MicroTCA
Power Module Reference Design

Features

- Complete MicroTCA Power Module Reference Design
  - System Management by Actel Fusion™ Mixed-Signal FPGA
  - Compliant to MicroTCA.0 Specification Revision 1.0
  - Ready to Plug In for Evaluation and Inter-operability Testing
  - Single-Card Design with Half-Brick DC/DC Converter Demonstrates the Incredible Space Saving of the Fusion-Based Power Module
  - Includes Hardware Design, HDL, and Software
  - Includes a Power Module EMMC Interface (IP and software)
  - Reduced Part Count with More Features and Performance Than MCU-Based Systems
  - Reference Design Greatly Reduces Time to Market and Development Effort
  - Includes Support for Power Module Redundancy and In-System Test and Firmware/ Software Upgrades via JTAG/JSM Interface
- Less Than 50% of the Cost, Size, and Components of Existing Power Modules Due to Superior Analog and Digital Circuitry of Fusion Devices
- Supports a Mix of Hardwired and MCU-Based Functionality for Speedy Processing
- Exceeds MicroTCA Specification for Power Monitoring
- In-System Reprogrammability Allows Customization and Field Updates
- Digitally Monitored and Configurable Voltage, Current, and Temperature Thresholds with Hardwired Fail-Safe Circuitry
- Hot-Swap Compatible
- Hardware and Software Support by Signal Stream Technologies, Including Custom Boards, Assemblies, and Software

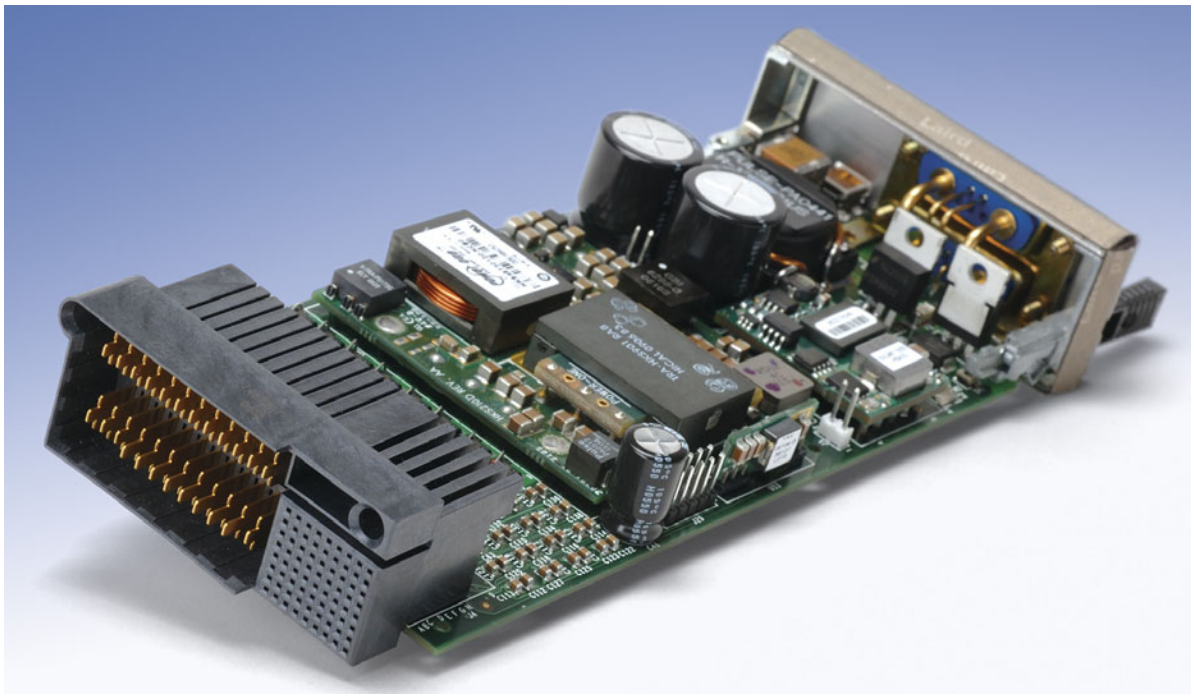

Figure 1 **• Actel Power Module**

The Actel MicroTCA Power Module

General Description

Actel is enabling the MicroTCA market by providing Fusion-powered reference designs. The Actel Fusion Programmable System Chip (PSC) improves the design of MicroTCA power modules by dramatically reducing part count, board space, system cost, and power while increasing reliability, flexibility, and system availability. The Fusion device includes analog I/O, an analog-to-digital converter, FPGA gates, large Flash memory, clocking, and other features that enable it to reduce the part count of the Actel Power Module (PM) reference design by hundreds of parts over other FPGA- and MCU-enabled power modules. The analog I/O, digital processing of analog signals, and Flash memory enable improved system monitoring and control so that system reliability and availability increases. As an FPGA, Fusion is the most flexible solution on the market, with in-system reprogrammable microcode and FPGA logic gates. Finally, Fusion improves performance with many functions coprocessed in FPGA gates alongside the Core8051 processor.

Actel has reduced the part count required for MicroTCA power module designs in a unique reference design platform that includes hardware, software, and FPGA hardware description language (HDL)—a full solution.

Unlike component-driven ASSP designs, the Actel Fusion FPGA enables integration of multiple functions, which include voltage and temperature monitoring, a large Flash memory for event logging, and nonvolatile FPGA fabric for nearly instantaneous hot-swap and power switchover. All of this functionality is delivered today with an Actel Fusion chipset while reducing your bill-of-materials cost over ASSP-based power module systems.

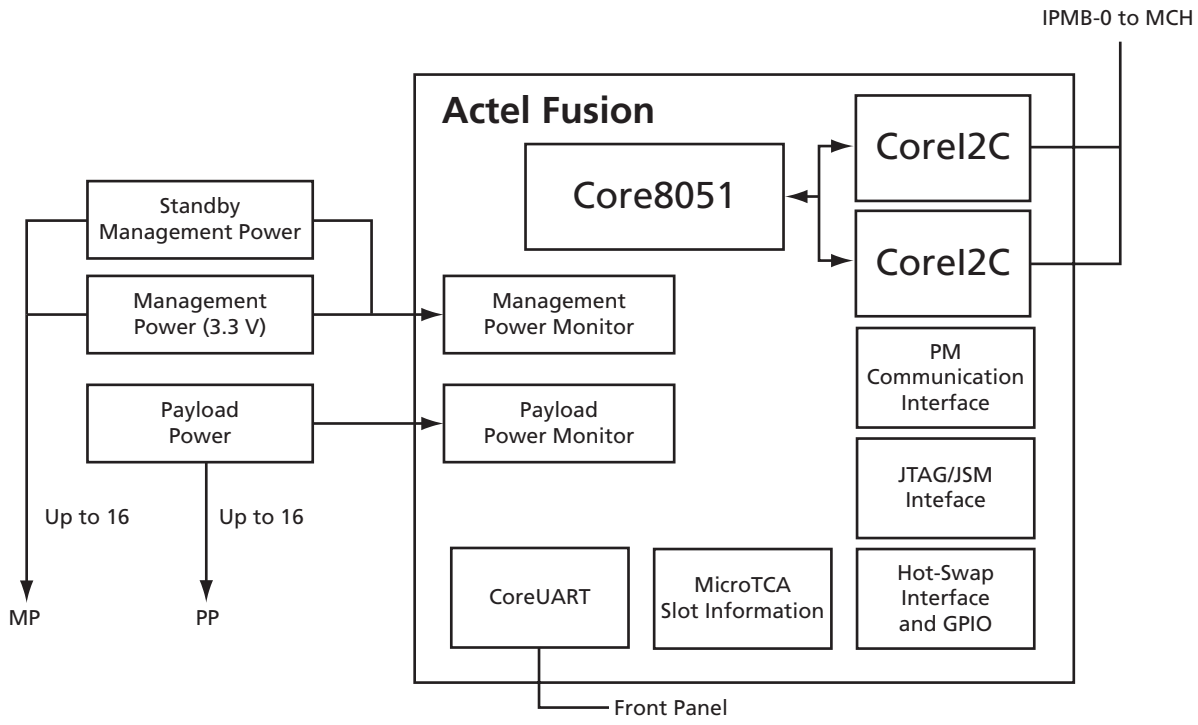

***Figure 2* • Power Module Fusion Device Block Diagram**

The Actel Power Module reference design functions as described in the MicroTCA Specification v1.0, Chapter 4, and provides all of the power subsystem functionality, including the following:

- Modular inputs
- Fusing
- Supply selection
- Emissions filtering
- Transient suppression and power conversion
- Payload and management power monitoring
- Power supply to the MicroTCA Carrier Hubs (MCH), AMCs, and cooling unit

The power module reference design includes the redundant Intelligent Platform Management Bus (IPMB-0) and the optional JTAG interfaces.

The reference design also includes functionally verified hardware, FPGA HDL, and third-party software support. All elements of the design will be thoroughly tested during MicroTCA interoperability testing.

For those who want to customize the design, Actel provides the source and can enable a path for turn-key modifications. Signal Stream Technologies has partnered with Actel to offer design services for customizing both hardware and software and will deliver timely engineering support and maintenance services. The Actel Protocol Design Services group can provide modifications to the HDL. For modules in production volume, our partner, MicroBlade™, Inc., offers complete turn-key power modules to your exact specifications. In summary, you can customize the design yourself or have Actel and its partners perform customization.

The power module reference design is delivered as a single-board design for the smallest form factor and superior thermal capabilities.

Unlike MCU-based designs, which are software-driven and slow, many functions, such as analog-to-digital conversion sequencing and sampling, over-current and under-voltage power switchover, and hot-swap disable, are hardwired. Hardwired fail-safe logic minimizes response time, if there is an unexpected board extraction or system failure.

Since payload power current regulation is fully implemented in hardware, the Actel power module is more accurate than MCU-based designs. The current limit for each output channel can be individually programmed in 256 steps with ±1% full-scale accuracy. Likewise, both payload power and management power output voltages are measured with ±1% full-scale accuracy.

The power module is also more flexible than anything on the market today. A customer can update the FPGA firmware and application software on-the-fly and can customize hardware, firmware, or software. With a total of 1 MByte of on-board Flash memory, software for the on-chip Core8051 microcontroller can be reprogrammed on-the-fly by uploading code to an isolated buffer in the Flash memory, performing verification, and then switching the context to the new software. Unlike an ASSP-based solution, the Actel controller is an FPGA, so even the "hardware" is reprogrammable, either on the bench using standard FPGA programming tools or in-system via the MicroTCA backplane JTAG interface. A customer can also add differentiation to the hardware design, since Actel provides a full set of design documents, including schematics, a bill-of-materials, layout drawings, and manufacturing drawings.

A Power Module That Goes Beyond the MicroTCA Standard

The Actel MicroTCA power module is a reference module designed specifically to meet the power conversion, power switching, and form factor requirements to enable MicroTCA applications.

It supports a dual –48 VDC input and delivers more than 380 W to the MicroTCA backplane. With the revolutionary form factor made available by the Actel Fusion device, power output levels greater than 700 W are easily possible in a single power module.

The monitoring and controller hardware supports input power filtering, conditioning, fusing and monitoring, output power control, monitoring and protection, and DC-to-DC conversion for management and payload power. The Intelligent Platform Management Interface (IPMI) software is IPMI v2.0 compatible and will manage the turn-on sequencing for local AMCs, voltage, and current monitoring, handle abnormal power conditions, and respond to commands and requests from an MCH via the IPMB-0 interface. The module works with a single or dual MCH or as a standalone device without an MCH present in the system. It is compatible with the new PICMG® MicroTCA.0 revision 1.0 standard.

The module can turn on each of the management and payload power lines individually, as specified in the MicroTCA specification. It also monitors temperature and power status and reports this back to the MCH. In the case of no MCH, the microcontroller on the module notices that no MCH is present and can execute an on-board preprogrammed system management application. If an AMC is inserted, the power for that slot is turned on and if a module is extracted, the power for that slot is turned off. System application software can be downloaded to the board using the serial port (RS-232) on the front of the module or by the JTAG interface. The IPMB bus on the power module will also monitor temperature and handle fan speed on the cooling module, when that reference design is available.

IPMI Debug and Self-Test

This power module allows the user to record and insert IPMI commands into any of the I2C busses in the system. This feature is useful for development, debugging, and testing of a system.

Technical Specifications

General

- Single-wide / full-height per AMC.0 revision 1.0
- 384 W with typical power dissipation under full load of 28.3 W
- 93% total efficiency
- Component part count
  - Less than 400 total parts
  - 65 stock-keeping units
- Payload and management brick temperature monitors
- Inlet air temperature monitor

System Management

- Single-cycle, 8-bit, Core8051 MCU in an Actel Fusion FPGA
- Fusion: 1,024 kilobytes of Flash, 216 kbits of RAM
- Analog monitoring and A/D conversion
- IPMI v2.0 for power module EMMC

Power Inputs

- < 415 W
- –36 to –72 VDC at 15 A maximum
- Power inputs are transient protected and fused
- Input voltage is monitored and event messages are generated for alarm conditions

Power Outputs

- 384 W output with a 1/2 brick
- 800 W output possible with two 1/4 bricks
- Support for all MicroTCA specified redundancy configuration
- Supports total payload power output channel on resistance as low as 3.4 mΩ
- Payload power channel outputs
  - ±50 mV resolution
  - Over-voltage monitored with configurable threshold
  - Under-voltage monitored with configurable threshold
  - Backup trigger threshold voltage configurable
  - Default current limit 7.6 A
  - Programmable from 200 mA to 9.7 A in 50 mA increments
  - Current threshold accuracy ±50 mA
  - Immediate current limit engages in less than 60 µs for over-currents greater than 105% of threshold
  - Warnings for over-currents greater than 100% and less than 105%
- Management power channel outputs
  - ±25 mV resolution
  - Over-voltage monitored with configurable threshold
  - Under-voltage monitored with configurable threshold
  - Backup trigger threshold voltage configurable
  - Current limited to greater than 150 mA and less than 225 mA
- Standby management power output/input
  - Output current greater than or equal to 350 mA
  - Input current less than or equal to 225 mA

Compliance

- Conforms to PICMG MicroTCA specification v1.0 / IPMI v2.0 (subject to verification)
- RoHS compliant
- Designed to meet or exceed (subject to verification testing)
  - Safety: UL 1950, UL94, CSA 22.2 No. 950, EN 60950, IEC 950
  - EMI/EMC: EN 55022 / EN 55024, EN 50081-1 / EN 6100-6-2

Front Panel

- AMC latch with hot-swap switch
- Blue hot-swap indicator LED
- Green ready indicator LED
- Red out-of-service indicator LED
- Green/Amber (LED) indicating IPMI Tx/Rx message traffic
- USB diagnostic port
- A and B power input connectors

Environmental

- Environment per PICMG MicroTCA.0 revision 1.0
- Operating temperature:
  - 5°C to 40°C long-term
  - –5°C to 55°C for 96 hours
  - Storage temperature: –40°C to 70°C
  - Operating humidity: 5% to 95% relative humidity (non-condensing and condensing)

Miscellaneous

- Dimensions: 186.7 × 73.2 × 30.5 mm
- Weight: less than 300 g
- MTBF: TBD

IPMI Commands

MicroTCA Power Module EMMC

IPM Device "Global" Commands

Get Device ID
Get Self Test Results
Broadcast "Get Device ID"

PEF and Alerting Commands

Get PEF Capabilities
Arm PEF Postpone Timer
Set PEF Configuration Parameters
Get PEF Configuration Parameters
Set Last Processed Event ID
Get Last Processed Event ID

Sensor Device Commands

Get Device SDR Information
Get Device SDR
Reserve Device SDR Repository
Get Sensor Reading

FRU Device Commands

Get FRU Inventory Area Information
Read FRU Data
Write FRU Data

SDR Device Commands

Get SDR Repository Information
Reserve SDR Repository
Get SDR
Add SDR
Partial Add SDR
Clear SDR Repository
Get SDR Repository Time
Set SDR Repository Time
Exit SDR Repository Update Mode

SEL Device Commands

Get SEL Information
Get SEL Entry
Add SEL Entry
Partial Add SEL Entry
Clear SEL
Get SEL Time
Set SEL Time

AdvancedTCA

Get PICMG Properties
FRU Control
Get FRU LED Properties
Get LED Color Capabilities
Set FRU LED State
Get FRU LED State
Set IPMB State
Get Device Locator Record ID
Set Port State
FRU Control Capabilities

AdvancedMC

Set AMC Port State
Get AMC Port State

MicroTCA

Power Channel Control
Get Power Channel Status
PM Reset
Get PM Status
PM Heartbeat

Reference Design Kit Contents

- Hardware
  - Schematic
  - BOM
  - Manufacturing files
- IP platform (FPGA HDL)
  - Object code: Netlist or obfuscated RTL
  - Source code: RTL source
- Application software
  - Object code: compiled source code
  - Source code: in C language

Ordering Information

Table 1 • **Ordering Codes**

Part Number	Description
MicroTCA Power Module Reference Design	
uTCA-PM-RD-O	With object code
uTCA-PM-RD-S	With source code
MicroTCA Power Module	
uTCA-PM-SA	Standalone power module

Datasheet Categories

In order to provide the latest information to designers, some datasheets are published before data has been fully characterized. Datasheets are designated as "Product Brief," "Advanced," and "Production." The definitions of these categories are as follows:

Product Brief

The product brief is a summarized version of an advanced or production datasheet containing general product information. This brief summarizes specific device and family information for unreleased products.

Advanced

This datasheet version contains initial estimated information based on simulation, other products, devices, or speed grades. This information can be used as estimates, but not for production.

Unmarked (production)

This datasheet version contains information that is considered to be final.

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