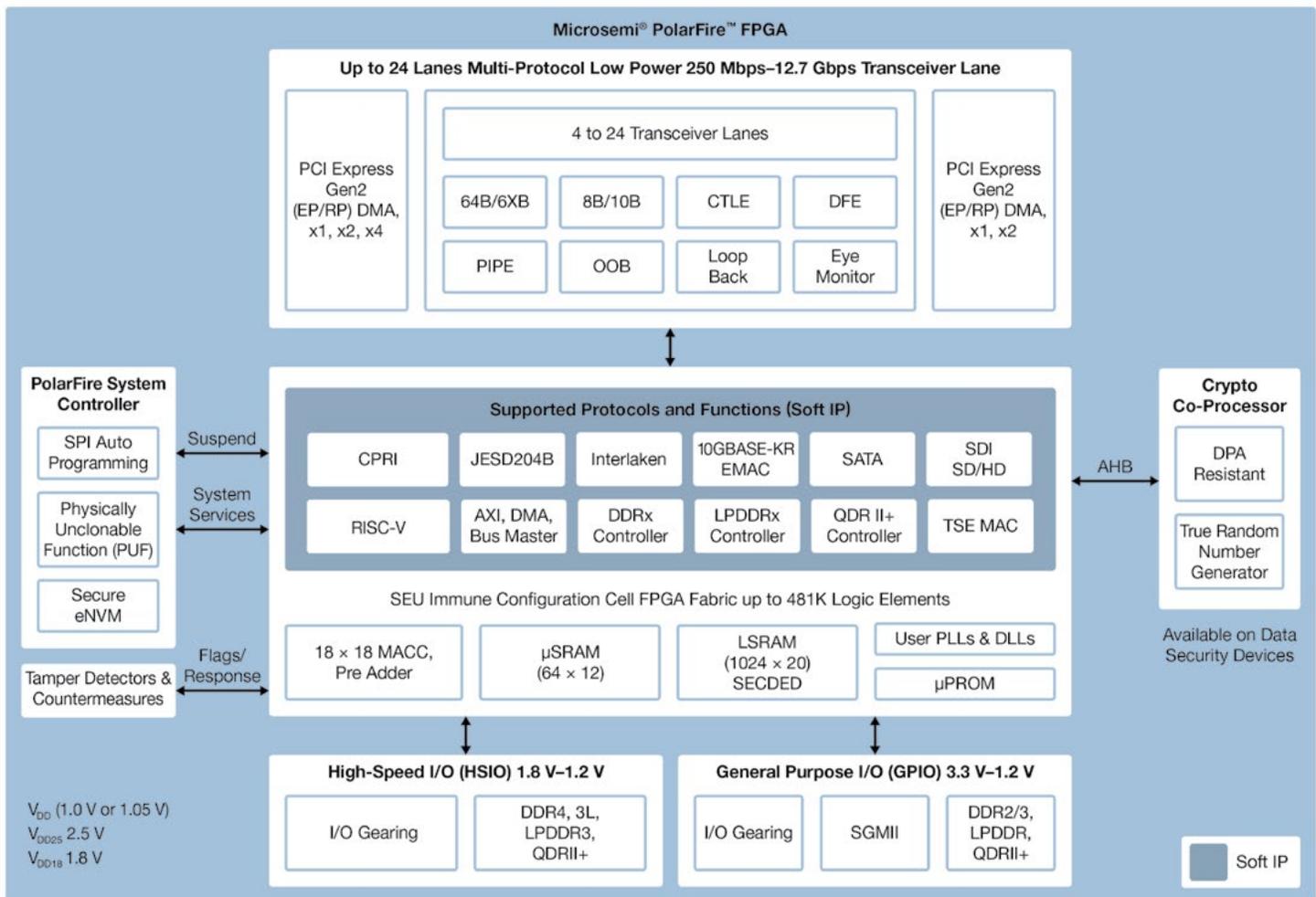
Reliability Features

- SEU immune FPGA configuration cells
- Built-in SECDED and memory interleaving on LSRAMs
- System controller suspend mode for safety-critical designs

Security Features

- Cryptography Research Incorporated (CRI)-patented differential power analysis (DPA) bitstream protection
- Integrated physically unclonable function (PUF)
- 56 Kbytes of secure eNVM (sNVM)
- Built-in tamper detectors and countermeasures

- Integrated Athena TeraFire EXP5200B Crypto Co-processor, Suite B-capable
- Digest integrity check for FPGA, µPROM, and sNVM
- True random number generator
- CRI DPA countermeasure pass through license

# Communications—Wireline Access and Cellular Infrastructure

Solving the Access Infrastructure Dilemma: Delivering Additional Bandwidth at Lower Cost

Today's cellular infrastructure and wireline access networks are facing a rapid transformation, having to deliver terabytes of high value content to consumers while reducing operational and capital expenditure spend, as well as reducing their thermal and carbon footprint. Microsemi's PolarFire FPGAs provide cost-effective bandwidth processing capabilities for the increasing number of converged 10 Gpbs ports with the lowest power footprint. The FPGAs also address the market's growing concerns over cybersecurity threats as well as the reliability concerns that face deep submicron SRAM-based FPGAs as they relate to SEUs in their configuration memory.

Applications

- Wireline access, edge, metro (1G–40G)
- Wireless heterogeneous networks
- Wireless backhaul
- Smart optical modules
- Video broadcasting

Wireline Access
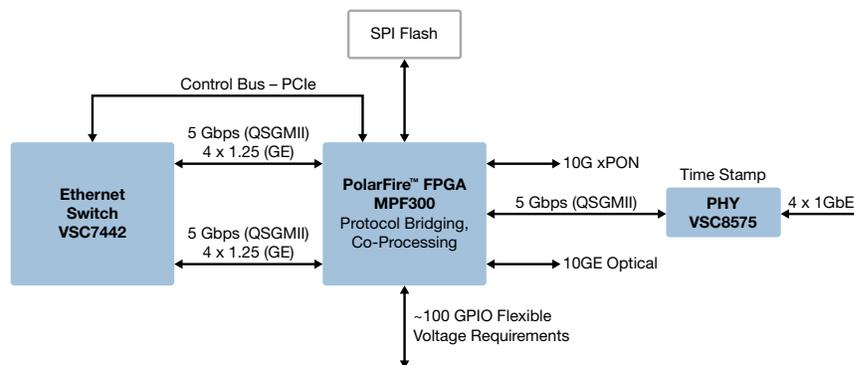
PolarFire Solution

- Low-cost 10G SERDES with built-in burst mode receiver for PON applications
- Built-in CDR on GPIO enables use of smaller devices when using GbE
- Up to 50% lower total power
- Non-volatile, instant-on
- Best-in-class security and immune to configuration SEU

HetNet—Remote Radio Head Digital Front End and BBU
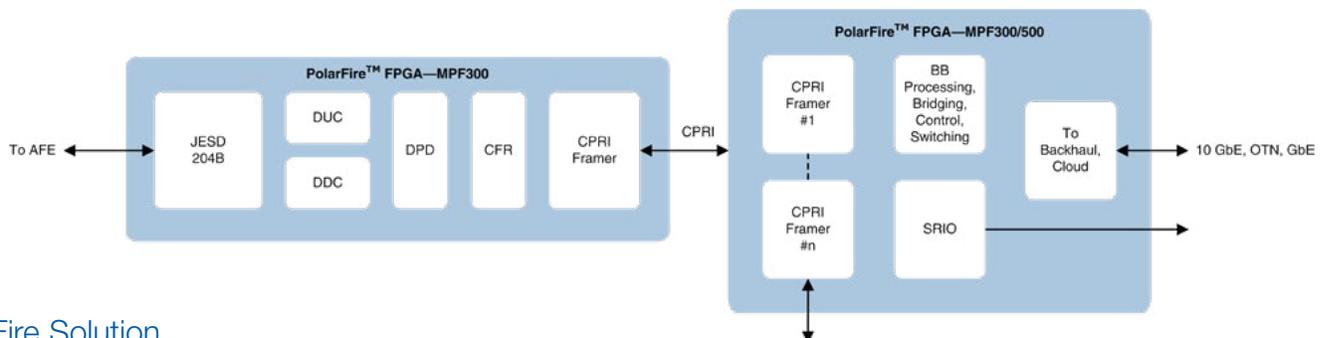
PolarFire Solution

- Lowers power up to 50% for power-constrained wireless products
- Especially important for power-constrained small cells and thermally-constrained outdoor units
- Signal processing capabilities with hardened pre-adders ideal for low/mid-bandwidth DFE 4 x 4 x 60 MHz and baseband processing
- Includes ultra-low power transceiver for 10G CPRI, bridging, and fronthaul/backhaul transport
- Provides best-in-class security against tampering and hacking

Enabling Security While Lowering Size, Weight, and Power

For the modern solider to be successful in the battlefield, it is imperative that they be equipped with gear that delivers high-tech capabilities at the lowest size and weight possible. Mission life is as key as portability, and power consumption is a decisive factor. PolarFire FPGAs provide high bandwidth radio and image signal processing capabilities at a fraction of the power of competing FPGAs. Microsemi also delvers best-in-class anti-tamper and data security capabilities in cost-efficient FPGAs for FMS, smart munitions, radar, and secure radios.

Defense and Aviation Applications

- Encryption and root of trust
- Secure wireless communications
- Smart munitions
- Radar and electronic warfare
- Aircraft networking
- Actuation and control

Handheld Military Radio
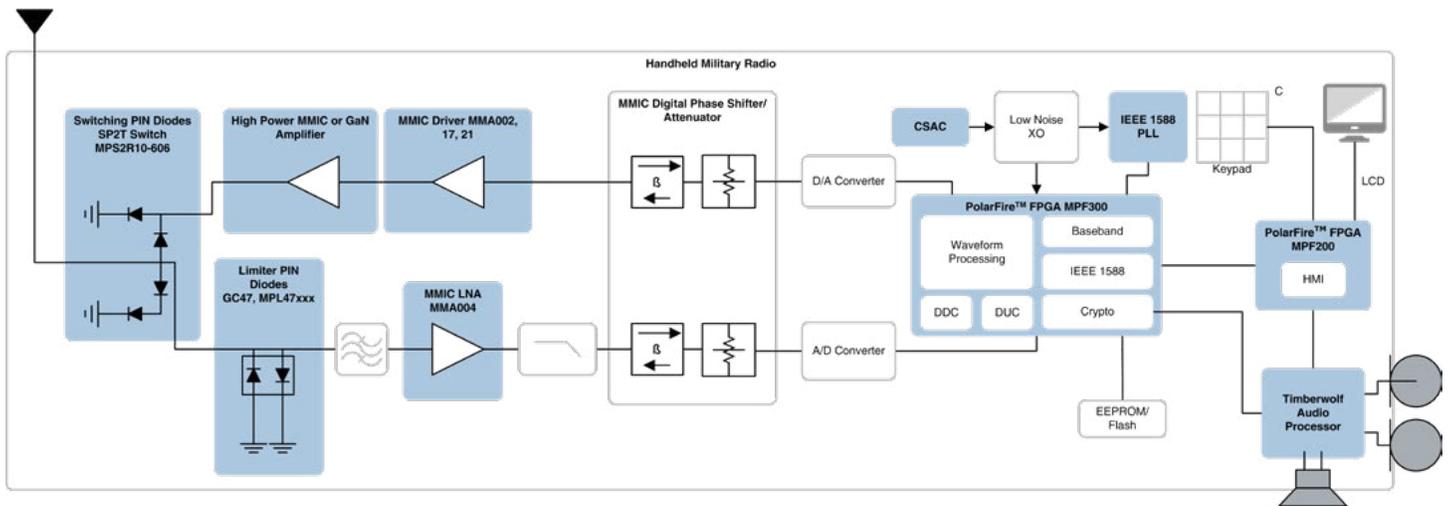
PolarFire Solution

- DSP blocks with hardened pre-address running at 450 MHz for high speed radio and image signal processing
- GPIOs supporting ADC/DACs at up to 1.6 Gbps
- Up to 50% lower total power
- Non-volatile, instant-on
- Best-in-class security and secure manufacturing
- Exceptional reliability—immune to configuration SEU

Secure Cryptographic Communications
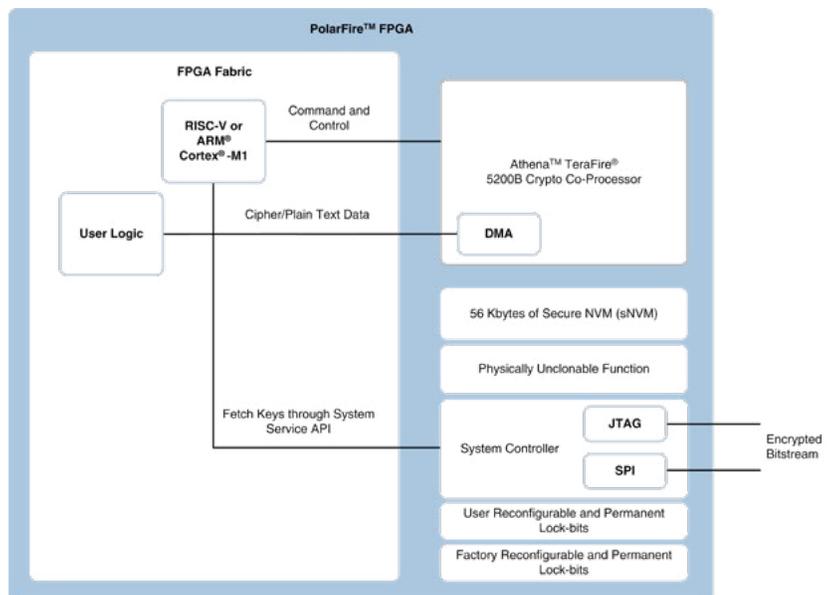
Industrial

## Enhance Tomorrow's Industrial Solutions

Today, Microsemi FPGAs and technology solutions are deployed at the highest safety levels within industrial markets around the world. Our heritage in safety-critical industrial applications range from hazardous area laser curtain sensors, liquid flow meters, nuclear power plant control, navigation systems, and secure communications.

Industry 4.0 combines the smart factory with connectivity using the Internet of Things (IoT). This will require the intelligence to move to the edge of the industrial network, and will require FPGAs with high bandwidth and processing capabilities using packet-based interfaces. Machine vision, robotics, thermal imaging, and other technologies will require increased image processing capabilities throughout the network in the most power-efficient manner.

Industrial Applications

- Process control and factory automation
- Machine vision, processing, and analytics
- Thermal and image processing
- Robotics and motion control
- Industrial IoT
- Programmable logic controllers
- Industrial networking

360 Surround Camera—Aggregates Multiple Image Sensors and Performs Image Processing
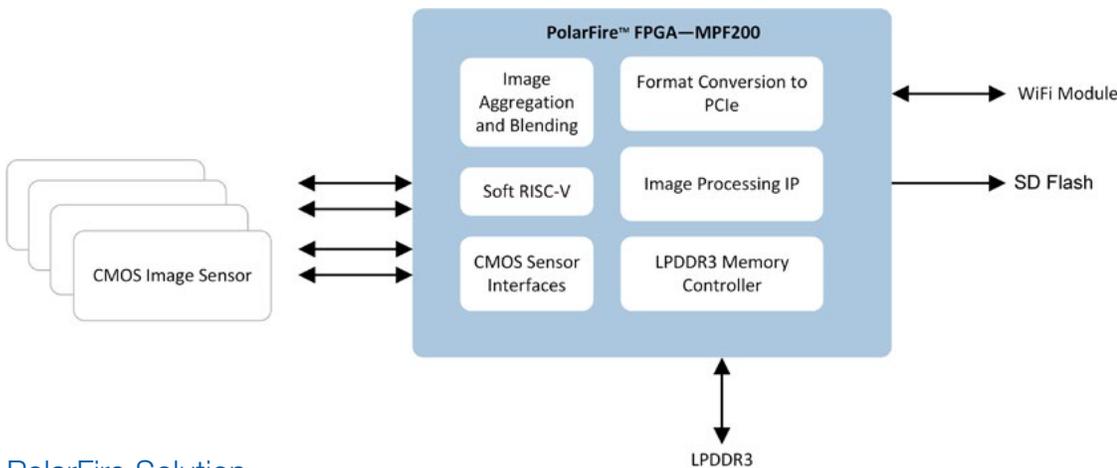
PolarFire Solution

- GPIOs supporting sensor interfaces at up to 1.2 Gbps
- Industry-leading 1588 algorithms for TSN
- Support for low-power multi rate SDI support
- DSP blocks with hardened preadders running at 450 MHz for 4K2K image signal processing
- Flash*Freeze mode to extend battery life on portable applications
- Up to 50% lower total power
- Non-volatile, instant-on
- Best-in-class security
- Soft RISC-V processor for protocol stacks
- SEU immunity for functional safety requirements

Industry's Best FPGA Security

Cyber Security is the #1 Concern for Connected Devices on the Network Edge

It is not enough for today's demanding applications to meet the functional requirements of their design—they must do so in a secured way. Security starts during silicon manufacturing and continues through system deployment and operations. Microsemi's PolarFire FPGAs represent the industry's most advanced secure programmable FPGAs.

Microsemi Security Leadership

Security Advantage	Low Density		Mid-Range	
	Microsemi	Competition	Microsemi	Competition
Prevent overbuilding and cloning	Best Low-density Security	N/A	Best Security in the Industry	N/A
Full design IP protection		N/A		Weak
Root of trust		N/A		N/A
Secure data communications		N/A		Weak
Anti-tamper		N/A		N/A

"The number of IoT sensors is expected to approach 30 billion in 5 years – and each unit is a potential entry point for cyber-criminals" – *The Economist Intelligence Unit, 4/11/2016*

"Some call cybercrime the greatest transfer of wealth in human history" – *The Center of Strategic and International Studies, July 2013, The Economic Impact of Cybercrime*

PolarFire Smallest Form Factors

PolarFire FPGAs offer best-in-class form factors at 100K, 200K, and 300K LEs.

MPF100
11 x 11 mm

MPF200
11 x 14 mm

MPF300
16 x 16 mm
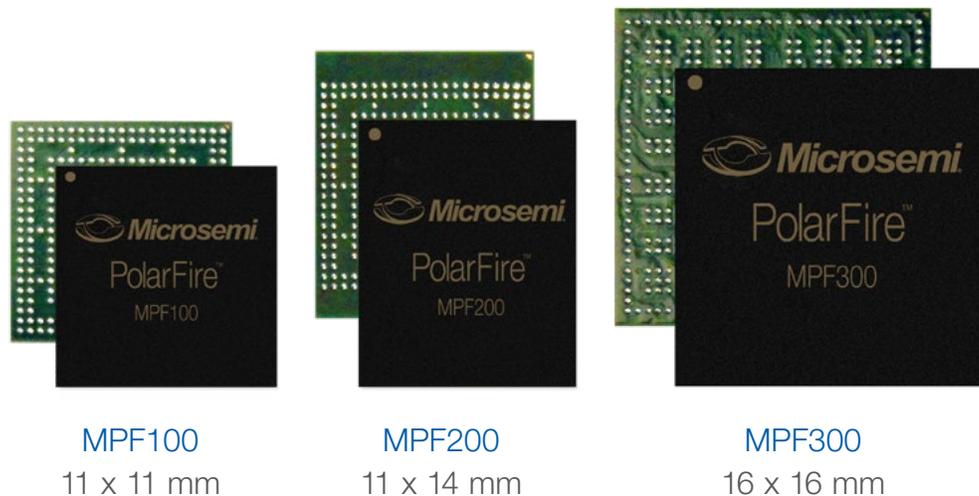
PolarFire Design Environment

Libero SoC PolarFire Design Suite

Microsemi enhances your design productivity by providing an extensive suite of proven and optimized IP cores for use with Microsemi FPGAs. Our extensive suite of IP cores covers all key markets and applications. Our cores are organized as either Microsemi-developed DirectCores or third-party-developed CompanionCores. Most DirectCores are available for free within our Libero tool suite and include common communications interfaces, peripherals, and processing elements.
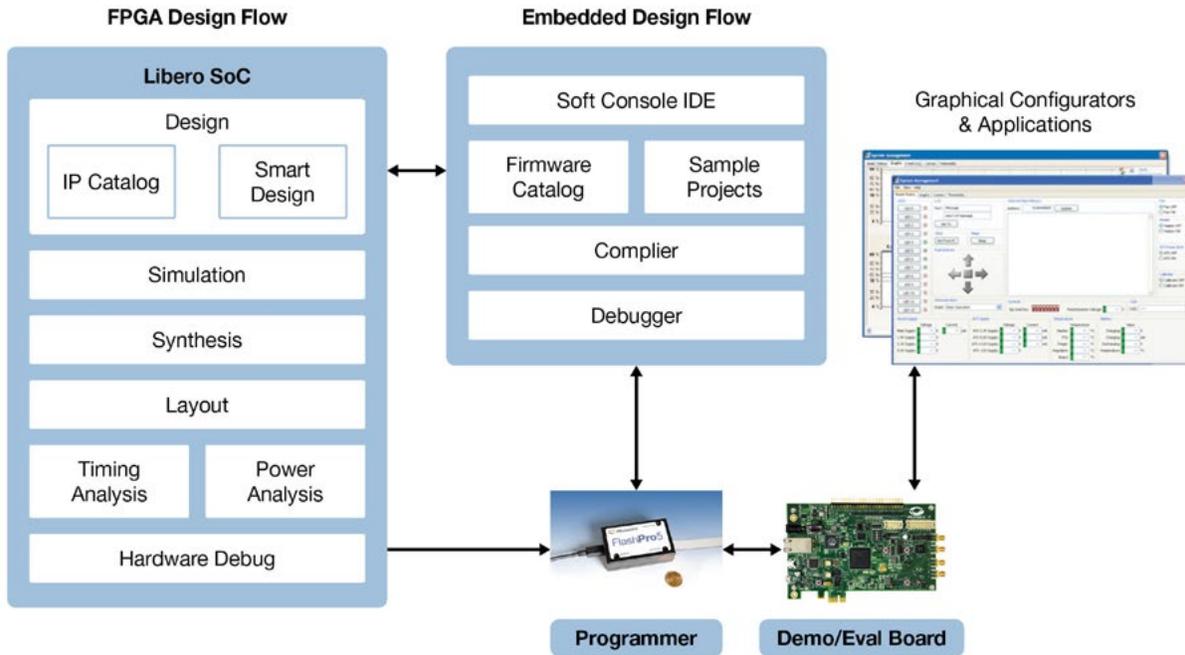
SmartDebug

SmartDebug offers the equivalent of an oscilloscope inside Microsemi FPGAs. SmartDebug features a tool called LiveProbes that enables an engineer to see any two nodes inside the FPGA on external pins, without requiring recompilation of a design. Nodes can be quickly selected and modified and the real-time signals can be seen externally immediately. This SmartDebug capability can cut engineers' debug time by weeks, if not months. In addition, the SmartBERT module allows customers to configure and monitor the built-in PMA tester in PolarFire devices.
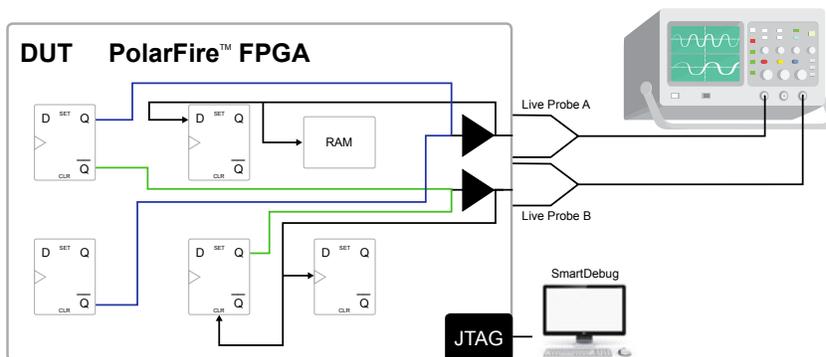
PolarFire Design Hardware

Microsemi and their distribution partners have created boards to allow customers to evaluate PolarFire FPGAs and the fully develop their applications.

PolarFire Evaluation Kit

Device: MPF300TS-1FCG1152EES   **Price: $1495**

- 4GB 32-bit DDR4, 2GB 16-bit DDR3, and 1Gb SPI Flash Memory
- 2x RJ45 ports with PHY for Ethernet 1588 applications
- Support for SFP+ interface and IOG loopback
- High-speed SerDes interface
- 4x FMC connector (HPC)
- In-silicon temperature monitoring
- On-board 50 MHz system clock

PolarFire Splash Kit

Device: MPF300TS-1FCG484EES   **Price: $699**

- x32 bit DDR4 and 1Gb SPI Flash Memory
- RJ45 port with PHY for SGMII applications
- FMC connector (LPC)
- Prototype breadboard area
- PCI express (x4) edge connector
- On-board 50 MHz system clock

Arrow Everest Kit

Device: MPF300TS-1FCG1152EES   **Price: $499**

- Triple 1GbE interface
- 1 × 10GbE SFP+ cage
- PCI express (x4) Gen2
- Dual DDR3L (x32 and x16)
- High-speed FMC (HPC) expansion
- HDMI output
- Expansion connectors: PMOD
- Other low-speed interfaces: UART, SPI, and I2C

Future Avalanche Board

Device: MPF300TS-FCG484EES   **Price: $179.95**

- 1GbE interface with PHY (VSC8531)
- WiFi module
- Expansion connectors: Arduino Shield, MikroBus, PMOD
- DDR3 SDRAM (256Mx16)
- SFP cage
- 64 Mbit SPI Flash
- Other low-speed interfaces: UART and JTAG

PolarFire IP and Demo Designs

Microsemi enhances your design productivity by providing an extensive suite of proven and optimized IP cores for use with Microsemi FPGAs. Our extensive suite of IP cores covers all key markets and applications. Our cores are organized as either Microsemi-developed DirectCores or third-party-developed CompanionCores. Most DirectCores are available for free within our Libero tool suite and include common communications interfaces, peripherals, and processing elements.

PolarFire IP (Available Now)

- AXI4Interconnect
- Core3DES
- CoreABC
- CoreAHBLite
- CoreAHBL2AHBL Bridge
- CoreAHBLTOAXI
- CoreAHBLSRAM
- CoreAHBtoAPB3
- CoreAPB3
- CoreAXI4DMA Controller
- CoreAXI4SRAM
- CoreAXItoAHBL
- CoreCORDIC
- CoreDDRMemCtrlr
- CoreDDS (NCO)
- CoreDES
- CoreFFT
- CoreFIFO

- CoreFIR
- CoreGPIO
- CoreI2C
- CoreJESD204BRX
- CoreJESD204BTX
- CoreMDIO_APB
- CorePCS
- CorePWM
- CoreRSDEC
- CoreRSENC
- CoreRISCV
- CoreRMII
- CoreSPI
- CoreSysServices_PF
- CoreUART
- CoreUART_APB
- CoreLSM
- CPRI (PHY only)

- CRYPTO
- DDR3
- DPSRAM
- DRI
- PCIe End Point
- TAMPER
- TPSRAM
- UPROM
- URAM
- 1GbE IO-CDR
- Core10GMAC 10GBASE-R
- Core429
- CoreSGMII
- CoreTSE, CoreTSE_AHB
- DDR4
- CoreRGMII

PolarFire IP (Soon to Be Released)

- CorePCIF/CorePCIF_AHB
- HD-SDI Tx/HD-SDI Rx (3G)
- CoreXAUI
- CoreRXAUI
- Core1553BRM
- Core1553BRT/Core1553BRT_APB

- PCIe Root Port
- CoreQDR
- 10GBASE-KR
- LPDDR3
- 10G NGPON
- CSI-2 Rx

- QSGMII
- 12G SDI
- CoreCIC
- CoreQSPI
- CSI-2 Tx

PolarFire Demo Designs

Microsemi provide demo designs to assist customers in designing with key elements of the PolarFire device and IP Cores.

PolarFire Evaluation Kit

The following demo guides targeted to the PolarFire Evaluation Kit. In addition, a Power Monitor GUI is available that can be used with any of the demo designs.

- DG0755: PolarFire FPGA JESD204B Standalone Interface Demo Guide
- DG0756: PolarFire FPGA PCIe Endpoint and DDR3/4 Memory Controller Demo Guide
- DG0757: PolarFire FPGA 10GBASE-R Ethernet Loopback Demo Guide UPDATED
- DG0759: PolarFire FPGA Multi-Rate Transceiver Demo Guide
- DG0762: PolarFire FPGA DSP FIR Filter Demo Guide
- DG0774: PolarFire FPGA Low Power Demo Guide
- DG0783: PolarFire FPGA: High-Speed Data Transfer in 8b10B Mode Using the LiteFast IP Demo Guide
- DG0798: PolarFire FPGA System Services Demo Guide
- DG0799: PolarFire FPGA 1G Ethernet Loopback Using IOD CDR Demo Guide
- DG0802: PolarFire FPGA PCIe Root Port Demo

PolarFire Splash Kit

- The following demo guides targeted to the PolarFire Splash Kit. In addition, a Power Monitor GUI is available that can be used with any of the demo designs.
- DG0796: PolarFire FPGA Splash Kit JESD204B Standalone Interface Demo Guide
- PolarFire FPGA Splash Kit PCIe Endpoint and DDR4 Memory Demo Guide
- PolarFire FPGA Splash Kit Multi-Rate Transceiver Demo Guide
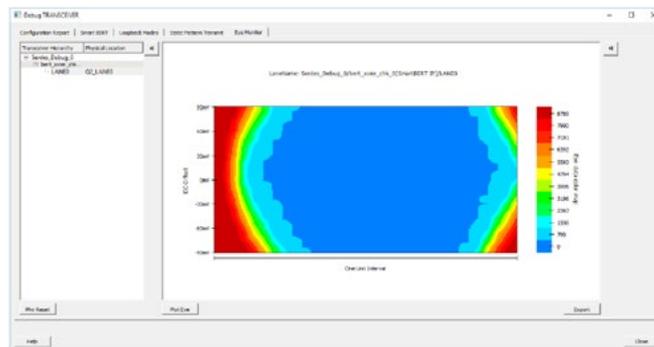
PolarFire Product Family

Feature and Packaging Overview of the PolarFire FPGA Family

Features		PolarFire FPGAs			
		MPF100T	MPF200T	MPF300T	MPF500T
FPGA fabric	Logic elements (4 LUT + DFF)	109	192	300	481
	Math blocks (18 x 18 MACC)	336	588	924	1480
	LSRAM blocks (20 kbits)	352	616	952	1520
	µSRAM blocks (64 x 12)	1008	1764	2772	4440
	Total RAM (Mbits)	7.6	13.3	20.6	33
	µPROM (Kbits, 9-bit bus)	297	297	459	513
	User DLLs/PLLs	8	8	8	8
High-speed I/O	250 Mbps to 12.7 Gbps transceiver lanes	8	16	16	24
	PCIe Gen2 endpoints/root ports	2	2	2	2
Total I/Os	Total user I/Os	284	368	512	584
Packaging	Type/size/pitch	Total user I/Os (HSIO/GPIO)/transceivers			
	FCSG325 (11 mm x 11 mm, 11 mm x 14.5 mm*, 0.5 mm)	170(84/86)/4	170(84/86)/4*		
	FCSG536 (16 mm x 16 mm, 0.5 mm)		300(120/180)/4	300(120/180)/4	
	FCVG484 (19 mm x 19 mm, 0.8 mm)	284(120/164)/4	284(120/164)/4	284(120/164)/4	
	FCG484 (23 mm x 23 mm, 1.0 mm)	244(96/148)/8	244(96/148)/8	244(96/148)/8	
	FCG784 (29 mm x 29 mm, 1.0 mm)		368(132/236)/16	388(156/232)/16	388(156/232)/16
	FCG1152 (35 mm x 35 mm, 1.0 mm)			512(276/236)/16	584(324/260)/24

Devices in the same package and family type are pin-compatible.
*Wider package dimension applies to the MPF200 device only.

Microsemi is continually adding new products to its industry-leading portfolio.

For the most recent updates to our product line and for detailed information and specifications, please call, email, or visit our website.

Toll-free: 800-713-4113

sales.support@microsemi.com

www.microsemi.com

Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for aerospace & defense, communications, data center and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; enterprise storage and communication solutions, security technologies and scalable anti-tamper products; Ethernet solutions; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, California and has approximately 4,800 employees globally. Learn more at www.microsemi.com.